WWW.FRONTIER-ECONOMICS.COM

CHALLENGES AND OPTIONS FOR EFUEL SUPPORT IN THE EU IN THE LIGHT OF THE US IRA

A study for eFuel Alliance, Porsche AG and Stihl AG.

08 NOVEMBER 2023

Contents

frontier economics

EXECUTIVE SUMMARY

In August 2022, the US Inflation Reduction Act (IRA) was signed with the aim of stimulating investments in clean technologies in the US. The IRA provides significant financial support to US-based producers of clean technologies, including producers of green hydrogen and eFuels[1] and is expected to have a massive impact on investments in the States. In response to the IRA, Canada has already established a similar support system.

In the EU, in contrast, support for eFuels is currently based on a range of measures, most of which are demand-side oriented. As a reaction to the IRA, the EU Commission has laid out measures in its' proposed Net-Zero Industry Act that are mainly based on reducing bureaucracy, but do not include additional financial support for technologies or producers.

Against this background, this short study discusses challenges and options for eFuel support in the EU in the light of the US IRA. The study builds on the views of stakeholders active in the eFuels market (in the EU and/or the US), which were expressed in workshops in March and April 2023. In the following, we summarise the main conclusions of the study.

The US Inflation Reduction Act grants massive tax credits for producers

The US IRA is very attractive for producers of clean energy products such as eFuels for three main reasons:

- **Secure payments for a pre-defined period of time** – The US-IRA offers tax credits (either production or investment tax credits) that provide a secure payment that is stable over a pre-defined period of time and thus creates a well-predictable revenue-stream (cost reduction) for producers. In the case of production tax credits, the support under the US-IRA is comparable to a feed-in-tariff-system that was used in many countries in the EU in order to foster the market ramp-up of green electricity.

- **High level of support** – The level of support granted by the US-IRA is substantial, at least if certain social and ecological (in terms of the intensity of life cycle greenhouse gas emissions) criteria are fulfilled. As an example, producers of green hydrogen can receive a production tax credit of up to 3 €/kg for a period of 10 years. In addition, there are possiblities to combine the subsidies for green hydrogen granted unter the IRA with subsidies for electriticy from renewable energy sources.

[1] eFuels are synthetic fuels derived from green hydrogen (which is defined as hydrogen produced from electricity from renewable energy sources). Within the EU, green hydrogen and eFuels belong to the category of "Renewable fuels of non-biological origin" (RFNBO). The US IRA only refers to clean fuels, a category which also includes fuels with low greenhouse gas emissions that are not based on renewable energy sources. With respect to support levels, the US IRA however distinguishes between different levels of greenhouse gas lifecycle emissions of the fuels such that fuels with lower emission levels receive higher support payments.

- **Simple and transparent support scheme** – The US IRA is perceived as a very simple support scheme that is easy to understand and substantially less complex than the EU support scheme(s).

The EU support landscape is perceived as being complex, associated with high regulatory uncertainty and higher risks for producers than the US-IRA

In relation to the European support landscape for eFuels (RFNBOs), stakeholders face several challenges:

- **High complexity of support landscape** – The regulatory framework in the EU to create a market for eFuels is scattered across many individual measures. The measures are designed to encourage the demand for eFuels (via already existing or planned quotas) or to reduce the cost gap between eFuels and their fossil alternatives (e.g. via the EU-ETS or the proposed reform of the European Tax Directive). In addition, some support schemes addressing explicitly the supply side of eFuels (such as direct funding) also exist, however with a limited financial volume.

- **High level of regulatory risk** – Many regulations that have a significant impact on both, the costs and revenues of eFuels, are currently still in the legislative process and therefore unclear to potential investors. In addition, the timeframes of regulations are considered to be too short (e.g., there is no renewable energy target beyond 2030) and/or there is a lack of timely coordination between different regulations. Also, EU regulation in the context of eFuels is mostly set out in directives, that have to be transposed into national law, which further lengthens the period during which the regulatory framework is unclear to market participants.

- **Higher revenue risks for producers** – As the European eFuel support is mainly based on demand-sided support (via quotas), the revenues producers receive are less stable and predictable for producers than a fixed payment as under the US-IRA. As stated above, direct support schemes for producers exist, however with a limited financial volume. This can have implications on the financing of projects and the contracting of offtaking agreements with consumers.

Options to address the challenges in the EU support landscape include the revision of the Energy Tax Directive and de-risking measures

The challenges eFuel producers currently face in the EU, can be alleviated by measures that

- **Stabilize revenues** – As part of the Fit-for-55 package, the European Commission has published a proposal to revise the Energy Tax Directive (ETD), including the setting of minimum tax rates based on the environmental impact of the individual fuels. This would reduce the costs that eFuel producers face on the European market by the amount of the

tax difference between fossil and renewable fuels. This tax difference would be predictable for eFuels and stabilize revenues.

- **Contribute to de-risking eFuel investments** – Measures to reduce risks faced by producers of eFuels include
  - Grandfathering rules – Grandfathering would allow to "freeze" the regulatory environment applicable to an eFuel project at a certain point in time.[2] This measure would give early projects the certainty of knowing the regulatory framework for a given period.
  - Extension of auctions for offtake-agreements such as those provided by the European Hydrogen Bank (EHB) and H2 Global – The European Hydrogen Bank and H2 Global are seen as positive examples of measures to de-risk and secure the long-term offtake of hydrogen by shifting the regulatory risk from producers to the legislator and giving producers an incentive to keep the difference payments low.
  - Development of political targets beyond 2030 to provide a long-term perspective for investments. For example, currently no renewable energy target beyond 2030 exists.
  - Strategic trade partnerships - Building strong strategic trade partnerships is essential as EU countries will also depend on imports of hydrogen and eFuels from countries with more favourable conditions for their production also in the long-term.
- **Reduce the complexity of the regulatory framework** – The single national competent authority being responsible for facilitating and coordinating the permit-granting process (one-stop shop) proposed in the Net-Zero Industry Act is recognised as a first step towards reducing the complexity of the EU support landscape. Project developers would also benefit from the simplified permit-granting procedures proposed in the Net-Zero Industry Act. However, the Act is currently only a draft, which needs to be approved by the Parliament and the Council. Recent examples have shown that this process can be lengthy.

Figure 1 summarises how the solutions outlined above would contribute to resolving the challenges faced by eFuel producers.

[2] For example, the regulatory framework at the time of investment of a plant would be guaranteed to be valid for this plant for a fixed period (such as during the lifetime or the depreciation time of the plant). Thus, e.g. if electricity criteria for green hydrogen would change over time, this plant would not be affected by these changes.

Figure 1 Potential solutions for resolving the challenges faced by eFuel producers

Challenge	Solution	Addressed in current EU regulation
Uncertain revenues under quota systems in an early market phase	Revision of the Energy Tax Directive and implementation in national tax law	⊖
	Extension of de-risking mechanisms such as EHB and H2Global	✗
High level of regulatory risk	Grandfathering rules	✗
	Development of political targets beyond 2030	✗
	Strategic trade partnerships	⊖
Complexity of regulatory framework	One-stop shop for regulatory procedures	✓

Source: Frontier Economics.

1 Background and introduction

In August 2022, the US Inflation Reduction Act (IRA) was signed with the aim of stimulating investments in clean technologies in the US. The IRA provides significant financial support to US-based producers of clean technologies, including producers of green hydrogen and eFuels. This support package is expected to have a massive impact on clean technology investments in the US.[3] In addition, the US IRA has triggered a lively debate about the impact of the IRA on the green industry in other parts of the world.

In response to the IRA, Canada has already established a similar support system, which provides direct support to Canadian producers of clean technologies via tax credits. In the EU, in contrast, support for eFuels is currently based on a range of measures, most of which are demand-side oriented. In response to the IRA, the EU Commission has laid out measures in its' proposed Net-Zero Industry Act that are mainly based on reducing bureaucracy, but do not include additional financial support for technologies or producers.

Against this background, this study

- provides an overview of the relevant aspects of the US IRA and the Canadian tax credit scheme for the eFuels industry and describes the support measures for eFuels in the EU (Section 2);
- describes which challenges for the ramp-up of the eFuels industry currently exist in the EU, and how they compare to the respective US industry (Section 3); and
- analyses how the EU could respond to the IRA to address these challenges (Section 4).

A cornerstone of this study are the assessments of stakeholders active in the eFuels market (in the EU and/or the US), which were shared in workshops in March and April 2023. The workshop participants cover all essential stages of the eFuels production, including the manufacturing of components for eFuels production, the production of hydrogen and eFuels, and the offtake of eFuels. The interactive workshops first discussed the challenges faced by the eFuels industry in Europe, with a focus on those that emerged due to the IRA. This was followed by a discussion of possible options for action, i.e. how the identified challenges could be addressed at the European level. The views expressed by workshop participants form the basis of this study.

[3] https://www.whitehouse.gov/cleanenergy/inflation-reduction-act-guidebook/

2 eFuel support in the US, Canada and the EU

Policymakers have a wide range of measures available to support the development of the eFuels industry. This section presents

- the tax credits available to domestic producers of clean fuels in the US as part of the US Inflation Reduction Act (Section 2.1);
- the similar approach taken in Canada (Section 2.2);
- and the variety of measures, mainly targeting the demand side, in place in the EU (Section 2.3).

Section 2.4 describes the Net-Zero Industry Act proposed by the European Commission in March 2023 in the context of a "global technological race" led by the US Inflation Reduction Act and other countries' investment plans in net-zero technologies.

2.1 The US Inflation Reduction Act grants massive tax credits to producers

The Inflation Reduction Act (IRA), signed in August 2022, provides significant financial support in the form of refundable tax credits along all stages of the eFuel value chain, i.e. renewable electricity generation, hydrogen production, CCUS and eFuel production. The IRA subsidies have no formal cap and the clean energy tax credits alone are estimated to cost about $260 billion (€ 237 billion) over the next ten years.[4] The production tax credits allow taxpayers to deduct a fixed portion of their costs per unit of final product from their federal taxes, and thus work similarly as a fixed premium.[5] Table 1 gives an overview of the relevant production and investment tax credits available to clean energy producers in the US.[6]

In addition, the Advanced Manufacturing Credit (IRC § 45X) provides subsidies for domestic manufacturing of components for solar and wind energy, inverters, battery components and critical minerals. The manufacturing of equipment for the production of hydrogen or eFuels (e.g. electrolysers) is not supported by this tax credit, but electrolysers are eligible for funding under the Advanced Energy Project Credit (IRC § 48C), which gives a credit rate of up to 30%. The program will have at least two allocation rounds and intends to allocate $10 billion of credits.[7]

4 https://www.washingtonpost.com/us-policy/2022/07/28/manchin-schumer-climate-deal/

5 Certain tax-exempt entities, e.g. local governments, are eligible for direct payment of tax credits. Eligible taxpayers also have the option to transfer all or a portion of certain tax credits to a third party. https://www.epa.gov/green-power-markets/inflation-reduction-act

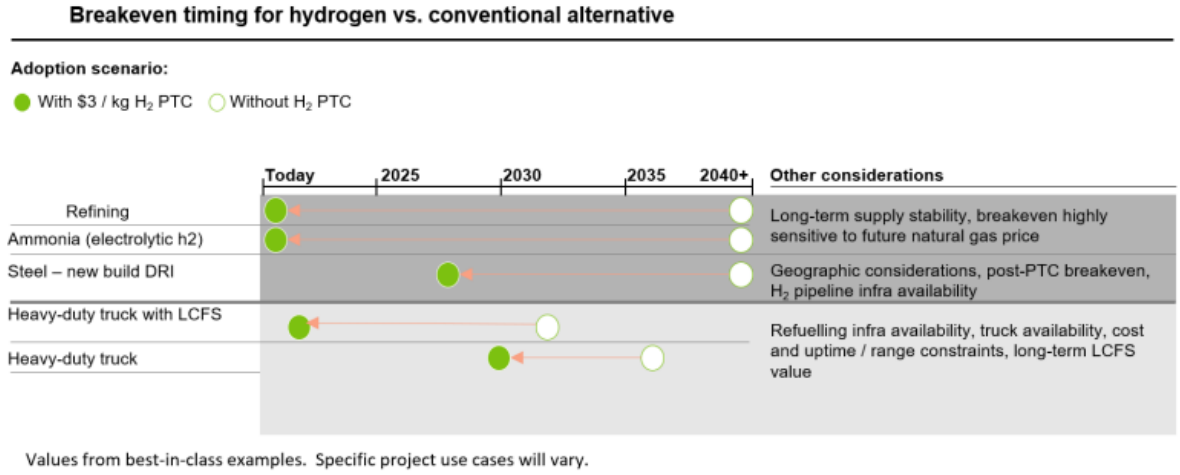
6 All tax credits are contained in the Internal Revenue Code (IRC), which is the body of law that codifies all federal tax laws.

7 The Section 48C program will have at least two allocation rounds (the first submission period takes place between 31 May 2023 and 31 July 2023) and intends to allocates further $10 billion of credits.

The maximum credit amount is only granted if the project meets certain prevailing wage and apprenticeship requirements. The beneficiaries of the funding must have their production site in the US, but may produce for the export market.

The impact of the production tax credits is illustrated by Figure 2, which shows that the production tax credit can substantially bring forward the break-even point for clean hydrogen compared to fossil hydrogen for certain end-use applications, particularly industrial applications such as ammonia and steel.

Figure 2 Breakeven timing for hydrogen with the clean hydrogen production tax credit vs. conventional alternative



Source: U.S. National Clean Hydrogen Strategy and Roadmap (June 2023), Figure 14, https://www.hydrogen.energy.gov/pdfs/us-national-clean-hydrogen-strategy-roadmap.pdf.

2.2 Canada introduced tax credits for producers in response to the US IRA

In response to the US IRA, the Canadian government has introduced subsidies in the form of refundable tax credits which resemble the US equivalent. The 2023 Canadian Federal Budget released on 28 March 2023 includes **Investment Tax Credits** (ITC) for the production of clean electricity, hydrogen and CCUS. Table 1 shows the main features of the ITCs, which are expected to cost C$43.9 billion (€ 30 billion) by 2035.[8]

The Canadian government also subsidises the manufacturing of clean technologies: the **Clean Technology Manufacturing ITC** is a 30% tax credit in respect of the CAPEX of machinery and equipment used, e.g., in the manufacturing of hydrogen production equipment or renewable energy equipment (among others). The tax credit is expected to cost an additional C$11.1 billion (€ 7.6 billion) between 2023 and 2035.

8 https://www.budget.canada.ca/2023/report-rapport/chap3-en.html.

As in the US, the credit amount will depend on the satisfaction of certain labour requirements. Where expenditures qualify under more than one ITC program, taxpayers will generally only be eligible for one of the ITCs. The tax rates will be reduced after 2030 to incentivise early investments.

Table 1 Production/investment tax credits in the US and Canada

Clean technology	USA	Canada
Electricity 	The **Production Tax Credit for Electricity from Renewables** (IRC § 45), **Clean Electricity Production Credit** (IRC § 45Y) and **Clean Electricity Investment Credit** (IRC § 48E) offer credits for net-zero electricity produced in the US. These credits replace the original investment tax credit and production tax credits (which are more narrowly defined) from 2025. Credits rates are up to 1.5 USc/kWh for the PTC (§ 45 and § 45Y) and 30% for the ITC (§ 48). The ITC is an upfront tax credit, while the PTC provides funding for 10 years.	The **Clean Electricity ITC** grants a 15% tax credit for investments in net-zero electricity generation systems. The ITC is available between April 2024 and March 2035.
Hydrogen 	The **Clean Hydrogen Production Credit** (IRC § 45V) offers credits of up to $3 per kilogram of hydrogen produced with lifecycle GHG emissions of less than 0.45 kgCO2/kgH2. Lower credits are given for hydrogen production with higher lifecycle GHG emissions (max. 4 kgCO2/kgH2). The IRA also broadened the existing ITC in § 48 to apply to clean hydrogen production facilities. The credit rate can be up to 30% for larger facilities producing very low emission hydrogen and meeting certain social criteria. The ITC cannot be combined with IRC § 45V. Producers of green hydrogen can benefit from the clean hydrogen credit also if the hydrogen is produced based on electricity from renewable energy sources that is subsidiesed by an electricity tax credit.	The **Clean Hydrogen ITC** gives CAPEX credits of 40% to projects producing hydrogen with GHG emissions below 0.75 kgCO2/kgH2. Reduced rates (min. 15%) are available up to lifecycle emissions of 4 kgCO2/kgH2. Certain equipment used to convert clean hydrogen to clean ammonia will also benefit from a fixed 15% credit. Equipment required to produce hydrogen from electrolysis (e.g. electrolysers) is also eligible if it is made available for use in Canada. The tax credit will be fully phased out for property that becomes available for use after 2034.

Clean technology	USA	Canada
Carbon Capture, Utilization and Storage (CCUS) 	The **Carbon Capture Credit** (IRC § 45Q) incentivises the use of carbon capture and storage (CCS) or carbon capture and usage (CCU), e.g. via credits for DAC projects of up to $130/tonne for used CO2.	Further details of a Carbon Capture, Utilization and Storage (CCUS) ITC will be released in the coming months.
Fuels 	The **Clean Fuel Production Credit** (IRC § 45Z) of up to $1 per gallon will be available between 2025 and 2027 to encourage the production of any sustainable transportation fuel. The production of sustainable aviation fuel is supported with credits of up to $1.75 per gallon ($1.25/gallon until 2024) by the **Sustainable Aviation Fuel Credit** (IRC § 40B).	N/A

Source: *US: https://www.whitehouse.gov/wp-content/uploads/2022/12/Inflation-Reduction-Act-Guidebook.pdf, Canada: https://www.budget.canada.ca/2023/pdf/budget-2023-en.pdf and https://www.budget.canada.ca/2023/pdf/tm-mf-2023-en.pdf.*

Note: *The maximum credit amount is only granted if the project meets certain prevailing wage and apprenticeship requirements. The base amount is five times lower. Bonus credits exist for certain projects in the form of a "domestic content bonus", "energy community bonus" and "low-income bonus".*

2.3 In the EU, a variety of mainly demand-side support mechanisms exist or are planned

In contrast to the support for producers (supply side) in the US and Canada described above, the EU is focusing on demand-side measures to support the energy transition regarding hydrogen and eFuels. The regulatory framework in the EU to create a market for eFuels is scattered across many individual measures. The measures are designed to encourage the demand for eFuels or to reduce costs for consumers such as:

- **Quota obligations**:
  - The Renewable Energy Directive (RED) sets cross-sector and sector-specific renewable energy targets. In its' third version (RED III), it gives Member States the option to choose between i) a binding target of a 14.5% reduction of greenhouse gas intensity in transport from the use of renewables by 2030 or ii) a binding share of at least 29% of renewables within the final consumption of energy in the transport sector by 2030. In addition, the RED III sets a combined quota for advanced biofuels and renewable fuels of non-biologic origin (RFNBO) of 5.5% and a sub-quota of 1% for RFNBOs in the transport sector *(in 2030)*. As a multiplier of 2 can be applied for these fuels, the quotas effectively only amount to 2.75% for the combined advanced biofuel

and RFNBO quota and 0.5% for the RFNBO sub-quota.However, anecdotal evidence from Finland and Germany suggests that some Member States may introduce higher quotas at national level.

- The ReFuelEU Aviation regulation sets a mandatory Sustainable Aviation Fuel (SAF) quota of 2% (6%) for aviation by 2025 (2030) and an e-kerosene sub-quota of 1.2% from 2030. The overall SAF-Quota increases stepwise to 70% until 2050, the e-kerosene subquota to 35% until 2050.[9]
- The FuelEU Maritime regulation sets a 2% RFNBO usage target in the maritime sector *(from 2034 on)* if the RFNBO amount in the fuel mix is less than 1% in 2031 and less than 2% in 2033.
- Additional, quota schemes also exist at the national level. The most notable is the national PtL kerosene quota in Germany, which mandates a minimum e-kerosene share in aviation of 0.5% in 2026, 1% in 2028 and 2% in 2030.[10]

- **Regulations that may reduce the cost gap between eFuels and their fossil alternatives** by increasing the price of the latter:
  - The Energy Tax Directive (ETD), which is the EU framework for the taxation of energy products, currently treats eFuels and fossil fuels equally. The Commission's proposal for a revision of the ETD (first adopted in July 2021) includes a proposal to tax fuels according to their energy content and environmental impact rather than their volume, which would result in eFuels being taxed at the minimum rate.
  - The EU emissions trading system (EU ETS), which also covers intra-EU aviation, and the planned ETS II, which will cover road transport and buildings *(to be established by 2027)*, increases the price of fossil energy carriers compared to clean energies.[11] In addition, the recent EU ETS proposal sets aside 20 million allowances between January 2024 and December 2030 to support aircraft operators uplifting RFNBOs and SAF and makes producers of green hydrogen eligible for free allowances.
- The consideration of eFuel vehicles in the EU fleet target regulation to allow the registration of cars running exclusively on eFuels after 2035 *(planned delegated act)*[12].

On EU level as well as on national member state levels, there exist also some support schemes addressing explicitly the supply side of eFuels such as

- Direct funding e.g. through the EU Innovation Fund (estimated budget of 38 billion € in 2020-2030 to support the demonstration of breakthrough low-carbon technologies with up to 60% of their relevant costs), InvestEU Fund (EU budget guarantee of 26.2 billion €), Just Transition Fund (19.2 billion € for regions most affected by the transition to climate

9 https://www.consilium.europa.eu/en/infographics/fit-for-55-refueleu-and-fueleu/

10 §37a (4) Bundes-Immisionsschutzgesetz, BImSchG. It has not yet been clarified how the German quota and the EU quota could coexist. The implementation of the ReFuelEU Aviation regulation could lead to an adjustment of the German quota.

11 The price of emission allowances in the ETS II is capped at 45 €/t CO_2 until 2030.

12 https://www.euractiv.com/section/road-transport/news/eu-countries-approve-ban-on-sale-of-petrol-diesel-cars-from-2035/.

neutrality for the period 2021-2027) or Important Projects of Common European Interest (IPCEIs). These funding programmes differ in terms of funding budget, eligibility criteria and technologies covered, selection criteria, type of funding and funding level.

- In addition, Member States may have other national regulatory and support mechanisms in place. National funding programmes include H2Global and NIP II („Nationales Innovationsprogramm Wasserstoff- und Brennstoffzellentechnologie“). These programmes are targeted at very specific technologies.
- Measures aimed at reducing the risks for investors or creating business opportunities include the European Hydrogen Bank (with a budget of 3 billion Euro), which aims to support the financial aspects of investments in the hydrogen value chain in the EU and in third countries *(planned to launch in late 2023)* and the Clean Hydrogen Partnership, which supports hydrogen R&I activities of public private partnerships in Europe.In addition, the production of hydrogen and hydrogen-based synthetic fuels (if RED-compliant) and the manufacturing of equipment for the production and use of hydrogen are classified as environmentally sustainable economic activities in the EU taxonomy.

As we will discuss in the following chapter, the supply-side support schemes are seen as an important first step towards building up an eFuel industry in Europe, but they are also seen as being too limited in funding, too complex and too slow – especially compared to simple support schemes such as the IRA in the US. This raises the need for additional political action in Europe if some form of eFuel investment is to be pursued in the EU.

Special characteristics of the eFuels sector in the EU

When discussing the challenges of the EU eFuels industry and comparing the EU support for eFuels with support schemes such as the IRA, it is important to take into account the different characteristics of the eFuels sectors in the EU and the US.

The use of eFuels is an essential element in phasing out fossil fuels in various applications. There is political consensus in the EU that eFuels are at least indispensable for the defossilisation of the aviation and maritime sector and the existing stock of vehicles with internal combustion engines. There is also a broad consensus in the EU that the EU's demand for eFuels cannot be met by domestic production alone. The EU is expected to remain an energy-importing region in the medium to long term due to limited land availability and less favourable location conditions for green electricity production compared to the rest of the world. For this reason, imports of green hydrogen and its derivatives, such as green ammonia and green methanol, play an important role in the EU's hydrogen strategy. For example, the EU aims to produce 10 million tonnes of renewable hydrogen in the EU and to import the same amount from countries outside the EU by 2030.[13]

This dependence on imports is an important difference between the EU and the US or Canada, where the availability of sites with favourable conditions for green electricity production is less of an issue.[14] It is therefore not appropriate in the case of the EU to focus solely on supporting producers within the EU, as is the case in the US or Canada. Instead, support for the eFuel-industry within the EU needs to address two issues:

- **Ensuring security of supply** – as the EU will have to import a large part of its' eFuel demand in the medium and long term, the engagement in trade relations is important.
- Setting the framework conditions for EU companies to **become leading technology providers in the global eFuels market** – Although the EU will not export eFuels due to its' less favourable location for renewable electricity production, as an industrial location it can be the world leader in exporting hydrogen and eFuel production technologies to countries with more favourable locations.

13 EC (2022): REPowerEU Plan, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2022%3A230%3AFIN&qid=1653033742483.

14 See, e.g., https://www.nrel.gov/analysis/re-futures.html.

2.4 The EU's Net-Zero Industry Act aims at scaling up manufacturing of clean technologies in the EU, but does not provide new financial incentives

In the light of the recent energy crisis and the "global technological race" for net-zero energy technologies triggered by the investment plans of the US, Canada and other countries, the EU Commission proposed on 16 March 2023 the Net-Zero Industry Act, which aims to reduce the EU's dependency on critical technologies from third countries and to support clean tech industries in the EU.[15] The overall aim of the Act is to reach an overall manufacturing capacity for net-zero technologies of at least 40% of the EU's annual deployment needs by 2030, which is intended to be achieved by creating a simpler and more predictable legal framework for net-zero industries in the EU. The proposal solely coordinates existing financing mechanisms, but does not introduce any new funding options.

The legislation generally promotes the deployment of the manufacturing capacity of 'net-zero technologies' as well as indispensable components, materials and machinery along the supply chain of these technologies. While the EC proposal distinguished between 'net-zero technologies'[16] and 12 'net-zero strategic technologies' (excluding eFuels) for which more extensive measures were proposed, the revised draft by the Committee on Industry, Research and Energy (ITRE) of the European Parliament of 25 October 2023[17] has removed this distinction. Instead, the ITRE's draft proposes that under certain criteria all projects within the extended set of 16 'net-zero technologies' are eligible for enhaced measures. The 16 technologies include eFuels for aviation and shipping, as defined in Regulations 2023/1805 and 2023/2405.

Specific actions proposed in the Act include:

- Accelerated permitting procedures;
- A single national competent authority responsible for facilitating and coordinating the permit-granting process ('one-stop shop');
- Mandatory sustainability and resilience criteria in procurement procedures and auctions;
- Net-Zero Industry Academies to provide training and education on net-zero technologies;
- A CO2 injection capacity target and measures to enhance the availability of CO2 storage sites;

15 The Net-Zero Industry Act is the first pillar of the Green Deal Industrial Plan. The Net-Zero Industry Act needs to be discussed and agreed by the plenary of the European Parliament (currently scheduled for 20 November 2023) and the Council of the European Union before its adoption and entry into force. https://single-market-economy.ec.europa.eu/publications/net-zero-industry-act_en.

16 'Net-zero technologies' in the EC proposal means certain renewable energy technologies (including renewable fuels of non-biological origin technologies and electrolysers), which shall have reached a technology readiness level (TRL) of at least 8.

17 https://www.europarl.europa.eu/meetdocs/2014_2019/plmrep/COMMITTEES/ITRE/DV/2023/10-25/05-CA_NZIA_EN.pdf

- Regulatory sandboxes for certain less mature technology projects ('innovative net-zero technologies');
- Enhanced measures for net-zero strategic projects[18]:
- National priority status to ensure fastest administrative treatment;
- Coordination and financing advice from the Net-Zero Europe Platform;
- Support by Member States to accelerated project implementation.

Overall, the Net-Zero Industry Act introduces several measures to facilitate the production of clean technologies in the EU, but unlike the US IRA and the Canadian investment plan, it does not introduce new financing options.

[18] To be recognised as a net-zero strategic project, a net-zero technology manufacturing project must meet certain criteria related to the technological and industrial resilience of the Union, competitiveness, job creation or improved sustainability.

3 Challenges for the ramp-up of the eFuels industry in the EU

During the workshops with stakeholders of the eFuels industry, challenges for the ramp-up of the eFuels sector in the EU were discussed. The most important challenges currently faced by the industry include

- the focus on demand-side support in the EU, which can lead to higher risks for producers compared to supply-side support, especially during market ramp-up phases (Section 3.1); and
- the high level of complexity and regulatory uncertainty (Section 3.2).

3.1 Focus on demand-side support in the EU leads to higher risks for eFuel producers in the EU compared to the US

As explained in Section 2.3, the market ramp-up of clean fuels in the EU transport sector is mainly incentivised (currently or planned for the future) by demand-side support mechanisms, such as the SAF quota within the ReFuelEU Aviation regulation, and the renewable energy target for the transport sector defined within the RED.

Generally, from an economic point of view, quota obligations are an effective and efficient instrument to stimulate investments (if they are well-designed): Quota systems create a reliable demand for a product or a range of products (e.g. for eFuels) and thus provide clear signals to investors about the size of the (future) market. For these investment signals to unfold, it is important that quota targets are defined on a long-term basis and sufficiently ambitious. Also, quota systems increase the willingness-to-pay of consumers for the product (as they are obliged to fulfil the quota) and thus create higher revenues for producers ("green premium" – see below). In addition, quota systems create a competitive and technology neutral market environment for producers to the benefit of consumers and thereby provide an efficient market outcome.

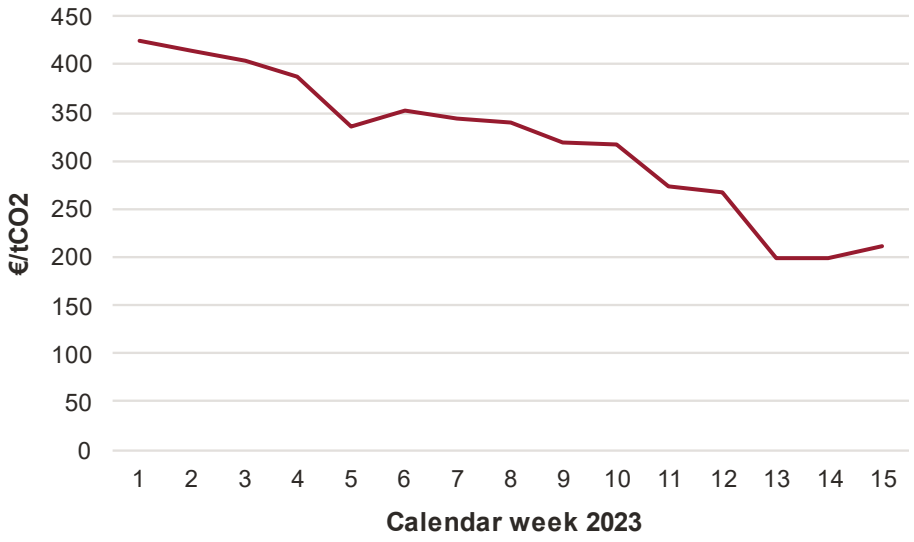
Nevertheless, especially during the market ramp-up phase, risks for producers are higher compared to the risks under supply-side support, as we explain below. Also, for quota systems to provide clear signals about future demand, the regulatory framework needs to be clear (i.e., market participants need to have certainty about what quota will be effective at which points in time and how the quota systems will be designed in detail, e.g. regarding eligibility of products, penalty levels for non-fulfilment of the quota, etc.). Thus, the current high-level of regulatory uncertainty prevailing in the European regulatory framework (Section 3.2) is also an important barrier in regard of unfolding the potential of the European quotas in stimulating eFuel investments.

Price risk in quota systems

Quotas generate a green premium (which corresponds to the quota price/the price of the certificates that prove compliance with the quota, e.g. the price of GHG emission certificates in Germany[19]) that eFuel producers can earn on top of the price for the equivalent fossil fuel. However, the future level of this green premium is uncertain, and price levels tend to be unstable over time. The price that can be achieved under a quota system depends on both demand-side developments (and thus not only on the politically set quota level, but also, for example, on the overall economic development) and on supply-side developments (in particular on the availability of alternative options of fulfilling the quota at a given point in time[20]). The price under a quota system can theoretically vary between zero in the case of oversupply (and missing banking option of certificates) and the price cap of the quota system (the regulatory penalty for not-fulfilling the quota).

In 2023 alone, average weekly prices for the GHG reduction quota in Germany fluctuated between 200 €/tCO2 and 425 €/tCO2 (Figure 3), illustrating the revenue risk for an eFuel producer selling its saved emissions via the GHG quota on the market.

Figure 3 Weekly average GHG quota prices in Germany, 2023



Source: *Data from https://equota.de/quotenerloese/.*
Note: *Weekly average prices.*

19 In Germany, the RED has been transposed into national law via the greenhouse gas reduction quota (Treibhausgasminderungsquote). Mineral oil companies that do not meet the GHG reduction targets have the option to purchase GHG emission certificates from third parties to fulfil the quota.

20 This uncertainty can be particularly challenging if different technologies are eligible to the quota and these technologies fall under different regulations. This it is e.g. the case for the GHG quota in Germany, that can be fulfilled, e.g., via renewable fuels but also via electricity charging certificates. Thus, a producer of renewable fuels would also have to make estimations about e.g., the development of e-mobility (which is widely supported by additional policy instruments) in order to estimate the future GHG quota price.

In general, investors are used to manage market based price risks and apply a range of risk mitigating measures such as for example risk hedging strategies. However, price risks can be very high i.e. in early market stages, when essential market information is not yet available, in small markets and in an uncertain political environment. All these circumstances currently apply to the European quota systems which are relevant for eFuels.

This uncertainty about quota prices has two consequences for producers:

- the financing of projects can be more difficult as future revenues are uncertain, in particular in immature markets;
- contracting offtake agreements with consumers is more difficult, as it is less clear to producers how to price the product to consumers and who bears which part of the price risk.

The US-IRA, in contrast, provides a secure level of support for a relatively long time (10-12 years), which provides a high level of investment security. In fact, these payments are comparable to feed-in-tariffs that have been in place during market ramp-up phases of green electricity in some European countries (see text box below).

The price risk in the EU quota market has been exacerbated by the IRA: US producers receiving IRA tax credits may potentially be able to export relatively cheap eFuels to the EU market (if the eFuels are assessed to be compatible with the Renewable Energy Directives), which would drive down the EU market price.[21] While lower prices are beneficial to consumers in the EU, cheap US imports are detrimental to producers outside the US who produce at higher costs (due to lower government support), which is a threat to preserving jobs and production in the European eFuels industry. In addition, large imports from the US could, in the medium to long term, hinder the development of trade partnerships with other countries.

[21] The impact of potential eFuel exports from the USA on market prices in the EU depends crucially on the eligibility of the different fuels towards EU targets.

Learnings from RES-E support: Quota obligations vs. feed-in tariffs

The current debate on policy support for the market ramp-up of eFuels can be compared to the support for renewable electricity in the early 2000s. At that time, there were two main types of support schemes to stimulate the market ramp-up: quota obligations and feed-in tariffs. As EU member states were free to choose national measures to reach the renewable electricity targets, the effectiveness of the measures can be analysed in retrospect.

A study by the EU Commission concluded that feed-in tariffs (e.g. implemented in Germany with guarantees for 20 years) were generally more effective than quota obligations (as e.g. implemented in the UK based on tradable green certificates) to increase the deployment of renewables.[22] The guaranteed duration of feed-in tariffs provided a strong long-term certainty, reducing the market risk for investors and thus stimulating investments very effectively. However, effectivity does not necessarily go alongside efficiency. Thus, as the (renewables) market matures, a shift towards market-based mechanisms is favourable to incentivise project cost reductions and integrate the new technologies into the market.[23] For example in Germany, the support scheme for renewable electricity was changed from a feed-in-tariff to a market premium system, in which investors are also exposed to market risks.

This means well-predictable and stable returns for producers can be especially valuable in the market ramp-up phase, while a higher exposure to market risks makes sense in later stages from an efficiency point of view.

3.2 High level of complexity and regulatory uncertainty

In addition to the market risk posed by the uncertain future development of quota prices, stakeholders have identified the high level of complexity of the EU support landscape and the high level of regulatory uncertainty (political risk) as key challenges to the development of the eFuels industry.

3.2.1 High level of complexity of EU support landscape

Market actors in the EU eFuel sector consider the European support landscape as a fragmented puzzle of various measures, which in many cases also interact with each other (e.g. quota prices can also depend on the level of the EU ETS price). This complexity is also seen as the main criticism of the various supply-side measures that exist in the EU: The sheer number of different funding programmes that is perceived as too complex from the industry's

22 European Commission (2008): The support of electricity from renewable energy sources, https://www.europarl.europa.eu/registre/docs_autres_institutions/commission_europeenne/sec/2008/0057/COM_SEC(2008)0057_EN.pdf

23 European Commission (2022): Report from the Commission to the European Parliament and the Council on the performance of support for electricity from renewable sources granted by means of tendering procedures in the Union, https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52022DC0638.

perspective. The different programmes often provide Capex support, whereas feed-in tariffs would be more effective (see above). In addition, most funding programmes require project developers to apply (on the basis of advanced proposals) and thus it is uncertain whether a project may receive funding, which is an additional risk for project developers – especially in light of the administrative procedure that is perceived to be too slow.

Overall, this makes it difficult for market actors to have a clear overview of the support available and to calculate their business cases. By contrast, the US IRA is perceived as much simpler and clearer. For example, eFuel producers in the US can determine the cost reduction of their product induced by the tax credits. In contrast, the impact of an EU measure that does not directly subsidise production (but, e.g., affects volumes) on the total cost of the product is not known to producers ex ante, which is a barrier to cost-reflective pricing and leads to high risks associated with long-term off-take agreements.

3.2.2 High level of regulatory uncertainty

Many regulations that have a significant impact on both, the costs and revenues of eFuels, are currently still in the legislative process and therefore unclear to market participants. In addition, the timeframes of regulations are considered to be too short and/or there is a lack of timely coordination between different regulations. Examples include:

- **The level and timing of quotas is uncertain** – The RFNBO quota for 2030 set out in the RED III has been significantly reduced compared to previous proposals. A post-2030 target is not defined, as the RED generally does not look beyond 2030. It is completely open what will follow after 2030. Given the long planning and construction timelines for eFuels projects, many plants that are now in the early planning stages would just have started operation relatively close to 2030, so their business case will ultimately heavily depend on the post-2030 regulation. In addition, stakeholders have raised that the political targets (and respective quotas) for eFuels (RFNBOs) in the EU are not ambitious enough to support a real ramp-up of the industry.
- **Other regulations will only become binding close to 2030** – The e-kerosene sub-quota defined in the ReFuelEU Aviation Regulation and the RFNBO sub-quota for the transport sector in the RED III would only apply from 2030. The introduction of the EU ETS II covering the road sector and buildings is planned for 2027 (see Section 2.3), but the cap of 45 €/t CO_2 until 2030 may limit the effectivity of the price signal.
- **Reform of the European Tax Directive not completed** – the proposal by the Commission presented in July 2021 intended implementation by January 2023, but the proposal is still awaiting a committee decision.[24] As the ETD revision is a consultation procedure, it requires unanimity in Council.
- **Definition of renewable hydrogen and delegated act on carbon not yet applicable law** – the "additionality" delegated act on the electricity criteria for green hydrogen has been modified several times since summer 2022 and was formally adopted by the

[24] https://oeil.secure.europarl.europa.eu/oeil/popups/ficheprocedure.do?reference=2021/0213(CNS)&l=en

Commission in June 2023. Similarly, the Commission adopted the delegated act setting out the methodology for calculating life-cycle greenhouse gas emissions for RFNBOs. However, there remains a long-term uncertainty: for example, the provisions on additionality will already be reviewed in 2028 and rules for the use of industrial sources of CO2 for imported eFuels remain unclear.

- **Implementation of EU directives into national law:** EU regulation in the context of eFuels is mostly set out in directives. Member States are free to choose how to implement them and usually have up to two years to do so.

The uncertainty about the future regulatory framework is currently delaying the market ramp-up of the eFuels industry in the EU. As explained by a market participant, investors only want to invest if offtake agreements are in place (and thus future revenues are ensured) while customers (e.g. in the aviation sector) are not yet willing to sign contracts because they are uncertain when the SAF quota will actually be in place.

In addition, taking into account historic changes in regulatory requirements (e.g., changing requirements in the biofuels sector with regard to caps on certain feedstocks or changes of the RED over time), market participants consider the political risk to be the most important risk factor with regard to their investments.

In summary, the complexity and uncertainty of key regulations currently in the legislative process and the lack of a long-term regulatory perspective pose a significant challenge to project developers whose current investments will be in operation well beyond 2030. In addition, the political targets and quotas are not perceived as ambitious enough in order to support a real ramp-up of the industry.

4 Potential solutions to the challenges hindering the ramp-up of the eFuels industry in the EU

In the following, we discuss potential solutions to address the existing challenges related to the ramp-up of the eFuels industry in the EU (Table 2). In line with the discussion during the stakeholder workshops, we focus on incremental improvements to the current regime and abstract from potentially more fundamental revisions of the EU's approach:

- The revision of the European Energy Tax Directive, as already proposed by the European Commission as part of the Fit-for-55 package, would be one step towards stabilising and securing revenues for eFuel producers, thereby addressing the challenge of uncertain revenues under quota systems (Section 4.1);
- The high level of regulatory risk currently faced by eFuel producers could be reduced by several measures, including grandfathering rules, the extension of de-risking mechanisms, the development of long-term targets and strategic trade partnerships (Section 4.2);
- The complexity of the regulatory framework would be reduced by the one-stop shop proposed in the Net-Zero Industry Act, if thoroughly implemented (Section 4.3).

Table 2 Potential solutions for resolving the challenges faced by eFuel producers

Challenge		Solution	Addressed in current EU regulation
Uncertain revenues under quota systems in an early market phase	→	Revision of the Energy Tax Directive and implementation in national tax law	⊖
		Extension of de-risking mechanisms such as EHB and H2Global	✗
High level of regulatory risk	→	Grandfathering rules	✗
		Development of political targets beyond 2030	✗
		Strategic trade partnerships	⊖
Complexity of regulatory framework	→	One-stop shop for regulatory procedures	✓

4.1 Revision of the Energy Tax Directive

Under the current Energy Tax Directive, fossil and renewable synthetic fuels are treated equally in the sense that the same minimum tax rates apply for both types of fuel. As part of the Fit-for-55 package, the European Commission has published a proposal to revise the ETD. Key elements of the revision include the setting of minimum tax rates based on the environmental impact of the individual fuels and the abolition of energy tax exemptions for fossil fuels used in intra-EU aviation and maritime transport. Under the proposal, the minimum tax rates for fossil kerosene, gasoline and diesel would be set at 10.75 €/GJ, while for RFNBOs only a minimum tax rate of 0.15 €/GJ would apply. In addition, renewable fuels in the aviation and maritime sectors would be exempted from energy taxes for a period of 10 years after the revised ETD would enter into force.

The revision of the ETD would reduce the costs that eFuel producers face on the European market by the amount of the tax difference between fossil and renewable fuels. Assuming that minimum tax rates would be applied[25], the revised ETD would increase revenues / reduce costs for producers of e-kerosene by approximately 0.36 €/litre. In other words, the cost difference between fossil and renewable fuels would be reduced by the tax difference.

The tax difference would be predictable for eFuel producers and thus constitute a stable revenue element. This would effectively reduce the current challenge of uncertain and unstable revenues under quota systems.

In the absence of a revision of the ETD, which requires the unanimous agreement of all member states, measures can be implemented at national level to reduce the tax rate applicable to eFuels.

4.2 De-risking of eFuel investments

Regulatory and market risks have been identified by workshop participants as the main risk associated with eFuel investments. In the following, we discuss several measures that could help to de-risk eFuel investments in the EU based on the information exchange with the stakeholders from the industry:

- **Grandfathering rules** – Grandfathering would allow to “freeze” the regulatory environment applicable to an eFuel project at a certain point in time. This measure would give early projects the certainty of knowing the regulatory framework for a given period, which is likely to be subject to changes due to the fact that many regulations include reviews and some regulation is implemented via delegated acts that allow revisions at any time (see Section 3.2.2). Similar practices already exist in California and the UK, where eFuel producers can get a pre-qualification of their fuels to comply with the regulatory framework.

[25] The ETD only sets minimum tax rates. Member States are allowed to set higher tax rates than the minimum tax rates and are currently doing so in many cases.

- **Extension of de-risking measures such as the European Hydrogen Bank (EHB) and H2 Global** – The European Hydrogen Bank and H2 Global are seen as positive examples of measures to de-risk and secure the long-term offtake of hydrogen by shifting the regulatory risk from producers to the legislator and giving producers an incentive to keep the difference payments low.
  - The EHB launched on 17 March 2023 and is designed to create a domestic market for hydrogen and its derivatives and support imports into the EU. The first objective is addressed by fixed premium auctions launched under the EU Innovation Fund. The first pilot auction, scheduled for autumn 2023, will have an indicative budget of 800 million € and will award a subsidy in the form of a fixed premium per kg of hydrogen produced for a maximum of 10 years. The Commission has recognised the need for instruments to support hydrogen flows from third countries (as the EU will be dependent on imports in the long run, see Section 2.3), but for the first auction only domestic production will be eligible.[26] While the actions by the EHB are assessed as positive, there are three aspects in which the EHB could further contribute to the creation of an early market for hydrogen and its derivatives: i) an extension of the budget of 3 billion €[27], ii) an extension of the maximum duration of support (e.g. early feed-in tariffs for solar PV in Germany were fixed for 20 years), and iii) the development of auctions for import projects located outside the EU.
  - H2 Global is an instrument funded with 900 million € by the German government that concludes long-term purchase contracts on the supply side and short-term sales contracts on the demand side and compensates suppliers (of hydrogen or its derivatives) for the difference between supply and demand prices. The project is considered to be a useful concept, and the fact that H2 Global includes projects aimed at importing hydrogen from third countries is taking the needs of the EU for energy imports into account. However, the financial volume of the program is very limited.

  Another measure to reduce investor risk would be to introduce temporary credits for early-mover projects that may face liquidity problems as a result of unexpected price fluctutations, as has been seen in the natural gas and electricity markets in recent years.
- **Setting of long-term political targets** – For capital-intensive investments such as those required in the eFuels sector, a long-term perspective is important. As explained above, the RED only covers the period up to 2030. Setting ambitious targets beyond 2030 to 2050 (as, e.g., in the ReFuelEU Aviation and FuelEU Maritime) is important to allow market participants to assess their project over its lifetime.
- **Building strong strategic trade partnerships** – Recognising that EU countries will depend on imports of hydrogen and eFuels from countries with more favourable conditions for their production, the EU and its member states have established strategic technological and energy partnerships with countries such as Egypt, Namibia, Canada

26 https://energy.ec.europa.eu/system/files/2023-03/COM_2023_156_1_EN_ACT_part1_v6.pdf

27 The Commission's own estimates suggest that 90-115 billion € is needed to cover the cost difference for green hydrogen and subsidise 20 million tonnes by 2030.

and Saudi Arabia. These partnerships are usually based on a signed declaration of intent or a memorandum of understanding, which broadly describe the objectives and areas of cooperation, but are not sufficient to provide credible security for project developers.

4.3 Reduction of the complex regulatory framework

The single national competent authority being responsible for facilitating and coordinating the permit-granting process (one-stop shop) proposed in the Net-Zero Industry Act is recognised as a first step towards reducing the complexity of the EU support landscape. Project developers would also benefit from the simplified permit-granting procedures proposed in the Net-Zero Industry Act. However, the Act is currently only a draft, which needs to be approved by the Parliament and the Council. Recent examples (see Section 3.2) have shown that this process can be lengthy.

Finally, only practical experience will show how the cooperation with the competent national authority works or whether further measures are needed to reduce the complexity from the point of view of project developers. In addition, certain barriers to investment will remain due to the European demand-driven regulatory approach: for example, even the competent authority will not be able to determine the total impact of the various measures affecting eFuel costs, as this will depend on future developments of regulatory measures. This fundamental complexity of the EU regulation is difficult to address.