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Cannibalising the Energiewende? 27 Shades of Green Hydrogen

Impact Assessment of REDII Delegated Act on Electrolytic Hydrogen CO_2 Intensity: A clear call for additional renewables

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Executive summary

The delegated act of the Renewable Energy Directive (RED II) on Renewable Fuels of Non-Biological Origin (RFNBOs) is bound to be published soon. This will set the regime under which hydrogen (local or imported) can be labelled as renewable hydrogen in Europe, determining its sustainability and eligibility for subsidy. This briefing looks into the proposal that is currently being discussed, testing it with real-world data in order to understand what it would mean in terms of real carbon emissions and running hours for the grid-connected electrolysers.

Electrolytic hydrogen requires large amounts of electricity to be produced. Models, such as the EU long term strategy, show that in the coming decades this will become a huge driver in demand for growing electricity. **Ensuring this electricity is from additional renewables and is not cannibalising existing renewable electricity currently used for direct electrification is crucial for the climate.**

Hydrogen production will be well suited in future electricity grids with very high renewable penetration and will be needed in the net-zero future, particularly to support industrial and some transport decarbonisation. However, today European grids are overall still in a transitional phase, where running an electrolyser inevitably leads to an increase of demand that will be covered by ramping up the available dispatchable generation, namely gas and coal electricity generation. Without the necessary safeguards in place, producing hydrogen today on the majority of the European grids will result in the cannibalisation of the renewable energy production that was deployed to decarbonise other parts of our economies, hampering the transition of the electricity system and increasing emissions.

In the development of the delegated act on RFNBOs the EU should acknowledge the emissions reduction limits of the production of hydrogen on carbon intensive electricity grids. Kick starting hydrogen production today to decarbonise European industry tomorrow will come at the compromise of increased fossil fuels consumption, and thus emissions. **To safeguard the electricity transition while in paralell creating the conditions for future large scale hydrogen production, the enabling legislation must ensure and catalyse additional deployment of renewables to meet the needs of hydrogen production.**

The proposed system-level matching regime in the delegated act is a creative compromise that will result in high running hours for electrolysers, making it less costly to produce renewable branded hydrogen in Europe by loosening the connection between renewable branded hydrogen and renewable electricity. **Additionality of new renewable generation to meet the needs of new electrolysis hydrogen production is the single remaining effective climate criteria in the proposed delegated act.**

Electrolysis hydrogen production will directly increase emissions if additionality is omitted. For instance, **renewable branded hydrogen produced in Germany would be as carbon intensive as fossil gas hydrogen – emitting 3.5 times more CO_2 than the EU Sustainable Finance Taxonomy threshold of 3 tCO_2/tH_2.**

Bellona calls on the European Commission and all EU Member States to sign up to the letter sent to the German EU Presidency in November 2020 by Austria, Denmark, Ireland, Luxembourg, Portugal and Spain, strongly backing the additionality principle as a prerequisite for keeping hydrogen green – and safeguarding the energy transition.

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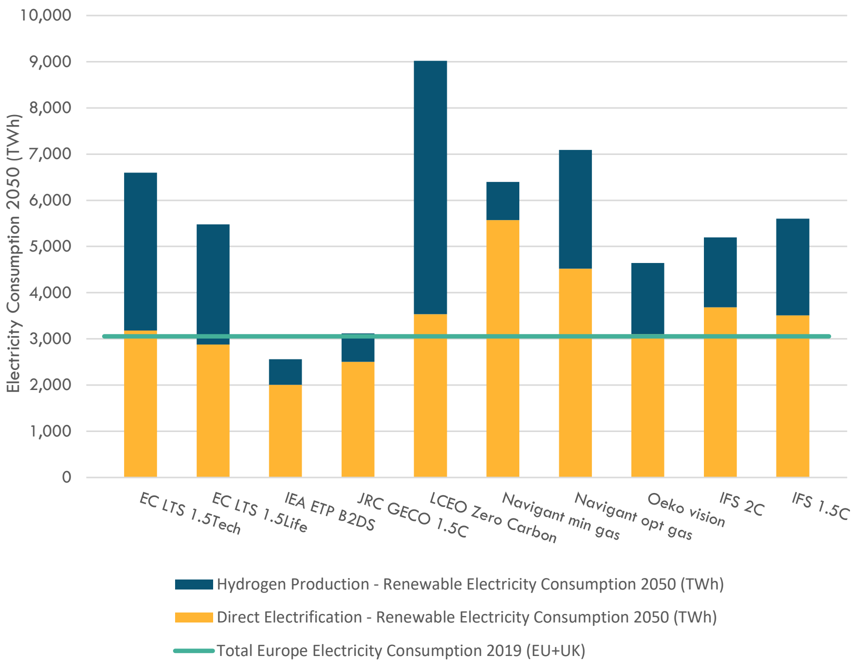
Projected hydrogen use in Europe

Hydrogen is a clean burning fuel as well as a climate friendly raw material for heavy industries, and as such is expected to play a central role in the transition to a zero-emission society. In most sectors, direct electrification is more efficient and cost-effective. However, some sectors are inaccessible to electrification because of their specific needs or require hydrogen as a raw material. Thus, they will inevitably need hydrogen to deeply decarbonise. This will likely be the case in some heavy industries (such as steel and basic chemicals) and targeted elements of the transport sector (aviation and shipping).[1]

A lot of new electrolysis hydrogen will require a huge amount of additional renewable electricity.

Producing hydrogen through electrolysis is a relatively inefficient process, where a third to half of the electrical energy is lost in the conversion[2], The EU long term strategy for climate anticipates hydrogen requiring a doubling of total European electricity production. Any sector that will require hydrogen to decarbonise will drive electricity demand up. Performing a literature review of some of the models getting to zero emissions in 2050, we found out that hydrogen will be one of the main drivers of electricity demand, requiring an enormous deployment of additional renewables, well beyond those needed to decarbonise current European electricity production.



Hydrogen and hydrogen-based fuels are electricity intensive to produce and generally have limited efficiency when used. Due to this Hydrogen is a big driver of increased electricity demand for modest emissions reductions

Direct electrification is efficient and effective in cutting emission and displacing fossil fuels. Electrifying huge sections of industry and transport can be met primarily within the envelope of current electricity demand.

Figure 1: *Inland (EU + UK) renewable electricity consumption in 2050 according to several models, split between the electricity used to produce hydrogen (blue) and the electricity used for direct electrification (orange).*[3]

Fundamentals of hydrogen production

High electrolyser running hours are attractive to lower the cost of electrolysis.

Electrolytic hydrogen is fully dependent on electricity. The renewable nature of hydrogen is fully dependent on the renewable nature of the electricity used. Hydrogen production will affect electricity supply, distribution and consumption. As a result, hydrogen production and support policies will affect electricity prices, competition for renewable resources, grid congestion and renewable electricity deployment targets. Hydrogen deployment and knock-on considerations are far more closely linked and relevant to European electricity supply policy than it it is to European gas policy.

The two primary considerations for electrolytic hydrogen's commercialisation are the cost of electricity and the number of hours the electrolyser can be run for.

Electricity cost and the price of Hydrogen

As the amount of hydrogen produced is directly proportional to the electricity used, the hydrogen final cost is dominated by the electricity cost at higher running hours. As renewables become more dominant on the European grids, the electricity price will go down in the future, driving hydrogen costs down.

How often an electrolyser can produce Hydrogen

Contrary to electricity cost, electrolyser running hours have an inverse effect on the cost of hydrogen. This is due to the high upfront capital expenditure (CAPEX) of electrolysers. Hence, the more often an electrolyser can be used, the shorter the time needed to recover the initial investment, so the less expensive the hydrogen will be. How often one can run an electrolyser has, thus, a big effect on the cost of hydrogen.[4] . At low running hours, CAPEX becomes the dominant cost factor instead of electricity.

Truly green hydrogen is produced from variable renewables that often have limited annual operating hours. Curtailed renewables offer even fewer hours for hydrogen operation. For this reason, industries have been calling for policies allowing hydrogen to be produced for an increased amount of running hours, often decoupling hydrogen production from renewable electricity generation.

Global witness, an environmental NGOs, has catalogued Hydrogen Europe, a hydrogen lobby association, and the Global Alliance Powerfuels, a lobby group whose members include the fossil fuel companies BP and ExxonMobil, both request that hydrogen production be matched to renewable generation exceptionally loosely. They in turn request matching of one month or one week between hydrogen production and renewable supply.[5]

Hydrogen production and climate change in Europe today

The EU Sustainable taxonomy[6] defines clean hydrogen to have a carbon intensity at or below **3 tonnes of CO_2 per tonne of H2**. This is in line with the Renewable Energy Directive II[7] requirement that hydrogen production meets a 70% greenhouse gas savings over a fossil comparator.

Electricity is the main input for hydrogen production, and no other part of the value chain produces direct emissions. So, **electrolytic hydrogen is only as clean as the electricity it is made from**. Low-carbon intensity electricity gives you low-carbon hydrogen, while higher carbon intensity electricity produces high-carbon hydrogen.

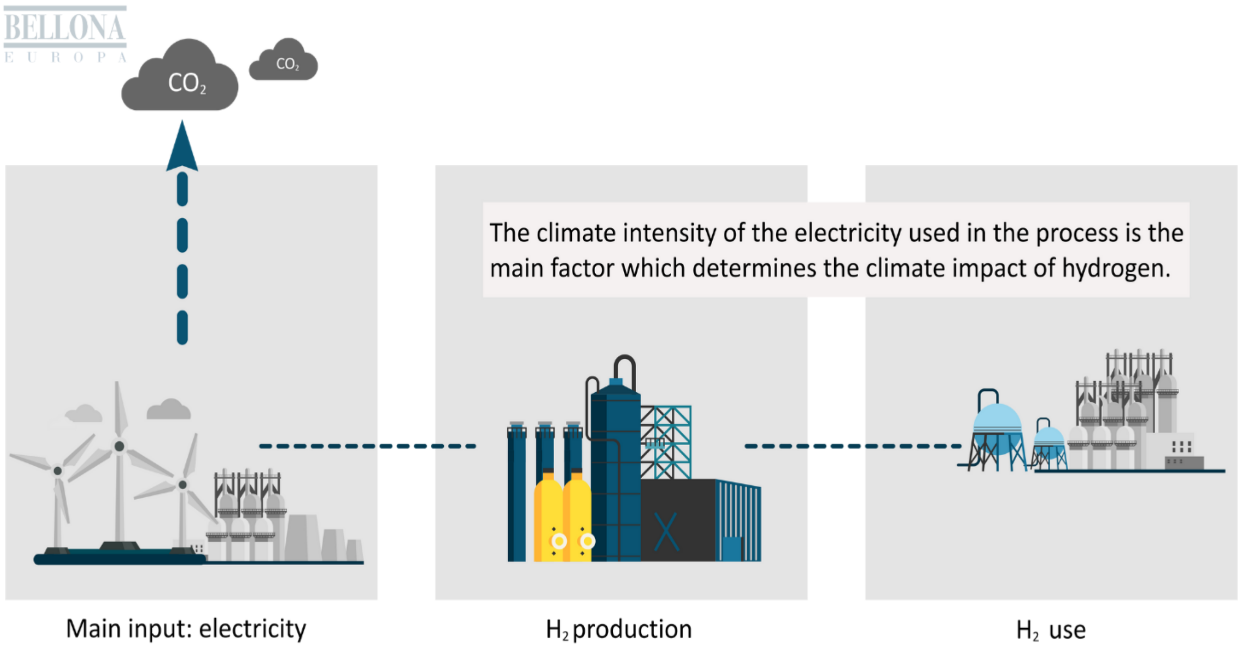


Figure 2: *Hydrogen production through electrolysis*

On-Grid Hydrogen

When hydrogen is produced using electricity directly from the grid, the carbon intensity of the grid overall needs to be taken into consideration to determine the final carbon intensity of the hydrogen itself.

Few European electricity grids have an average carbon intensity low enough to meet the EU Sustainable Taxonomy requirement for hydrogen production emissions below 3 tCO_2/tH_2. The map below shows that currently only Norway, Sweden, France and Lithuania would qualify for producing low carbon hydrogen with national grid electricity (Figure 3). **The use of current grid electricity in many European countries would increase CO_2 emissions when compared to fossil hydrogen.[8]** This is in contrast to direct electrification, such as electric vehicles (EVs) and Heat Pumps that reduce emissions on almost all grids due to very high efficiency.[9] For example, an EV does not need exclusively renewable electricity to cut emissions, whereas renewable branded hydrogen must be manufactured with renewable electricity. European grids will grow cleaner in the coming years;[10] however, this will require sustained efforts on renewable deployment, grid strengthening and smart integration.

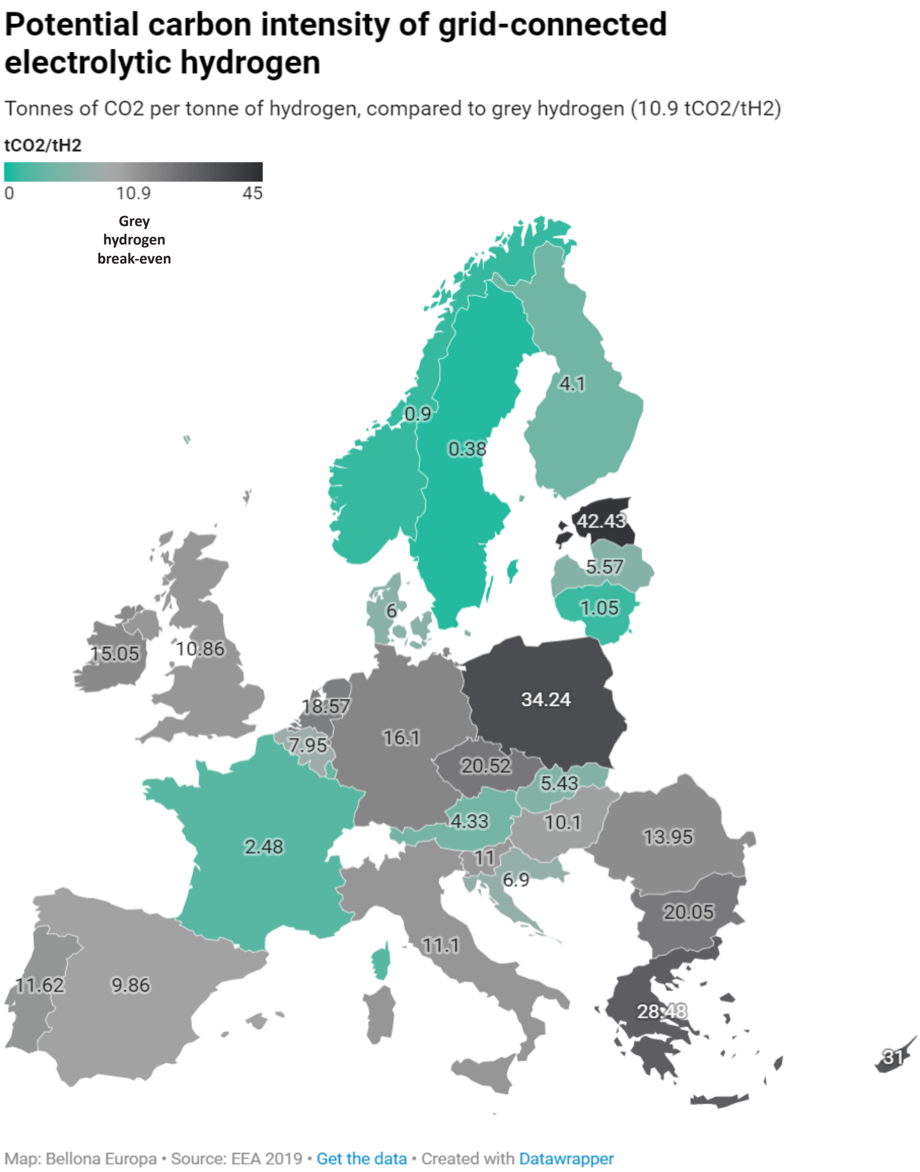


Figure 3: *Potential 2019 carbon intensity of grid electric hydrogen production in Europe.*

Off Grid Hydrogen

When the electricity grid is too high carbon to produce hydrogen around the clock, alternative systems can be put into place to ensure that the electricity that goes into hydrogen production is renewable. Both a Direct Connection and a Virtual Connection of renewables and hydrogen were proposed in the REDII. Both direct and virtual connection ensure that the hydrogen produced is fully renewable, as hydrogen is produced only when and to the extent to which electricity is generated from renewable sources.

Direct Connection[11]

The most straightforward way to produce hydrogen when the electricity gid is too high carbon is through a direct connection to a renewable energy producer. For example, a wind farm connected directly to a hydrogen electrolyser. However, since renewable production is variable, hydrogen cannot be produced around the clock. Running hours would be limited to those in which renewable electricity is being produced.

Direct connection is less attractive to some of the hydrogen producers, as using only locally produced renewable power makes operation fluctuate and lowers the hours of operation substantially.

Both the Direct and Virtual Connection methodologies produce true green hydrogen closely linked to renewable electricity generation. A stronger assurance of renewable energy input comes at the cost of lower running hours for the electrolyser.

Virtual Connection[12]

An alternative system is a virtual connection through a power purchase agreement (PPA). In this case, the grid is used as a means to bring contracted renewable electricity from the producer to the electrolyser. The producer and consumer must be located in the same bidding zone, ensuring that a functional physical grid connection exists between them. To guarantee that green hydrogen is indeed green the electrolyser is permitted to produce only when the contracted renewable electricity is generated. The virtual connection described here requires high-resolution data for monitoring and verification purposes. Compared to the direct connection there is a clear advantage, hydrogen can be produced close to where it is consumed.

The main disadvantage remains the constrained number of operating hours an electrolysis unit can anticipate. Some project developers would prefer to produce hydrogen year-round and not be dependent on the variability of renewable generation. This will decrease the cost of initial hydrogen deployment, but can that hydrogen be green?

Green hydrogen on a brown electricity grid?

Producing electrolytic hydrogen around the clock on a carbon-intensive electricity grid will not provide fully renewable hydrogen under any circumstances. Using high-carbon grid electricity to produce hydrogen is fraught with pitfalls, and will inevitably end up increasing CO2 emissions.

Compromises to produce hydrogen on carbon intensive grids are being discussed, however, it is crucial to match the need for the industry to deploy electrolysers and scale up production with the short and long-term goals of climate action. **Hydrogen can be extremely useful in decarbonisation, however, if its production results in large carbon emissions it could deplete the EU carbon budget, resulting in increased climate damage.** In many countries, using the electricity grid as it is to produce hydrogen will inevitably result in big emissions increases, as shown in the map (figure 3).

Bending the rules to aid deployment and lower cost

Proposals to allow electrolysis hydrogen producers increased running hours, and thus lower cost, are now circulating. In essence, they would permit more hydrogen to be manufactured in the absence of renewable energy input and still label that hydrogen as "green".

The system-level matching proposal is no undue legal barrier, but in fact a carbon-intensive compromise, allowing for high running hours on dirty grids.

A "system-level matching" proposal is being discussed in the context of the RED II delegated act on Renewable Fuels of Non-Biological Origin (RFNBOs). **System-Level Matching in essence defines green (or renewable) hydrogen as hydrogen produced when the share of renewable electricity generation running on the grid is higher than the average. The average is based on the renewable share of two years before.** It is understood in the draft proposals that hydrogen production would need to be paired up with **additional deployment of renewable generation covering the entirety of the electricity demand for hydrogen.** However, no specific matching between renewable generation and hydrogen production would be needed.

This is a radical expansion of the scope of what would be classified as green hydrogen, allowing for a great deal of additional use of electricity from fossil fuels. For example, if the average share of renewables were only 10%, hydrogen could be counted as green whenever renewable generation was above this. This would enable hydrogen to be labelled green despite being produced with nearly 90% fossil fuel electricity.

More Hydrogen now, but far less Green

For electrolysis hydrogen producers, this will be very appealing, as it results in high running hours hours, the possibility of producing hydrogen on any grid in Europe, and anticipates massive hydrogen deployment before the greening of the electricity grid.

For the climate, this will not be an optimal solution. The only requirement that ensures a positive trade-off for the climate is the one on additionality, ensuring the roll out of new capacity to avoid the cannibalisation of the available renewable electricity for hydrogen production. Moreover, given the complexity of the system it will be particularly complicated to track the emissions related to the hydrogen production, making it sub-optimal for monitoring the climate effect of hydrogen.

For the climate, this will not be an optimal solution. The only requirement that ensures a positive trade-off for the climate is the one requiring additionality of renewables to replace the electricity consumed by hydrogen production

How is the REDII Delegated Act proposal a deviation from the original RED II?

The close linking of renewable generation and hydrogen production is loosened and substituted with a system-level correlation. Instead of using production evidence in real-time, a proxy is built using an average comparator based on the average penetration of two years before. **Ultimately this allows for many more running hours.**

Bellona impact assessment of REDII delegated act proposal

In this briefing, we provide an assessment of the "System-Level Matching" of green hydrogen production in six EU member states, summarised in the table below. The impact assessment will estimate the number of operating hours a hydrogen electrolyse unit could expect under system-level matching and the real-world emission of green hydrogen produced under this regime.

Our Data

The assessment is based on real-world high-resolution hourly electricity generation and consumption data from 2020. The data includes information on electricity sources and their associated carbon intensity, for each hour in 2020. The data used to perform the analysis was collected by Tomorrow[13], a European electricity data firm. To assess the System Level Matching, we compared the renewable penetration in each hour in each bidding zone in 2020, to the yearly average renewable penetration in 2018.

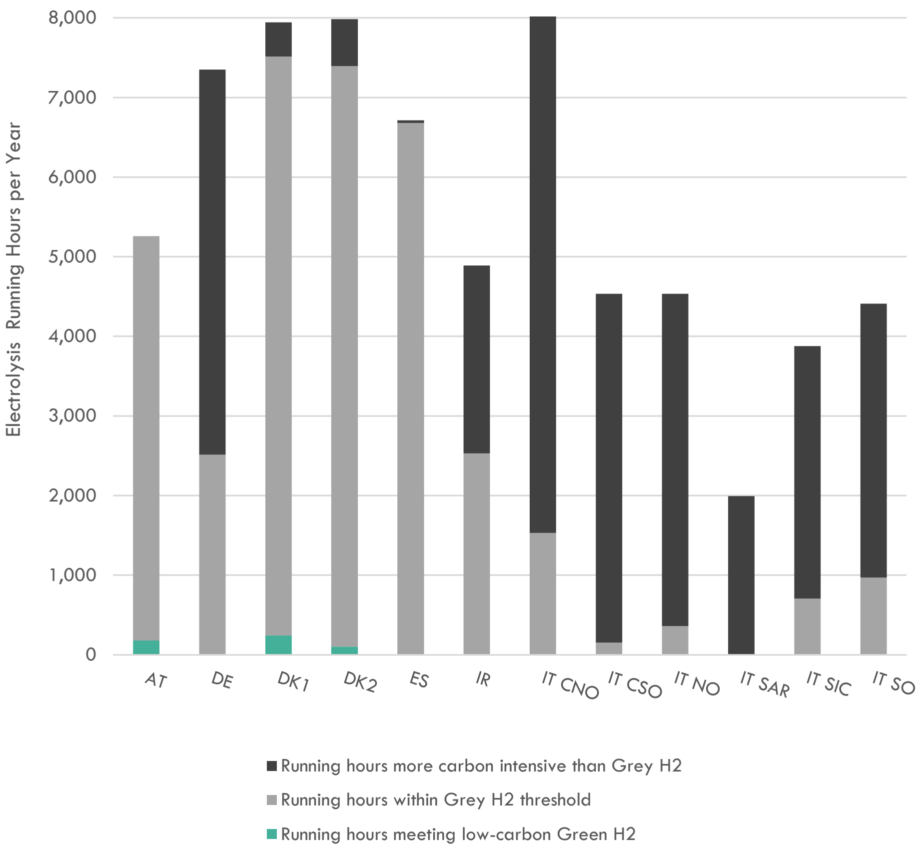
The six countries were selected as they have varying penetration of renewable electricity, but as of 2020, none have average grid electricity low-carbon enough to produce green hydrogen year-round. A technical annex with a deep dive of country data can be found here.

Country	Electricity Grid Bidding Zone
Austria	AT
Denmark	DK1: West Denmark
	DK2: East Denmark
Germany	DE
Ireland	IR
Italy	IT CSO: Central South
	IT CNO: Central North
	IT NO: North
	IT SO: South
	IT SAR: Sardinia
	IT SIC: Sicily
Spain	ES

System-level matching: a big utilisation bonus for hydrogen producers

System-level matching increases utilisation across all the analysed countries. Hydrogen production gets very close to baseload operation in several of the analysed countries. Electrolysers will be able to run nearly all the time, regardless of the real carbon intensity of the grid on which they are running. Renewable branded hydrogen will be able to be produced when variable renewable generation is low and far in excess of the potential of curtailed renewable generation.

With system-level matching, hydrogen electrolysers are provided high running hours in many of the bidding zones, despite big variation in carbon intensity



An electrolyser in Denmark or Germany would have run year round. A hydrogen prodution unit woud act as a baseload electricity consumer

Only in Denmark & Austria is there a handful of hours where the electricity grid is truly low carbon enough to comply with the EU sustainable taxonomy definition of green hydrogen

Figure 4: *Total running hours in 2020 applying the system-level matching, divided by carbon intensity. In green below 63 gCO2/kWh, in grey below 229 gCO_2/kWh, in black above 229 gCO_2/kWh.*

The difference between the bidding zones shown in the graph can be explained by two factors, both independent from the actual renewable penetration in the zone itself.

Recent uptake of renewables is the main driver of running hours, not the actual greenness of the grid

Where the recent uptake in renewables (over the past 2 years) have been significant, this results in very high running hours, regardless of the final actual penetration of renewables. In essence, every year exceeds the average of two years prior when some renewable uptake has happened. For instance, if renewable penetration has increased over the past two years from 10 to 30% on average, it is very likely that most hours will now be above the 10% threshold. This would allow the electrolyser to run almost around the clock, despite the low renewable penetration.

In our analysis, a clear example of this can be seen comparing the cases of Germany and Austria. Germany with a penetration of renewable of 49% would have been allowed to run its electrolysers on the grid for 7,349 hours, while Austria with a share of 73% renewable electricity, only for 5,259 hours. This can be explained by the fact that Austria has improved its renewable share only from 70 to 73% over the past two years, while Germany has moved from 32 to 49%.

Mixing national and bidding zone data leads to inconsistencies

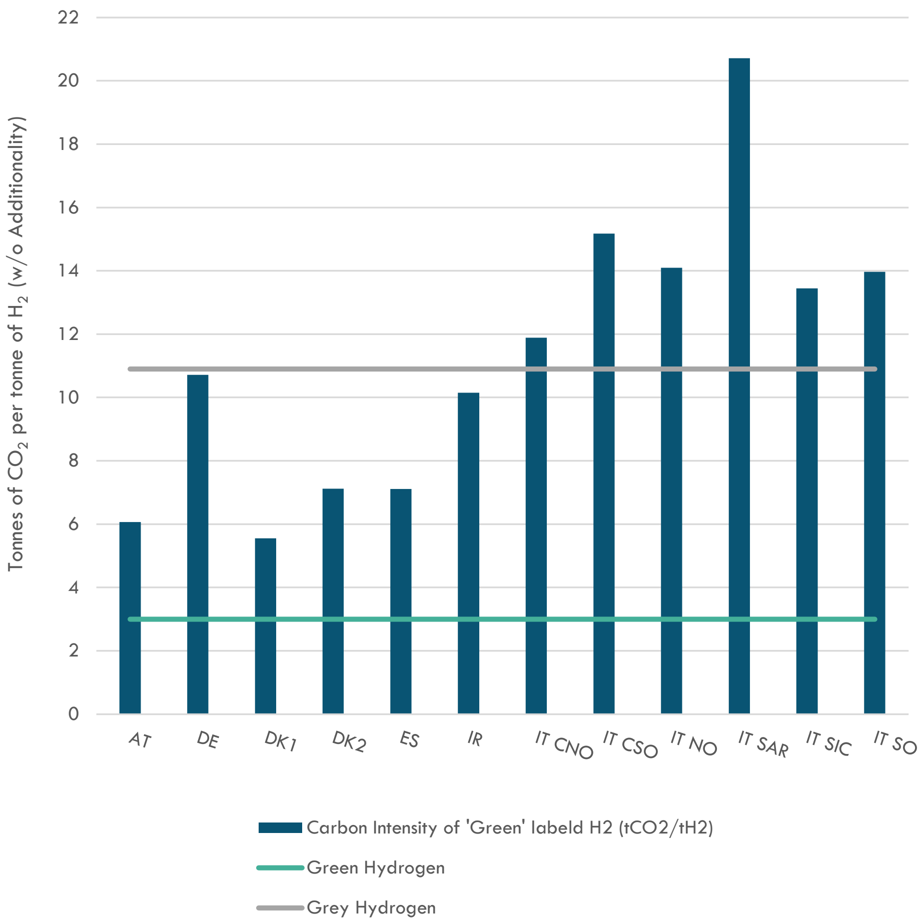
This proposal compares the average penetration of renewable at the country level from two years before, with the momentary share of renewable production in the bidding zone. When a big variation exists between bidding zones within a country, this results in a great distortion.

In our analysis, a clear example of this can be seen in Italy which is divided in six different bidding zones with renewables penetration varying from 26 (Sardinia) to 51% (Central North) in 2020. The average penetration of renewable in 2018 was 36%, therefore the Central North bidding zone will have most hours with renewable penetration higher than the threshold, while very few hours in Sardinia will meet it.

Higher running hours results in higher emissions

Increasing the operating hours for electrolysers on carbon intensive grids will inevitably result in an increase of emissions. As shown in figure 4 above, only for a handful of hours is the electricity grid clean enough to produce low carbon hydrogen, for the rest of the time, the electrolyser would run at higher carbon intensities.

The figure showed that many of the running hours under the system-level matching regime are at a time when the electricity grid is highly carbon intensive. This inevitably leads to the production of carbon intensive hydrogen. Below, in figure 5 one can see that on average none of the countries meet the criteria for green hydrogen in the EU sustainable taxonomy. Some of green branded hydrogen would be far above the criteria, producing hydrogen that on average is more carbon intensive than fossil gas hydrogen or so called "grey hydrogen".



In Germany and Ireland, the carbon intensity of green branded H2 would be very similar to the one of grey H2.

In all the Italian bidding zones, the green branded H2 produced would be on average more carbon intensive than grey H2

In none of the countries analysed does the green branded H2 meet the EU sustainable taxonomy emissions intensity

Figure 5: *Average carbon intensity of the hydrogen that would have been produced in 2020 applying the system-level matching proposal without additionality. For comparison, green hydrogen as defined by the EU green taxonomy and grey hydrogen.*

German green branded hydrogen will be as carbon intensive as grey hydrogen

Using the information on the operational hours in Germany and the actual carbon intensity of the German grid in 2020, we calculated that on average the associated carbon intensity of the hydrogen labelled as green would have been 10.7 tonnes of CO_2 for every tonne of hydrogen. In the marginal most carbon intensive hour (16/10/2020), the average carbon intensity of the grid was 459 gCO_2/kWh, so the "green branded" hydrogen produced would have emitted 22 tCO_2/tH_2, twice as high as grey hydrogen.

The Austrian grid is better, but not good enough

Even in Austria, where the renewables penetration is much higher, the average carbon intensity of hydrogen would have been 6 tCO_2/tH_2. On the 18th of March 2020 at 7 PM, the electrolysers would have been running on the grid with a carbon intensity of 222 gCO_2/kWh.

Hydrogen production targets will be met under this regime, but at the expense of climate budget, rather than saving it

A carbon intensive compromise

The delegated act proposal on how and when hydrogen could be branded as renewable is a departure from the REDII. The proposal is clearly be a compromise, balancing the stable operational needs of an emerging hydrogen industry, with a requirement that new additional renewable capacity be deployed to match the renewable electricity consumed. Producing hydrogen under such a regime will help achieving the European goals in terms of production. However, **this comprise proposal will be done at the expense of the climate, instead of for the climate.**

The delegated act proposal provides hydrogen producers with long running hours in return for the necessary obligation of additional renewable deployment.

Our assessment has shown that on existing grids and when no additional renewables have been deployed there is a high average carbon intensity for green branded hydrogen across all the analysed countries. If no additional renewables are to be added to meet the needs of hydrogen, it is clear that high carbon hydrogen produced in this regime would be called green, decoupling the definition of green hydrogen from its real carbon intensity. Turning a potential climate-friendly fuel into a very carbon intensive one will decouple EU's ambitious plans for hydrogen production from climate action.

Additionality is not a conditionality

What is additionality?

The deployment of new, unsubsidised renewable generation able to cover completely the electricity demand of the electrolyser.

Why do we need it?

Producing hydrogen on the grid will add a heavy electricity consumer to the grid. Electricity must be produced to meet this demand. If no new renewable capacity is deployed, this will be met with available dispatchable energy sources, notably gas and coal. Deploying additional renewable generation meeting this demand would prevent this from happening.
Additionality will be needed to stop the electricity transition from going backwards. Without additionality, the renewable power that was deployed to decarbonise the electricity system would be cannibalised and redirected to account toward hydrogen production. **This would push the transition backwards instead of forward, opposite to European and global climate goals.**

Installing electrolysers on the grid will result in a new high demand for green electricity, this will need to be matched with additional renewable generation.

Without additionality, green branded hydrogen will be even more carbon intensive. The products manufactured using carbon intensive green branded hydrogen will be far more carbon intensive than advertised.

How do we do it?

Additional renewable generation must be new. As Transport & Environment has argued this "means that renewable electricity generation comes into operation before or at the same time as the hydrogen facility." [14]

Moreover, **additional generation to meet the needs of hydrogen should not receive a double subsidy.** Hydrogen production and use is anticipated to require subsidies and the provision of additional renewables to meet the hydrogen production needs is an integral part of the supply chain. Subsidising both the hydrogen production and the renewable deployment would result in double subsidies which should be avoided. Moreover, hydrogen is energy intensive and thus its use must be directed where most needed. If subsidies were directed at specific users instead of at the deployment of additional renewables, public authorities would be able to target green hydrogen in those sectors that lack any technical alternatives for decarbonisation.

Finally, **additional renewable generation will need to be deployed in the same bidding zone** in which the electrolyser is running. Insufficient grids interconnections and growing grid congestion in Europe preclude the free physical transfer of renewable electricity from one bidding zone to another. Pan-European renewable certificates which only constitute a virtual paper connection between hydrogen consumer and renewable producer will not provide any incentive for greater European grid interconnection.

Why do we need to fight for additionality?

Some hydrogen proponents are actively pushing against additionality, to develop their industry as fast as possible, without keeping in mind its potential effect on the climate. The secretary general of Hydrogen Europe, Jorgo Chatzimarkakis, declared that "the bureaucratic and cumbersome additionality principle is a show stopper."[15]

Global witness, an environmental NGOs, found via freedom of information disclosure that Hydrogen Europe, a hydrogen lobby association, 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*." [16]

Will additionality prevent hydrogen from happening?

Despite what is often said from parts of the hydrogen industry, the delegated act won't block the emergence of clean hydrogen projects, but will help projects to develop in the right direction as Lopez Nicolas, head of unit for renewables and energy system integration at the Commission's directorate general for energy, said during a panel debate organised by industry group SolarPower Europe.[17]

The Commission is not the only stakeholder backing additionality. Six Member States (Austria, Denmark, Spain, Ireland, Luxemburg and Portugal) have sent a joint letter on additionality in renewable hydrogen production to the German presidency asking for stringent and transparent requirements on additionality.[18] This is a crucial request to prevent hydrogen from cannibalising the energy transition and drastically increase emissions in Europe, ensuring that the industry will develop keeping climate at it's core.

Policy recommendations and discussion

Electrolytic Hydrogen deployment today results in a compromise of emissions accounting

Deploying electrolytic hydrogen today on European electricity grids that are far from clean will ultimately require a compromise in emissions accounting. Green hydrogen produced under the REDII proposal will not be strictly green. CO_2 emissions will be higher than reported and much of the electricity used will be fossil in origin. **Coal and gas electricity will be used, either directly or due to renewable capacity redirected from homes and businesses to hydrogen production.**

Such compromise can be acceptable in an initial deployment phase to allow for the European electrolysis industry to scale up, putting the EU in a leadership position for the decarbonisation of sectors such as steel and chemicals.

Renewable additionality is foundational for hydrogen to be branded as "Green"

Additionality can compensate in part for emissions increases driven by hydrogen production on unsuitable electricity grids. As some Member States called in their letter, additionality will need to be ensured to prevent hydrogen production from compromising the energy transition and cannibalising renewable electricity that is better used to decarbonise our homes and industry.[18] Even with additionality, the hydrogen produced on the grid in many European countries won't meet the EU Sustainable Finance Taxonomy threshold of 3 tCO_2/tH_2.

In the absence of local additional renewable deployment, in all the countries analysed hydrogen will be produced at high carbon intensities, close to - or above - the emissions of fossil grey hydrogen. For instance, German hydrogen production in 2020 would result in an emissions intensity of 3.5 times that of true green hydrogen. If the delegated act proposal of "system-level matching regime" was to be put in place without additionality then green branded hydrogen would be produced from greenwashed fossil electricity, increasing emission. **Additionality ultimately ensures that more green hydrogen equals more green electricity.**

Dangers to the greening of the grid and electricity market distortion

Building a regime that allows for the production of hydrogen on the current European grids ultimately entails two dangers: cannibalising the renewable production, slowing down the electricity transition; and substantially increasing European emissions.

If hydrogen would be produced using existing renewable capacity, this will be diverted from the overall greening of the electricity grid. Additionality is essential to prevent this from happening. A singular focus on hydrogen at the expense of strengthening electricity grids and incentivising efficient direct electrification of heating and transport will hamper decarbonisation and increase overall costs. Hydrogen production should be prevented from distorting the development of flexible smart grids essential for high renewable penetration. Hydrogen electricity taxation and grid charges should not distort electricity use from highly efficient and climate effective solutions such as EVs and Heat Pumps.

Producing electrolytic hydrogen on a carbon-intensive electricity grid will not give you fully renewable hydrogen under any circumstances. Massive deployment of renewables is needed to decarbonise existing electricity consumption and meet the needs of direct electrification of industry, transport and heating. Additionality of renewable deployment is essential to meet the needs of a hydrogen production industry. **The higher the penetration of renewables the more suitable the grid will be to produce real green hydrogen, with real emissions reductions.**

Technical Annex: Countries data deep dive - https://network.bellona.org/content/uploads/sites/3/2021/06/Technical-Annex-Countries-Data-Deep-Dive.pdf

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3 In house assessment of a series of energy models, reaching climate neutrality by 2050. The models selected are developed by a variety of different stakeholders: the European Commission (EC LTS 1.5Life and EC LTS 1.5Tech); the International Energy Agency (IEA ETP B2DS); the European Joint Research Center (JRC GECO 1.5C and LCEO Zero Carbon); Navigant (Navigant opt gas and Navigant min gas); the Oeko institute (OEKO vision); and a consortium of University of Technology Sydney, Graduate School of Energy Science, Kyoto University, German Aerospace Center and University of Melbourne (IFS 2C and IFS 1.5C).

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10 https://www.transportenvironment.org/sites/te/files/downloads/T%26E%E2%80%99s%20EV%20life%20cycle%20analysis%20LCA.pdf

11 Definition of direct connection from RED II, art. 27 (3)

12 Definition of grid connection from RED II, recital (90). The Commission should [...] ensure that there is a tempo-ral and geographical correlation between the electricity production unit with which the producer has a bilateral renewables power purchase agreement and the fuel production.

13 https://www.tmrow.com/

14 https://www.transportenvironment.org/sites/te/files/publications/T%26E%20Briefing%20sustainability%20RFN-BOs_202101.pdf

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