Sustainable Electricity Sources

Renewable fuels of non-biological origin in the RED II

powered by

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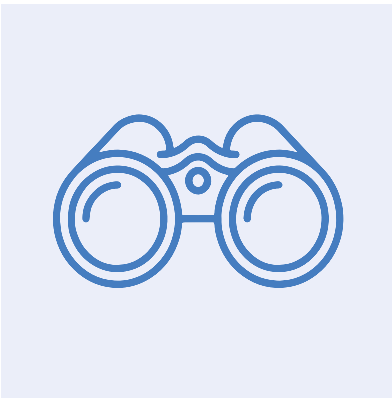

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Executive Summary

The revised EU Renewable Energy Directive is the first regulation to require powerfuels – or "renewable fuels of non-biological origin" (RFNBOs) – to meet certain standards when procuring electricity. As such, it is a **landmark** in the global development of powerfuels.

Any upcoming definitions of criteria for sources of electricity should be cautious not to suffocate a nascent market. Certification criteria need to be **transparent and feasible**. In line with regulation on biofuels, they should be defined as **minimum standards** that increase in ambition as the industry develops.

Sustainability criteria must be **globally applicable**. The largest potential for low-cost powerfuels is outside of Europe. These regions should be considered by devising regulations that can be verified in a variety of regulatory and institutional conditions.

Most importantly, the regulation must move forward quickly in order to give early certainty to project developers and national governments in the process of implementing the directive. A **decision before 2021** would therefore be welcome.

Alliance Proposal

Four criteria can safeguard the sustainability of electricity used for RFNBOs and should be implemented accordingly within the Delegated Act Art. 27 of the Renewable Energy Directive II.

1 **Renewability:**
Electricity should be limited to renewable energy sources only.

2 **Temporal Correlation:**
A range of weekly to daily balancing between generation unit and RFNBO plants if commissioned between 2020 – 2025, daily to hourly correlation 2026 – 2030, and hourly to imbalance settlement period (15 minutes) after 2030.

3 **Geographical Correlation:**
The production and power plants should be located in the same bidding zone, and not be separated by permanent grid congestion.

4 **Additionality:**
The renewable generation unit can demonstrate additionality if it is not receiving any offtake subsidies aimed at the power market.

1 Introduction

Powerfuels – energy carriers derived from renewable electricity – will play an essential and indispensable role in the transition towards a renewable energy system. Not only would powerfuels make it possible to utilise the worldwide potential for renewable energy, as they can be transported and traded globally, but they have also been shown to reduce the overall system cost of the energy transition by capitalising on the existing infrastructure and providing long-term storage options for renewable energies. They thereby complement direct electrification and can accelerate de-fossilisation as drop-in alternatives to fossil fuels.

Adequate sustainability criteria must be formulated to ensure that powerfuels have a positive climate impact. To fully demonstrate the benefits of powerfuels over other options, the assessment of sustainability must be approached as a holistic concept beyond climate benefit, including their effect on land, water, ecosystems and society. Within this wider concept of sustainability criteria, this paper analyses the challenges around sources of electricity for powerfuels and proposes approaches towards defining clear criteria for them. Sources of electricity are the essential element influencing the life-cycle emissions of the technology. As the largest share of operational costs in powerfuels production, they also have strong implications for the economics of powerfuels.

The revised Renewable Energy Directive (RED II) of the European Union is one of the first regulations to provide wide-ranging definitions and applications for powerfuels in the transport market. Within the RED II, Article 25 establishes that renewable fuels of non-biological origin (RFNBOs) can be used to fulfill the overall target of 14 % for the share of renewable transport fuels within member states. It also defines a set of rules for sources of electricity, distinguishing three possible pathways (Figure 1).

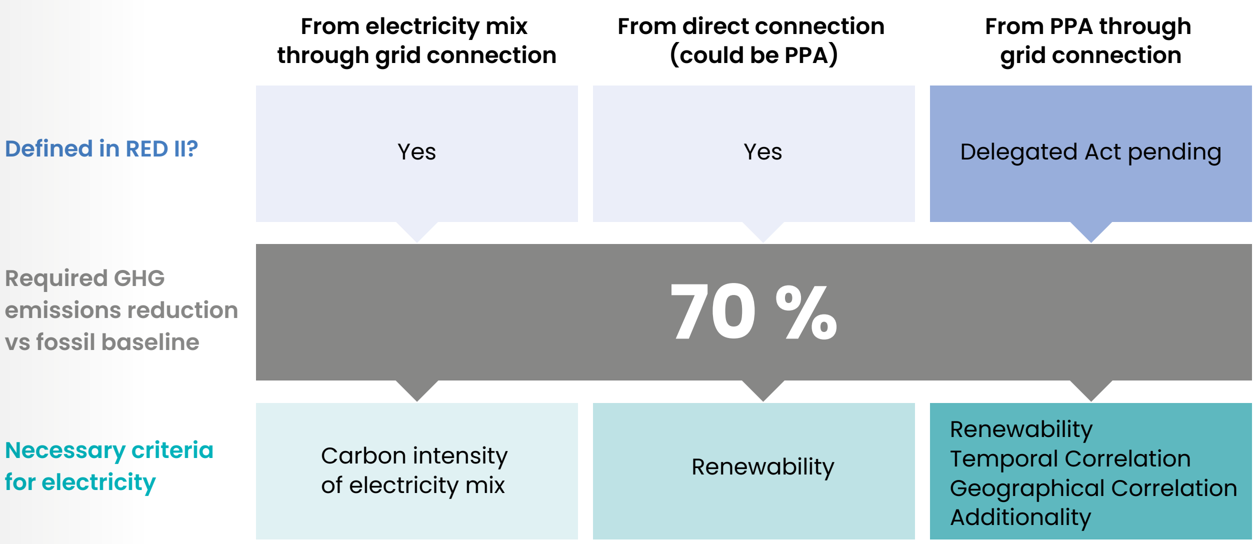

Figure 1: Possible sources of electricity as defined in the RED II

From the perspective of a powerfuels producer, the most convenient way of accessing the required electricity is to draw power from the electricity grid. In cases where the grid is supplied almost exclusively by renewable electricity (such as Norway, Iceland, Quebec, Tasmania), there is no conflict between the objectives of greening the power system and powerfuels production. The sourcing of electricity from renewable power sources can be guaranteed, allowing RFNBOs to achieve the necessary 70 % emissions reduction threshold compared to the fossil fuel baseline, as laid down in the RED II.

In countries where the composition of the grid mix is more carbon intensive, powerfuels producers can purchase electricity through the grid by means of Power Purchase Agreements (PPAs) with a renewable power plant to guarantee the sustainability of their power supply. As laid out in Article 27 of the RED II, this type of power purchase is, however, subject to four criteria **(renewability, temporal correlation, geographical correlation and additionality)**, the exact definition of which is still pending. In the following chapters, we will present our proposal for the elaboration of these criteria.

2 Requirements for sustainability regulation

Simplicity, Verifiability and Certifiability

The existing discussion on sustainability criteria for powerfuels is evidence of the analytical challenges associated with devising appropriate criteria. While the challenge is undoubtedly complex, resulting proposals should be simple, certifiable and enforceable. Complex proposals will suffocate the nascent market, create loopholes and place a large administrative burden on governments, regulators and producers. Only simple and effective regulation with easily verifiable criteria will enable third-party evaluators to enforce these criteria. This approach has proven successful in existing sustainability certification of alternative fuels which is based on audit checklists that clearly state requirements, verification guidance and the necessary evidence and documents that must be submitted. Last but not least, time is also a factor. In order to achieve meaningful, near-term market development of powerfuels, it is important to find agreement on criteria as soon as possible. Therefore, we propose the following ideas as a "fast-tracked" yet solid way of safeguarding the sustainability of powerfuels.

Global Applicability and Comparability

With the perspective of developing a global market for powerfuels, one of the principal challenges lies in defining verifiable, internationally enforceable rules for power sources. We expect some of the most promising supply regions for powerfuels to be far from demand centres, i.e. outside of the EU. This holds for both gaseous and liquid powerfuels, and both base chemicals and energy carriers based on green hydrogen. Sustainability criteria therefore need to apply equally in these supply regions and should be designed in such a way that they are globally enforceable. The existing biofuels regulation is fulfilling this criterion which enables the EU to import approximately half of its crop for biodiesel to date while still complying with sustainability standards [2]. In addition, similar standards must apply to fuels independent of their origin in order to prevent regions from undermining the sustainability efforts of other suppliers which could eventually lead to a "race to the bottom". Similarly, sustainability regulation for powerfuels must be comparable across sectors.

Predictability for project developers and investors

Predictability and planning security is key for the development of a powerfuels market. Project developers and investors need certainty early on in the process about whether or not their project would produce a product that is counted as renewable within the regulatory framework. A high degree of predictability can be achieved with rules that are certifiable independent of national institutions of supply markets and can be implemented globally. Furthermore, similar to the certification of biofuels and renewable electricity, certification should therefore be done on a per-project basis.

Coherence with existing regulation

Any effective regulation should also be coherent with existing regulation, e.g. on sustainability certification from biofuels. Current practise, under the RED for example, involves the separate evaluation of transport fuels for their sustainability and their GHG reductions (depending on the feedstock used). This system implies that, once the sustainability of a fuel production facility is certified, the GHG reduction determines the market price for the resulting fuel. Sustainability regulation is then revised regularly, resulting in increasing strictness over time by regulators reviewing the "best available technologies". This principle of separating sustainability and GHG reduction is also embodied in the logic of RED II, by defining separate delegated acts for the life-cycle assessment of powerfuels (Art. 25) and criteria for sources of electricity (Art. 27).

3 Renewability

In order to achieve GHG reduction through the substitution of fossil energy carriers, powerfuels need to have a lower carbon footprint than their conventional counterparts. Compared to other factors, the type of electricity used in their production has the largest impact on GHG emissions. Therefore, the renewable origin of the electricity must be ensured. If this is not the case, powerfuels can have a higher carbon footprint than conventional fuels.

RED II Proposal

RED II mandates that RFNBOs need to achieve a greenhouse gas reduction of at least 70 % [4] compared to the fossil fuel baseline to be eligible to count towards the targets for renewable energy in the transport sec-tor. To achieve this emissions reduction, the electricity used for powerfuels that are directly blended and used in transport would need to have a GHG intensity of approximately 45 – 70 gCO_2/kWh to qualify as RFNBO, depending on the type of powerfuel produced . Renewable power sources generally achieve these values in lifecycle analyses and should therefore be permitted for the production of powerfuels.

By defining the minimum reduction level, the regulation also places an implicit limit on the partial use of renewable electricity. In the most conservative scenario, for a combined cycle plant using onshore wind, which is the renewable power source with the lowest life-cycle emissions , and natural gas with an overall high process efficiency of 70 %, the rules would require the producer to procure at least 88 % of the electricity from the renewable resource. In a more realistic scenario involving solar PV and less efficient fossil fuel plants, the use of any fossil electricity is virtually excluded. This is also the reason why powerfuels production from grid electricity will only be feasible in very few countries for a foreseeable period of time; with the exception of Norway, no European country can currently achieve an electricity mix with such low carbon intensity.

For powerfuels produced from dedicated renewable energy assets and with electricity trans-ported through the grid, Recital 90 states, "To ensure that renewable fuels of non-biological origin contribute to greenhouse gas reduction, the electricity used for the fuel production should be of renewable origin." [5] Just like the previous RED, REDII gives no definition of renewable energy; it merely lists certain sources of renewable energy. Article 2 [4] states that 'renewable energy' includes wind, solar (solar thermal and solar photovoltaic) and geothermal energy, ambient energy, tidal, wave and other ocean energy, hydropower, biomass, landfill gas, sewage treatment plant gas, and biogas. Therefore, compared to other prerequisites for RFNBOs, there is not much scope for interpretation of which energy sources can be counted as renewable, according to the RED II.

[1] RED II stipulates a fossil fuel comparator ("baseline") of 94 tCO_2eq/GJ for biogenic fuels used in transport, and emissions for fuels must fall below 30 % of this value (70 % reduction). Calculations based on Öko-Institut ("not to be taken for granted") [17].

[2] ICCT 2014 [18], median value for life-cycle of various plant types, in combination with data from Öko-Institute (see above).

With the source of electricity being the largest determinant of the GHG emissions reduction potential, we agree that the source of electricity for the powerfuels production needs to be renewable. With the above definition found in REDII, all major sources of renewable electricity are covered. Nonetheless, any upcoming regulation through the Delegated Act of Article 27 should ensure the inclusion of all the above sources in order to grant the greatest possible degree of flexibility in choosing a renewable energy source. Furthermore, powerfuels producers should have the opportunity to complement PPAs with spot market electricity through Guarantees of Origin (GOs) or at average GHG intensity – especially as grids get greener. Currently more of a theoretical option, this allows for more flexibility in terms of supply in the future, potentially increasing RFNBO plant capacity utilisation and improving the availability of RFNBOs without creating additional risks.

4 Temporal Correlation

When the renewable power source and the powerfuels production facility are connected through the electricity grid, it is technically possible to run the electrolyser when the renewable power plant is not generating electricity. This would require designing a criterion to ensure that a degree of correlation between electricity production from renewable sources and its timely consumption in the electrolyser is guaranteed.

In the event that the powerfuels plant is using electricity from the grid while its dedicated renewable power plant is not simultaneously producing electricity, the electricity demand is covered by grid electricity. The additional demand will then be covered by the electricity market, and more specifically by the "marginal plant". Following the merit order principle, the power plant with the next lowest production cost will cover the additional supply. In most energy systems around the world, this marginal power plant is a fossil power plant, as renewable power plants generally have lower short-run marginal costs than fossil power plants. Therefore, a situation can arise where the additional power demand of a powerfuels plant is momentarily covered by a fossil fuel plant. However, it is important to bear in mind that, as long as the total demand and supply from powerfuels production is balanced, the renewable asset will supply the same amount of electricity at another point in time. Therefore, the total GHG emissions are unaffected by the degree of temporal correlation – as long as there are fossil fuel plants to be displaced at all times.

From a technical point of view, requiring powerfuels production to coincide with the generation of electricity from a contracted renewable asset does pose some challenges for certain applications, while being of little concern in others. More specifically, start-up times of small and medium scale PEM electrolyzers are generally below a 15-minute window. Alkaline and SOEC electrolysers significantly exceed this; however, they may react more quickly to smaller changes in power supply (standby). From the powerfuels producer's perspective, the degree of temporal correlation is crucial to commercial viability. A smoother temporal correlation allows the producer to achieve higher continuity in production.

Firstly, the degree of temporal correlation determines the load factor of the capital asset – the electrolyser and all subsequent process steps. Although falling fast, electrolyser costs are still comparably high. Therefore, the achievable capacity factor or full-load hours are decisive for total costs, as has been noted before[3]. To achieve any market for powerfuels in the short to medium term, setting a sensible threshold for temporal correlation is crucial and will be decisive for investment decisions.

[3] See also Agora 2018 "The future cost of Electricity-Based Synthetic Fuels" [19].

Secondly, next to the utilisation of the capital asset, the entrepreneur also chooses the renewable generation capacity linked to the powerfuels production plant. The required capacity can either be provided by integrating a renewable power source or contracting them through PPAs. For the decision, the entrepreneur must balance the need for a high load factor of the powerfuels production plant with the increased capital requirements for the renewables assets. In many cases however, businesses will opt to build or contract renewables that are of significantly higher capacity than the electrolyser. For example, and very much depending on local conditions, they may couple a 100 MW electrolyser with 200 MW of renewables capacity, e.g. 100 MW of onshore wind and 100 MW of solar PV. In many cases, they may do so even if this means selling any excess electricity at lower prices in the general power market or not selling it at all[4].

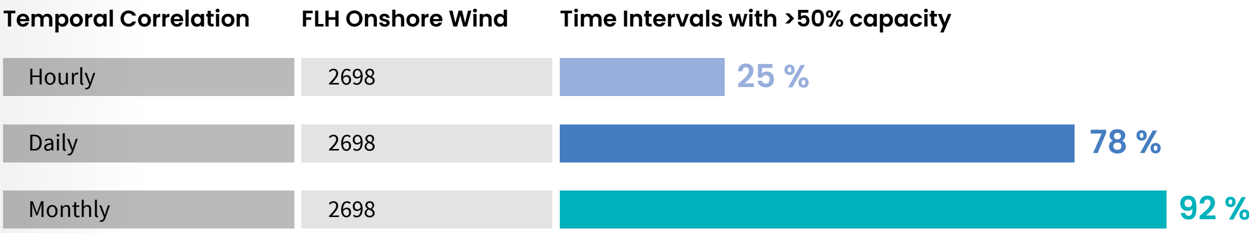

Figure 2: The effect of temporal correlation on electrolyser full-load hours. Author's calculation[5]

The degree of temporal correlation then determines the degree of oversizing renewable generation assets, and therefore the other most important cost component (next to the utilization of the electrolyser). Through the direct link between temporal correlation and total cost, setting a regulatory threshold for temporal correlation is potentially the most relevant of the criteria for making powerfuels production a business case.

RED II Proposal

The directive mandates that the "methodology should ensure that there is a temporal [...] correlation between the electricity production unit with which the producer has a bilateral renewables power purchase agreement and the fuel production. For example, renewable fuels of non-biological origin cannot be counted as fully renewable if they are produced when the contracted renewable generation unit is not generating electricity." [4]. As the RED II states only a temporal correlation, and no absolute time-window, the exact definition of the temporal correlation will need to be defined in the Delegated Act of Article 27, due in June 2021. Any upcoming regulation faces a trade-off between limiting the extent to which marginal fossil fuel plants may cover the electrolyser's demand for electricity in a certain moment and severely increasing the cost of producing RFNBOs.

[4] The latter may occur in electrical systems which already have a high share of renewables: contracted renewables' excess generation competes with existing renewables that may have preferential treatment in the power market.
[5] For Onshore Wind, Northern Germany (Schleswig-Holstein), 2698 FLH, Source: Author, based on ForWind & Öko-Institut (2016): „Generische Einspeisezeitreihen der Onshore-Windenergie auf Bundeslandebene für Deutschland im Zeitraum 2020 bis 2050" [20].

The lower bound of temporal restriction is the resolution of the power market. Power markets, along with grid operators, match supply and demand in the time window of the imbalance settlement period (ISP). In such a scenario, the net effect of electricity production for the powerfuels plant and its demand for electricity is always zero. The ISPs in the European Union are generally 15 minutes[6]. On the other extreme, regulation may require RFNBO producers to balance supply and demand only within weeks or months[7]. As demonstrated above, the lengths of the required time window would have a strong impact in making a viable business case for RFNBOs. Too strict a time window would make powerfuels production considerably more expensive and thus inhibit its market development. In our view, the upcoming Delegated Act should therefore start with a more generous correlation of weekly balancing while aiming at tightening the timeframe by moving towards daily and hourly correlation in the long-term. A pragmatic scenario would be to narrow the balancing periods in gradual phases of five-year intervals as shown in Figure 3 below. The specific time intervals, as well as their respective required temporal correlation criteria, should be defined from inception and remain unalterable in order to provide long-term planning and investment security for plant operators and investors. In addition, we propose a target range for each interval to account for the uncertainties associated with the future development of this nascent technology. In conjunction with a regular review process on the advancement of the best available technologies, targets could be adjusted towards more ambitious time frames, if appropriate.

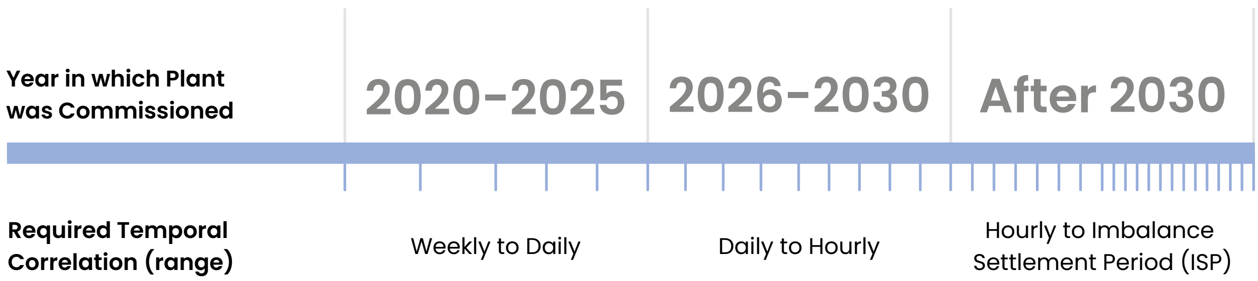

Figure 3: Regulatory proposal for temporal correlation

6 Imbalance settlement periods do vary significantly across the world. They usually range from 60 minutes (Scandinavian countries and Brazil) to 15 minutes in e.g. Germany and Benelux countries [21]. In many countries and regions, however, there are proposals to gradually increase the time granu-larity in electricity markets [22], most notably the EU Electricity Balancing Guideline requiring TSOs to harmonise the imbalance settlement period across the EU to 15 minutes until late 2020 [21].

7 These proposals are also part of the EU Tender for the study preceding the development of the Delegated Act of Art. 27.

5 Geographical Correlation

Similar to temporal correlation, the requirement of geographical correlation arises primarily from electricity grid considerations. The primary intention is to limit the extent to which the production of powerfuels contributes to the need for additional grid capacity. This criterion is meant to prevent the exacerbation of any existing bottlenecks in distribution and transmission grids or links between goth rid zones by powerfuels production.

In principle, any additional consumer or producer of electricity adds to grid requirements. However, powerfuels production that is linked to renewable generation through power purchase agreements may be set up in such a way that electricity flows primarily in one direction, exacerbating existing patterns in transmission grids between areas of renewable electricity potential and demand centres.[8] In some countries, this is more of a concern than in others. The most striking case of geographical supply-demand disparity is Germany, where much of the wind capacity is situated in the northern part of the country, whilst a large part of industrial power demand, in conjunction with larger population density, is in the South. This continues to create a necessity for the re-dispatch of 351.5 million Euros worth of electricity in 2018 [7]. In other countries with a similar issue, this situation has been largely resolved with (ultra) high-voltage direct current (HVDC) transmission lines. In China for example, demand is concentrated along the densely populated and industrialised coastline, whilst a large share of renewable generation is further inland. This has been countered with high-voltage DC interconnectors. A similar situation exists in Brazil, where hydro capacity can be hundreds or thousands of kilometres away from demand centres, and appropriate transmission grids are in place.

In designing appropriate regulation to address the issue of geographical proximity, we propose to rely chiefly on existing regulation by answering the questions of how RFNBO producers sourcing their power through the grid differ from existing generation and consumption units and in which regard existing regulation needs to be modified.

RED II Proposal

Recital (90) of the RED II states that the upcoming Delegated Act for Article 27 should "[…] ensure that there is a […] geographical correlation between the electricity production unit […] and the fuel production. […] Another example is the case of electricity grid congestion, where fuels can be counted as fully renewable only when both the electricity generation and the fuel production plants are located on the same side in respect of the congestion." [4] RED II therefore already sets specific requirements: In the case of grid congestion, the final product can only be certified as partially renewable.

Nonetheless, grid congestion can be seen as a temporal state and is therefore difficult to define. The Electricity Regulation (recast[9]) provides the definition of "structural congestion" which refers to congestion in the transmission system that is "capable of being unambiguously defined, predictable, geographically stable over time, and frequently reoccurs under normal electricity system conditions". [8]. To avoid ambiguity, this definition of grid congestion should be used.

[8] Which is different to a regular case which considers demand and supply independently.
[9] Regulation (EU) 2019/943 of the European Parliament and of the Council of 5 June 2019 on the internal market for electricity.

As mentioned above, any regulation has a strong impact on the economics of RFNBO production. For investments in production capacity to be bankable, plant developers need investment security, knowing that the product of the plant will be certified as a sustainable powerfuel over the entire operational lifetime of the plant. Therefore, any regulation should certify this geographical criterion, not for the production in a given year, but for the plant itself. Certification could be provided by certifying bodies in reference to the national grid regulator, and definitions for grid bottlenecks could be based on national rules and existing development plans.

In the absence of structural congestion in the electricity grid, RFNBO plants should still be limited in geographical scope, so that they can access the renewable electricity production units directly. This is because stress on electricity grids increases with distance, and limited interconnection capacity between grids may be a limiting factor. The strictest regulation would be to limit distance by mandating that renewable electricity be produced and used within the same transmission grid, as supply and demand are always balanced within. However, within the same bidding zone, transmission system operators (TSOs) have congestion management mechanisms in place to facilitate this. In the EU, bidding zones are defined as areas where market participants are able to exchange electricity without capacity allocation[10]; hence, uniform wholesale prices are formed. In line with this definition, they should be the area where electricity for RFNBOs can sustainably be procured.

[10] Article 2(65) of Regulation (EU) 2019/943 of the European Parliament and of the Council of 5 June 2019 on the internal market for electricity.

6 Additionality

As a final requirement, electricity for powerfuels production must demonstrate the property of additionality. The principle rationale for this is the interplay of electricity demand for powerfuels production and the defossilisation of the power sector. Additionality ensures that additional demand for renewable electricity for powerfuels does not interfere with efforts to increase the share of renewable electricity with regard to the existing demand for electricity. The primary challenge lies in demonstrating that powerfuels production really adds to the overall renewable energy generation capacity by adding capacity that would otherwise not have been provided.[11]

As has been noted before [9], [10] & [11], two scenarios can be discerned: the current status quo in many regions, where renewable electricity is still dependent on some degree of public offtake subsidy, such as feed-in tariffs or auctions and tenders. This is still the case for most countries, although the amount of subsidies is falling as renewables become more competitive. In this case, any new renewable electricity generation capacity is generally dependent on these subsidies. Conversely, any newly built renewable electricity production unit that does receive offtake subsidies can be considered as additional. Therefore, if a renewables plant can demonstrate commercial viability without requiring offtake subsidies, it is built in addition to the renewables that do require subsidies.

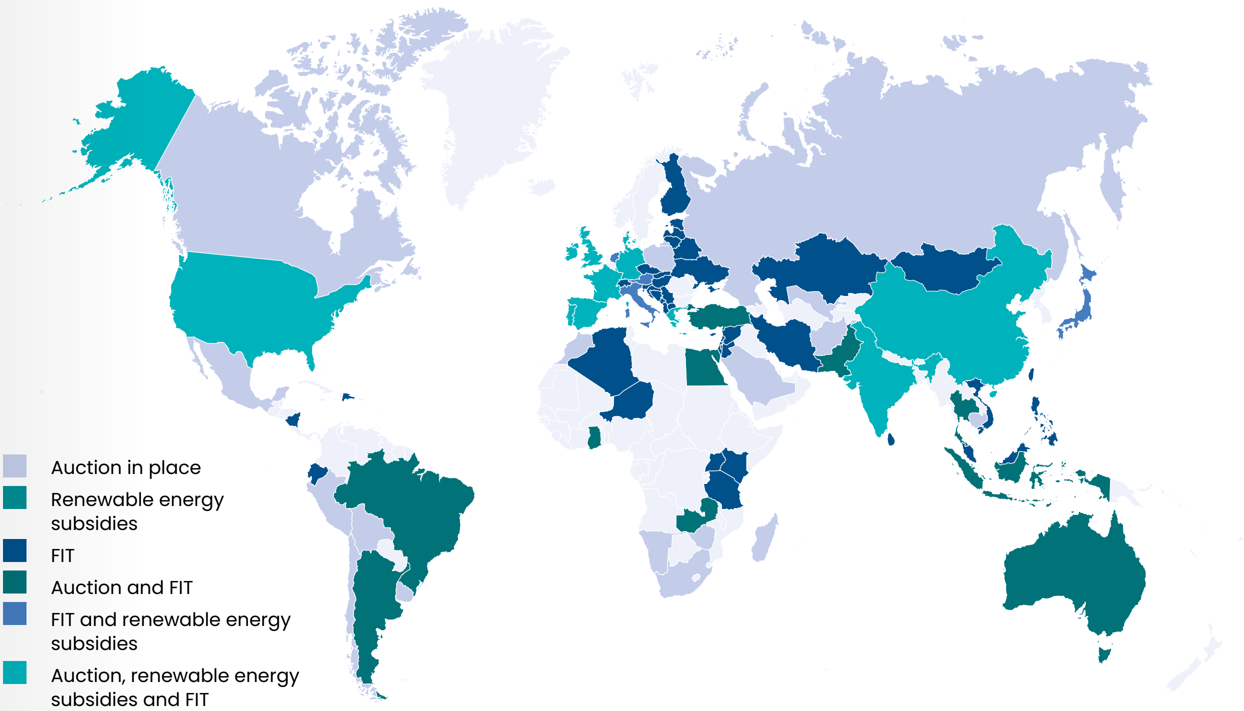

Figure 4: Renewable power offtake subsidies by country.
(Author's design based on: REN21 [13], Financial Times [14] & Energy Post [15])

[11] This has been noted previously [12] & [23].

This argument also holds in a scenario where renewables do not require or receive offtake subsidies. In such a scenario, all economically viable renewable capacity will be built and new renewables for the production of powerfuels do not hinder the transition in the power sector. In many regions, the levelised total cost of renewable electricity is below total or even marginal cost in conventional fossil electricity generation. With prices for renewable electricity decreasing at a faster pace than electricity provided by fossil sources, we are approaching this situation in other countries as well; the impact assessment for RED II concluded that "onshore and solar PV become gradually profitable and by 2030 such projects could be financed entirely by the markets". [12]. With this outlook, utilities will increasingly include renewables in their electricity mix for economic reasons. Therefore, any newly built renewable electricity production unit would be in addition to the defossilisation of the existing demand in the power sector, as there is no competition for a limited resource and the defossilisation of the power sector occurs naturally.

The argument above relies crucially on the absence of scarcity. The only binding constraint in this context is the availability of land or locations for wind and PV. In some regions, the production of powerfuels may compete with the need to decarbonise the power sector. This issue should be addressed carefully, yet is something best left to national governments to decide.

Any feasible regulation should allow certification bodies to demonstrate additionality in a way that is internationally comparable. Demonstrating additionality by proving the absence of offtake subsidies would allow certification directly on the plant level. Considering that renewable power auctions were held in at least 48 countries in 2018 and feed-in tariffs existed in 111 countries, states, or provinces [13] , the importance of finding a globally applicable solution becomes clear.

An issue not addressed in this proposal concerns existing renewable energy plants that would otherwise go out of business. Particularly in Germany, where renewable energy subsidies kick-started the market for wind and PV in the early 2000s, this issue is very much part of the current discussion. The underlying assumption is that fixed operation and maintenance costs (FOM) remain high, even as the asset is usually written off. The power producer might not be able to recover costs in the power market. The assumption is that an offtaker in the production of powerfuels would pay a premium over the market price, and hence ensure the economic viability of the renewable energy plant, keeping the plant in operation; otherwise, having reached the end of its subsidy period, its operation would end prior to the end of its lifespan. This argument may hold in some cases. In general, however, it remains to be seen whether a powerfuels plant operator with an asset that usually depreciates over a period of between 20 and 30 years would link it to a renewable energy generation unit at the end of its lifespan (with an unpredictable remaining lifetime and the associated reliability and maintenance issues) – at a higher cost than the electricity spot price.

RED II Proposal

Recital 90 states that "there should be an element of additionality, meaning that the fuel producer is adding to the renewable deployment or to the financing of renewable energy". [4]. As shown above, additionality can generally be sufficiently demonstrated by the absence of offtake subsidies for a newly constructed renewable electricity production unit. This allows for a way of certifying the additionality of a RFNBO in a transparent, and globally comparable manner.

As stated in Article 27, the commission is further tasked with developing a "framework on additionality in the transport sector" beyond RFNBOs, due to the expected increase in demand for electricity from battery-electric vehicles. Therefore, for coherence with any such regulation, a similar definition of additionality for both RFNBOs and electric vehicles may be pursued.

We propose a regulation where, in the absence of general renewable offtake subsidies, additionality can be certified directly by the certification body. In the presence of such subsidies, any renewable generation unit providing electricity to the RFNBO plant should demonstrate to the certification institution that it is not a recipient of subsidies. If national registers of subsidies exist, they may be used for this process by the certification body. The strict constraint on renewable potential – the availability of sites – should be monitored by national governments, as no universal regulation can be devised. National governments could implement this by introducing national limits on total electrolyser capacity or renewable capacity used for RFNBOs, or devising restrictions on permits.

Outlook

As one of the first regulations to recognize the role of electricity-based renewable fuels, the RED II constitutes a landmark for the establishment of binding sustainability standards for powerfuels and as such ensures the sustainability and positive net climate impact of this technology. With national implementation pending, it is now necessary to exploit and develop the full potential of the RED II in safeguarding these goals.

While the market development of powerfuels is inhibited by the current lack of investment certainty, this paper also calls on policymakers for the timely and feasible implementation of Article 27, which will enable market development instead of restricting it. Time is particularly pressing, as clarity regarding regulatory conditions is a prerequisite for investors and producers alike to be able to take the necessary next steps that will carry the market development of powerfuels forward.

The elaboration of sustainability criteria as defined in the RED II also has the potential of serving as a blueprint for future regulations in other markets, regions and sectors, which highlights the significance of this regulation beyond the transport sector and the EU. Keeping in mind that the EU is likely to play the role of a lead market for powerfuels, it will be paramount to choose rules with a universal appeal and validity which are globally enforceable and can be transparently audited.

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