A workable approach to additionality, geographic and temporal correlation is key to the achievement of the EU Hydrogen Strategy

Key recommendations:

- The European Commission should consider exempting Renewable Fuels of Non-Biological Origin (RFNBO) producers from proving additionality until 2025. In 2025, the Commission and relevant stakeholders should assess progress towards meeting the 2024 6GW and 2030 40GW target of the H2 strategy.
- Member States (MS) should bare responsibility for providing additional renewable electricity (RE) capacity by setting dedicated RE targets to be used for RFNBO production.
- RFNBO producers should be allowed to produce renewable hydrogen from curtailed renewable electricity.
- Accept Guarantees of Origin alongside Power Purchase Agreements (PPAs) to prove the renewable character of the electricity used in the production of hydrogen.
- Acknowledge that renewable hydrogen creates demand exclusively for renewable energy not for fossil-based power. All renewable hydrogen producers need to prove the origin of renewable sources.

Hydrogen Europe supports the EU's objective to achieve climate neutrality. We advocate for hydrogen as an enabler of a carbon neutral society. The production of renewable hydrogen contributes to decouple the deployment of renewable energy from grid bottlenecks unlocking the full potential of renewable energy to **replace fossil energy carriers in all sectors of our economy**. Furthermore, hydrogen enables the integration of ever-growing amounts of renewable energy into "hard to abate" sectors such as steel, chemicals, and transport, including refineries, maritime and aviation.

From the outset, it is important to state that we strongly believe that the revised Renewable Energy Directive (RED) should be more ambitious in contributing to climate targets and accelerating the transition to a more integrated system with hydrogen being a key part of this effort. **The existing renewable energy target for 2030 should be revised upwards in line with the new ambition of the 2030 target plan** to facilitate faster decarbonisation and the growth of renewable energy. An increase in this target is also an important driver for much needed additional renewable electricity into the system.

Hydrogen Europe does not challenge the direct use of renewable electricity where most efficient. Hydrogen Europe considers that all new electricity demand should be met with new renewable generation. This remains valid for electrolysers and the subsequent electricity demand these generate. Hydrogen production helps accommodate growing shares of renewables, unleashing their potential and enabling the decarbonisation of those sectors where direct electrification is not an option.

We fully recognise the importance and support the principle of additionality, namely the idea that additional renewable electricity consumption must always be covered by additional renewable capacity. Hydrogen Europe has expressed concerns regarding the practical implementation of additionality principle criteria not the principle itself. Furthermore, given the lack of clarity, we raise concern over the possible extension of these criteria to other sectors (beyond the scope of the RED), the subsequent impact on the deployment of renewable hydrogen, meeting the targets set by the EU Hydrogen strategy and ultimately the long-term EU climate objectives.

Additionality criteria should not hamper the rollout of renewable hydrogen but incentivise it

Indeed, there are significant challenges posed by the requirement to prove additionality as prescribed by the RED and recently published leaks of the delegated act on article 27 and recital 90. Below is a list of potential challenges and solutions:

- The fact that **the lead time for investments into some renewable electricity generation assets (e.g., offshore wind – up to 7 years) does not coincide with the time needed to construct an electrolyser (less than 2 years)**. **Until new electricity capacity is available, electrolyser project developers will therefore have a very low incentive to build**, as the main demand driver is precisely the renewable character of the hydrogen and its contribution towards RED targets. Additionality means perfectly timed investments and commissioning of the RES, electrolyser and the technological investments at the consuming plant (e.g., the ammonia plant, refinery or steel plan) planning to replace fossil sources with the renewable hydrogen. This is almost impossible to achieve in practice and effectively requires ship owners, refiners, steel plants[1] etc. (i.e., the potential end users of the renewable hydrogen) to go into the RES development business as they cannot just access the market for renewable electricity that they need to power their electrolyser. This effectively disincentivizes (to the point of cancelling plans to switch to renewable energy) renewable hydrogen integration in hard to abate sectors, especially those that are located in areas with no or insufficient access to new renewables.[2]
- The leaked delegated act refers to a 12-month period between the time that new renewable energy is made available and the time that it is consumed. **Consider the following case study**: there is a refinery or industrial process that requires 500MW of electrolysis to achieve full decarbonisation and a new 500MW offshore windfarm is introduced alongside a 100MW electrolyser. Suppose the two are built within the 12-month period. Once that 12-month period is over, the possibility to increase the scale and size of the electrolyser would be hindered. **The stakeholders would have to associate with another new wind farm every time that they want to grow the renewable hydrogen production capacity at a site. That will effectively force the adoption of 500MW of electrolysis in Year 1, which will be unrealistic for the stakeholders and inhibit building a progression in electrolyser capacity across around 10 years** (which is what stakeholders see as sensible).
- The **current EU legislative framework does not provide incentives to build electrolyers for grid balancing and flexibility services**. On the contrary, the additionality criteria disincentivise the business case for electrolysers that could help prevent costly curtailment of renewable electricity. Most of those surpluses predominantly originate from already installed renewable sources e.g., curtailed win or unused hydropower. **In 2021, €1,35 billion[3] of renewable electricity was curtailed and ultimately paid by the taxpayer. Electrolysers should be allowed to use surplus renewable electricity for renewable hydrogen production. This can play an important role in achieving "energy system efficiency"** alongside the "energy efficiency first" principle.
- The leaked delegated act refers to the need to prove the use of renewable electricity in 15-minute intervals. **There is currently no technological, practical and legal way of aligning hydrogen production and energy production within a 15-minute interval. In case such means become available, the associated OPEX will drive costs up significantly. Furthermore, the practical consequences for ramping up and down ELY production in tandem with the RES at such intervals may also lead to premature degradation, further increasing the CAPEX of the plant.** Additionally, we highlight that holding hydrogen producers

[1] If the principle of additionality would be expanded to other sectors, as some stakeholders are advocating.

[2] This example is not applicable to solar PV where permits are granted much faster and projects can be built relatively quickly, even within a year.

[3] https://forschung-energiespeicher.info/wind-zu-wasserstoff/projektliste/projekt-einzelansicht/74/Wasserstoff_unter_Tage_speichern/ (in German).

responsible for such elaborate reporting in absence for such requirements for other energy producers and consumers, is immensely discriminatory. **To meet the temporal correlation requirement, allowing a time span of at least one month to correlate renewable electricity generation and the fuel production would be more realistic using the current system of Guarantees of Origin**. However, the Guarantees of Origin system needs to be reformed.[4]

Moving forward, this could be reduced to 24 hours once Guarantees of Origin have the proper time stamps. Hourly may be possible, but only after technology and systems are ready and only following a suitable impact assessment into feasibility. **In case of absence of technical and practical instruments to prove these short time intervals in Member States today, the DA could define a phase-in period until such instruments become available. In that period, temporal correlation should consider those time intervals that can be demonstrated with state-of-the-art power purchase agreements (PPAs).**

To avoid delaying the rollout of electrolysers, which would ultimately have a negative impact on achieving EU climate goals, we have engaged in detailed technical discussions with our members, other industry associations and the European Commission to find cross-industry consensus and practical solutions in preparation for the Delegated Act (DA)[5]. **We remain fully committed to work with the European Commission and other stakeholders to find technical solutions within the current framework of RED[6].**

However, the process of having to find technical solutions on how to implement the requirements related to additionality and other appropriate criteria for grid connected electrolysers have shown just how difficult these legal barriers are to overcome in practice. **The rapid uptake of renewable hydrogen and the development of a renewable hydrogen industry is central to the Green Deal and to us. It is in within this spirit that we seek to remove undue barriers to hydrogen production and hydrogen infrastructure as stated in multiple papers**.

Unfortunately, additionality criteria and, to a lesser extent, geographic and temporal correlation represent the single highest regulatory barriers holding back renewable hydrogen deployment in Europe today. As a result, a Delegated Act which implements these criteria in a constructive and clear way is essential for unlocking the market for renewable hydrogen. Moreover, it should be stated that the criteria imposed by the RED create major competitive imbalances and discrimination not affecting hydrogen production, but also relative to renewable energy producers as well. **Countries with already high RES-shares (early movers) and consequently less potential to build new RES-E (compared to other countries) are also placed at a competitive disadvantage**.

A level playing field for hydrogen

Additionality criteria are not needed if the growth in demand is met with an equal amount of RES capacity. **A revised Renewable Energy Directive should support the uptake of renewable energy in all sectors of the EU economy and ensure that the responsibility to add to the existing renewable energy capacity is shared by all energy consumers and not only by producers of renewable fuels of non-biological origin (RFNBOs).** With the additionality principle, the DA intends to make RFNBO producers responsible for additional RE capacity. **This is motivated by the idea that renewable electricity is already in short supply and that a ramp-up of renewable electricity-intensive renewable hydrogen production could cause fossil energy to also ramp up again.**

While this is a fair argument in a transition phase, this issue does not only relate to RFNBO production, but to all new renewable electricity demand including, for instance, BEVs and heat pumps. Not only is the principle of additionality, as it is defined now, highly discriminatory, but also counterproductive. **Without such rules for heat**

[4] Hydrogen Europe will be releasing a separate position paper on the reform of the GO system.
[5] Delegated act foreseen by Article 27.3 to supplement this Directive by establishing a Union methodology setting out detailed rules by which economic operators are to comply with the requirements laid down in the fifth and sixth subparagraphs of this paragraph to be adopted by 31 December 2021,
[6] See annex in attachment of cover email – input provided to Guidehouse Consultants on the relevant DA

pumps or battery electric vehicles (BEVs), for example, fluctuations in renewable electricity generation or grid congestions will cause additional fossil energy to be used for those applications. Therefore, the DA should act as a blueprint for a subsequent roll-out from electrolysers to all new renewable electricity off-takers in the EU. The effect of additionality applied only to hydrogen producers is detrimental to the market uptake and deployment of renewable hydrogen, and with it, the demand for more renewable energy. Member states should also be responsible for providing additional RE capacity by setting dedicated RE targets to be used for RFNBO production.

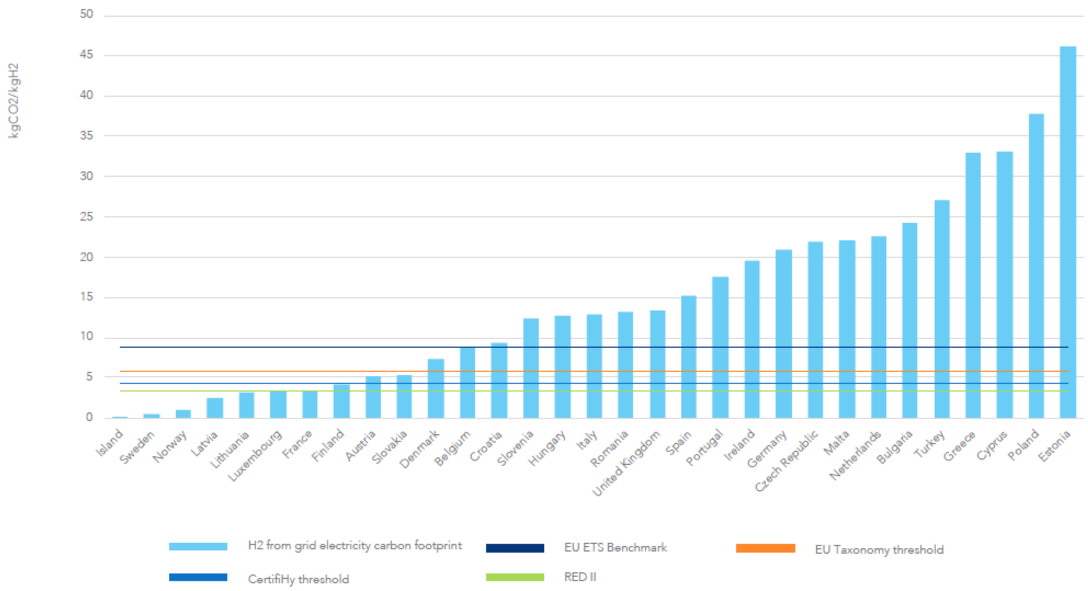
Prioritisation of renewables and grid intensity

We are acutely aware that the GHG intensity of power grids across Europe differs significantly. This is why we often point out that electrification should not be promoted for the sake of electrification, but with careful consideration to the CO2 intensity of e-grids and with the purpose of reducing overall emissions rather than increasing them.

We are aware that, simply connecting an electrolyser to the grid without any other measures in place (e.g., power purchase agreements with renewable energy producers and Guarantees of Origin to prove renewable character and CO2 intensity of the electricity procured) would result in hydrogen with a GHG emission factor in some cases much higher than the ETS benchmark. We have published this analysis in our Clean Hydrogen Monitor 2020[7] which we invite you to consult.

It should be clear that we promote the production of hydrogen only when such hydrogen meets the thresholds to be defined as low-carbon and, in the context of the RED only when it meets both the criteria for being considered low-carbon as well as being from renewable sources.

Figure 1: Carbon intensity of hydrogen produced from grid electricity (without extra measures), compared to selected benchmarks.



Source: Hydrogen Europe, based on EEA data.

Note:
EU ETS Benchmark: 8.85 kg CO2 / kg H2 (73.8 gCO2/ MJLHV),
EU Taxonomy threshold for sustainable hydrogen manufacturing: 5.8 kg CO2 / kg H2 (48.3 gCO2/ MJLHV),
CertifHy threshold for low carbon hydrogen: 4.4 kg CO2 / kg H2 (36.4 gCO2/ MJLHV),
RED II threshold for RFNBO: 3.384 kg CO2 / kg H2 (28.2 gCO2/MJLHV).

It should be made clear that a renewable hydrogen producer generates demand exclusively for renewable energy (one cannot and should not be allowed to produce renewable hydrogen unless they can prove that they have used

[7] https://www.hydrogeneurope.eu/node/1691

renewable sources to do so). It is false to state that renewable hydrogen producers generate demand for fossil-based power.

However, we understand that proponents of additionality criteria which legitimately care about the climate impact of the energy system and who are not simply advocating for additionality as a means to hurt the hydrogen sector (of which there are many) view renewable energy as a finite, limited resource which needs to be carefully directed towards areas where it can have the greatest impact. They believe that, when this energy is used as electricity, it will have the most impact, because it avoids the energy conversion loss associated with the production of hydrogen. As a result of this view of renewable energy, such proponents consider that the electricity demand generated by the electrolysers will lead to increased power generation from fossil sources to compensate for the increased demand. Such a view is flawed for several reasons:

1. Holding renewable hydrogen producers responsible for the residual mix of the electricity system in a particular country is deeply unfair. No other consumer of renewable energy is subject to such conditions in order to be able to claim renewable character. Applying additionality criteria only to hydrogen producers is as such, highly discriminatory.
2. It ignores the basic economic rules of supply and demand: **renewable hydrogen creates exclusively demand for renewable energy**. **More demand for renewable energy leads to more supply of renewable energy**. This is a basic economic principle. To explain our position on this, the idea that by generating more demand for renewable energy you would inadvertently create more demand for fossil electricity is based on a flawed assumption:
    - that demand for renewable electricity is highly elastic (which it is not the case). When a renewable hydrogen producer enters the market and begins “claiming” renewable energy for himself, the existing renewable electricity consumer (such as a data centre or a supermarket) will not simply accept not being supplied with renewable power (as per his contract with the electricity supplier), the electricity supplier will be forced to look for and contract more renewable power to meet the extra demand. We concede that a minor impact may be felt in the short term, but this will be limited only to those consumers which receive renewable electricity “by mistake” (i.e., those that only asked for electricity, irrespective of how it is produced).
3. The fears themselves are exaggerated, as most of the production of hydrogen using renewable energy delivered by the electricity grid will only happen in the initial stage of market development, will be scattered across Europe, and, in relative terms, will be a drop in the ocean compared to the size of the electricity market. Any possible negative impacts that may occur will be small and short lasting (see Annex I with analysis of the pipeline of planned hydrogen projects).

Finally, even if the effect of connecting electrolysers to the grid would be to inadvertently generate demand for fossil-based electricity (NB. please remember that renewable energy producers generate demand exclusively for renewable electricity), **the net effect would actually be positive in a significant number of countries**, and the sector where the hydrogen would be used. For example, if the Hydrogen would go to the steel sector[8], and all the renewable power one takes away from the grid would be replaced with the grid average of that country, one would still have a positive effect in all EU countries, except Estonia – the net effect is more nuanced if the resulting hydrogen would simply replace grey hydrogen in a refinery or diesel in trucks, but it would still be positive in a number of countries. In this case, **applying additionality blindly, across the EU, without consideration of the CO2 intensity of the e-grids, closes the door on those countries who have already cleaned up their power sector** (see annex II for more detail).

[8] If additionality would be expanded to other sectors than transport, as some stakeholders are suggesting.

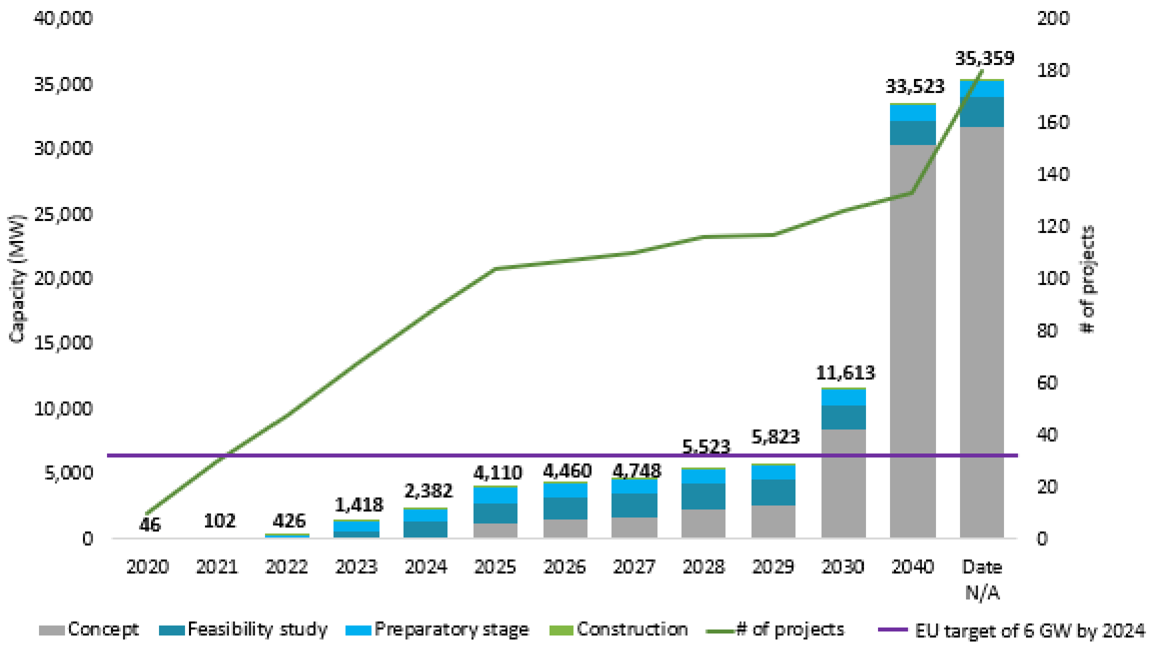
ANNEX I

Additionality, EU long-term climate objectives and the EU Hydrogen Strategy

To achieve the objectives laid out in the EU Hydrogen Strategy and the long-term EU climate objectives, hydrogen needs to start being deployed, at large scale, across different sectors as soon as possible.

An analysis carried out by Hydrogen Europe of the current plans to install electrolysis capacity in Europe[9] shows that, as of November 2020, 32,743 MW were planned to be installed by 2040.

Figure 2: Cumulative planned PtH projects by year 2020 - 2040 (MW and # of projects)



As can be seen in the figures below**, 76% of all capacity which is planned to be installed by 2024** (1,76 GW of 2,38 GW) **relies either totally (43%) or partially on the use of renewable energy supplied via the electricity grid** (N.B. not to be confused with grid electricity). **These plans will be severely disrupted or even stalled unless the Delegated Act** proposes workable solutions for proving compliance with Article 27.3 and recital 90 (additionality, temporal and geographic correlation). The main reasons why most renewable hydrogen projects (in the next few years) rely on renewable energy supplied via the electricity grid are:

(i) as new renewable energy sources take many years to develop in the short term there simply is not any "additional" (as defined by the Directive) renewable energy that hydrogen producers can realistically use in order to directly connect to in the next few years, this is why, in order to exist, they must procure renewable energy from the market;

(ii) a transmission and distribution infrastructure for pure hydrogen does not exist, meaning that, until gas infrastructure is repurposed from natural gas to hydrogen, electrolysers have to rely on the electricity grid for their energy needs.

In the long term, grid connected electrolysers will become less common as post 2030, we expect that a large majority of projects will be directly connected to new renewable energy plants. The main reasons for this are:

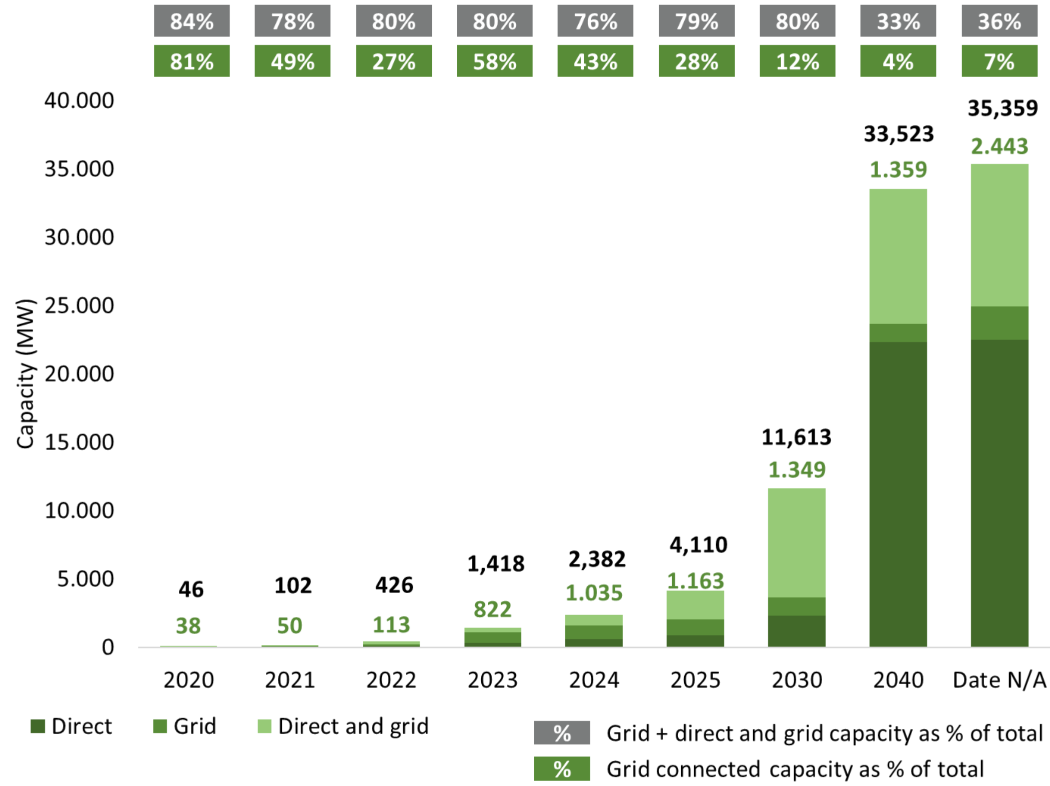
(iii) In the longer term, **hydrogen production automatically gravitates around new RES development because new renewable power is the cheapest form of electricity**. As the cost of electricity comprises ~70-80% of the cost of hydrogen, hydrogen producers naturally seek to connect their electrolysers to

[9] Source: Hydrogen Europe (based on publicly announced P2H projects)

new renewable energy. This is precisely what we are seeing when looking at the pipeline of projects being developed at the moment.

(iv) Also, for cost considerations, post 2030, a hydrogen backbone allowing the transmission of pure Hydrogen via pipelines will emerge (both new and repurposed pipelines). This will allow the transport of renewable energy as hydrogen at significantly reduced cost than the transport via cables, (it is 10-20 times cheaper to transport energy in the form of hydrogen than in the form of electrons). This means that electrolysers will have an incentive to be placed closer to the renewable energy source to avoid the cost of electricity transmission and **this is a major reason why the production of renewable hydrogen, in complement with higher electrification is a key driver for faster and broader renewable energy integration across the entire energy system**.

Figure 3: Cumulative planned PtH projects by year and grid connection 2020 - 2040[1] (MW)[10]



It should also be said that the principle of additionality not only imposes hurdles to projects which rely on renewable energy supplied via the electricity grid but also those projects which are planned to have a direct connection to new renewable energy sources.

While a role for electrolysis using renewable energy supplied via the electricity grid **beyond 2030** is still likely, at that stage, the **electricity grids are primed to become more renewable, meaning that the potential harm to the residual mix (i.e., the main reason behind the principle of additionally) will no longer be an issue as the feared effect of diverting renewable energy to electrolysers rather than other uses will no longer be as prevalent**. At the same time, we would also like to underline that the **power sector is responsible for the residual mix of the electricity system**. Its immediate and deep decarbonization is necessary to meet new demand with renewable sources and replace fossil power generation with sustainable energy. As such, **achieving rapid emissions reductions in the electricity sector and massively increasing renewable electricity capacity is the responsibility of power utilities.**

[10] Source: Hydrogen Europe database of H2 Production Projects (2020-2040)

ANNEX II

Table: Net change in emissions from using existing renewable energy to produce green hydrogen replacing fossil fuel consumption in various sectors assuming that renewable energy would be replaced with grid mix (in g CO2/kWh)

Country	Carbon intensity of Grid electricity (in g/kWh)	Replacing Grey hydrogen	Replacing Trucks diesel TTW	Replacing Shipping HFO TTW	Replacing Coal for steel production
EU-28	294,2	108,21	27,21	15,21	-501,79
EU-27 (from 2020)	295,7	109,74	28,74	16,74	-500,26
Austria	104,0	-82,02	-163,02	-175,02	-692,02
Belgium	176,1	-9,93	-90,93	-102,93	-619,93
Bulgaria	486,2	300,21	219,21	207,21	-309,79
Croatia	188,0	1,95	-79,05	-91,05	-608,05
Cyprus	660,7	474,69	393,69	381,69	-135,31
Czech Republic	437,9	251,85	170,85	158,85	-358,15
Denmark	147,7	-38,34	-119,34	-131,34	-648,34
Estonia	922,4	736,41	655,41	643,41	126,41
Finland	82,8	-103,21	-184,21	-196,21	-713,21
France	67,2	-118,77	-199,77	-211,77	-728,77
Germany	418,8	232,82	151,82	139,82	-377,18
Greece	657,3	471,31	390,31	378,31	-138,69
Hungary	253,0	66,96	-14,04	-26,04	-543,04
Ireland	392,5	206,53	125,53	113,53	-403,47
Italy	258,8	72,80	-8,20	-20,20	-537,20
Latvia	49,2	-136,84	-217,84	-229,84	-746,84

Lithuania	63,7	-122,31	-203,31	-215,31	-732,31
Luxembourg	65,2	-120,82	-201,82	-213,82	-730,82
Malta	441,8	255,77	174,77	162,77	-354,23
Netherlands	452,6	266,63	185,63	173,63	-343,37
Poland	755,7	569,72	488,72	476,72	-40,28
Portugal	349,8	163,78	82,78	70,78	-446,22
Romania	262,5	76,52	-4,48	-16,48	-533,48
Slovakia	107,3	-78,69	-159,69	-171,69	-688,69
Slovenia	248,3	62,26	-18,74	-30,74	-547,74
Spain	304,3	118,30	37,30	25,30	-491,70
Sweden	9,3	-176,73	-257,73	-269,73	-786,73
United Kingdom	268,5	82,52	1,52	-10,48	-527,48
Turkey	541,4	355,43	274,43	262,43	-254,57
Island	0,0	-185,98	-266,98	-278,98	-795,98
Norway	18,9	-167,08	-248,08	-260,08	-777,08

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Hydrogen Europe – June 2021

Hydrogen Europe is the European association representing the interest of the hydrogen industry and its stakeholders and promoting hydrogen as an enabler of a zero-emission society. With more than 260 companies and 27 national associations as members, our association encompasses the entire value chain of the European Hydrogen and fuel cell ecosystem collaborating together with the European Commission in the Fuel Cell Hydrogen Joint Undertaking.

For more information, please visit www.hydrogeneurope.eu.