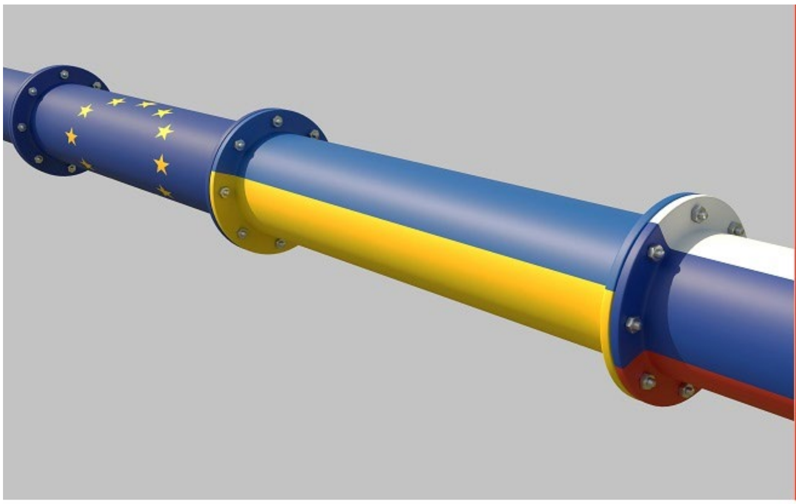
IN-DEPTH ANALYSIS
Requested by the TRAN Committee

European Parliament

Assessment of the potential of sustainable fuels in transport in the context of the Ukraine/Russia crisis



Transport and Tourism

Policy Department for Structural and Cohesion Policies
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RESEARCH FOR TRAN COMMITTEE

Assessment of the potential of sustainable fuels in transport in the context of the Ukraine/Russia crisis

Abstract

This briefing provides the European Parliament's Committee on Transport and Tourism (TRAN) with an overview of the potential of sustainable fuels in transport in the context of the current Ukraine/Russia crisis. It assesses biofuel's potential to be quickly ramped up, the impact on LNG demand in the EU transport sector, and the potential use of gas pipelines repurposed for hydrogen.

This document was requested by the European Parliament's Committee on Transport and Tourism.

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Contents

LIST OF ABBREVIATIONS

CGH_2	Compressed Gaseous Hydrogen
CH_4	Methane
CO_2	Carbon dioxide
EU	European Union
FAO	Food and Agriculture Organisation
FAME	Fatty Acid Methyl Esters
FT	Fischer-Tropsch
H_2	Hydrogen
HEFA	Hydroprocessed Esters and Fatty Acids
HVO	Hydrotreated Vegetable Oils
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
LH_2	Liquefied Hydrogen
LNG	Liquefied Natural Gas
MeOH	Methanol
MS	Member State
NG	Natural Gas
NH_3	Ammonia
OECD	Organisation for Economic Co-operation and Development
PBtL	Biomass-to-Liquids
RED	Renewable Energy Directive
RES	Renewable Energy Sources
RFNBO	Renewable Fuel of Non-Biological Origin
TRL	Technology Readiness Level
UCO	Used Cooking Oil

GLOSSARY OF TERMS

Renewable hydrogen	Hydrogen produced via electrolysis, using renewable (mainly wind and photovoltaic) based electricity.
Renewable hydrogen derivatives	Comprise all products and fuels produced with renewable hydrogen including e-ammonia, e-methanol, e-liquids (also called liquid derivatives), e-gases.
PtL, e-liquids or liquid derivatives	Power-to-Liquids or liquid derivatives are all hydrogen based derivatives produced via Fischer Tropsch synthesis[1]. They comprise e-kerosene, e-diesel and e-gasoline.
e-ammonia	Ammonia produced with renewable hydrogen.
Hard-to-abate sector	Any sector for which the options to decarbonise are not straightforward, due to the lack of appropriate technology or lack of competitiveness.

[1] The Fischer-Tropsch process is a catalytic chemical reaction in which carbon monoxide (CO) and hydrogen (H_2) in the syngas are converted into hydrocarbons of various molecular weights, see also https://netl.doe.gov/research/coal/energy-systems/gasification/gasifipedia/ftsynthesis

LIST OF FIGURES

EXECUTIVE SUMMARY

KEY FINDINGS

- Due to the looming food supply crisis, using energy crops that compete with feed and food crops to produce bioethanol or biodiesel is an issue. It is more appropriate to explore the potential of waste-based resources.
- Sustainable biofuels will have a role to play in decarbonising transport, especially in aviation and maritime, under strict sustainability conditions and according to a progressive pathway. However, their quick ramp-up will have limited scope as a viable option to make a substantive contribution to the rapid phase out of fossil energy sources.
- Natural gas use in the transport sector represents a minor fraction of the total EU transport energy demand. Due to various reasons, its role is likely to remain limited, even if some LNG use grows in the shipping sector. Hence, the transport sector's leeway to ease the natural gas supply constraint is negligible.
- Biogas could play a role in decarbonising the transport sector. However, limited sustainable biogas supply will likely need to be prioritized (e.g. industry, power, and buildings).
- In the medium- to long-term (beyond 2030), domestic or imported renewable hydrogen and its derivatives could partially replace fossil energy sources, especially in the aviation and maritime sectors, and possibly in heavy duty road vehicles. However, renewable hydrogen will not contribute at scale, in the short-term, to a fossil fuel phase out.
- Reducing fossil fuel demand through the use of fossil-based hydrogen is not possible, since energy losses are inevitable in the conversion of methane to hydrogen.
- The effectiveness and the extent of the future contribution of hydrogen and its derivatives to the reduction of fossil fuel use and transport decarbonisation depends on progress that can be achieved to stimulate demand, especially in sectors where there are more cost effective options than direct electrification for decarbonisation.
- An increased independence from Russia's fossil fuels should rely mainly on enhanced energy efficiency, behavioural changes, electrification and the diversification of energy supply.

In 2020, the EU's transport sector globally was directly dependent on oil for 90% of its energy needs [Eurostat, 2022], mostly crude oil. In November 2021, prior to the Ukraine/Russia crisis, 34% of OECD Europe's total oil imports were coming from Russia (4.5 mb/d) [IEA, 2022a].

A range of analytical assessments consider that achieving the objectives of the European Climate Law and the Paris Agreement will require a reduction in fossil energy use across all sectors. In transport, these analyses suggest that the current dominance of oil-derived energy carriers like petroleum fuels need to be replaced by electricity, hydrogen, sustainable biofuels and hydrogen-based fuels, on top of an overall reduction in energy use from increased energy efficiency and behavioural changes.

The Ukraine/Russia crisis is causing inflation in the global economy due to the price increases in energy, commodities and services. This is leading to major economic consequences, pointing towards a reduction in global and European economic growth.

These developments are placing increased pressure on the need to reduce European reliance on fossil fuels, starting with those the EU imports from Russia, adding an energy security driver to the climate mitigation imperative. This assessment builds on these considerations to investigate whether sustainable fuels in transport can help address the Ukraine/Russia crisis and contribute to the reduction of EU dependence on fossil fuels. The focus of this analysis is biofuels, methane, and hydrogen and its derivatives.

Biofuels: due to the looming food supply crisis affecting grains and virgin oils, using energy crops that compete with feed and food crops to produce bioethanol or biodiesel beyond the existing RED II framework may be a concern, notably in terms of food supply. It is more appropriate to explore the potential of waste-based resources. Renewed policy targeting faster decarbonisation (especially in aviation) is currently stimulating the development of renewable diesel capacity (mainly with HVO/HEFA plants). These have a better cost-competitiveness performance than other pathways that rely on waste-based feedstocks (lignocellulosic), despite being more limited in scope for waste feedstock supplies. Both biodiesel and HVO/HEFA can be produced from waste oils, largely consisting of used cooking oil (UCO), complemented by animal fat. However, Europe is a major importer of UCO from Asia and the United States, and rapid increases in waste oil use are likely to lead to land use change, compromising sustainability. While sustainable biofuels will still have a role to play in decarbonising transport, especially in aviation and maritime, **they are not expected to make a substantive contribution to the rapid phase out of fossil energy sources in the short-term (to 2030), as a quick ramp up of biofuels is not practicable.** Increased reliance on non-food crops could be an option, but faces clear limitations, both in economic terms and due to sustainability issues.

Natural gas (fossil methane) use in the EU transport sector currently represents a small fraction of total transport energy demand. Due to limited life-cycle emission benefits and significant EU policy action to mitigate greenhouse gas emissions, the role of natural gas in transport is likely to remain limited. However, LNG use in the shipping sector might grow with increased diversification of supply. Biogas can effectively reduce life-cycle emissions of greenhouse gases in comparison with fossil methane and it has other environmental and circular bio-economy advantages. It could therefore play a role in the transport sector in the future. However, limited sustainable biogas supply will need to be prioritized, in the near term for fuel current major uses of fossil natural gas (i.e. the sectors where gas demand is already locked-in like industry or building). Its role in transport will therefore remain small. **Given the transport sector's low use of natural gas, its leeway to ease supply constraints is negligible**.

Hydrogen and its derivatives: in the medium- to long-term (beyond 2030), renewable hydrogen and its derivatives (e.g. e-ammonia, e-methanol or e-liquids) can help supplant fossil energy sources in all transport modes, especially in the aviation and maritime sectors, and possibly also in heavy duty road vehicles. Hydrogen and its derivatives can be produced domestically or imported, with imports expected to be more competitive, especially for hydrogen derivatives (thanks to lower transport costs). While the EU's existing natural gas infrastructure can technically be repurposed to transport hydrogen, it raises major challenges in terms of hydrogen distribution and end-use devices (as these would need replacements). The successful transition to low-carbon and renewable hydrogen also depends on the existence of large-scale hydrogen market uptake prospects. Existing large-scale users of hydrogen in industry are likely to be the first viable candidates. Transport could follow if hydrogen can compete on cost with other technologies, and/or if alternatives are subject to other constraints. Despite this medium- to long-term potential, **hydrogen has limited scope to contribute significantly in the near-term to massively phase out fossil energy sources**. **Renewable hydrogen will most likely play a role in a decarbonised world. However, renewable hydrogen will not contribute effectively and at scale, in the short-term, to the significant phase-out of fossil fuels**, mainly due to the current lack of available production capacity and import facilities. Deploying the entire supply and conversion chain would require time and progressive development.

Renewable hydrogen will also complement other decarbonisation options in different sectors and for different applications. **The effectiveness and the extent of its future contribution to the reduction of fossil fuel use and decarbonisation depends on progress that can be achieved to stimulate demand, especially in sectors where it would be a more cost-effective decarbonisation option.**

As there is no single solution for all applications, the priority for increased independence from fossil fuels from Russia should be clearly on enhanced energy efficiency, behavioural changes, electrification and the diversification of energy supply. In the very near-term, enhancing energy efficiency will likely require shifts (including behavioural changes) towards transport modes that consume less energy and rely more on electricity. Beyond this initial phase, increased transport electrification is crucial to maximise opportunities for energy efficiency, energy diversification and the abatement of emissions.

1. CONTEXT & BACKGROUND

The scope of this rapid-response briefing is an assessment of the potential of sustainable fuels in transport in the context of the current Ukraine/Russia crisis. It forms part of the larger research project whose primary aim is to assess the potential of sustainable fuels, in particular biofuels, to decarbonise the transport sector, and help the sector achieve the Green Deal GHG reduction targets by 2030 and 2050, including the 90% reduction in transport emissions by 2050. This rapid-response briefing responds to three specific questions from European Parliament:

1 What type of biofuel production has the highest potential for quickly being ramped-up in the Union in the short-term (to 2030) so as to make a substantive contribution when the Union is rapidly phasing out fossil energy sources (also as a consequence of the Russian invasion in Ukraine)?

2 Is there any quantifiable figure for how the ongoing Russian war of aggression in Ukraine will impact LNG demand in the Union transport sector?

3 What is the potential use of pipelines currently used for gas transport and their future conversion to hydrogen transport?

The briefing starts with an introduction to contextualise the use of sustainable fuels in the broader framework of making transport more sustainable and less dependent on fossil oil products.

Policy context

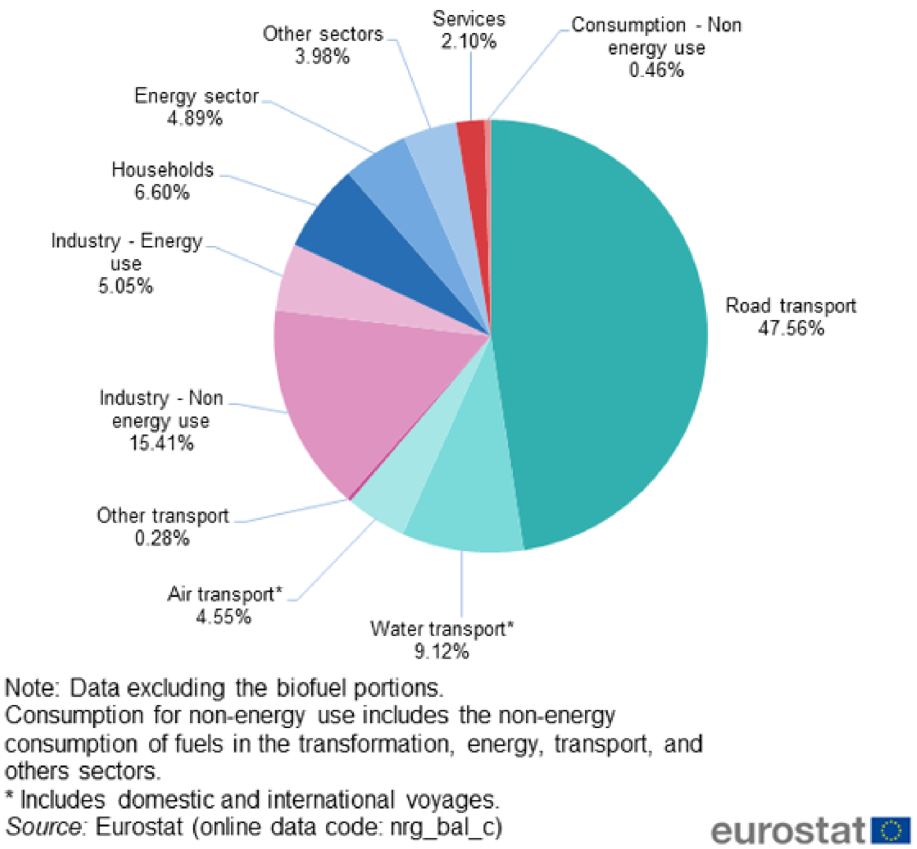
The EU's dependency on crude oil imports is high. Crude oil production in the EU peaked in 2004 and has since been declining; in 2020 (the latest year of validated data) it reached its lowest point, 18.7 million tonnes[2]. By contrast, in 2020, total imports of crude oil to the EU amounted to 440.3 million tonnes [Eurostat, 2022]. Figure 1 shows the consumption of oil by sector in the EU in 2020. Road transport accounted for approximately 47% of oil demand, with other transport sectors contributing around 14%. This makes the EU economy, and in particular the transport sector, heavily sensitive to supply and price shocks. In the EU in 2020, motor gasoline and diesel accounted for more than 90% of the fuel used in road transport, with Liquified Petroleum Gas (LPG) and natural gas providing less than 3% [Eurostat, 2022]. Renewables and biofuels provided 6.7%, and electricity only 0.12%.

Recent high profile analyses, including the IPCC Mitigation of Climate Change report [IPCC, 2022] and IEA's Net Zero Emission (NZE) pathway to 2050 [IEA, 2021], show that achieving the objectives of the Paris Agreement and the European Climate Law requires the progressive phase out of fossil fuels. These analyses suggest that oil will be progressively phased-out, with electricity and hydrogen-based fuels displacing a large part of fossil fuel use in transport by 2050, with a role for bioenergy[3].

2 Although 2020 figures were impacted by the Covid pandemic, the general production trend is similar to recent previous years.

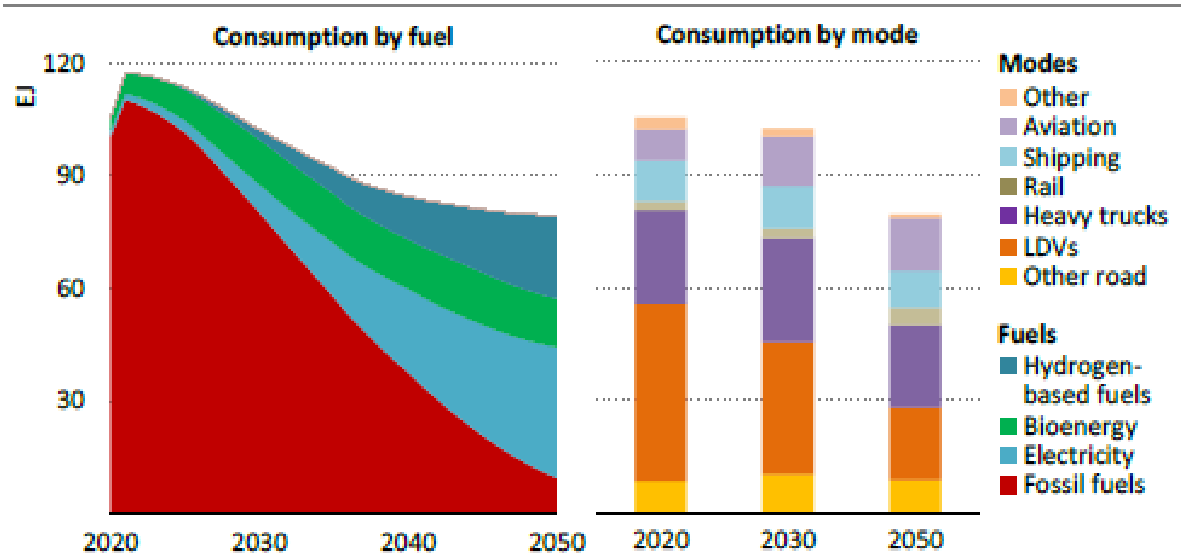
3 Bioenergy refers to a form of renewable energy that is derived from recently living organic materials known as biomass, which can be used to produce transportation fuels (as well as heat, electricity, and other products).

Figure 1: Consumption of oil by sector, EU, 2020 (%)



Source: Eurostat: Oil and petroleum products – a statistical overview 2022.

Figure 2: Global transport final consumption by fuel type and mode in the IEA's NZE, Exajoules (EJ)



Source: IEA (2021) Net Zero 2050.

Russia is the world's third largest oil producer behind the United States and Saudi Arabia. In November 2021, prior to the Ukraine / Russia crisis, OECD Europe imported a total of 4.5 million barrels /day of oil from Russia (34% of its total imports) [IEA, 2022a]. Meanwhile, Russia has been reducing its piped gas supplies to the EU market. This decrease became more pronounced in the first seven weeks of 2022, when Russian gas flows via Ukraine averaged 55 million cubic metres /day (mcm/d), well below the contractually available capacity of around 109 mcm/d. This was partly due to the deliveries to Germany via the YAMAL pipeline (which goes through Belarus) stopping in December 2021. Lower Russian pipeline flows have in part been compensated by higher LNG inflows, which in January 2022 reached an all-time high of 13 billion cubic metres (bcm) [IEA 2022b]. In order to improve energy supply security and to shift to a more sustainable pathway, effort is required to reduce the transport sector's dependency on fossil fuels. Reducing transport related energy and emissions will also be crucial to meet the ambition of the European Green Deal and the EU Climate Law.

Improving transport sustainability

When assessing energy consumption by the transport sector, the impacts from cradle to grave should be taken into account. Life Cycle Analysis identifies four main aspects: (1) creation and distribution of fuel, (2) vehicle production, (3) vehicle use, and (4) vehicle disposal. Each of these components will use energy and result in GHG emissions. This briefing paper (and the larger research project being undertaken) focuses on (1) and (3) - energy and sustainability during the **fuel production** and **vehicle use**. Examples of policies to improve the former aspect (production and distribution of the fuel) include the proposed revision of the Renewable Energy Directive [European Commission, 2021], RefuelEU Aviation [European Commission, 2021] (focused on sustainable aviation fuels) and FuelEU Maritime [European Commission, 2021] (focused on low-carbon fuels for maritime transport). For vehicle use, examples include the proposal for limiting CO_2 emissions from road vehicles (for example the target of zero tailpipe emissions from new cars by 2035). For maritime transport, these include a number of measures taken in the context of the International Maritime Organisation (IMO) including the Energy Efficiency Design Index (EEDI), the Energy Efficiency Existing Ship Index (EEXI), and the requirement to reduce Operational Carbon Intensity through the Carbon Intensity Indicator (CII) [IMO, 2021]. For aviation, they include the binding requirements for energy efficiency and CO_2 emissions from aircraft adopted in the context of the International Civil Aviation Organisation (ICAO).

Reducing energy consumption in transport requires three main areas of action: the reduction in the need to travel by means of land use planning and transport demand management (**Avoid**), switching to lower carbon modes such as walking, cycling and public transport (**Shift**) and the enhancement of the energy efficiency of vehicles and the reduction of the fossil carbon content of energy vectors/fuels (**Improve**) [GIZ, 2011]. For example, switching to sustainable fuels and electric powertrains may reduce energy, and in particular fossil fuel consumption, and hence lead to emission reductions.

Solutions for improving the sustainability of transport need to take into account "hard-to-abate" sectors where reducing energy and emissions is likely to prove difficult because technological solutions do not currently exist or are costly. This includes long distance transport (shipping, aviation and long-distance heavy-duty vehicles). For example, hydrogen is not yet technically widespread nor economically viable for truck operations and electricity is currently better suited for short -haul routes. Therefore, sustainable fuels including biofuels could be used to displace oil-based diesel and gasoline for this sector, whilst light goods vehicles and passenger cars are good candidates for electrification given their generally urban use and lower weight [IEA ETP 2020].

The global issue

The demand for sustainable fuels will depend on the scale of action taken by all countries to address climate change, security of supply, willingness to pay for sustainable fuels over fossil fuels and the need to respond to other policy goals in terms of resilience and energy diversification. Such a response may be subject to specific circumstances for different global regions, such as the availability and cost of primary energy sources and renewable energy sources, the level of socio-economic development, region-specific policy frameworks (including the subject of direct and indirect land use change), the willingness to import and/or export energy/sustainable fuels, and geo-political relationships between countries and regions. The potential for biofuel production to distort global commodity markets and cause indirect land use change elsewhere in the world is also a key consideration; this is a major focus of the 2018 revision to the Renewable Energy Directive.

The Ukraine/Russia crisis is contributing to rising inflation in the global economy due to the increase in energy prices and broader consequences on the price of other commodities and services. This is leading to major economic consequences, pointing towards a reduction in global and European economic growth and potentially resulting in stagflation. The continued dependency of the EU on oil and gas imports from Russia is also leading to increased wealth transfers towards Russia, despite economic sanctions adopted to counter its war of aggression in Ukraine.[4]

These developments are increasing pressure on the EU to reduce its reliance on fossil fuels, starting with those that Europe imports from Russia. This introduces an energy security of supply issue to the Union's climate mitigation ambition.

The following sections provide an assessment of the potential of sustainable fuels in transport in the context of the Russia / Ukraine crisis, identifying the potential production of biofuels in the EU, the role of LNG in meeting energy demand, and the applicability of repurposing natural gas pipelines for dedicated hydrogen use. These are relevant topics, and they should be considered in the wider context as outlined above.

[4] Although the EU as a whole is highly dependent on oil and gas imports from Russia, it is worth noting the high variability between EU Member States. See the following link for further information: https://www.iea.org/reports/russian-supplies-to-global-energy-markets/oil-market-and-russian-supply-2

2. POTENTIAL TO RAMP UP BIOFUELS PRODUCTION IN THE EU

What type of biofuel production has the highest potential for quickly being ramped-up in the Union in the short-term (to 2030) so as to make a substantive contribution when the Union is rapidly phasing out fossil energy sources (also as a consequence of the Russian invasion in Ukraine)?

Current status of biofuel use in transport

According to the IEA, **biofuel demand almost recovered to pre-Covid levels in 2021** (IEA, 2022c). Based on OECD/FAO data, this corresponds to roughly 180 billion litres (OECD/FAO, 2021). **Nearly all the demand is currently in road transport and consists of ethanol, conventional biodiesel** (consisting of Fatty Acid Methyl Esters – FAME) **and renewable diesel** (consisting of Hydrotreated vegetable oils – HVO – and hydro processed esters and fatty acids – HEFA).

The main feedstocks used for ethanol production consist of food crops including corn (accounting for most of the production in the United States), sugar cane (accounting for the vast majority of the production in Brazil), wheat and sugar beet (IEA, 2022c, USDA, 2021, T&E, 2021 and Cerulogy, 2022). Cereals and beet provide an important share in the ethanol production in Europe, which imports also significant amounts of ethanol from food-based crops from Canada (T&E, 2021).

Most biodiesel and renewable diesel are derived from virgin vegetable oils (rapeseed, palm oil, soy). This is supplemented by production from waste oils, largely consisting of used cooking oil (UCO), complemented by animal fat and a few other options, some of which are still derived from virgin oil production (Neste, 2022). The European Union is a major import market for UCO, with roughly three quarters of it coming from third countries such as Asia and the United States (T&E, 2021). (Cerulogy, 2022).

In 2019, the **bio-based components in transport gasoline and diesel use in Europe accounted for 5% and 43% of their overall global demand** respectively, totalling 21 and 6.6 billion litres (OECD/FAO, 2021). These fuels were estimated to **cover 7.4% and 6.1% of the energy content in the European diesel and gasoline blends, respectively**, remaining at similar (but slightly higher) shares (8.1% and 6.8%) in 2020 (T&E, 2021).

Recent dynamics of biofuel supply and demand

To date, increased production of ethanol, FAME biodiesel and renewable diesel has been primarily driven by policy requirements. In recent years, neither ethanol nor FAME biodiesel production capacities have been developing through natural market forces, given the fact that these are not yet competitive. This was the case both in EU and globally.[5]

Key reasons that contributed to shape this development include:

- An initial phase characterised by a strong policy push on biofuel supply growth, not yet integrating stronger sustainability requirements.
- A second phase in which policy action placed a greater attention on environmental concerns, resulting in the development of sustainability criteria, increased pressure for a reduction of use of food and feed crops, and a shift in focus towards renewable fuels of non-biological origin.

[5] One exception may be ethanol demand, which, through its qualities as an octane enhancer, may remain in place even without policy support, in the United States.

This second phase followed important warnings on the need to account for direct and indirect effects of bioenergy production on food and feed crops, direct and indirect land use changes, as well as biodiversity loss (PNAS, 2022, Searchinger, 2022).

In contrast with the evolution of the biofuel market over the past few years, which was rather weak after an initial policy push, recent developments point to a significant increase in processing capacity, mainly for renewable diesel, with major HVO/HEFA plants being built. These developments are the likely result of renewed policy action targeting decarbonisation, not only in road transport but also in other modes. Key among these are the European Green Deal (European Commission, 2019), the Climate Law (European Commission, 2021a), and the *Fit for 55* package (European Commission, 2021b). The growing interest in HVO/HEFA also results from better cost competitiveness of HVO/HEFA pathways and good technical compatibility with the use of sustainable waste-based feedstocks. HVO/HEFA based fuels are also subject to good alignment with other measures that help bridge costs between sustainable fuels and fossil fuel options, including instruments implemented beyond the European Union (as in the case of California's Low Carbon Fuel Standard).

The focus on HVO/HEFA is also a signal of an interest of investors to respond to an expected increase in demand for Sustainable Aviation Fuel (SAF) and the identification of some feedstocks (namely waste oils, including but not limited to UCO) as suitable to fulfil economic and sustainability requirements. Increased investments in HVO/HEFA production capacity are located in North America, Europe and Asia. In the United States, this comes with an expected three- to five-fold increase by 2025 compared with the existing one (Cerulogy, 2022). In the EU, production capacity of HVO/HEFA is expected to more than double by 2024 (T&E, 2021). China and Singapore also have a clear focus on building renewable diesel and bio-jet supplies to service export markets (IEA, 2022c).

Challenges for the biofuel ramp-up

The developments referred to previously are materialising at a time where a number of factors point to downward revisions of biofuel demand expectations and related feedstock supplies (IEA, 2022c). Key reasons for these mitigated prospects include:

- The downward effects on transport fuel demand (and therefore also of biofuel demand) following the generalised price increases triggered by Russia's invasion of Ukraine, resulting in slower global GDP growth.[6]
- An upward pressure on an already high-price environment for biofuel feedstocks (in particular vegetable oils), due to energy price increases, supply disruptions from the war and difficulties in market access for Ukrainian agricultural products (including cereals and virgin vegetable oils).[7]

Despite increases in processing capacity for HVO/HEFA, the extent to which sustainable feedstocks will be available for processing in the new plants being built is unclear. Waste oils (in particular used cooking oil) are indeed the most relevant near-term candidate, as pointed out by

[6] The GDP growth assumptions by the IEA have been lowered to 3.4% in April compared to 4.3% in January (IEA, 2022c). This is in line with reductions in global GDP growth flagged by the International Monetary Fund (IMF) in April 2021 (IMF, 2022), and similar considerations by the European Central Bank (ECB, 2022). Both the IMF and the ECB refer to energy prices and negative confidence effects limiting domestic demand in the near term. For the ECB, sanctions and sharp deterioration of the prospects for the Russian economy are also expected to weaken the euro area trade growth. Further exacerbations of global growth and slowdowns in transport energy demand have also been induced by Covid-related mobility restrictions in China.

[7] This second point is also flagging important criticalities for the agricultural sector as a whole (due to generalized increases in food prices). Also in this case, the issues summarized in the text are consistent with the considerations brought forward by the IEA (IEA, 2022c), the IMF (IMF, 2022) and the ECB (ECB, 2022).

the IEA in its 10-point plan to cut oil use (IEA, 2022d), but, like alternative options based on food and feed crops (which still account for the vast majority of all biofuels produced today globally), they are hampered by a number of limiting factors. These include, in particular:

- **Sustainability risks inherently linked with the concept of a "quick ramp up", since all rapid changes that need to take place at scale have a higher likelihood to lead to market disruptions, higher costs, and/or reduced GHG benefits (primarily due to direct and indirect land use change pressure, leading to losses in soil carbon).** The example of Palm Fatty Acid Distillate (PFAD), which, despite being a by-product, requires the identification of a substitute if displaced by sectors currently reliant on it, is a case in point since it shows the extent to which sudden changes in demand for different feedstocks can drive expansion of others (Cerulogy, 2017).[8]
- **Competition for land use with food production, especially for food and feed based biofuels.[9] There is also the related risk of inducing price increases, as well as inherent interlinkages between fossil fuel costs and biofuel costs (as long as the latter need fertilizers to be produced).** This is because fertilizers are currently obtained from fossil energy. This same reason makes biofuels reliant on fertilizer use (especially agricultural crops, possibly including cover crops, and much less for waste and residues) struggle to achieve cost competitiveness, also in a high fossil fuel price environment (IEA, 2013).
- **A low likelihood that anything like a "quick ramp up" could happen to advanced biofuels, given that the production capacity of advanced biofuels is still a small fraction of the total** (less than 10% of the total for ethanol from lignocellulosic feedstocks[10]), which adds to a limited scope for a sudden scale up in production of lignocellulosic and waste feedstocks without inducing land-use changes.

Additional evidence about the challenges of blending biofuels into oil product pools in the near-term without harming food markets is also available in a recent communication by the Commission (European Commission, 2022). This Communication clearly states the importance of avoiding the use of food and feed crops as feedstock for biofuel increases in the current context and it has actually enabled Member States to pass legislation freezing or lowering 2022-2023 low-carbon blending mandates for their transport fuels (EnergyPost, 2022). The Communication of the Commission is also focusing on enhanced investments in the production of biogas (which is likely more relevant as a substitute of fossil methane for end uses other than transport) and accelerated deployment of renewable electricity production, including in the rural economy. The same communication stresses the importance of reducing reliance on mineral fertilisers produced with fossil fuels, favouring investments in the circular bio-economy to replace fossil-based products, materials and energy, and giving a specific attention to leguminous crops, which fix nitrogen and use less nitrogen fertilisers (currently largely produced from fossil methane). Leguminous crops also recycle phosphorus and potassium.

Based on these considerations, handling the energy- and food-related challenges posed by the Russian war of aggression in Ukraine requires the prioritisation, especially in the near term and

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8 In the specific case of PFAD, palm oil appears to be the most relevant alternative (Cerulogy, 2017). Similar examples apply to the expected surge in renewable diesel processing capacity in the United States, as the use of waste oils to fulfil this demand would induce a growth in demand for their closest substitute (this is likely the case for virgin oils) in other sectors.

9 Competition for land may also lead to an expansion of the HVO/HEFA industry happening at the expense of the biodiesel industry, shifting the resource rather than delivering truly additional supply. Production costs are comparable (and largely driven by the price of the lepidic feedstocks), while HVO/HEFA lead to fuels with greater compatibility for blends with petroleum fuels.

10 The 10% is based on a 90% estimate for food and feed crops using ePURE data (T&E, 2021). In terms of actual production, the percentage is lower: 4.3% in 2020 (T&E, 2021). However, the category “other cereals and starch rich crops” in the ePure includes lignocellulosic, wastes or other non-crop material (wine lees, cheese waste and the like). The lignocellulosic fraction is therefore likely to be lower.

until the risks of inflationary pressures and food price increases are prominent, of a focus on energy efficiency, including via behavioural changes (e.g. prioritising public transport and micro-mobility for urban mobility, and trains for long distance mobility over car and aircraft travel) and switching to electricity (in particular for short distances and lighter vehicles, and for highly utilised fleet vehicles), rather than to focus on a rapid switch to biofuels.[11]

Increases in biofuel production have a role to play in climate mitigation beyond this critical phase and will be especially relevant in hard-to-abate sectors, like aviation and maritime transport. However, minimising direct and indirect effects on land use change is unlikely to be eased by quick ramp ups in production. Ensuring that sustainable and advanced biofuels play an effective role in climate mitigation requires a combination of different factors, contributing to a progressive, rather than a sudden process, as already reflected in RED II (which integrates a progressive phase out of high indirect land use change-risk biofuels from food and feed crops, until 2030). These factors include: an increased shift towards cellulosic feedstocks (ICL, 2021), selective identification of options that do not result in removal of soil carbon stocks[12], exclusion of options whose combustion would release large quantities of carbon (irreplaceable within a reasonable time scale), continued updates for regulations to account for feedstocks and agricultural practices that lead to land use change risks (O'Malley, 2021b), as well as technological progress in thermochemical and biochemical conversions (IEA Bioenergy, 2019). The integration of low-carbon hydrogen in biofuel production, in processes referred to as power and biomass-to-liquids (PBtL), is also likely to be crucial, as it can maximise biofuel yields from biogenic carbon sources despite risks of higher costs (Hannula, 2016a and 2016b).[13]

The role for renewable fuels of non-biological origin (RFNBO)

Beyond the immediate future, renewable fuels of non-biological origin[14] (such as hydrogen, ammonia and synthetic hydrocarbons) could **also contribute to support the phasing-out of fossil energy sources**, including through imports from other global regions, where production costs are lower.[15]

One option to achieve this could be the acceleration of the pace of adoption and technology development of RFNBOs deployment targets (e.g. in the Refuel EU proposed regulation for aviation) or their explicit integration in the Fuel EU maritime framework. For some of these, which are not yet widely used as fuels (e.g. ammonia and methanol), this would require the development of safety and environmental standards and the development of adequate infrastructure, while for other fuels, suitable for drop-in blending with petroleum products (e.g. e-diesel, e-kerosene), few or no changes are required.

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11 Similar indications have been recommended by the IEA in its 10-point plan to cut oil use (IEA, 2022e).

12 These may include cover crops (i.e. plants that are meant to cover the soil and enrich its carbon content rather than being harvested), but only to the extent to which they can effectively contribute to soil carbon enrichment and avoid negative environmental impacts such as those caused by fertilizer that accompany all cash crop production (i.e. crops produced for their commercial value and planted to be harvested) (O'Malley, 2021a).

13 Other feedstocks, like microalgae as biomass feedstocks for advanced biofuels, have been facing major challenges from both technical and economic barriers (NREL, 2012 and 1998). Today, algal biomass is directed primarily towards high value products for food supplements. Their development for the bioenergy sector is still subject to uncertainties, so that even analyses commissioned by the fuel industry did not attempt to make projections on their possible contribution for biofuel production (ICL, 2021). For these reasons, they have not been considered here.

14 These are fuels produced from renewable energy, primarily renewable electricity, following the production of hydrogen and its combination with atmospheric carbon, following direct air capture processes. The latter are also reliant on renewable energy.

15 Similar considerations also apply to recycled carbon fuels (RCFs) produced using the residual fossil energy in certain types of wastes and by-products, such as waste plastics and industrial off-gases.

The choice of an accelerated development of hydrogen and its derivatives (including renewable fuels of non-biological origin) also **needs to be weighed against the high effectiveness of the direct use of renewables for electricity, since this is an effective way to displace fossil methane** (as discussed in the next section, with a focus on hydrogen). The same choice should also be considered relative to limitations in material extraction and other supply chain limitations to enable adequate installation of renewable electricity capacity at production sites.

As in the case of biofuels, which are likely to be more expensive than fossil alternatives, a decision to accelerate the pace of deployment of RFNBOs would also require flanking instruments capable of leading to cost savings via technology learning and scale increase. Complementary action such as regulations that enhance the energy efficiency of vehicles using these fuels (and therefore favours cost savings) will also be important to handle drawbacks in terms of competitiveness and affordability for vulnerable households due to the increases in fuel costs.

In conclusion, **the quick ramp up of biofuels in the Union in the short-term (to 2030) has limited scope as a viable option to make a substantive contribution to the rapid phase out fossil energy sources**. Increased reliance on non-food crops could be an option, but this faces clear limitations, both in economic terms (as inflationary pressures also apply to the feedstocks needed) and due to sustainability issues (mainly linked with induced land use change, as competing demand will remain for other economic sectors).

3. IMPACT ON NATURAL GAS/LNG DEMAND IN THE EU TRANSPORT SECTOR

Is there any quantifiable figure for how the ongoing Russian war of aggression in Ukraine will impact natural gas/LNG demand in the Union transport sector?

Natural gas demand in transport

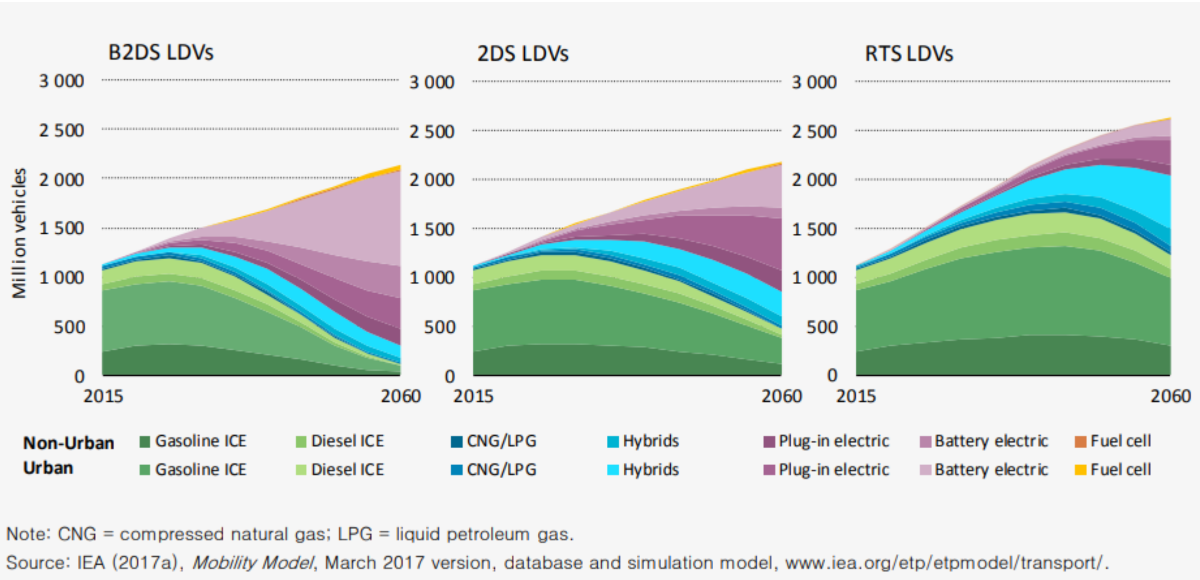
In 2017, natural gas use in the transport sector in EEA countries represented less than 0.5%[16] of total transport energy demand (EEA, 2019). Natural gas consumption in transport represented 2%[17] of total natural gas use in 2019 in Europe (IEA, 2022d). These figures suggest that **natural gas demand in the transport sector, and transport uses of natural gas, are not significant**. The number of cars and vans fitted with CNG and LNG powertrains in 2021 in the EU was close to 1.4 million (0.5% of a total estimated fleet of around 270 million light-duty vehicles). Of these, over 1 million were located in Italy, the EU country where CNG powertrains are most deployed (EAFO, 2022). The number of CNG and LNG trucks in the EU in 2021 was 30 000 (0.5% of a total estimated fleet of around 6 million trucks). In the same year there were also around 24 000 CNG buses out of a total estimated fleet of around 700 000 buses, hence around 3% (EAFO, 2022; ACEA, 2021).

The three major consumers of gas in the EU are the residential sector, industry sector and power generation (ACER, 2021); the transport sector consumes far less. In 2020, 4% of gas consumption across all sectors in EU plus the UK was low-carbon (mainly biogas) (ACER, 2021).
By 2060, gas powertrains could remain marginal in both light-duty vehicles (see figure 2) and in heavy-duty road vehicles across three scenarios considered by the IEA which depict various achievements

[16] Around 72 000 Terajoules, for an overall energy consumption in transport of 17.5 million Terajoules (figure 4 "Energy consumption in transport" of EEA, 2019).
[17] Around 288 000 Terajoules-gross, for an overall natural gas final consumption of 14,2 million Terajoules-gross.

in terms of climate objectives (IEA, 2017). The three scenarios are the Reference Technology Scenario (RTS), the 2 Degree Scenario (2DS), and the Beyond 2 Degree scenario (B2DS).[18] In the decarbonisation scenarios (2DS and B2DS), CNG/LPG powertrains represent a very small share throughout the 2015-2060 time-period. Internal combustion engines are being progressively phased-out with electric powertrains, with the contribution of a limited share of hybrid vehicles. In the Reference Technology Scenario (which does not reach climate objectives), CNG/LPG powertrains do not exceed a few percentage points (under 5%) of the light-duty vehicles in circulation. In the decarbonisation scenarios, a key reason for this is the limited effect on life-cycle GHG emission abatement from substituting oil products with fossil methane.[19] The CNG and LNG vehicles (including buses and trucks) that are present in the B2DS run exclusively on biomethane.

Figure 3: Global technology penetrations in LDV stock by scenarios, 2015-2060



Source : IEA (2017) Energy Technology Perspectives.

Notes: LDVs = Light-Duty Vehicles; ICE = Internal Combustion Engine

In the IEA Sustainable Development Scenario, fossil (natural) gas represents less than 5%[20] energy use in the global shipping sector by 2050, plus a limited share of biomethane (as part of the 2 100 Petajoules of biofuels in the sector under this scenario) (IEA, 2020). As international maritime flows of LNG will further increase in the near future as an alternative to pipeline natural gas and in a context of a diversification of natural gas supplies to Europe (away from Russia), LNG use will also increase slightly. This is because many LNG carrier ships also run on LNG themselves.

Little to no methane gas is expected to be used in the aviation sector in the future given physical constraints for energy and the high volumetric density of gaseous fuels, which lead to favouring energy-dense liquid fuels (IEA, 2020). Hydrogen has however recently been a discussed option in aviation in a decarbonisation context, although its use as a direct fuel (such as in Airbus' plans [Airbus, 2022]) or as an intermediate in e-liquid fuel production is questioned.

[18] The more recent Net-Zero Emissions by 2050 scenario of the IEA, showing a pathway to reach net-zero emissions globally by 2050, depicts close to 100% electric powertrains (either battery electric or fuel cell electric) by 2050 globally for road vehicles, including trucks (IEA, 2021, Figure 3.23).

[19] The same report (IEA Energy Technology Perspectives 2017 (IEA, 2017)) also features a "high-LNG" fuel mix scenario but points out that "even if LNG has promising potential to reduce sulphur emissions, the GHG reduction potential of LNG is small. Shifting 50% of the international shipping fleet to LNG would reduce GHG emissions by only 10%".

[20] Around 400 Petajoules, for an overall global energy consumption in the international shipping sector of around 8 500 Petajoules (Figure 5.11, IEA, 2020).

These current and future prospects suggest a quite limited role for natural gas in the transport sector in the future, especially in trajectories consistent with the Paris-agreement climate objectives. Only in the shipping sector, and in particular as LNG (and eventually bio-LNG) trade grows, a number of ships could run on the gas they carry. It is important to note that other alternative fuels are also being researched for the shipping sector, including ammonia.

Next to natural gas, a primary use of biomethane in transport, especially in the near-term emergency, is as a viable alternative to natural gas for those CNG and LNG fleets already on the road today (e.g. in Italy). However, biomethane seems unlikely to play a growing and large-scale role in transport in the future, for the following reasons:

- Available biomethane is likely to primarily serve the current major uses of natural gas, such as heating and cooking, in a context where there is a need to substitute fossil gas in existing end-use sectors (for energy supply security and decarbonisation reasons).
- Due to localised and limited feedstock supply, mostly relying on waste streams (unless very large quantities of bio-LNG are imported in the future), combined with cost minimisation imperatives, biogas is best used in the proximity of production, or, after purification, via injection in the existing gas grid. In areas with such local biomethane production, local transport, in particular fleets, may benefit from it and convert to CNG powertrains.
- Biomethane is very likely to be outcompeted on a cost basis by electrification in light and heavy road vehicles, starting from those with high usage profiles.

Impacts of a natural gas supply constraint in the transport sector

Our analysis is that **it is unlikely that natural gas supply constraints will significantly impact the European transport sector in the short-term because the sector does not rely much on natural gas.** However, there are cases (e.g. Italy, which has a million vehicles running on gas) where it will be essential to ensure supply security via diversified supply sources and routes and energy saving measures (not limited to the transport sector). Due to this limited demand for transport uses, any natural gas saving measures in the transport sector will not have much impact on the availability of natural gas in general, as less than 2% of natural gas in Europe is used in transport (IEA, 2022d). **In short-term, the use of natural gas in the transport sector is too small to influence the EU's total general natural gas use/demand, and the transport sector's reliance on natural gas is not large enough to be impacted as a whole by any supply constraints**. However, natural gas supply constraints, if they arise, can have significant impacts locally on businesses/individuals with natural gas vehicles, and in places where natural gas demand in transport is higher, such as Italy, as prices spike. In cases where biomethane prices are correlated to natural gas prices, fleets using biomethane may also be impacted.

This, in addition to the limited GHG emissions reduction potential of any significant substitution of oil by natural gas in the transport sector, points to limited prospects for significantly expanding the use of natural gas in the transport sector in the future.

The deployment of independent production and delivery channels of biomethane may however, as a low-carbon fuel and an alternative to gas imports in particular from Russia, serve the transport sector, primarily for the already-existing CNG and LNG vehicles as described above. In conclusion, **natural gas supply constraints will not have a significant impact on the European transport sector, as future deployment of CNG and LNG vehicles will remain limited, although biomethane could play a (minor) role**. Attention should however be paid to existing uses of natural gas in transport (just as for all the other current uses of natural gas) and the consequences of supply constraints on them.

4. REPURPOSING NATURAL GAS INFRASTRUCTURE FOR HYDROGEN USE

What is the potential use of pipelines currently used for gas transport and their future conversion for hydrogen transport?

As a response to the crisis in Ukraine, **the EU reinforced its efforts to decarbonise and to end its dependency on Russian fossil fuels**. This included an increased ambition for renewable hydrogen production and import, the inclusion of hydrogen in the scope of a joint purchasing mechanism[21] as well as in the EU External Energy Strategy (EC, 2022a). These efforts are consistent with the 2050 objective of the European Climate Law (EC, 2021) and a growing requirement for renewable hydrogen and derivatives in the energy mix in a net-zero context by that year (IEA, 2021), but they are not expected to significantly displace fossil fuel use in the coming five years.

As announced in REPowerEU (EC, 2022b), **the EC set a production target of 10 Mt renewable hydrogen by its Member States, plus a 10 Mt of renewable hydrogen import target, for 2030** (EC, 2022). The foreseen decrease of Russian gas imports, as well as the enhanced renewable hydrogen ambition, reinforces the attention on repurposing the existing natural gas infrastructure to transport renewable hydrogen. In this section, we elaborate on the repurposing of the natural gas infrastructure for hydrogen transport and consider the case for an increased reliance on renewable and low-carbon hydrogen to displace fossil fuel use and decarbonise the economy. The **EC prioritises the use of renewable hydrogen, but acknowledges a role also for low-carbon hydrogen[22] but only as an interim solution in the short- to medium-term** (Nuñez-Jimenez and De Blasio, 2022).

Several characteristics make renewable and low-carbon hydrogen a relevant decarbonisation option. First and foremost, **hydrogen is important to decarbonise heavy industrial facilities where hydrogen is used as feedstock** (e.g. the case already today in ammonia and fertiliser production) or processes requiring both high temperature heat and a chemical reactant (e.g. steel production). Second, **hydrogen and its derivatives may partially replace fossil use in transport**, for instance in maritime, aviation or heavy road transport, although hydrogen trucks compete with electric trucks in this field. Third, **hydrogen is also better suited for meeting large-scale seasonal energy storage needs than batteries** (due to technical characteristics of the latter), even though this is a field where there is still competition with other options (e.g. reservoir or pumped hydro storage, whose remaining potential is however not sufficient to meet the EU's long-term seasonal storage needs for heating purposes, or seasonal heat storage technologies). Repurposing some existing gas infrastructure to hydrogen would also support asset owners and operators to avoid stranded assets. Complementary benefits from hydrogen use as a natural gas alternative could also come from the possibility to avoid or delay investments in the reinforcement of the electricity grid and other investments in flexibility sources to the electricity system.[23]

Based on these considerations, several studies have looked at the opportunity to repurpose the existing gas infrastructure and end-use equipment for hydrogen. A key conclusion emerging from

[21] https://ec.europa.eu/commission/presscorner/detail/en/IP_22_3131

[22] In order to be labelled as a low-carbon hydrogen, this needs to be produced form a non-renewable energy source and its carbon footprint needs to be lower than 36.4 g CO2/MJ, the threshold boundary between low-carbon hydrogen and grey hydrogen (IRENA, 2020).

[23] The extent to which it will be used in other applications and the forms of its use (e.g. as a feedstock or as an energy carrier) are not subject to universal agreement. The adoption of hydrogen depends on structural characteristics of the technologies considered (e.g. "blue" or "turquoise" hydrogen from fossil methane with carbon capture or solid carbon black as a by-product, "green" hydrogen from low-carbon electricity, "yellow" or "pink" hydrogen from nuclear electricity) and future technological developments. These include not only the costs reductions and other constraining factors for hydrogen technologies, but also those that will characterise competing options, in particular direct electrification.

these analyses is that, while the EU's existing natural gas infrastructure can technically be used or repurposed to transport hydrogen, at least to some extent (IAEW & Frontier Economics, 2019, Guidehouse, 2022,) **there are important challenges for repurposing the distribution and end-use processes and devices** (e.g. some industrial processes such as glass manufacturing, or older boilers) (Dodds and Demoulin, 2013). Moreover, alternatives to meeting the heating demand of distribution-connected users are often more competitive, such as heat pumps or (renewable-based) district heating.

Regarding hydrogen transport, a recent literature review (ACER, 2021b) that analysed in depth the option of repurposing natural gas infrastructure (the most relevant from a cost minimisation perspective[24]) found that its successful transition is conditional on three main factors: (1) the existence of parallel pipelines in natural gas networks, (2) ensuring security of natural gas supply to consumers during the conversion period and (3) the existence of hydrogen market uptake in the area served by a pure hydrogen corridor. These indications point to important risks (and therefore barriers) linked with gas infrastructure repurposes and hydrogen end-use in a multitude of applications. This leads to timing constraints (due to the need to substitute natural gas flows with renewable hydrogen flows while keeping customers' services, to ensure that industrial clusters can avoid high mothballing costs) and adding to the challenges of converting a wide number of small end-use equipment and appliances, as mentioned above. Additional challenges arise from path dependency for hydrogen transport and distribution infrastructure. This is due to the fact that while pipelines are the cheapest transport option for hydrogen, they are only cost effective where large-scale volumes are needed (in the absence of these, costs are lower for other forms of hydrogen transport and distribution such as transport of compressed or liquefied hydrogen tanks by trucks, but still higher, per unit volume, than what they could be with high volumes of hydrogen deliveries in pipelines). Transporting derivatives over long distances rather than hydrogen will also be a cheaper option.

Hydrogen pipelines will also compete with or complement alternative options, including high voltage direct current (HVDC) cables, pipelines or ships transporting sustainable fuels (such as e-ammonia or e-diesel, or other synthetic hydrocarbons). Low-carbon fuels including all hydrogen derivatives face the disadvantage of greater energy losses during production and limited scope for their rapid scale up, but some of them (namely those that can be blended with petroleum-based fuels) have the advantage of being able to use existing transport and distribution infrastructure, therefore also facing lower investment risks. Balancing pros and cons, **it is reasonable to expect that a hydrogen pipeline network will exist, but also that it will be smaller than the existing natural gas network**, and initially supplying existing industrial clusters in the EU already making use of (gas-based) hydrogen. Even the European Hydrogen Backbone initiative, proposed by gas grid operators, only considers a transmission network of about 53 000 km in a mature hydrogen market, while the natural gas transmission network length is over 200 000 km (Rodríguez Gómez, 2016).

Despite uncertainties on the extent and the forms that this will have, there is consensus that low-carbon and renewable-based hydrogen will play a role in a decarbonised world, also contributing effectively to fossil fuel substitution. Conversion losses, though, uncover important limitations for renewable hydrogen to displace fossil fuel (in particular natural gas) use, especially in the near term. Two main reasons explain this:

[24] The first solution allowing the transport of hydrogen in natural gas pipelines is to blend it with methane. With hydrogen shares exceeding 20% (Agora Energiewende, 2021), repurposes and adaptations become necessary to guarantee safe operations. Repurposes are preferable to dedicated pipeline construction not only because they are technically viable in many cases (In Germany for instance, Cerniauskas et al. [2020] find that around 80% of the pipeline network can be repurposed), but also because they are the cheapest solution to transport hydrogen over long distances (Guidehouse, 2022).

1. **Hydrogen derived from methane** (even if decarbonised, via carbon capture) **is subject to inevitable net conversion losses occurring during production**, resulting in higher demand for methane for the same energy content delivered. These losses rule out fossil-based hydrogen production as an effective way to cut current end-uses of methane.
2. Other losses are taking place across the hydrogen energy chain (like compression, liquefaction, cryogenic containment, amongst others). **These losses result in greater primary energy needs for the same services that could be offered by direct electrification**. Direct electrification is also favoured by the better energy efficiency of battery electric powertrains, in comparison with hydrogen fuel cell powertrains.[25]

For fossil-based hydrogen with carbon capture, this exacerbates the energy efficiency issues already flagged under point 1, worsening further the net fossil methane replacement balance. For renewable hydrogen, the issues flagged under point 2 mean that the same amount of renewable electricity would offer greater end-use services if used directly. This direct use of renewable electricity would also offer far greater savings of fossil methane in regions that are still significantly reliant on gas for electricity generation, in comparison to its use for renewable hydrogen production and hydrogen blending in the gas grid.

Imports of hydrogen and its derivatives could support the reduction of methane demand in Europe, but the scale of this impact would be progressive, due to the fact that for some carriers (in particular CGH2, LH2), adequate facilities like terminals, storage capacities are still lacking, while for other carriers (in particular e-diesel, e-kerosene, e-ammonia) production capacity in partner countries still need to be developed, even when existing facilities and transport modes are adequate (EnTEC, 2022).

Imports of hydrogen would also be dependent on policy and investment choices (in terms of renewable energy deployment or natural gas extraction) **made beyond the European borders and subject to the risk of delays** (due to financing, material sourcing, development of production and export facilities, etc.) before offering any benefit. Hence, bilateral and multilateral strategic partnerships and dialogue should be established with exporting countries as a framework for future trade, providing certainty to investments, developing technical expertise, addressing financing, and considering the systemic context.

In conclusion, **reducing fossil fuel demand is not possible for fossil-based hydrogen**, since energy losses are inevitable in the conversion of methane to hydrogen. **Renewable hydrogen can and will most likely play a role in a decarbonised world. In this context, renewable hydrogen can also contribute to fossil fuel displacement. However, renewable hydrogen will not contribute effectively and at scale, in the short term, to significantly phase out of fossil fuels**, mainly due to the time required to deploy the entire supply and conversion chain.
Renewable hydrogen will also complement other decarbonisation options in different sectors, for different applications. **The effectiveness and the extent of its future contribution to the reduction of fossil fuel use and decarbonisation depends on progress that can be achieved to stimulate its demand, especially in sectors where it would be a more cost effective option for decarbonisation.**

The existence of hydrogen pipeline networks and its extension is conditional on the existence of large-scale transport volumes and is subject to competition from other technological options, in particular when considering renewable hydrogen derivatives, which are cheap and efficient to transport.

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[25] Similar considerations also apply to buildings, if heat pumps are compared with hydrogen boilers, even without entering in safety-related and other barriers limiting the scope for its distribution to a large number of small end-uses.

This briefing provides the European Parliament's Committee on Transport and Tourism (TRAN) with an overview of the potential of sustainable fuels in transport in the context of the current Ukraine/Russia crisis. It assesses biofuel's potential to be quickly ramped up, the impact on LNG demand in the EU transport sector, and the potential use of gas pipelines repurposed for hydrogen.

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