global witness

GREENWASHED HYDROGEN

Exposing corporate lobbyists' push to gut EU renewable energy rules

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Credit: Chris Ratcliffe/Bloomberg via Getty Images

> **Freedom of information documents show that the European Commission has come under pressure from the corporate lobby group Hydrogen Europe to adopt sustainability standards that would count carbon intensive hydrogen fuel as 'green'.**

> **Failing to set strong sustainability standards risks creating a European hydrogen industry that increases carbon emissions instead of reducing them, with billions invested in a supposedly green technology that could slow progress towards the EU's climate targets.**

> **The EU's sustainability standards for renewable hydrogen must ensure that the industry reduces carbon emissions.**

The fuel of the future?

Hydrogen, best known for being the most abundant element in the universe, is also gaining a reputation for being the green fuel of the future.

Technologies exist that can replace climate-destroying fossil fuels with hydrogen, which emits no harmful greenhouse gases if the energy used to produce hydrogen is renewable.

Because of its climate-friendly potential, governments around the world are banking on hydrogen to help bring down emissions.

Industry lobbyists also see big opportunities in hydrogen and want it to be used across the board: to replace the petrol in your car; the fossil gas that heats your home; the diesel used in trains; and the jet fuel that gets you to your holiday destination.

It sounds like a wondrous cure for the climate crisis, but a closer look reveals that the industry's push to create a full-blown 'hydrogen economy' is unrealistic, and could end up damaging rather than fixing the climate.

Hydrogen policy is in the grip of corporate lobbyists

The European Commission has recently started to promote hydrogen as a way of cutting carbon emissions and helping to meet its Green Deal climate targets. This includes proposals for a large-scale ramping up of hydrogen production over the next decade and beyond.[1]

Hydrogen secured a greater focus in the EU's climate plans through pressure from corporate lobbyists, who have been granted an excessive amount of influence over important decisions made on hydrogen.[2]

These include industry associations such as Hydrogen Europe, whose members include fossil fuel giants like Shell, BP, Total and Equinor. As hydrogen can be made from fossil gas, these companies see it as a potentially lucrative future market for their fossil fuels, and are influencing policies that affect the hydrogen sector.[3]

This is a cause for deep concern, as the fossil fuel industry carries a shameful track record for blocking policies designed to tackle the climate emergency, and is responsible for the majority of the global heating that caused it.[4]

Evidence gathered by Global Witness shows that corporate lobby groups are trying to weaken new EU rules for hydrogen production.

These rules are meant to ensure that hydrogen made from electricity is fossil free. But if industry lobbyists get their way, it would turn what's supposed to be a climate-friendly fuel into a polluting one.[5]

Not all hydrogen is created equally

For hydrogen to work as a tool to combat the climate crisis, it has to be produced in the right way.

Currently, almost all of the EU's hydrogen is made from fossil gas.[6] This is a cheap way of producing hydrogen, but it causes a vast amount of greenhouse gas emissions and is very damaging for the climate, even if in theory some of those emissions can be captured and stored.[7]

It also perpetuates the extraction and burning of fossil gas, which needs a rapid and managed phase out if the world is to avoid a catastrophic rise in temperatures.[8]

Hydrogen can also be made by passing a current of electricity through water. If all of the electricity used for this process comes from renewable sources such as wind or solar, the resulting hydrogen is virtually carbon free. This is known as 'renewable hydrogen', and is considered to be the gold standard for hydrogen production.

Although costs are set to come down, renewable hydrogen is currently expensive to produce.[9] Because of this, industry lobby groups are pushing for rules that would allow companies to cut corners and make it cheaper to produce renewable hydrogen.

These rules would allow hydrogen companies to use large quantities of fossil electricity to make hydrogen – i.e. electricity that comes from coal- or gas-fired power plants.

This is another cause for concern, because hydrogen made with fossil electricity produces even more carbon emissions than using the fossil electricity directly.

This is because it takes large amounts of electricity to produce a relatively small amount of hydrogen. So if these large amounts of electricity came from fossil fuel power plants, the resulting hydrogen would have a disproportionately big carbon footprint. [10]

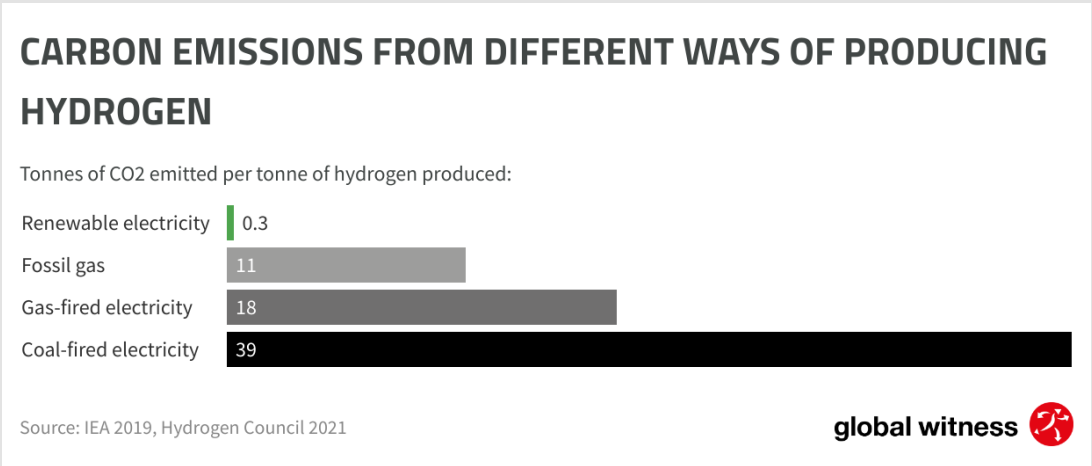
Hydrogen from fossil gas is terrible for the climate, but hydrogen from fossil electricity is even worse

Hydrogen made directly from fossil gas generates very high carbon emissions. For every tonne produced, 11 tonnes of carbon dioxide is dumped in the atmosphere.[11]

In the EU, hydrogen made directly from fossil fuels emits up to 100 million tonnes of carbon dioxide every year.[12] For comparison, Austria's total carbon emissions were around 80 million tonnes in 2019.[13]

However, hydrogen from fossil electricity is an even worse climate offender, with a carbon footprint between two and four times bigger than hydrogen from fossil gas.[14]

As mentioned above, this is because the production process for renewable hydrogen is inefficient. Only about half of the energy from the electricity gets converted into hydrogen, so the carbon intensity of the electricity is effectively doubled into the carbon intensity of the resulting hydrogen.[15]



So, even if hydrogen was made mostly with renewable electricity, but also included just a small proportion of fossil electricity, it would still have an oversized carbon footprint.

In other words, dirty electricity makes very dirty hydrogen. This is why it's so important to ensure that hydrogen is produced with 100% renewable electricity.

A chance to ensure renewable hydrogen is properly climate-friendly

An EU law, known as the revised Renewable Energy Directive (RED II), includes a set of requirements for companies to ensure their production of renewable hydrogen is genuinely sustainable.[16]

Currently, RED II only applies to hydrogen produced for use in the transport sector. However, the law is being revised again, and these requirements may be extended to cover other industries.

RED II outlines some principles for how renewable hydrogen should be produced but doesn't go into specifics, leaving the European Commission to work out the finer details in a more obscure legislative process.

As such, the Commission is currently developing sustainability standards that will define RED II's requirements in more detail, and how companies should implement them.

But as this briefing shows, the Commission has come under sustained pressure from Hydrogen Europe to adopt weak standards.

Failing to set strong sustainability standards risks creating an industry that increases carbon emissions instead of reducing them, with billions invested in a supposedly green technology that could slow progress towards the EU's climate targets.

It is crucial, therefore, that RED II's sustainability standards are strongly climate-oriented from the outset, and not drawn up in the commercial interests of energy companies.

Hydrogen Europe's proposal could result in hydrogen production increasing net carbon emissions

Hydrogen Europe is a Brussels-based industry association whose members include the fossil fuel giants Shell, Total and Equinor.[17] It's perhaps the most influential player in EU policy debates on hydrogen, and has been using its sway to try and weaken key elements of RED II.

This includes attempts to water down a crucial requirement for ensuring that the renewable electricity used to make hydrogen is 'additional'.[18]

This requirement means the electricity must come from renewable energy installations, such as wind turbines or solar panels, that were built specifically to produce hydrogen and are additional to the existing fleet of renewable energy installations.

Or, if a hydrogen producer uses renewable electricity from existing sources, it can only be counted as additional if the electricity is surplus to requirements and otherwise would have gone to waste.

This principle, also known as 'additionality', is crucial because it's designed to prevent hydrogen companies from diverting renewable electricity from existing sources, which is urgently needed to decarbonise the electricity grid and everything it powers.

Another reason it's important is because renewable electricity that gets diverted from existing sources would often be replaced by fossil electricity. In other words, the grid would compensate for the lost renewable electricity by firing up fossil fuel power plants to fill the gap, and thereby increase emissions.[19]

Weak EU regulations for hydrogen production would result in companies using large volumes of electricity from gas- or coal-fired power plants to produce 'renewable' hydrogen and increasing carbon emissions. *Credit: Omar Marques/Getty*

The climate risks of diverting renewable electricity to make hydrogen are a particular concern in Europe, given the huge quantities of renewable electricity that would be needed to implement the EU's plans for a large-scale ramping up of hydrogen production.

For all these reasons, it is vital that RED II includes strong requirements for additionality.

Lobbying against additionality

Despite the need for additionality, Hydrogen Europe has called for this measure to be eliminated, and has lobbied against it at the highest levels of the European Commission.

For example, documents obtained through freedom of information requests show that Hydrogen Europe sent a set of 10 policy recommendations to a close adviser to the President of the European Commission, Ursula von der Leyen.[20]

One of the recommendations is titled "Remove undue barriers to hydrogen production and hydrogen infrastructure". The text below this heading states that additionality, along with other RED II requirements for producing hydrogen, "create limitations which could place insurmountable barriers to the introduction of renewable hydrogen in the transport sector."[21]

Another freedom of information disclosure shows that Hydrogen Europe sent a letter to Frans Timmermans, Commission Executive Vice-President for the European Green Deal, stating that: "we openly question why renewable hydrogen needs to prove additionality."[22]

Writing to the director of the Commission's department for climate action, Hydrogen Europe again questioned the need for additionality. The letter relates to an EU subsidy scheme, but in a section on additionality and Europe's hydrogen industry in general, the lobby group says: "our sector believes that no such requirement should be present."[23]

Hydrogen Europe presented its position publicly in a report from October 2020, which states that the requirements imposed by RED II's additionality principle will increase production costs and place significant burdens on hydrogen companies. The report recommends a number of measures to reduce these costs, including by "eliminating legal barriers (e.g. double-taxation, additionality, etc.)."[24]

In April 2021, Hydrogen Europe confirmed to Global Witness that it is calling for there to be no requirement for additionality until 2025. After this date, the group's proposal is for the Commission to carry out an assessment of the hydrogen sector and decide if the 2025 cut-off point should be extended.[25]

Hydrogen Europe said this decision should factor in whether or not the Commission's target for installing at least six gigawatts of renewable hydrogen production capacity within Europe by 2024 has been achieved.[26] In another policy briefing, the group states that the six gigawatt milestone is its preferred point for introducing the requirement for additionality.[27]

Six gigawatts is a substantial proportion – 15% – of the EU's target for installing 40 gigawatts of renewable hydrogen capacity in Europe by 2030.[28] Given the high volume of hydrogen this represents, if adopted Hydrogen Europe's proposal would almost certainly lead to large quantities of renewable electricity being diverted from the grid, with the knock-on effect of increasing carbon emissions.

Hydrogen Europe's proposal risks using a lot of fossil electricity to produce hydrogen

RED II's requirement for additionality aims to ensure hydrogen companies add to the existing fleet of renewable energy installations. However, a company could meet this obligation, but go on to produce hydrogen using electricity generated by fossil fuel power plants.

To prevent this from happening, another crucial measure in RED II aims to ensure that companies use renewable electricity to make hydrogen, so that the resulting hydrogen is also renewable.

However, Hydrogen Europe is calling on the European Commission to adopt very weak rules to implement this measure, which applies to hydrogen companies when they source renewable electricity from the grid.

Again, if the industry group gets its way, hydrogen could turn from being a renewable fuel into one that's dangerous for the climate.

Grid connection v direct connection

As well as sourcing electricity from a direct connection to a renewable energy installation, such as a wind farm, hydrogen companies can also source renewable electricity from the grid.

In these cases, environmental best practice is for a hydrogen company to sign a contract with a renewable energy installation that supplies electricity via the grid.[29]

However, renewable electricity from that contracted installation might not always be available, because supply fluctuates depending on how sunny or windy it is. So when the renewable energy installation isn't generating electricity, there's a risk that the hydrogen company would switch temporarily to using fossil-based electricity from the grid.

To minimise this risk, RED II includes a measure to ensure that companies produce hydrogen only when their contracted renewable energy installation is generating electricity, which is otherwise known as 'temporal correlation'.[30]

This can be achieved by requiring companies to produce hydrogen within a specified timeframe. However, RED II doesn't say how long the timeframe should be, so the European Commission is developing standards to decide this.

European Commission Green Deal chief Frans Timmermans. Hydrogen Europe questioned the need for additionality in a letter to Timmermans. *Credit: Virginia Mayo/Getty*

It's all in the timing

Over a short timeframe, the availability of renewable electricity can be forecast with a lot of accuracy. This helps to ensure that demand for renewable electricity matches supply, so hydrogen companies produce only when their contracted renewable energy installation is generating electricity.

If demand for renewable electricity exceeds supply, the hydrogen company will need to temporarily shut down production, otherwise its hydrogen output will be carbon intensive.

Over a longer timeframe, hydrogen companies' production might not always coincide with the supply of renewable electricity. This would increase the risk of them using fossil electricity when renewable energy is scarce, and continuing rather than stopping production when this happens.

Duking it out over the time limit

Climate campaigners including Global Witness are calling for the timeframe to be short – one hour – as this would ensure companies produce hydrogen in lock-step with renewable electricity generation, and therefore that the hydrogen is guaranteed fossil free.

With a short time limit, day-ahead forecasts could be used to determine the availability of renewable electricity. This would help ensure that every hour of hydrogen production matches every hour of renewable electricity generation.[31]

The one-hour time limit should apply when RED II's sustainability standards first come into force, and could be narrowed down further in future.

Hydrogen Europe, however, has called for an excessively long time limit of one month from when the standards first come into force.[32] In Global Witness's view, this goes against RED II's stated intention that hydrogen can only be considered renewable if it's produced when the contracted renewable energy installation is generating electricity.

Industry has argued that having a long time limit would help to reduce costs and attract investment into the sector, as it would allow hydrogen companies to achieve higher continuity in production.[33]

But this would risk hydrogen companies using fossil electricity in potentially very large amounts. For example, if it was sourcing electricity from a solar farm, a hydrogen producer could run on fossil electricity throughout the night when the solar power stops generating.

This would create higher demand for electricity that would often be met by firing up fossil power plants, and the end result would be hydrogen fuel that damages rather than protects the climate.

Hydrogen Europe's response to questions

When asked by Global Witness for more information on its policy proposals, Hydrogen Europe provided a detailed response.

The group stated that the requirement for additionality discriminates against hydrogen companies, as it doesn't apply to other users of renewable electricity.

While detailed, EU-wide additionality rules may be particular to hydrogen companies, the industry is being created specifically to reduce carbon emissions.[34] Additionality is therefore needed for hydrogen production otherwise it's likely to increase emissions, which would defeat its purpose.

Furthermore, large quantities of electricity are needed to produce relatively small amounts of hydrogen. So apart from in the limited instances where hydrogen may be a better option than direct electrification, it's an inefficient use of renewable electricity that's urgently needed to decarbonise the grid.[35]

It also cuts both ways, because having no or lax standards for additionality would discriminate against responsible companies that want to produce genuinely sustainable hydrogen – i.e. from 100% renewable electricity that's 100% additional – potentially to the point of making more sustainable projects financially non-viable.

Meanwhile hydrogen companies that took advantage of weak additionality standards would still have their product counted as renewable, even if it had a bigger carbon footprint, which would risk undermining the industry's credibility.[36]

These factors justify requirements for ensuring that hydrogen companies add to, rather than take away from, existing sources of renewable electricity.

Hydrogen Europe also said the concern that diverting renewable electricity from existing sources would lead to an increase in fossil power generation is exaggerated, because increased demand for renewable electricity from the hydrogen industry will create a bigger supply base of renewable sources to meet that extra demand.

For example, if renewable electricity from an existing source was diverted to produce hydrogen, the company that 'lost' the electricity will want to replace it by contracting more renewable power.

But this would rely on voluntary, corporate goodwill, and there's no guarantee that an electricity user would continue to go green. In reality, it's likely that increased demand for electricity in the EU would be met by a mix of energy sources. Some of the replacement electricity would no doubt be renewable, but some of it would be fossil-based.[37]

Hydrogen Europe also pointed out that while it takes around two years to build a hydrogen plant, it can take several more years than this to construct a renewable energy installation to supply it with electricity.

The group said that because of this, the requirement for additionality will reduce the incentive to invest in the industry, as for a long period of time the hydrogen produced couldn't be counted as renewable, and would therefore lose market value.

Hydrogen Europe cites this as a reason to allow companies to produce hydrogen with renewable electricity from existing sources, in cases where their additional renewable energy installation hasn't yet come online, and count this hydrogen as 'renewable' under RED II's sustainability standards.[38]

This could lead to companies producing hydrogen for very long periods with renewable electricity from existing sources. As this briefing shows, this is likely to increase carbon emissions and slow progress towards the EU's climate goals. Therefore, any hydrogen produced with renewable electricity that isn't additional must not be counted as renewable.

EU standards for renewable hydrogen production must prevent electricity being diverted from existing renewable energy installations. *Credit: Nathan Stirk/Getty*

Global Alliance Powerfuels' proposals raise similar climate concerns

The lobby group Global Alliance Powerfuels (GAP), whose members include the fossil fuel companies BP, ExxonMobil and Uniper, is also calling for weak sustainability standards to implement RED II.

The group was founded by DENA, the German government's energy agency, together with 16 companies from various sectors. It promotes fuels made from renewable electricity including hydrogen, and aims to influence regulations that affect the industry.[39]

As with Hydrogen Europe, GAP's policy proposals, if adopted, would lead to hydrogen companies using fossil electricity in potentially large quantities. The group is calling on the European Commission to adopt sustainability standards for RED II that will:

> Allow a time limit of one week to match demand for renewable electricity with supply. Although this is shorter than Hydrogen Europe's proposal for a one month limit, it still creates a risk of companies using large amounts of fossil electricity to produce hydrogen.[40]

> Prevent the time limit from being changed for hydrogen plants built when this set of standards is in place, even if more stringent standards are introduced in future which shorten it (sometimes known as a 'grandfather' clause).[41]

This would lock in potentially climate-damaging regulations, and place future producers of genuinely sustainable hydrogen at a competitive disadvantage if stricter standards are introduced.[42]

GAP's response to questions

In response to questions from Global Witness, GAP stated that if a hydrogen company temporarily switched to using fossil electricity, its renewable electricity provider would make up for this by supplying the same amount of electricity at another point in time, which would displace fossil electricity at that moment.

Therefore, according to GAP, the overall greenhouse gas emissions will be unaffected by having a longer time limit to match demand with supply.

However, having a longer time limit, or even none at all, would give companies a green light to produce hydrogen with fossil electricity. As shown above, this results in the production of highly carbon intensive hydrogen, which may not comply with RED II's carbon footprint reduction rule (see below).

Such an approach would also mean the EU's energy system would miss out on a crucial source of flexibility. Hydrogen production plants have a special ability to turn on and off very quickly. This makes them ideal for absorbing and storing excess renewable energy as hydrogen, and feeding that hydrogen back into the energy system when there aren't enough renewables. But if companies keep producing hydrogen continuously for long periods of time, this flexibility would be lost.

GAP also states that a grandfather clause for the electricity demand-supply time limit is needed for early producers of hydrogen, as this will help them with long-term planning and attract investment into the industry. However, the concern remains that the benefits of this incentive could be outweighed by its cost to the climate.

Phasing in tougher standards for new 'clean fuels' – a false promise?

Although Hydrogen Europe's and GAP's proposed sustainability standards are to varying degrees loose, both groups say that over time they should be tightened as the hydrogen sector develops.

However, experience from the biofuels industry highlights the danger of lax rules becoming entrenched and difficult to amend over time.

Initially, EU regulations permitted biofuels companies to disregard the higher emissions that result from clearing land to establish large-scale palm oil and soy production for biofuels.

Campaigners have called for the regulations to be amended to recognise the climate impact of deforestation caused by biofuels and count these emissions.

However, pressure from industry meant that these indirect climate impacts are not taken into account and currently, producers are still permitted to ignore the deforestation resulting from producing palm oil and soy for biofuels.

As a result, biofuels with high indirect emissions can still comply with EU standards and access European markets.[43]

This shows that improving sustainability standards after a new industry becomes established can be extremely difficult and blocked by vested interests that are likely to defend outdated or failing regulations.

RED II's carbon footprint rule – a risk of greenwashing?

Another key requirement in RED II says that in order to be counted as renewable, hydrogen for the transport sector must have a carbon footprint that's at least 70% smaller than a comparable fossil fuel.[44] Currently, the European Commission is developing a methodology that regulators can use to check whether a company's hydrogen production complies with this 70% rule.

One option is for the methodology to automatically treat renewable electricity sourced from the grid as being carbon free. In other words, it would assume that RED II's sustainability standards – such as for additionality, and matching renewable electricity demand with supply – have done their job of ensuring the electricity used to produce hydrogen is zero carbon, or at least very low carbon.

This wouldn't be a problem were RED II's sustainability standards strong enough to ensure the electricity is carbon free. But as this briefing highlights, industry groups are pushing for weak standards that could lead to large volumes of carbon intensive electricity being used to produce hydrogen.

As such, the methodology needs to account for the carbon content of the electricity used, otherwise this would result in hydrogen production that on paper complies with RED II's requirements, and therefore gets counted as renewable, even if it's carbon intensive and doesn't meet the 70% threshold.

This would run the risk of hydrogen being 'greenwashed' – i.e. labelled as sustainable, but in reality is far from it.

This makes it all the more important that RED II's sustainability standards are fit for purpose and ensure that the electricity used to produce hydrogen is as renewable as possible.

The hydrogen pipe dream

Along with improving energy efficiency and phasing out fossil fuels, decarbonising Europe's economy will be achieved primarily through direct electrification.

This is a cheaper and more efficient way of using renewable electricity than converting it into hydrogen. The process of making hydrogen uses large amounts of renewable electricity,[45] adds substantial costs,[46] and the delivered energy can be less than 30% of what was in the initial electricity input.[47]

This means that industry lobbyists' goal of using hydrogen to decarbonise huge swaths of Europe's economy – from fuelling cars to trains to household boilers – is unrealistic.[48]

Steelmaking is an industry that genuinely renewable hydrogen could help to decarbonise. *Credit: Maja Hitij/Getty*

This was highlighted in a recent study by the UK Climate Change Committee, which showed the UK would need 30 times more offshore wind capacity to facilitate a switch from fossil gas to hydrogen boilers in all UK homes. Chris Stark, head of the Committee, deemed this "unwieldy and impractical".[49]

Renewable hydrogen is therefore likely to be an important but limited resource which should be considered for only for sectors that are harder to electrify. Potentially these include steel production and certain forms of transport, as well as storing hydrogen for use when wind and solar power is scarce.[50]

Even if the EU relies almost exclusively on renewable hydrogen to decarbonise its hard-to-electrify sectors, and does not use any hydrogen made from fossil gas, energy scenario modelling shows that renewable hydrogen would still play a limited role in meeting the EU's climate targets.[51]

This suggests that the high volumes of hydrogen to supply the full-blown hydrogen economy being pushed for by business lobbyists won't be needed, and casts doubt on claims that weak sustainability standards are needed to help kick-start hydrogen production.

Weak hydrogen standards risk undermining other EU climate initiatives

The European Commission published its hydrogen strategy in July 2020. In contrast to industry's proposals for RED II's sustainability standards, the strategy is clear that hydrogen produced from fossil electricity should be avoided.[52]

The Commission's strategy promises financial support for renewable hydrogen, including through the EU's €750 billion COVID recovery fund and the €95 billion Horizon Europe scheme.[53] But if weak sustainability standards were in place that led to EU-funded hydrogen projects tapping fossil fuel power, taxpayers

would end up subsidising the production of a climate-damaging fuel.

The EU has set a legally binding target for at least 32% of its energy consumption to come from renewables by 2030.[54] Campaigners say this target is too low, albeit a step in the right direction, and it's set to be revised upwards.[55] However, if RED II's additionality standards are weak, electricity could get diverted from sources that should be contributing to the EU's renewables target, which would slow progress towards the this currently unambitious goal.

Another key EU climate initiative is the 'energy efficiency first' framework, a set of laws and targets to reduce EU Member States' energy consumption and waste.[56] Efficiency first is a fundamental principle applied to policymaking in the energy sector, around which the EU's energy system is meant to be designed. However, if hydrogen is over-used in sectors where direct electrification is a more efficient use of renewable energy, it risks undermining this core EU principle.

Recommendations

The EU needs to make sure its policies do not deter investment in green technologies. At the same time, granting unnecessary concessions to energy companies could lead to rising emissions and undermine progress towards the EU's climate and energy targets.

As such, Global Witness is calling on the European Commission to adopt sustainability standards for hydrogen production that are fit-for-purpose. At a minimum, these must ensure:

> 100% of the renewable electricity used by hydrogen producers is additional. This requirement should come into full effect with no delay, and any hydrogen produced with non-additional renewable electricity must not be counted as renewable.

> Hydrogen producers carry out hourly matching of renewable electricity demand with supply, using day-ahead forecasts.

> Hydrogen producers either commission their own renewable energy installations or use power purchase agreements to source additional renewable electricity from the grid. Guarantees of Origin are not sufficient to drive additionality or ensure the sustainability of electricity sourced from the grid.[57]

> No grandfathering of sustainability standards for sourcing renewable electricity.

ENDNOTES

[1] European Commission, 'A hydrogen strategy for a climate-neutral Europe', July 2020: https://ec.europa.eu/energy/sites/ener/files/hydrogen_strategy.pdf

[2] Corporate Europe Observatory, 'The hydrogen hype: gas industry fairy tale or climate horror story?', December 2020: https://corporateeurope.org/en/hydrogen-hype

[3] The EU Integrity Watch database shows 50 out of 111 meetings on the subject of hydrogen between senior European Commission officials and lobbyists since November 2019 were with private companies, including Shell, Equinor, Snam and Engie. A further 38 meetings on hydrogen were with industry associations such as Hydrogen Europe and the International Association of Oil and Gas Producers. Eight of the 111 meetings were with NGOs: https://www.integritywatch.eu/

[4] Influence Map, 'Big oil's real agenda on climate change', March 2019: https://influencemap.org/report/How-Big-Oil-Continues-to-Oppose-the-Paris-Agreement-38212275958aa21196dae3b76220bddc; Union of Concerned Scientists, 'The climate deception dossiers', June 2015: https://www.ucsusa.org/resources/climate-deception-dossiers; CDP, 'Carbon majors report 2017', July 2017: https://www.cdp.net/en/articles/media/new-report-shows-just-100-companies-are-source-of-over-70-of-emissions

[5] Whilst this report was in preparation Hydrogen Europe issued a press release criticising descriptions of the body as a lobbying front for fossil fuel interests. Hydrogen Europe said that by its assessment only 19% of its 267-strong membership count as fossil fuel businesses and all members have equal voting rights. It stated that its fossil fuel members have engaged in four out of five green hydrogen projects in Europe to date, and that all members subscribe to the climate targets in the Paris Agreement and the subsequent EU Climate Law: 'Hydrogen Europe reacts to false accusations', 6 May 2021: https://fuelcellsworks.com/news/hydrogen-europe-reacts-to-false-accusations/

[6] Fuel Cells And Joint Hydrogen Undertaking, 'Hydrogen roadmap Europe: a sustainable pathway for the European energy transition', January 2019, page 40: https://www.fch.europa.eu/sites/default/files/Hydrogen%20Roadmap%20Europe_Report.pdf

[7] Currently, carbon capture systems installed at existing fossil hydrogen plants remove only 60% of the CO2 emitted (UK Climate Change Committee, 'Hydrogen in a low-carbon economy', page 67). Also, carbon capture systems within hydrogen plants cannot remove greenhouse gas emissions that occur in the supply chain for fossil gas. Once a carbon capture system is in place, up to two-thirds of the emissions from hydrogen production occur in the fossil gas supply chain (Hydrogen Council, 'Hydrogen decarbonization pathways: a life-cycle assessment', page 6). Supply chain emissions include those from methane, which as a greenhouse gas is more than 80 times as potent than CO2 over a 20-year period.

[8] European Commission, Impact Assessment, 'Stepping up Europe's 2030 climate ambition: investing in a climate-neutral future for the benefit of our people', October 2020, page 55: https://eur-lex.europa.eu/resource.html?uri=cellar:749e04bb-f8c5-11ea-991b-01aa75ed71a1.0001.02/DOC_1&format=PDF; Global Witness, 'Overexposed: the IPCC's report on 1.5°C and the risks of overinvestment in oil and gas', April 2019, pages 9-11: https://www.globalwitness.org/en/campaigns/oil-gas-and-mining/overexposed/

[9] BloombergNEF, 'Hydrogen economy outlook: key messages', March 2020, page 2: https://data.bloomberglp.com/professional/sites/24/BNEF-Hydrogen-Economy-Outlook-Key-Messages-30-Mar-2020.pdf

[10] IEA, 'The future of hydrogen: seizing today's opportunities', June 2019, page 53: https://www.iea.org/reports/the-future-of-hydrogen

[11] Hydrogen Council, 'Hydrogen decarbonization pathways: a life-cycle assessment', January 2021, page 6: https://hydrogencouncil.com/wp-content/uploads/2021/01/Hydrogen-Council-Report_Decarbonization-Pathways_Part-1-Lifecycle-Assessment.pdf

[12] European Commission, 'A hydrogen strategy for a climate-neutral Europe', July 2020, page 1: https://ec.europa.eu/energy/sites/ener/files/hydrogen_strategy.pdf

[13] Umweltbundesamt, 'Austria's greenhouse gas emissions in 2019', January 2021: https://www.umweltbundesamt.at/en/news210122en

[14] IEA, 'The future of hydrogen: seizing today's opportunities', June 2019, page 53: https://www.iea.org/reports/the-future-of-hydrogen

[15] Malins, C, 'What does it mean to be a renewable electron?', December 2019, page 9: https://theicct.org/publications/cerulogy-renewable-electrons-20191209

[16] EU Directive (2018/2001) on the promotion of the use of energy from renewable sources (recast), Articles 25, 27 and 28; Recitals 87 and 90: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018L2001&from=EN

[17] https://hydrogeneurope.eu/

[18] EU Directive (2018/2001) on the promotion of the use of energy from renewable sources (recast), Article 27: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018L2001&from=EN

[19] Malins, C, 'What does it mean to be a renewable electron?', December 2019, page 9: https://theicct.org/publications/cerulogy-renewable-electrons-20191209

[20] Email from Hydrogen Europe to Kurt Vandenburghe, European Green Deal adviser at the Cabinet of European Commission President Ursula von der Leyen, 16 June 2020. Obtained through a freedom of information request made by Corporate Europe Observatory and available at: https://www.globalwitness.org/documents/20131/Hydrogen_Europe_FOI_request_response_email_-_May_2021.pdf

[21] Document sent by Hydrogen Europe to Kurt Vandenburghe, European Green Deal adviser at the Cabinet of European Commission President Ursula von der Leyen, 16 June 2020, page 16. Obtained through a freedom of information request made by Corporate

Europe Observatory and available at: https://www.globalwitness.org/documents/20130/Hydrogen_Europe_EU_Hydrogen_Strategy_-_May_2021.pdf

[22] Letter from Hydrogen Europe to Frans Timmermans, European Commission Executive Vice-President for the European Green Deal, 25 February 2020. Obtained through a freedom of information request made by Corporate Europe Observatory and available at: https://www.globalwitness.org/documents/20129/Email_from_Hydrogen_Europe_to_Frans_Timmermans_-_May_2021.pdf

[23] Document emailed by Hydrogen Europe to the Directorate-General for Climate Action on 21 February 2020, page 4. Obtained through a freedom of information request made by Corporate Europe Observatory and available at: https://www.globalwitness.org/documents/20132/Hydrogen_Europe_Comments_on_the_ETS_Innovation_Fund_May_2021.pdf

[24] Hydrogen Europe, 'Clean hydrogen monitor 2020', October 2020, page 34: https://www.hydrogeneurope.eu/wp-content/uploads/2021/04/Clean-Hydrogen-Monitor-2020.pdf

[25] Hydrogen Europe email to Global Witness, 13 April 2021.

[26] European Commission, 'A hydrogen strategy for a climate-neutral Europe', July 2020, page 3: https://ec.europa.eu/energy/sites/ener/files/hydrogen_strategy.pdf

[27] Hydrogen Europe, 'RED II Delegated Act – Hydrogen Europe position', provided by Hydrogen Europe to Global Witness via email, 8 February 2021.

[28] European Commission, 'A hydrogen strategy for a climate-neutral Europe', July 2020, page 3: https://ec.europa.eu/energy/sites/ener/files/hydrogen_strategy.pdf

[29] These contracts are known as 'power purchasing agreements', or PPAs. Crucially, they can be used to spell out how demand for renewable electricity will be matched with supply, as well as help facilitate the development of additional renewable electricity capacity. Other instruments used for sourcing renewable electricity such as Guarantees of Origin are not well-suited for these purposes. Transport & Environment, 'Getting it right from the start: how to ensure the sustainability of electrofuels', January 2021: https://www.transportenvironment.org/publications/how-ensure-sustainability-electrofuels

[30] EU Directive (2018/2001) on the promotion of the use of energy from renewable sources (recast), Recital 90: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018L2001&from=EN

[31] Transport & Environment, 'Getting it right from the start: how to ensure the sustainability of electrofuels', January 2021, page 13: https://www.transportenvironment.org/publications/how-ensure-sustainability-electrofuels

[32] Hydrogen Europe, 'RED II Delegated Act – Hydrogen Europe position', page 13. Provided by Hydrogen Europe to Global Witness via email, 8 February 2021. The position paper says the time limit could be brought down progressively to 24 hours if conditions permit this in all EU member states.

[33] Global Alliance Powerfuels, 'Sustainable electricity sources: renewable fuels of non-biological origin in the RED II', August 2020, page 10: https://www.powerfuels.org/newsroom/publikationsdetailansicht/pub/sustainable-electricity-sources-renewable-fuels-of-non-biological-origin-in-the-red-ii/

[34] RED II's additionality requirement also applies to the direct use of renewable electricity in electric vehicles, as well as to renewable electricity for hydrogen production (Article 27). However, for electric vehicles, the European Commission is only tasked with developing a framework with different options for EU Member States on how to put additionality into practice, as opposed to creating detailed, EU-wide sustainability regulations for renewable hydrogen production.

[35] After converting electricity to hydrogen, shipping the hydrogen and storing it, then converting it back to electricity in a fuel cell, the delivered energy can be below 30% of what was in the initial electricity input. IEA, 'The future of hydrogen: seizing today's opportunities', June 2019, page 33: https://www.iea.org/reports/the-future-of-hydrogen

[36] Joint contribution from Austria, Denmark, Ireland, Luxembourg, Portugal and Spain, 'Additionality in renewable hydrogen production', November 2020: https://politi.co/3bMycLu

[37] International Council on Clean Transportation, 'Decarbonization potential of electrofuels in the European Union', September 2018, page 15: https://theicct.org/publications/decarbonization-potential-electrofuels-eu#

[38] Hydrogen Europe, 'RED II Delegated Act – Hydrogen Europe position', page 9. Provided by Hydrogen Europe to Global Witness via email, 8 February 2021.

[39] https://www.powerfuels.org/home/

[40] Global Alliance Powerfuels, 'Sustainable electricity sources: renewable fuels of non-biological origin in the RED II', August 2020, page 12: https://www.powerfuels.org/newsroom/publikationsdetailansicht/pub/sustainable-electricity-sources-renewable-fuels-of-non-biological-origin-in-the-red-ii/

[41] Ibid, page 12.

[42] Bellona Europa, 'Feedback on the delegated act of RED II', January 2021, page 2: https://network.bellona.org/content/uploads/sites/3/2021/01/Bellona_Feedback-on-the-delegated-act-of-REDII-electricity.pdf

[43] Transport & Environment. 'Biofuels: what's the problem and how can we fix it?': https://www.transportenvironment.org/what-we-do/biofuels-whats-problem

[44] EU Directive (2018/2001) on the promotion of the use of energy from renewable sources (recast), Article 25: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018L2001&from=EN

[45] IEA, 'The future of hydrogen: seizing today's opportunities', June 2019, page 43: https://www.iea.org/reports/the-future-of-hydrogen

[46] After converting electricity to hydrogen, shipping the hydrogen and storing it, then converting it back to electricity in a fuel cell, the delivered energy can be below 30% of what was in the initial electricity input. This makes

hydrogen more expensive than the electricity used to produce it. IEA, 'The future of hydrogen: seizing today's opportunities', June 2019, page 33: https://www.iea.org/reports/the-future-of-hydrogen

[47] See the preceding endnote. Furthermore, in many applications, direct electrification has a greater end use efficiency than hydrogen. For example, use of electric vehicles and heat pumps can deliver 75% and 270% more energy services respectively compared to hydrogen fuel cell vehicles and hydrogen boilers in equivalent applications. UK Committee on Climate Change, 'Hydrogen in a low carbon economy', November 2018, page 21: https://www.theccc.org.uk/wp-content/uploads/2018/11/Hydrogen-in-a-low-carbon-economy.pdf

[48] Ueckert, F *et al*, 2021, 'Potential and risks of hydrogen-based e-fuels in climate change mitigation', Nature Climate Change, May 2021, page 1: https://www.nature.com/articles/s41558-021-01032-7

[49] The Times, 'Switching all boilers to hydrogen is "impractical"', 7 December 2020: https://www.thetimes.co.uk/article/switching-all-boilers-to-hydrogen-is-impractical-zw00f3v9l

[50] E3G, 'Renewable and decarbonised gas: options for a zero-emissions society', June 2018, page 25: https://www.e3g.org/publications/renewable-and-decarbonised-gas-options-for-a-zero-emissions-society/; Ueckert, F *et al*, 2021, 'Potential and risks of hydrogen-based e-fuels in climate change mitigation', Nature Climate Change, May 2021, page 8: https://www.nature.com/articles/s41558-021-01032-7

[51] Climate Action Network Europe & The European Environmental Bureau, 'Building a Paris Agreement compatible (PAC) energy scenario', June 2020, pages 5, 8 and 40: https://caneurope.org/building-a-paris-agreement-compatible-pac-energy-scenario/; DIW Berlin, 'Make the European Green Deal real – combining climate neutrality and economic recovery', page 3: https://www.diw.de/documents/publikationen/73/diw_01.c.791736.de/diwkompakt_2020-153.pdf

[52] European Commission, 'A hydrogen strategy for a climate-neutral Europe', July 2020, page 13: https://ec.europa.eu/energy/sites/ener/files/hydrogen_strategy.pdf

[53] Ibid, pages 9 and 11.

[54] EU Directive (2018/2001) on the promotion of the use of energy from renewable sources (recast), Article 3: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018L2001&from=EN

[55] Greenpeace, 'EU overturns barriers to rooftop revolution but renewable target falls short of serious climate action', 14 June 2018: https://www.greenpeace.org/eu-unit/issues/climate-energy/1142/eu-overturns-barriers-to-rooftop-revolution-but-renewable-target-falls-short-of-serious-climate-action/; Solar Power Europe, 'EU confirms plans to increase 2030 renewable energy target and develop alliance in advanced solar', 18 September 2020: https://www.solarpowereurope.org/eu-confirms-plans-to-increase-2030-renewable-energy-target-and-develop-alliance-in-advanced-solar/

[56] The EU's energy efficiency framework consists of a number of directives, including the Energy Efficiency Directive: https://www.europarl.europa.eu/factsheets/en/sheet/69/energy-efficiency

[57] See endnote 29.