

Don't fall for the hydrogen hype



A Friends of the Earth International position paper

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Hydrogen is being promoted as a 'clean' alternative to the fossil fuels used for domestic heating, transport and heavy industry. But it's expensive to produce, inefficient and far from a low carbon solution. In fact, the majority of the global hydrogen supply is made from fossil fuels¹.

Pushed by the same fossil industry that has caused – and continues to fuel – the climate crisis, hydrogen is yet another false solution, sold by the industry as a magical fix which allows business as usual to continue. Like other false solutions, it represents a dangerous distraction from the urgent, deep, real emission cuts that are needed to address the climate crisis. The latest report from the Intergovernmental Panel on Climate Change (IPCC) confirmed the alarming state of our climate, with the window of action to keep temperature rise to 1.5 degrees rapidly closing². We cannot rely on 'net zero' plans and more so-called 'solutions' that take us further from the fossil fuel phase out and just transition path.

Hydrogen props up the fossil fuel industry, especially the fossil gas industry. Given the well-documented evidence of the disastrous impacts of fossil gas globally – from the devastating outcomes of fracking in Colombia to ongoing conflict and destruction in Mozambique³ – it is clear that we should not be investing in an industry that consistently wrecks our communities and our climate. Addressing the climate crisis can only come through deep systemic change, dismantling the neocolonial, patriarchal, neoliberal capitalist system that created the crisis, to build a more just and equitable world for all.

Blue, grey, green – the industry is trying to sell us hydrogen in all types of colours and packaging, but when the smokescreen dissipates, the reality becomes clear: hydrogen is big polluters's latest trick, and we can't afford to fall for it.

Debunking the hydrogen 'rainbow'

01

Globally, more than 62% of hydrogen production is derived from fossil gas (known as grey hydrogen, blue hydrogen when coupled with Carbon Capture and Storage, or turquoise hydrogen when produced from methane pyrolysis). About 21% comes from coal and lignite (black/brown hydrogen), 16% is produced as a bi-product at refineries, 0.5% derived from oil, whilst only 0.1% is produced via water electrolysis (green from renewable electricity, purple/pink from nuclear)⁴.

Grey hydrogen – Fossil (gas) hydrogen

Grey hydrogen is produced from fossil gas through a process called Steam Methane Reforming (SRM). Because of its origin from fossil gas, and the inevitability of leakage along gas' life cycle, grey hydrogen means high levels of methane emissions. Methane is a potent greenhouse gas, 86 times more powerful than CO₂. This is why grey hydrogen is sometimes called 'fossil hydrogen'. It has the worrying potential to lock us into decades more fossil fuel production.

Blue hydrogen – Fossil hydrogen + CCS

Blue hydrogen is grey hydrogen (or fossil hydrogen) coupled with Carbon Capture (Utilisation) and Storage (CCS/CCUS)⁵. Blue hydrogen is doubly problematic because it amounts to stacking a false solution onto a fossil fuel. In addition to the concerns around the origin of blue hydrogen – ie. fossil gas – it relies on and promotes CCS, a dangerous, unproven, and costly process intending to capture carbon from an emitting source and somehow store it underground. Globally, and despite desperate attempts from the industry for decades, CCS remains unproven for reducing emissions at the level required, with many projects dormant, cancelled, or at pilot phase. Blue hydrogen therefore bets on an unproven and risky technology to justify more fossil fuel production. Research has shown that because of the power demands of CCS and the risk of methane leakage, the greenhouse gas footprint of blue hydrogen is actually greater than coal⁶, meaning it could be even worse for the climate than grey hydrogen.

Black/brown hydrogen – Fossil (coal) hydrogen

Black/brown hydrogen is produced from coal or lignite through a process of gasification. Coal, the most polluting of the main fossil fuels⁷, must be phased out urgently. The declining coal industry globally is trying to promote highly polluting unconventional coal technologies, including underground coal gasification⁸. These processes would enable the destructive coal industry to stay alive at a time when we cannot afford any more coal or any other fossil fuel to be extracted and exploited⁹.

Purple/pink hydrogen – Nuclear hydrogen

Purple/pink hydrogen is also produced through a process of electrolysis (like green hydrogen), but the electricity required is sourced from nuclear energy. This is the latest attempt of the nuclear industry to remain relevant, despite its well documented risks. Nuclear power is a highly dangerous, high cost energy source which poses the threat of nuclear proliferation and a severe risk to human life and the environment. Its potential as a major source of destruction has been proven time and again. It therefore makes no sense to prop up this dangerous and dying industry with new processes such as purple/pink hydrogen production¹⁰.

Turquoise hydrogen – Fossil (gas) hydrogen

Turquoise hydrogen (sometimes called blue-green hydrogen) is hydrogen produced from methane

pyrolysis, a process that directly splits methane into hydrogen and solid carbon with extreme heat. Although it produces solid carbon not CO₂ as a product, the heating process could release CO₂ into the atmosphere. Moreover, it still sources its energy from, and justifies continued production of fossil gas.

Green hydrogen – "Renewable" hydrogen

Green hydrogen is made from a process called electrolysis, using an electric current to split water into its component elements of oxygen and hydrogen. Because it is supposedly made from renewable sources of energy, 'green' hydrogen gets all the hype and is at the forefront of the industry's effort to sell hydrogen as 'clean'.

It is worth remembering that currently green hydrogen doesn't even amount to 1% of global hydrogen production. This is because green hydrogen demands huge amounts of cheap renewable electricity to function, rendering the process highly inefficient. Renewable energy should be first and foremost used to supply electricity for people. There are also concerns that

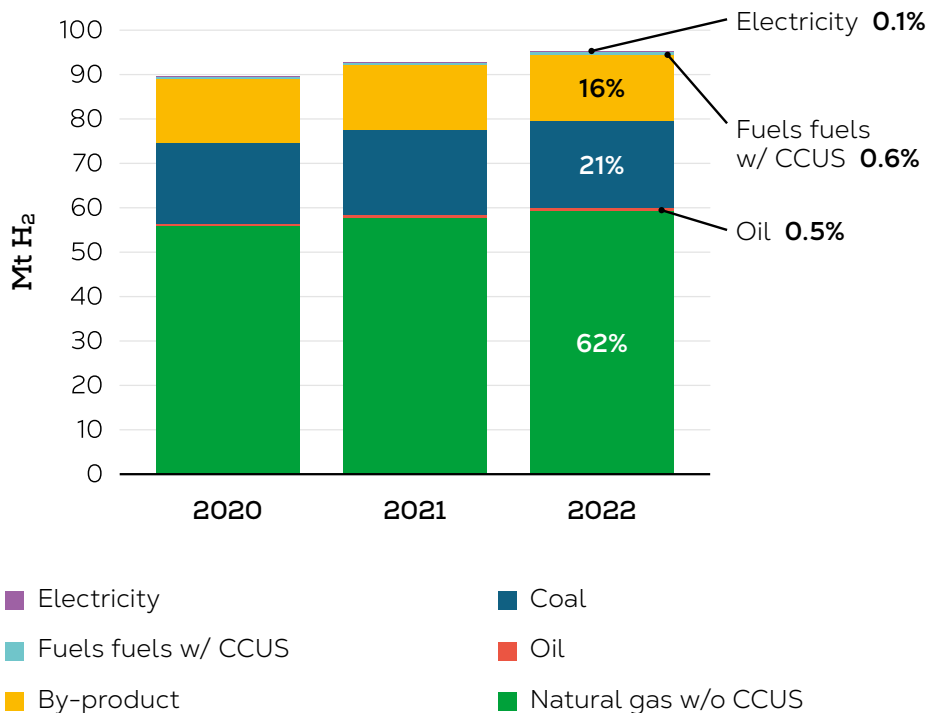
the electricity used to produce 'green' hydrogen is not actually renewable, and could be taken from polluting sources such as biomass.¹¹

The process also requires vast amounts of water, an increasingly rare and precious resource that shouldn't be wasted in the production of energy sources such as hydrogen. This contributes all the more to green hydrogen's broad inefficiency, as well as to concerns around its perpetuating of extractivist patterns (see 'Disproportionate impacts' section).

Green hydrogen's high inefficiency and extremely low part in global hydrogen production runs the risk of diverting efforts away from cheaper and more readily available options (such as solar and wind). It is further feeding into the hydrogen frenzy by helping to greenwash the industry and distract from the high proportion of fossil hydrogen.

Finally, it is worth noting that the development of green hydrogen would require building thousands of kilometres of pipelines for its transportation, yet again more costly and inefficient infrastructure that we don't need.

Figure 01: Hydrogen production mix, 2020-2022¹²



Chemical compounds explainer

Methane
= CH₄ = one carbon atom bonded with four hydrogen atoms

Water
= H₂O = two hydrogen atoms bonded with one oxygen atom

Carbon dioxide
= CO₂ = one carbon atom bonded with two oxygen atoms

Figure 02: The 'Hydrogen rainbow'¹³

Process: Gasification (adding steam and oxygen)

CO₂ emissions? Very big

Verdict: Climate and community killer

Process: Steam Methane Reformation (SMR)

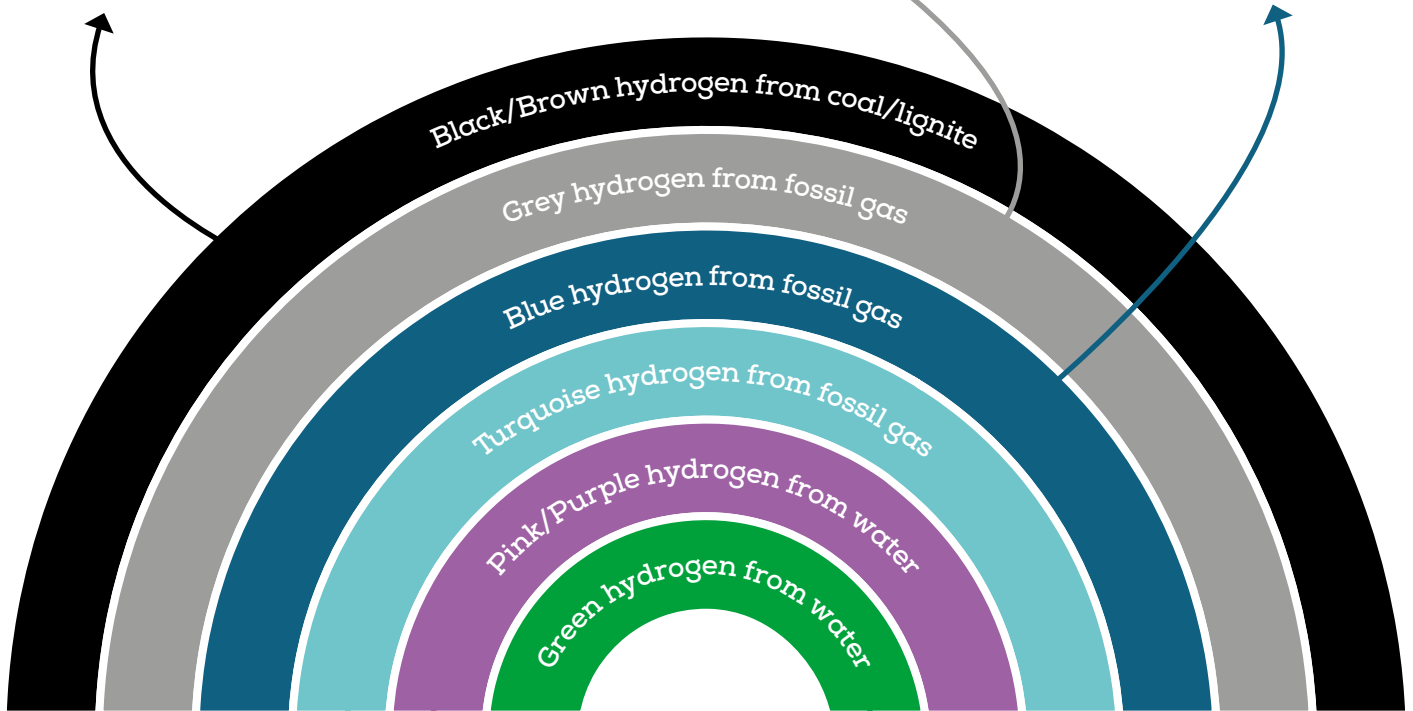
CO₂ emissions? Lots from SME, as well as methane leaking all along the life-cycle of gas

Verdict: Climate and community killer

Process: SMR but with carbon capture and storage or usage (CCS/U)

CO₂ emissions? Claims to capture CO₂ via costly experimental technology but still has methane and CO₂ leakage

Verdict: Industry's 'clean' solution is a pie in the sky techno-fix to keep the fossil fuel economy in place



Process: Pyrolysis (extreme heat without oxygen)

CO₂ emissions? Produces a solid Carbon byproduct, not CO₂, but heating process could produce CO₂

Verdict: Still based on climate and community-wrecking fossil gas

Process: Nuclear-powered electrolysis (splitting water molecules using electricity)

CO₂ emissions? The mining and processing of uranium to produce nuclear energy is carbon intensive

Verdict: Latest failed attempt by the nuclear industry to be relevant

Process: Renewable-powered electrolysis (like nuclear)

CO₂ emissions? Will the electricity be from wind, waves and sun, or polluting biomass/waster incineration?

Verdict: Cleanest form, but at scales relies on neocolonial mega projects outside EU

A note on co-firing

Co-firing is the combustion of two different fuels in the same combustion system. Countries like Japan are exploring putting hydrogen in coal or gas fired power plants in a co-firing process in supposed decarbonising efforts. The idea is that because

hydrogen doesn't emit CO₂ when it is burnt, then the process would be 'greener'. However, not only is the technology costly and yet to be proven at scale¹⁴, in reality it also leads to increased rather than lower greenhouse gas emissions¹⁵, and enables the continuation of the fossil economy we desperately need to bring to a close.

High stakes for the fossil industry

02

Because the largest part of hydrogen production is derived from gas, the source of the intensifying hydrogen frenzy isn't hard to locate: the powerful fossil gas lobby led by big polluters. If we all buy into the hydrogen hype, this would allow the fossil industry to lock us into decades more of fossil gas infrastructure, fuelling climate catastrophe and devastating impacts for communities everywhere.

As the reality and urgency of the climate crisis has become undeniable, the fossil fuel industry has been positioning itself as key to the energy transition; selling gas as a stepping stone to renewables. More recently, and even more dangerously, the industry has added another stepping stone to the transition in the form of hydrogen – now claiming that this can be a 'clean' source of energy – in a further attempt to justify more fossil gas infrastructure.

In Europe the gas lobby has succeeded in securing several pieces of legislation promoting hydrogen¹⁶ – including legislation that allows public funds to go to fossil gas infrastructure as long as it promises to be "hydrogen ready"¹⁷ despite the fact that Europe already has more gas infrastructure than necessary¹⁸. In the US as well, the hydrogen hype is catching with new regulation investing \$21 billion in tax incentives and direct spending for hydrogen,¹⁹ spurring a wave of proposals to produce blue hydrogen and

blend hydrogen into fossil gas infrastructure. The industry is succeeding in artificially creating a "need" for hydrogen to justify this increased investment in hydrogen and 'hydrogen-ready' infrastructure, when in reality the demand is, and should remain, limited to very few sectors.

In addition to justifying more fossil gas, hydrogen conveniently allows the fossil industry to push another one of its lifelines: Carbon Capture and Storage. They propose to make hydrogen an entirely clean source of energy by using CCS – an unproven techno-fix – to reduce emissions from the fossil gas involved. Despite the regulatory and financial support secured by the industry through intense lobbying and greenwashing efforts for decades, the technology has failed to deliver on its promises. Yet, it continues to be branded as justification for emissions by the industry.

Disproportionate impacts

03

Regardless of the tiny proportion of green hydrogen in the mix, overall, hydrogen is rooted in the fossil industry's arena. It is unsurprising that hydrogen, just like the fossil fuels and other false climate solutions pushed by that same industry, further reinforces neocolonial patterns of extractivism and exploitation.

Hydrogen produced from fossil gas props up an industry that has shown time and again its disregard for communities and the environment, especially in the Global South. In

Mozambique for example, fossil gas exploration in Cabo Delgado, led by Total Energies and ENI, and supported by public money from the Global North, has brought devastation across the region. The projects have resulted in land grabs, destroyed

local livelihoods, violated rights and fuelled conflict within communities. They have also been linked to environmental and climate impacts²⁰.

Because of its high inefficiency, green hydrogen requires huge amounts of electricity. Whilst Europe dives fully in to the hydrogen frenzy, it lacks the domestic capacity to produce the amount of electricity required for the hydrogen industry and for direct use. That means their plans rely heavily

on imports – of hydrogen or renewable electricity. This replicates the same neocolonial patterns of exploiting the resources of other countries – mostly in the Global South – for their own benefit and at the expense of local communities²¹.

At a time when renewable energy needs to be rolled out in a just and equitable manner, and for the direct benefit of local communities, the mega-projects required to serve the hydrogen market seem ludicrous. They fail to take into account the financial cost of such projects, as well as the energy needs of local communities, and the

social and environmental impacts such as water scarcity and land grabs²².

The ‘cleaner’ hydrogen sources also rely on electrolysis, a highly water intensive process. Scaling up green hydrogen would require vast amounts of clean water to be used in producing hydrogen and processing its derivatives. To produce 1 kg of hydrogen from electrolysis, about 9 litres of water are needed, therefore, to obtain 1 ton of hydrogen, a good 9000 litres must be consumed²³. As water becomes an increasingly scarce resource it seems ludicrous to rely on energy sources that would waste it²⁴.

Green hydrogen’s red flags

From **Germany's great hydrogen race - Corporate Europe Observatory, March 2023**

“A shocking example of human rights violations connected with green hydrogen projects is Saudi Arabia’s planned megacity Neom, where Thyssenkrupp will install a huge electrolyser to produce hydrogen for export. Ancient tribes have been forcibly evicted from their land to make way for Neom. Several protestors have been sentenced to death because of their resistance to the eviction, and one of them was shot dead by security forces in April 2020. Nonetheless, the 2021 German-Saudi Arabia hydrogen cooperation seeks to implement joint projects in Neom. Such cooperations risk the reproduction and legitimisation of authoritarian regimes in the name of sustainability.”

From **Contested transition, State and Capital against Community - GroundWork, December 2022**

“Sasol is leading a pre-feasibility study for GH2 production at Boegoebaai. This would be part of a special economic zone (SEZ) mega project at Alexander Bay which would dwarf the town of 1700 people. [...] Effectively [the project] requires a whole new town with full urban infrastructure of housing, roads, water, sewage, power and waste system and the largest part of that must be temporary. The social impacts that follow from the influx of a very large and almost exclusively male construction workforce will be overwhelming. [...] Further, the town, industrial parks and renewable energy farms will occupy an immense stretch of land. The easy assumption that there is ‘available land’ comes with a colonial echo as the question of whose land has apparently not been asked. This is the Richtersveld, which the local Nama people won back after a century of dispossession through a fierce court struggle against government and the Alexkor diamond mining corporation. [...] The Boegoebaai project is to be included in an expanded Namakwa SEZ [that] would be serviced by the deep water port. [...] Boegoebaai provides a rich and relatively unspoilt fishing ground. Local fisherfolk say it will be heavily impacted by the construction of the port and subsequently by heavy port traffic.”

Hydrogen's price tag

04

It is worth noting that in addition to the disproportionate social and environmental costs, hydrogen also comes with a high financial cost. Some types of hydrogen are costly because of the inherent cost of the technique from which it is derived. This is the case for pink/purple hydrogen which is derived from costly nuclear, and for blue hydrogen given that CCS is an expensive technology. Along the same logic, grey, blue and turquoise hydrogen, because they are derived from fossil gas, are subject to the volatility of the market. In 2021 for example, the spike in gas prices led the cost of hydrogen production to triple²⁵.

Green hydrogen on the current market is not cost competitive compared to grey or blue hydrogen, and despite promises and hopes from the industry, it cannot be. This is partly because the cost of transportation, conversion, and infrastructure drive green hydrogen's cost up, but also because the production of hydrogen requires a constant supply of cheap renewable electricity. In the absence of abundant and cheap renewable electricity, green hydrogen's cost cannot be competitive.

Regardless of the type of hydrogen, there is an additional cost related to transport and infrastructure, especially when hydrogen is planned to be produced far away from where it is planned to be used. This is overwhelmingly the case with Europe as most of its production is planned to take place in Africa. Whichever method is used to transport hydrogen will occur such an large cost that it would render it economically inviable²⁶.

Figure 03: Price sensitivity of hydrogen manufacturing to utilisation and cost of electricity²⁷

Polymer electrolyte membrane (PEM) electrolyzer (100 MW)

		Electrolyzer Utilization				
		100%	90%	80%	70%	60%
Energy Cost (\$/MWh)	\$/kg					
	\$10	\$1.26	\$1.32	\$1.37	\$1.50	\$1.65
	\$20	\$1.57	\$1.62	\$1.68	\$1.81	\$1.96
	\$30	\$1.88	\$1.93	\$1.99	\$2.11	\$2.27
	\$40	\$2.19	\$2.24	\$2.30	\$2.42	\$2.58
	\$50	\$2.49	\$2.55	\$2.60	\$2.73	\$2.88

Expensive, inefficient, dangerous distraction:

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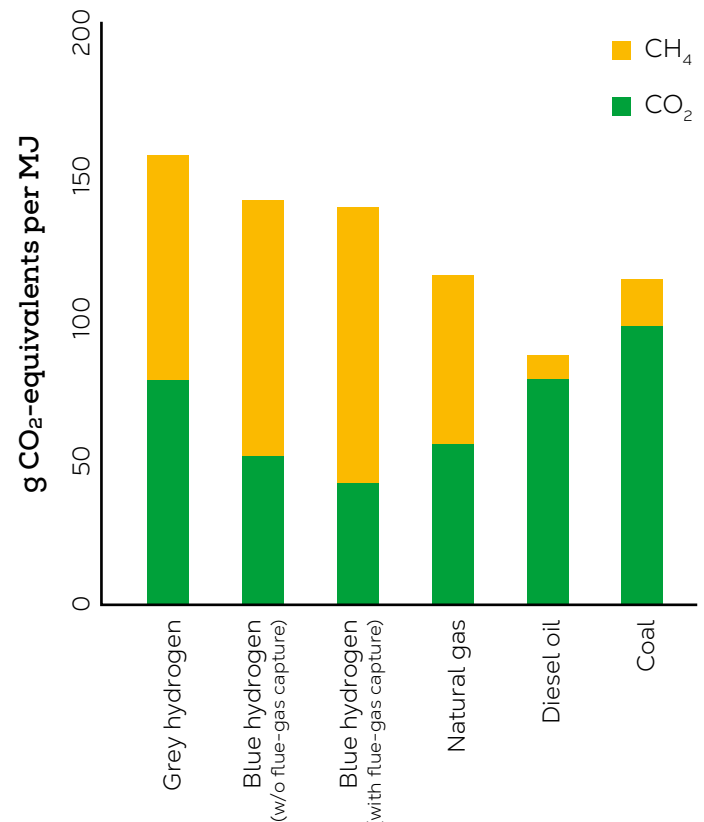
The characteristics of all false solutions

Expensive, inefficient, dangerous distraction... These are the characteristics of all false climate solutions. Whether in the form of hydrogen, offsets, geoengineering, or so called 'nature-based solutions', big polluters have for decades been coming up with magical fixes to the climate crisis that would enable them to continue business as usual. When looked at more closely, these so called solutions all share common characteristics:

1. They provide a distraction from the real, deep, urgent emissions reductions needed to address the climate crisis. The theory is that the fossil industry can continue emitting greenhouse gases because somewhere, somehow, these emissions can be compensated. This narrative is not only based on false assumptions, it provides an increasingly dangerous get away card to high emitters when we can't waste any more time for phasing out fossil fuels.
2. They are ineffective. Put very simply, they do not work in reducing, avoiding, or compensating for emissions. This is as true for unproven and risky technologies like CCS and all forms of geoengineering, as it is for offsetting, which has been proven to not amount to real emissions reductions. Hydrogen, like all other false solutions, does not contribute to reducing emissions. On the contrary, it continues to prop up the fossil fuel industry.
3. Disproportionate financial, social, and environmental costs. Unsurprisingly, as these false solutions are being pushed by big polluters, they further replicate patterns of extractivism, exploitation and neocolonialism. The disproportionate impacts they bear for the environment as well as communities across the world – and especially Indigenous Peoples, communities in the Global South, and small-scale farmers or peasants – are simply unacceptable.

Hydrogen and all false solutions pushed by the industry through their lobbying and greenwashing efforts, and their implementation in 'net-zero' plans, must be opposed if we stand any chance of limiting temperature rise to the critical 1.5 degrees threshold.

Figure 04: Graph showing greenhouse gas footprint per unit of heat energy for each type of hydrogen. Estimated methane leakage rate is 3.5%.²⁸



Our positions

- There is absolutely no space for hydrogen derived from fossil fuels if we are to limit temperature rise to 1.5 degrees. Grey, black/brown, blue and turquoise hydrogen all take source from fossil fuels – whether it's coal, lignite or fossil gas. The need for real, deep and urgent emission cuts renders any fossil energy source unacceptable. **Friends of the Earth International strongly opposes any promotion of all these types of hydrogen** that would lock us into decades more of fossil fuel infrastructure.
- The case for blue hydrogen, pushed by the industry as a 'clean' solution for hydrogen derived from fossil gas, presents a dangerous risk and distraction from real emission cuts. It promotes more fossil gas infrastructure and unproven, dangerous and costly Carbon Capture (Utilisation) and Storage technologies. **We reiterate our opposition to CCS as well as all forms of geoengineering and technofixes**, and to the efforts to paint these as 'solutions' to the climate crisis.
- As the nuclear industry pushes pink/purple hydrogen in a desperate attempt to stay relevant, **we reiterate our opposition to all nuclear projects** given the risks they pose to communities and the environment. Nuclear is a dirty energy and cannot be part of solutions to the climate crisis.
- **We oppose green hydrogen** for its high inefficiency (including high volumes of cheap electricity and water required for its production), its perpetuating of extractivist patterns, its greenwashing of the fossil industry, and its diverting of efforts away from scaling up community-owned renewable energy. **We recognise that green hydrogen may be needed in limited amounts for currently hard to decarbonise industries, however this can only be justified if green hydrogen production can meet the following criteria:**
 - green hydrogen is only produced to meet the needs of a very limited pathway to decarbonisation for sectors that cannot easily electrify;
 - green hydrogen production is shifted away from profit-driven industry and toward public ownership and control, to deliver a just transition;
 - green hydrogen is not used to allow for further expansion of the existing fossil gas network or to lock people into gas use at domestic level;
 - green hydrogen is produced locally and for domestic use, not imported along extractivist and neocolonial routes where Global South resources are exploited to meet the energy needs of the Global North;
 - green hydrogen is not produced in water-stressed areas, and is produced with respect for nature and biodiversity.

Recommendations:

If not hydrogen, then what?

As the climate crisis worsens and communities across the world suffer from its devastating impacts, the fossil industry together with high emitting countries desperately hang on to a system that has consistently put profit above people. In this context, we must not only push back against the false solutions they want us to buy into – be it hydrogen, geoengineering, or so-called ‘nature based solutions’ – but also continue to advance our demands for real, adequate, fair and just solutions to the climate crisis.

Our demands for real zero emissions, for system change²⁹:

- Governments must urgently begin to cooperate on a coordinated phase-out of fossil fuel production and consumption, with equity at the core.
- We must accelerate the transformation towards a climate-just world by transforming our energy system, based on principles such as energy sufficiency for all, energy sovereignty, energy democracy, energy as a common good, 100% renewable energy for all, community-owned, low-impact renewable energy.
- We demand that the inherent rights and sovereignty of Indigenous Peoples, and human rights of peasants and local communities are granted and implemented, so that the traditional knowledge and practices of Community Forest Management (CFM) can be fully implemented to help halt climate change and biodiversity loss. Forests should be kept out of carbon markets, offsets and other such schemes.
- We demand support for peasant agroecology, artisanal fishing, and the small-scale farmers who still feed 70-80% of the people on our planet. We must move away from a neoliberal, corporate-controlled industrial food system, towards a system based on the principles of food sovereignty, food as a human right, and peoples’ control over seeds, land, water and other commons.
- We demand a new economics for people and planet, which values the care system and the reproduction of life, recognises our interdependence as human beings, and re-organises care and domestic work to be shared between men, women and the State. This transformation is essential to building our resilience against health and environmental crises.
- We must reclaim the public sphere and political arena from the perspective of economic, social and gender justice, and ensure peoples’ rights. Public services can guarantee peoples’ access to water, health, energy, education, communication, transport and food. To pay for these public services we need fair, transparent and redistributive tax systems.
- We demand binding rules on big business, allowing us to reign back the power of transnational corporations and provide victims with access to justice, compensation and restoring of their livelihoods wherever corporate crimes occur.
- Governments must build a just recovery from the Covid-19 crises, based on environmental, social, gender, racial, economic and people-centred justice.
- We demand a climate-just world that is free from patriarchy, white supremacy, and all systems of oppression, domination and inequality.

Endnotes

- 1 According to the International Energy Agency (IEA), in 2022 only 0.1% of total hydrogen production came via water electrolysis. See: *Global Hydrogen Review 2023*, IEA, September 2023, <https://www.iea.org/reports/global-hydrogen-review-2023>
- 2 *AR6 Synthesis Report: Climate Change 2023*, IPCC, March 2023, <https://www.ipcc.ch/report/sixth-assessment-report-cycle/>
- 3 See for example *Gas in Mozambique: A windfall for the industry, a curse for the country*, Friends of the Earth International, Justiça Ambiental & Les Amis de la Terre France, May 2020, <https://www.foei.org/publication/gas-in-mozambique-a-windfall-for-the-industry-a-curse-for-the-country/>
- 4 *Global Hydrogen Review 2023*, IEA, September 2023, <https://www.iea.org/reports/global-hydrogen-review-2023>
- 5 Carbon Capture and Storage (CCS) and Carbon Capture, Utilisation and Storage (CCUS) are the – unproven – idea that CO₂ emissions can somehow be collected from an emitting source (eg. a powerplant) and stored underground or reused in other means of production once they've been removed from the atmosphere.
- 6 *Deconstructing the Hype on Hydrogen Hubs*, Bruce Buckheit, Friends of the Earth US, 2022, <https://foe.org/wp-content/uploads/2022/07/Deconstructing-the-Hype-on-Hydrogen-Hubs-FINAL-.pdf>
- 7 Coal contains more carbon than other fossil fuels, resulting in the release of greater quantities of carbon dioxide into the atmosphere when burnt.
- 8 Underground coal gasification is a process that involves drilling into coal seams and combusting the coal in situ in the presence of steam, air or oxygen to create syngas (mainly hydrogen, methane, carbon dioxide and carbon monoxide) that is drawn to the surface through the production well.
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- 15 See figure 14, p. 10 in *Re-examining Japan's Hydrogen Strategy – Moving Beyond the "Hydrogen Society" Fantasy*, Renewable Energy Institute, September 2022, https://www.renewable-ei.org/pdfdownload/activities/REI_JapanHydrogenStrategy_EN_202209.pdf
- 16 Including the EU Hydrogen Strategy whose ambition to produce 10 million tonnes and import 10 million tonnes of renewable hydrogen in the EU by 2030.
- 17 See *revised TEN-E Regulation, 2022*
- 18 *An updated analysis on gas supply security in the EU energy transition*, Artelys, January 2020, <https://www.artelys.com/wp-content/uploads/2020/01/Artelys-GasSecurityOfSupply-UpdatedAnalysis.pdf>
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- 23 *The Illusion of Green Hydrogen*, ReCommon, November 2022, <https://www.recommon.org/en/the-illusion-of-green-hydrogen/>
- 24 See this example of hydrogen in Namibia and the risks it poses to water sources in a country where the resource is scarce: *Issues, Challenges and Opportunities to Develop Green Hydrogen in Namibia*, Konrad-Adenauer-Stiftung, October 2021, <https://www.kas.de/documents/279052/279101/s%252C+Challenges+and+Opportunities+to+Develop+Green+Hydrogen+in+Namibia.pdf/a4729b11-5f95-11fc-3203-737fad34543a?version=1.0&t=1638951171809>
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 - [Contested Transition, State and Capital against Community](#), groundWork/Friends of the Earth South Africa, December 2022
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