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COMMISSION STAFF WORKING DOCUMENT

**IMPLEMENTING THE REPOWER EU ACTION PLAN: INVESTMENT NEEDS,
HYDROGEN ACCELERATOR AND ACHIEVING THE BIO-METHANE TARGETS**

Accompanying the document

**COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN
PARLIAMENT, THE EUROPEAN COUNCIL, THE COUNCIL, THE EUROPEAN
ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE
REGIONS**

REPowerEU Plan

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1. INTRODUCTION

Achieving the objectives of the REPowerEU communication¹ to reduce the dependence of Russian fossil fuels will require on the one hand, reducing faster our dependence on fossil fuels, and, on the other hand, diversifying gas supplies. Both efforts imply investments including to boost energy efficiency gains, increase the share of renewables, address infrastructure bottlenecks, increase LNG imports and pipeline imports from non-Russian suppliers and increase the level of renewable hydrogen and bio-methane.

This Staff Working Document provides an estimate of the investment needs and additional costs of reducing the fossil fuel dependence from Russia to zero by 2027, with specific focus on natural gas use. The decoupling between the EU and fossil fuel imports from Russia has already started and will pass through different stages, affecting the demand and the supply side. Taking into account the above elements, the analysis indicates that implementing the full potential to reduce the dependence to zero (310 bcm) would require €300bn² cumulative from now until 2030 – beyond the Fit-for-55 proposals³. By the end of 2027, this transition corresponds to approximately €210bn investments (and 235 bcm). These REPowerEU investments correspond to about 5% of the total Fit-for-55 investments until 2030, and come on top of them. The Commission analysis estimates that with the Fit-for-55 and REPowerEU measures combined, the EU can save €80 bn on gas import expenditures, €12 bn on oil import expenditures and €1.7 bn on coal import expenditures per year.

Full implementation of our Fit-for-55 proposals would lower our gas consumption by 30%, equivalent to 116 billion cubic meters (bcm), by 2030. Together with additional gas diversification and accelerated gas decarbonisation, frontloaded energy savings and electrification have the potential to jointly deliver at least the equivalent of the 155 bcm imports of Russian gas by 2027.

This SWD explores notably how the higher renewables (45%) and energy efficiency (-13% final energy consumption) levels contribute to the objectives of the RePowerEU.

Achieving the objectives of REPowerEU relies notably on scaling up renewable hydrogen and bio-methane and provide a crucial contribution to the effort of reducing the dependence of Russian gas. Therefore, this Staff Working Document also explores how the development of hydrogen can be accelerated and the bio-methane targets achieved.

The scaling up of the deployment of renewable hydrogen will reduce our dependence of natural gas, coal and oil imports from Russia, and will help to accelerate the EU energy transition. Therefore, the REPowerEU communication of 8 March included the Hydrogen Accelerator with the ambition of using 20 million tonnes of renewable hydrogen in 2030 in the EU.

¹ COM(2022) 108 final

² All monetary values are in EUR 2022 with HICP index (March 2022) being 115.88 (compared to 2015).

³ The additional investments beyond the Fit-for-55 proposals reflect both the impact of the REPowerEU measures and that of the higher (see Annex 1) fossil fuels price context. The analysis excludes:

- Transport.
- The possibility to increase intra-EU sources of fossil fuels (e.g Groningen in the Netherlands).
- The investments and infrastructure needed outside of the EU (e.g. LNG terminals or tankers outside the EU removing bottlenecks to increase supply from Third Countries).

This Staff Working Document further develops the Hydrogen Accelerator by identifying activities to support the implementation of these accelerated ambitions. It describes in which priority sectors the increased amount of renewable hydrogen can be used and what measures would enable this uptake, identifies possible activities and support for the rapid development of the needed hydrogen infrastructure, including pipelines, storages and terminal facilities and sets out how the EU could step up its international engagement and coordinate its actions to facilitate the import of 10 million tonnes of renewable hydrogen, while ensuring respect for the EU's international trade obligations.

In order to reduce its reliance on Russian gas, the European Union also needs to boost biomethane production to 35 bcm by 2030. This Staff Working Document presents a number of possible actions to achieve this ambitious target. The actions cover four key areas and could unlock the full biogas and bio-methane potential that exists across all EU Member States.

The proposed measures would not only facilitate the increase in production of biogas but would also boost its subsequent conversion into bio-methane, respecting strict environmental criteria agreed in the REDII. Recognising existing barriers to entry, the actions also target the facilitation of biomethane integration into the EU internal gas market. Further co-ordination of support to biogas and bio-methane at the EU, national and regional levels is needed if we collectively want to achieve the 35bcm target. Challenges also include improving infrastructure deployment, improving access to finance, and supporting research, development and innovation.

2. INVESTMENT NEEDS

1. Reduction of gas demand and investments by technology

Achieving the objectives of the REPowerEU communication to reduce the dependence of Russian fossil fuels will require significant investments to:

- **Reduce faster our dependence on fossil fuels** at the level of homes, buildings, transport, industry and the power system by boosting energy efficiency gains, increasing the share of renewables and addressing infrastructure bottlenecks.
- **Diversify gas supplies**, via higher LNG imports and pipeline imports from non-Russian suppliers, and higher levels of bio-methane (domestically produced) and renewable hydrogen (domestically produced and imported).

Full implementation of our Fit-for-55 proposals would lower our gas consumption by 30%, equivalent to 116 bcm, by 2030. Together with additional gas diversification and more renewable gases, frontloaded energy savings and electrification have the potential to jointly deliver at least the equivalent of the 155 bcm imports of Russian gas by 2027.

For the purpose of this analysis, fossil fuels considered are coal, oil and refined petroleum products (e.g. diesel) and, in particular, natural gas.

The analysis considered 3 dimensions for the menu of options:

- 1- How fast can these measures be deployed?
- 2- How cost-efficient are these measures (contribution to reducing the dependency, number of bcm saved in the case of gas)?
- 3- How green? The measures should not lead to stranded assets and should be future-proof, to the extent possible.

Several policy actions can be considered both from the supply and demand side:

- In the short-term
 - Diversification of gas pipeline routes (incl. higher load factor of existing pipelines)
 - Limited additional LNG under current infrastructure or floating storage regasification units (e.g. import terminals and pipeline network)
 - Demand-side behavioural measures
 - Energy efficiency investments (including heat pumps)
 - Industry gas prioritisation (emergency measure)
 - Price-driven fuel switch
- In the medium-term:
 - Further energy efficiency investments and innovation (including heat pumps, retrofitting and energy efficient industrial processes)
 - Development of bio-methane production and infrastructure

- Additional photovoltaic (PV), on-shore and off-shore wind deployment and energy system integration
- Additional investment in the power grid and storage
- Limited new LNG and gas pipeline infrastructure and adapting the existing gas networks to bio-methane and renewable hydrogen

In the longer term

- Development of renewable hydrogen production and hydrogen infrastructure

The analysis looks at the investments needed to build a structurally new energy system that is independent from Russia as a fossil fuel producer. Taking into account the above elements, the up-front additional investment needs, complementing the Fit-for-55 package, to reduce the dependence to zero would amount to **€300bn from now until 2030** (or, approximately €210bn by the end of 2027).

Table 1 below focuses on a gradual decoupling from Russian gas and assesses the options for additional gas demand reduction and associated investment needs compared to the Fit-for-55 scenario. It is based on comparing results of modelling scenarios of REPowerEU and implementation of the Fit-for-55 package using the PRIMES model⁴. The investments listed in the table below cover notably the implementation of all the measures in the REPowerEU Communication and the specific needs for gradual gas decoupling from Russia by 2027, new LNG infrastructure and gas pipeline corridors, and production, transmission and demand sides of the transition outlined in the REPowerEU Communication including energy efficiency, renewables, heat pumps, renewable hydrogen including electrolysers, biomethane. Those investments do not cover the impacts of sanctions, oil savings, oil production or demand measures, curtailment of oil, natural gas or coal, nor investments in existing infrastructures related to the diversification of gas supply. As the focus of the analysis is on gas, Table 1 does not include transport, and investments in transport are similar in REPowerEU and Fit-for-55 projections.

⁴ The additional investments beyond the Fit-for-55 proposals reflect both the impact of the REPowerEU measures and that of the higher fossil fuels prices.

Table 1: Potential measures and investments to reduce dependence on Russian gas by technology, in addition to the Fit-for-55 package

Timing	Measure	bcm (in 2030)	€ bn investments (2022-2030)	Justification/ explanation of the bcm figure	Eligibility under EU financial programmes
Ff55 savings by 2030	Total of all Fit-for-55 measures	116		Fit-for-55 modelling estimates 30% natural gas savings	-
Short-term prepared-ness	Diversification (additional LNG using existing infrastructure)	50		RePowerEU Communication COM(2022) 108 final	-
	Diversification of pipeline imports using existing infrastructure	10	-	In 2030, long term contracts account for about 110 bcm (of which about 55 bcm are take-or-pay contracts)	-
	Delayed phase-out and more operating hours for coal	24	2	Using existing capacity. The investment refers to CAPEX. The fuel cost (coal) is not included (OPEX). The total expenditure of the switch from gas to coal is the sum of CAPEX and OPEX.	-
	Abandoned phase-out nuclear plants	7	⁵	Recent political decisions in BE and FR	-
	Fuel switch in the residential and service sectors	9		Fuel switch driven by price changes	
	EU Save: Demand measures (behaviour)	(10)	-	Measure 9 of the IEA plan on gas in the EU (gas saving counted under energy efficiency)	-
	EU Save: Industry curtailment	-	-	Emergency measure	-

⁵ Investments for nuclear long term operation are included in investments for other power technologies and infrastructure.

Timing	Measure	bcm (in 2030)	€ bn investments (2022-2030)	Justification/ explanation of the bcm figure	Eligibility under EU financial programmes
Mid-term (until 2027)	New LNG infrastructure and pipeline corridors	-	10	These infrastructure and pipelines facilitate the full effect of the diversification. Compared to average EU LNG imports of 7 bcm/month (in 2019-21), the EU system could absorb an additional 3.8 bcm/month (45.6 bcm/year) of LNG if bottlenecks are removed. However, there are currently only 8 to 10 available Floating Storage Regassification Units LNG terminals in the world. ⁶	Modernisation Fund ⁷ , RRF ⁸ , CEF ⁹ , ERDF and CF, for projects on the 5 th PCI list
	Additional investments in the power grid and storage	-	39	The storage is about 10bn.	CEF, InvestEU ¹⁰ , HE ¹¹ , ERDF ¹² , CF ¹³ , JTF ¹⁴ , RRF, ETF Funds ¹⁵
	Biomass in power generation	1	2	In line with the sustainability criteria of the Renewable Energy Directive.	HE, InvestEU, LIFE, ERDF, CF, JTF, RRF, ETS Funds, RES EU FM, EAFRD ¹⁶

⁶ As an example, the Wilhelmshaven LNG Import Terminal, scheduled to enter service by 2023 once completed could deal with 10bcm of additional gas per year. The cost of the project is around €672m.

⁷ Natural gas transmission (and distribution as well as gas-fired energy generation) are capped at a maximum of 30% of the overall Modernisation Fund allocation.

⁸ Recovery and Resilience Facility

⁹ Connecting Europe Facility

¹⁰ InvestEU Programme

¹¹ Horizon Europe

¹² European Regional Development Fund

¹³ Cohesion Fund

¹⁴ Just Transition Fund

¹⁵ Refers to two funds established under the ETS Directive: the Innovation Fund and the Modernisation Fund. The Modernisation Fund is available to 10 Member States: BG, HR, CZ, EE, HU, LV, LT, PL, RO, SK

¹⁶ European Agricultural fund for Rural Development

Timing	Measure	bcm (in 2030)	€ bn investments (2022-2030)	Justification/ explanation of the bcm figure	Eligibility under EU financial programmes
	Energy Efficiency and Heat Pumps	37	56	Incl. Energy efficiency in buildings; Lower final electricity demand;	HE ¹⁷ , InvestEU, LIFE, ERDF, CF, JTF, RRF, ETS Funds
	PV and wind	(21 bcm See justification)	86	In the scenario, about 12 bcm is achieved through almost 4Mt of additional domestic hydrogen production and 9 bcm through additional substitution of gs in the power system. These bcm savings are distributed across the other sectors in the table.	HE, InvestEU, CEF ¹⁸ , LIFE, ERDF, CF, JTF, RRF, ETS Funds, RES EU FM ¹⁹
	Sustainable bio-methane	17	37	Increased use in households, industry and agriculture. The total (with Fit for 55) adds up to 35 bcm in 2030.	InvestEU, ERDF ²⁰ , CF ²¹ , JTF ²² , CEF ²³ , ETS Funds ²⁴ , EAFRD
	Reduced use in industry	12	41	Incl. Electrification, energy efficiency, and fuel substitution (incl. hydrogen); Excl. the cost of production of hydrogen and biogas/bio-methane; Excl. refineries.	HE, ETS Funds, InvestEU, ERDF, CF, RRF
Long-term needs (by 2027 & beyond)	Renewable hydrogen	27 (domestic and import)	27	€27 bn is direct investment in electrolyzers and distribution of hydrogen in the EU.	CEF, InvestEU, HE, ETS Funds, RRF, ERDF, CF, JTF ²⁵

¹⁷ Horizon Europe

¹⁸ Here, eligibility would be possible under CEF-Energy cross-border RES envelope

¹⁹ RES EU financing mechanism

²⁰ European Regional Development Fund

²¹ Cohesion Fund

²² Just Transition Fund

²³ Connecting Europe Facility

²⁴ Refers to two funds established under the ETS Directive: the Innovation Fund and the Modernisation Fund. The Modernisation Fund is available to 10 Member States : BG, HR, CZ, EE, HU, LV, LT, PL, RO, SK

²⁵ Concerning the ERDF, Cohesion Fund, JTF the eligibility refers to RES hydrogen – under “promoting renewable energy in accordance with Directive (EU) 2018/2001” according to Regulation (EU) 2021/1058 on the ERDF/CF

Timing	Measure	bcm (in 2030)	€ bn invest- ments (2022- 2030)	Justification/ explanation of the bcm figure	Eligibility under EU financial programmes
				<p>(excludes the investment of solar and wind electricity needed to produce green hydrogen; and excluding the investments needed for the imported renewable hydrogen)</p> <p>About 6.6 Mt is produced domestically and included in the Fit-for-55 scenario.</p> <p>RePowerEU increases the domestic production by 3.4 Mt while 6 Mt of renewable hydrogen and approximately 4 Mt of ammonia are imported.</p> <p>Out of the approximately additional 10 Mt hydrogen, 8 Mt replace 27 bcm of gas, whereas the remaining 2 Mt replace oil and coal.</p>	
Total		310	300		

Note: bcm figures in brackets are provided for information but not included in the total.

2. Drivers of natural gas demand reduction in RePowerEU

The March REPowerEU Communication states that the full implementation of our Fit for 55 proposals would **lower our gas consumption by 30%**, equivalent to 116 bcm, by 2030. The higher long-term gas and oil price paths reduce the natural gas demand further by about 40 bcm until 2030, whereas the implementation of the RePowerEU measures completes it with almost an additional 100 bcm reduction by 2030.

Together with additional gas diversification and renewable gases, frontloaded energy savings and electrification have the potential to jointly deliver **at least the equivalent of the 155 bcm** imports of Russian gas by 2027.

While there is currently some shift from gas to coal and oil, under the Fit-for-55 proposal, demand for oil and coal is projected to decrease by 28% and 50% respectively between 2019 and 2030. Under REPowerEU, demand for coal is projected to decrease by 36% (2030 vs 2020). Demand for oil is comparable in 2030 to the Fit-for-55 projections (since the focus of the analysis is on gas). The reduction in coal demand is sufficient to fully replace Russian coal imports by 2027.

Three main drivers will change the energy system beyond the Fit-for-55 proposals:

1. The decoupling from Russian gas imports, leading to the need for alternative suppliers and entry points into the EU, alternative intra-EU pipeline routes and other infrastructure;
2. The REPowerEU plan further increases the ambition level beyond the Fit-for-55 Package for gas alternatives (bio-methane, renewable hydrogen), deployment of renewables, and structural demand measures such as energy efficiency;
 - The renewables reach a 45% share in 2030²⁶;
 - Energy efficiency reaches a 13% share in 2030;
 - Bio-methane production reaches 35 bcm in 2030;
 - Renewable hydrogen use²⁷ reaches 20 Mt by 2030 (of which about 4 Mt as ammonia);
 - Respecting the at least -55% GHG objective of the Fit-for-55 package is achieved.
3. Prices are expected to be persistently higher than the reference (albeit lower than the peak prices observed in 2021 and 2022). Experts expect that the current events will temporarily fragment oil and coal markets resulting in higher prices, while these markets will rebalance in the medium term. The fuel price trajectories used in the REPowerEU and Fit-for-55 scenarios are provided in Figure 1 in Annex A.

²⁶ Using the definition in RED III.

²⁷ Including the use of e-fuels derived from hydrogen.

3. Why should the potential for natural gas reduction be higher than 155 bcm?

The combined effect of the Fit-for-55 proposals, the measures announced in the March Communication, a higher price trajectory for natural gas, and the LNG and pipeline diversification have the potential to lead to a cumulative demand reduction of 310 bcm of natural gas by 2030 compared to 2020. By 2027, this corresponds to 235 bcm (including 60 bcm of diversification measures).²⁸

REPowerEU aims at improving the energy security in the EU, while respecting cost-efficiency and the decarbonisation pathway. Therefore, it is in the interest of the EU to have a broad range of options to allow for sufficient flexibility and prepare for other unforeseen events, rather than a very narrow transition path.

1. The objective should go beyond 155 bcm, which is a snap-shot of the Russian natural gas imports in 2021. In various recent years, the Russian imports have been significantly higher (e.g. 195 bcm in 2019²⁹). Further, the domestic natural gas production continues to decrease by several bcm every year in the EU (and its neighbourhood). And, while still helping the general EU energy security, not all reduction in natural gas consumption will directly translate into less imports from Russia (e.g. in the western part of the EU).
2. Another uncertainty are the price trajectories of natural gas and the other fossil fuels. Higher than usual gas prices as in the price trajectory of Figure 1 drive about 40 bcm out of the EU energy system by 2030 (e.g. by switching to coal). While lower gas prices would be beneficial for the EU economy, the price incentive to use less gas would evaporate, possibly compromising the decoupling from Russia, and putting the energy security of the EU at risk in the longer term.
3. The REPowerEU measures combined with the Fit-for-55 proposals rely heavily on a quick and ambitious deployment of fossil-free technologies. Various bottlenecks may put this deployment and the energy security objectives at risk, such as the dependence on rare earths, supply chain constraints, skilled labour shortages and financing. In particular, renewable hydrogen needs new production capacity and dedicated transport infrastructure; and may only start to contribute significantly after 2027. Nevertheless, renewable hydrogen projects serve both the long-term EU energy security and the decarbonisation pathway. The project lead times justify starting initiatives early on in order to be ready for the next stage of the decarbonisation pathway and any future energy security challenges³⁰.

Additionally, the higher potential of gas reduction may allow the EU to roll back the temporary measures before 2027, such as (i) the measure to reduce the thermostat with one degree (10 bcm), (ii) more operating hours and delayed phase out of coal power plants (24 bcm), and (iii) delayed phase-out of nuclear plants (7bcm).

²⁸ The 60bcm of diversification measures can be achieved entirely by 2027; the remainder is multiplied by 70% (to bring 2030 figures to 2027). Arithmetically, $235 = 60 + 70\% * (310-60)$.

²⁹ Total of 178 bcm of pipeline and 17 bcm LNG (ENTSO)

³⁰ For example, at present no real hydrogen shipping capacity is available and needs to be quickly developed.

4. A Changing Energy System

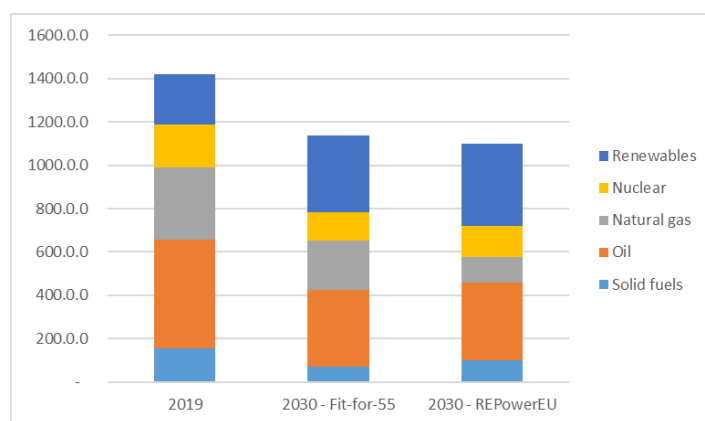
Our analysis suggests that the higher energy prices and the measures announced in the March Communication will change the energy system, and its Fit-for-55 transition:

- **Gas use in the EU will decrease faster** than in the Fit-for-55 proposals;
- **Fuel switch** is a major driver of diversification. The higher gas prices **increase the operating hours of coal and nuclear power plants**. In the longer term, the analysis shows **more renewables** (including direct natural gas substitutes such as bio-methane and hydrogen), and **more energy savings** than in the Fit-for 55 proposals.

On gas, coal and nuclear:

- **As a direct effect of sustained high natural gas prices, installed capacity of gas plants will be approximately 8 GW lower by 2030** than anticipated in the Fit-for-55 proposals. The gross electricity generated from gas power plants is 240 TWh lower (-67% in 2030) than in the Fit-for-55 proposals.
- **The utilisation of coal plants increases** and the gross electricity generation is 105 TWh higher for coal power plants in 2030 than in the Fit-for-55.
- The analysis incorporates the operation of two Belgian nuclear units beyond 2025 and maintained nuclear capacity in France. Gross nuclear electricity generation is 45 TWh higher in 2030 than in the Fit-for-55 proposals.
- Net imports of natural gas decrease by 97 Mtoe, but increase for solids (+13 Mtoe) and oil (+6 Mtoe) compared to the Fit-for-55 (all fossil fuels imports decrease compared to today).

Figure 1: Gross inland consumption by fuel in 2019 and in 2030 in the Fit-for-55 and REPowerEU scenarios (Mtoe)

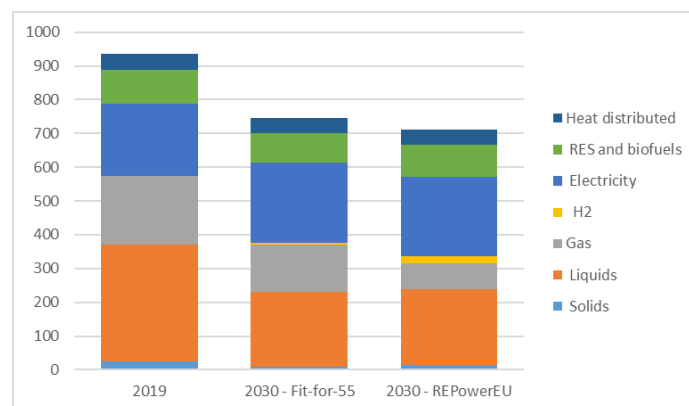


Source: Eurostat (2019) and Primes (2030)

Regarding the potential of renewable energy sources and energy efficiency:

- Compared to the Fit-for-55 proposals, the use of renewables and to a lesser extent coal increases as a share of gross electricity generation (respectively +3.7 pp and +2.6 pp), while that of gas decreases (-7 pp to 3.3% in 2030).
- In this RePowerEU modelling scenario, most of the additional PV and wind production is used by the increased domestic production of green hydrogen. However, if directly used to displace gas-fired power generation, investments of approximately 1.6 bn€ in wind or solar PV are required to save 1 bcm of gas.
- As a result, **the share of renewable energy in 2030 is 45%** (compared to 40% in the Fit-for-55 proposal).
- Driven by higher prices, dedicated policies and consumer awareness, energy efficiency also improves. Final energy consumption in the EU in 2030 is 768 Mtoe, or 4.6% lower than in the Fit-for-55 proposal.
- The use of natural gas decreases significantly in the residential and services sectors. By 2030, gas use in buildings decreases by 27 Mtoe (equivalent to approximately 32 bcm of gas). In these sectors, natural gas is replaced mainly by electrification, heat pumps and bio-methane transported in the existing gas network. Higher consumption of hydrogen in hard-to-abate transport sectors, especially in heavy duty trucks and through the production of sustainable fuels for aviation and waterborne sectors provides another opportunity to replace Russian fossil fuels.

Figure 2: Final energy consumption by fuel in 2019 and 2030 in the Fit-for-55 and REPowerEU scenarios (Mtoe)



Source: Eurostat (2019) and Primes (2030)

5. Preparing for the next winter by Short-Term and Behavioural measures Energy System

There are two types of **short-term measures** to reduce the dependence on Russian fossil fuels: alternative sources of imports, behavioural demand reduction measures. Short-term measures can reduce the demand for Russian natural gas by 70 bcm p.a. (without curtailment) and the demand for crude oil by up to **850,000 barrels per day in the EU27**.

Alternative sources of imports

Regarding **natural gas**, additional imports from alternative sources can reach Europe either by pipeline or in the form of LNG. In the short term, i.e. by using only existing infrastructure, additional 10bcm can be imported by pipeline and 50 bcm using existing LNG infrastructure.

Behavioural measures

Behavioural measures, in particular the reduction of thermostats by 1 degree Celsius, can save around 10 bcm of natural gas, according to the IEA. To avoid double-counting, this reduction in thermal comfort would have to come in addition to any price-induced demand reduction.

Table 2: Estimated Russian gas import reductions from some short-term measures

Measure	Natural gas saved (bcm)
Additional pipelines imports	10
LNG imports ³¹	50
Behavioural measures	10
Total	70

Table 3: Estimated oil savings from behavioural measures

Measure	Oil saved (kb/d)
Reduce speed limits on highways by at least 10 km/h	160
Working from home up to 3 days where possible	115
Car-free Sundays in cities	80
Make the use of public transport cheaper and incentivise micro-mobility	105
Alternate private car access to roads in large cities	50
Increase car sharing and adopt practices to reduce fuel use	150
Promote efficient driving for freight trucks and delivery of goods	110
Using HSR and night trains instead of planes where possible	30
Avoid business air travel where alternative options exist	70
Reinforce the adoption of electric and more efficient vehicles	35
Total	850³²

Source: Estimates from IEA's 10-point plan to cut oil use, re-scaled to the EU

³¹ A 10-Point Plan to Reduce the European Union's Reliance on Russian Natural Gas, IEA, March 2022.

³² This table lists the behavioural measures, estimated by the IEA (A 10-Point Plan to Cut Oil Use, March 2022), and adapted to EU27. The total is smaller than the sum of all measures. This is because if all measures are taken there is some overlap, which we have accounted for.

6. Costs and benefits

Higher fuel costs and the additional efforts to reduce gas consumption increase the cost of the energy system³³ by **almost 10% to about €1900 bn** per year.³⁴ As a share of GDP, system costs increase from **11.3% of GDP to 13.4%**.

The joint implementation of the Fit-for-55 proposals with REPowerEU will generate a number of benefits too.

The Commission analysis estimates that with the Fit-for-55 and REPowerEU measures combined, the EU can save €80 bn on gas import expenditures, €12 bn on oil import expenditures and €1.7 bn on coal import expenditures per year.

IEA experts suggest that the Fit-for-55 and REPowerEU measures will make gas prices converge to lower levels (albeit possibly higher than historic levels).

7. Overall investment needs

The current analysis indicates that the investment needs to reduce the dependence to zero would amount to **€300bn from now until 2030** on top of the total Fit-for-55 investments (or, €210bn by the end of 2027). Not delaying the phase-out of existing coal and nuclear plants as officially announced would lead to higher investment needs. Despite temporarily higher coal use in power generation, the climate ambition levels are reached since REPowerEU leads to investments in renewables and energy efficiency beyond the Fit-for-55 proposals. In this context, investments needed for scaling up the production of clean energy technology components and equipment in the EU need to be facilitated at various policy levels, which would further help achieve EU's decarbonisation, energy security, and resilience objectives.

Two trends drive investments with persisting high gas prices and reduced imports:

1. As a response to high prices, users switch to other fuels. With existing capacities, this can be achieved with relatively little additional investments (e.g., when coal and nuclear power plants increase operating hours).
2. Users switch to new technologies (e.g., to renewable energy or heat pumps), or new capacities are installed (e.g. new nuclear plants). This increases the investment needs.

A careful in-depth analysis is needed to disaggregate and quantify the two effects.

The current analysis indicates that the investment needs to reduce the dependence on Russian fossil fuels to zero would amount to **€300bn from now until 2030** on top of the total Fit-for-55 investments.

³³ Including the cost of fuels (fossil, biomass, etc.), O&M costs and capital costs, but excluding the cost of carbon emissions.

³⁴ Average for the 2021-2030 decade (compared to the Fit-for-55 package) including the transport sector (values in €'22).

By the end of 2027, the investments add up to approximately **€210bn**. Table 1³⁵ shows the investment needs for some of the measures proposed.

Table 4: Investment by 2030 for reaching the RePowerEU objectives

Investment areas	REPowerEU	Ff55	Difference	Diff. due to high prices
Installed wind capacity (GW)	510	469	41	13
Installed solar PV capacity (GW)	592	530	62	16
Installed heat pumps in residential and services (million units)	41.5	39.9	1.7	3.4
Installed electrolyser capacity (MW hydrogen)	65	44	21	1.6
Net imports of hydrogen (Mt)	6.16	0.05	6.11	0
Biogas used in power plants (Mtoe)	12.3	11.8	0.5	0.9
Biogas as transformation input in industry and district heating (ktoe)	6.9	3.3	3.6	42
Electricity grid investments over the decade (bn€'22)	583.8	554.4	29.4	37
Annual renovation rate in 2030 (as % of entire housing stock)	2.3	2.0	0.2	0
Annual renovation rate - medium and deep renovation in 2030 (as % of entire housing stock)	2.1	1.9	0.2	0
Investment expenditure in residential buildings in 2021-2030 (bn €'22)	2068	2023	45	-

Implementing REPowerEU will require investments in several areas. The strong increase in the consumption of renewable hydrogen translates in needs to increase the installed capacity of electrolysers, from 44 GW in Fit-for-55 to 65 GW³⁶ in REPowerEU. Installed capacity of wind and solar also need to increase to supply electrolysers with renewable electricity. In REPowerEU, there are 41 GW of wind and 62 GW of solar in additional capacity. In addition to production, net imports of renewable hydrogen are also higher, at more than 6 Mt of hydrogen in 2030.

³⁵ Costs and investment numbers are preliminary estimates and are subject to change.

³⁶ Lower running hours would need up to 80 GW of installed hydrogen electrolyzers (cfr. hydrogen accelerator). Running hours are determined by the electricity system, flexibility requirements and geographic location of electricity sources, among others.

The use of biogas as transformation input in industry and district heating is twice higher in REPowerEU. Investments will also need to occur in the buildings sector, with the annual renovation rate higher in REPowerEU than in Fit-for-55. The electricity grid would need further reinforcement and additional investments to the amount of bn EUR 29 bn over the decade. Beyond these investments an additional investment of circa EUR 10 bn would be necessary for storage.

8. Infrastructure Needs and Bottlenecks

The measures proposed for decoupling the energy supply from Russia constitute a significant change to the energy system in terms of quantities, prices, and directions of energy flows.

As a result, the infrastructure needs for electricity, hydrogen and natural gas should adapt. These infrastructure investments should solve the needs of the forthcoming decade in a coordinated manner, avoiding creating stranded assets to the extent possible, facilitating the long-term transition to a carbon-neutral economy. By 2030, €39 bn of additional investments (Table 1) are needed in the power grid (including transmission, distribution and storage plants), compared to the Fit-for-55 scenario, in order to balance the power grid and in line with the higher deployment of renewables.

The diversification of import sources is essential to eliminate natural gas imports from Russia. In particular, it will be necessary to import sufficient additional natural gas from other pipeline suppliers and LNG ports. These new import routes and new intra-EU gas flows will require a **sufficient level of gas infrastructure (LNG terminals, pipelines, reverse flows)** corresponding to € 10bn of investments by 2030 additional to those necessary to achieve the Fit-for-55 objectives, in order to guarantee sufficient supply and a fluid distribution of natural gas across all Member States, such for PCIs on the 5th PCI list and the Recovery and Resilience Facility for any additional infrastructure, supplementing the Trans-European Network policy. The need for any additional infrastructure should be well assessed also at the regional and EU level, avoiding stranded assets. The resilience of the infrastructure and the future use of the assets in a decarbonised energy system (e.g repurposing) should be taken into consideration in the design of such projects. Simultaneously, the REPowerEU proposes ambitious level of renewable hydrogen deployment, which also requires an acceleration of the development of **renewable hydrogen infrastructure**. Given the expected decrease in natural gas demand and in order to avoid locking-in fossil fuel use, the gas and hydrogen infrastructure investments should make use of synergies in order to be future-proof investments. Hydrogen networks should enable a pan-European integration of hydrogen supply and demand. The development of a suitable hydrogen infrastructure is closely related to the deployment of renewable energy, the location of electrolyzers producing renewable hydrogen and the form in which hydrogen is to be transported or imported. In particular, ammonia is an important alternative to liquefied hydrogen for international trade. There exists potential to modify regasification facilities to receive shipments of ammonia.

The further increase and integration of renewable energy requires **an efficient and adapted electricity network**. REPowerEU increases and frontloads the renewable capacities compared to Fit-for-55, and the electricity network should adapt accordingly, including offshore and onshore grid.

EU-level and regional action will continue to be discussed in well-established and dedicated groups for EU-wide infrastructure planning such as the TEN-E policy regional groups, the relevant High-Level Groups (CESEC, BEMIP, South-West Europe, NSEC), Gas Coordination Group and the LNG platform to ensure that capital-intensive energy (particularly gas) network investments are optimised across the EU avoiding duplication resulting in overcapacity and stranded assets. At the national level, the REPowerEU component of the RRP will need to support REPowerEU objectives, ensure that investments and reforms fit with national contexts and avoid fossil-fuel lock-in and stranded assets. Under the Technical Support Instrument, the Commission is helping Member States³⁷ to identify additional investments and reforms to phase out the dependency on fossil fuel imports from Russia.

³⁷ [Commission's Technical Support Instrument to help 17 Member States curb their reliance on Russian fossil fuels | European Commission \(europa.eu\)](#)

9. Industry

Compared to the Fit-for-55 proposals, we see additional scope for decreasing consumption of natural gas in all industrial sectors by 2030. Implementing REPowerEU would, in addition to higher fuel prices, lead to a switch in the industrial sector from natural gas to hydrogen and coal, and to a lesser extent oil.

As indicated in Table 5, natural gas consumption in industry is 35% lower in the REPowerEU analysis compared to Fit-for-55. Natural gas consumption of the chemicals and non-metallic minerals sectors is lower by 6.6 and 7.8 bcm respectively in REPowerEU compared to Fit-for-55, thus accounting for the largest reductions together with refineries. Together, these three sectors account for approximately 60% of the reduction in gas consumption from the industry in the decade to 2030. Only about one-tenth of the reduction in natural gas use by industry is driven by higher fossil fuel prices. In percentage change, the changes are most significant in the non-ferrous metals (-46%), non-metallic minerals (-63%), and paper and pulp (-49%) sectors.

Reducing the use of natural gas by the industry requires a coordinated action to activate all levers including energy efficient industrial processes, integration of renewables and renewable hydrogen, electrification of industrial processes, digitalisation and industrial symbiosis.

Table 5: Natural gas use by industrial sector in 2030 (bcm)^{38,39}

Sector	REPowerEU	Ff55	Difference	Diff. due to high prices
Chemicals	25.4	32.0	-6.6	-0.8
Engineering	6.7	10.0	-3.2	-0.8
Food, drink and tobacco	7.6	11.2	-3.5	-0.7
Iron and steel	4.3	6.7	-2.4	0.0
Non ferrous metals	1.7	3.2	-1.5	-0.1
Non metallic minerals	4.6	12.5	-7.8	-0.8
Paper and pulp	1.7	3.4	-1.6	-0.4
Refineries	1.2	7.4	-6.2	0.1
Textiles	0.9	1.3	-0.4	-0.1
Other industries	2.7	4.3	-1.5	0.2
Total	57.0	91.9	-34.9	-3.4

Source: Modelling using PRIMES. Note: conversion from Mtoe to bcm GCV uses a 1/0.84 factor.

The decrease in natural gas use in industry is to a limited extent compensated by somewhat higher oil (+4%) and coal (+9%) use. For coal (but not for oil), much of this increase is driven by the different price trajectories alone: the strong increase in gas prices creates incentives for industries to switch from gas to coal. For the chemicals sector for instance, coal use is 28% higher in REPowerEU compared to

³⁸ The data in Tables 4 to 6 add up final energy consumption and fuel use as an input. In addition, *Iron and steel* includes fuel use in blast furnaces. *Refineries* refers to own consumption by the energy sector in refineries.

³⁹ Including refineries and the uptake of hydrogen and bio-methane.

Fit-for-55, albeit from relatively low levels (Table 7). For engineering, non-ferrous metals and paper and pulp, coal use is higher by more than 80% in REPowerEU. The slightly higher oil use in REPowerEU compared to Fit-for-55 is not due to different fuel prices trajectories but by the implementation of REPowerEU. For instance, oil use in the paper and pulp sector is higher by 180%, with only a marginal share driven by different fuel prices (Table 6).

Table 6: Oil use by industrial sector in 2030 (Mtoe)

Sector	REPowerEU	Ff55	Difference	Diff. due to high prices
Chemicals	59.74	59.16	0.57	0.23
Engineering	1.48	1.01	0.46	-0.03
Food, drink and tobacco	1.36	1.25	0.11	0.00
Iron and steel	0.86	0.86	0.00	-0.02
Non ferrous metals	0.37	0.23	0.14	0.00
Non metallic minerals	5.21	4.16	1.05	-0.12
Paper and pulp	1.26	0.45	0.81	0.03
Refineries	0.00	0.00	0.00	0.00
Textiles	0.14	0.12	0.02	-0.01
Other industries	28.36	27.55	0.81	-0.01
Total	98.78	94.81	3.97	0.06

Source: Modelling using PRIMES.

Table 7: Coal use by industrial sector in 2030 (Mtoe)

Sector	REPowerEU	Ff55	Difference	Diff. due to high prices
Chemicals	2.10	1.64	0.46	0.09
Engineering	0.12	0.07	0.06	0.00
Food, drink and tobacco	1.06	0.78	0.28	0.05
Iron and steel	15.42	15.82	-0.40	1.28
Non ferrous metals	0.17	0.09	0.08	0.01
Non metallic minerals	3.16	2.39	0.77	0.04
Paper and pulp	0.79	0.34	0.45	0.05
Refineries	0.02	0.02	0.00	0.00
Textiles	0.03	0.03	0.00	0.00
Other industries	1.76	1.50	0.26	-0.01
Total	24.64	22.68	1.96	1.49

Source: Modelling using PRIMES.

In REPowerEU the potential for renewable hydrogen use in industry is illustrated by a significantly higher consumption in all sectors. Hydrogen consumption is higher by a factor of 3.7 in refineries, 4.8 in industrial heat, 2.5 in petrochemicals in REPower compared to Fit-for-55. Consumption of hydrogen in the transport sector is also higher by 1.4 Mt of hydrogen in REPowerEU, or about 2.5 times what it would be in Fit-for-55 (Table 8). Without REPowerEU and with the influence of higher fossil fuel prices, the use of renewable hydrogen by the industry would be lower in 2030, notably in

petrochemicals, blast furnaces, synthetic fuels and refineries. REPowerEU therefore plays a key role in generalising the use of renewable hydrogen in industry.

Table 8: Hydrogen use by sector in 2030 (kt hydrogen)

Sector	RePowerEU	Fit-for-55	Difference	Diff. due to high prices
Bunker fuels	0	0	0	0
Refineries	2273	613	1660	-32
Industrial Heat	3629	756	2873	146
Transport	2319	882	1437	90
Petrochemicals (Ammonia)	3232	1306	1925	-116
Blast furnaces	1520	1152	368	-92
Synthetic fuels	1788	1870	-82	-63
Power generation	105	0	105	0
Blending	1335	0	1335	0
Total	16200	6579	9621	-67

Note: conversion from ktoe to kt H2 uses a 2.87 factor.

In addition to the RePowerEU analysis, a bottom-up assessment of existing projects indicates that the energy intensive industries (EII) have various projects in the pipeline with high technological readiness level and high potential for decarbonisation and the reduction of Russian fossil fuels' consumption. The acceleration of investments could provide a substantial contribution in terms of energy savings, both short term and long term.

10. Skills, social, employment

To ensure a successful implementation of the REPowerEU Plan, and in line with the Fit-for-55 packages⁴⁰ as well as the narrative of the European Green Deal to ensure that nobody is left behind, social and labour market investments as well as fair transition aspects have to be considered from the outset. Moreover, skill shortages may slow down the implementation of the RePowerEU and Fit-for-55. increased and accelerated green transition.

⁴⁰ In particular COM(2021) 801.

3. RENEWABLES AND ENERGY EFFICIENCY FOR REPOWEREU

1. Renewables

The RePowerEU scenario shows that the increase of the overall RES to 45% in 2030 leads to an increase in all supply and demand renewable sectors – electricity, heating and cooling, industry, buildings and transport as illustrated in Table 9.

Table 9: Renewables in RePowerEU scenario

	Renewables in RePowerEU	Renewables in Fit-for-55
<i>Overall RES Target</i>		
EU binding	45%	40%
<i>Heating & Cooling</i>		
Average yearly increase for 2020-2030 at EU level	2.3 percentage point	1.5 percentage point*
<i>District Heating & Cooling</i>		
Average yearly increase for 2020-2030 at EU level	2.3 percentage point	2.1 percentage point
<i>Buildings</i>		
EU RES Share in Buildings in 2030 at EU level	60%	49%
<i>Transport</i>		
RES-T share in 2030 / GHG intensity reduction in transport	32% / 16%	28% / 13%
Share of advanced biofuels in 2030 (single-counted)	2.2%	2.2%

Share of RFNBOs in 2030 (single counted)	5.7%	2.6%
Biomethane production beyond the transport sector	35 bcm	18 bcm
<i>Industry</i>		
RES share in industry - Average yearly increase for 2020-2030 at EU level	1.9 percentage point	1.1 percentage points
RFNBOs in industry	78% of hydrogen consumed in industry is renewable	50% of hydrogen consumed in industry is renewable

** for the purpose of the RED, the heating and cooling target is divided into the annual minimum and top-ups.*

By 2030, the renewable energy share in the electricity ('RES-E') sector would reach 69% in the RePower context. This implies that substantial acceleration will be needed.

During the same time period, the share of renewables in the heating and cooling sector ('RES-H&C') would increase to 46% compared to the 38-40% observed in the Fit-for-55 proposals.

Of all sectors, transport has, in 2020, the lowest penetration of renewables with a share ('RES-T') of 10%⁴¹. By 2030, this needs to increase to reach 32%.

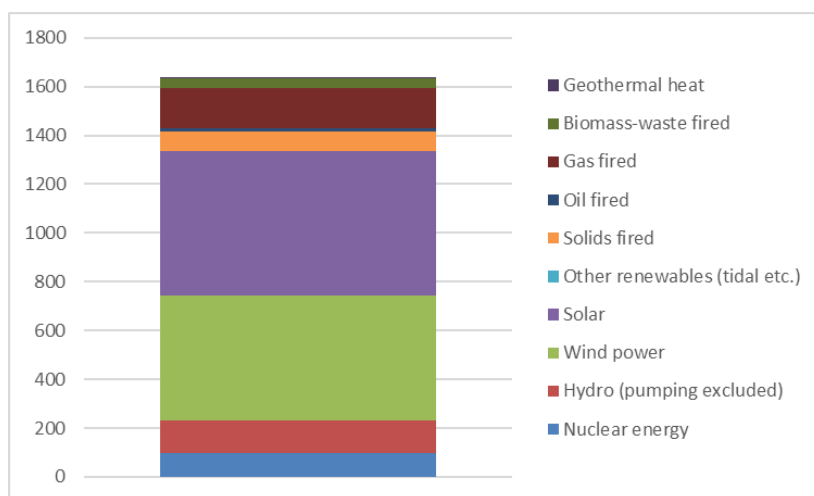
Between 2020 and 2030, the share of wind and solar energy in installed power production capacities is projected to increase from 33% to 67%. In 2030, solar energy would be also the largest electricity source in terms of capacity, with more than half expected to be solar-rooftop capacities. Wind energy would have a 31% share of installed capacity in 2030, with an increase of 12 p.p. from 2020. Figure 3 shows PRIMES modelling projections of the net installed power capacity in REPowerEU in 2030.

In this context, boosting the capabilities in Europe for manufacturing clean energy equipment across their value chains would help ensure that EU climate objectives are not jeopardised by creating import dependencies elsewhere, as well as improve EU energy security and resilience prospects. This will require diversifying the supply of renewable energy equipment, reducing sectoral dependencies,

⁴¹ According to Articles 25-27 of Directive 2018/2001/EC (revised RED) where specific caps and multipliers apply for different renewable fuels. If the share was to be calculated according to the methodology in Directives 2009/28/EC and 2015/1513/EC (RED up to 2020) it would be equal to 7%.

overcoming supply chain bottlenecks and expanding the EU’s clean energy technology manufacturing capacity.

Figure 3: Net installed power capacity in REPowerEU in 2030 (GWe)



Source: Modelling using PRIMES.

2. Energy Efficiency

The combined effect of high fuel prices and policies designed to reduce gas dependence will affect the way energy is used in Europe. The effect of high fuel prices alone is twofold. The price increase is particularly high for natural gas prompting a shift towards fuels with lower conversion efficiency (e.g., coal). This shift tends to increase primary energy consumption. Secondly, in final consumption sectors, high prices tend to promote energy conservation reducing final energy consumption. These two effects tend to counterbalance each other: by 2030, in a scenario driven by high prices alone, Gross Inland Consumption is slightly higher (+0.4% compared to the Fit-for-55 scenario) while Final Energy Consumption is slightly lower (-0.6% compared to the Fit-for-55 scenario).

Additional policies aimed at reducing gas consumption further promote energy efficiency. Fuel shift from gas to coal and oil still take place, but it is now more than compensated by a deeper reduction in energy consumption. Compared to the Fit-for-55 scenario, both Gross Inland Consumption and Final Energy Consumption is significantly lower by 2030 (-3.8% and -4.8% respectively).

In all scenarios (including the Fit-for-55 scenario) consumption of all fossil fuels is significantly lower compared to 2020. However, by 2030, the fuel shift prompted by high prices and security of supply policies is significant: compared to the Fit-for-55 scenario, consumption of natural gas is 48% lower while consumption of coal is 41% higher. Gross electricity generation is slightly higher in 2030 compared to the counterfactual. Power generations the residential sector consume a high share of natural gas and are particularly affected. Table 11 illustrates the change in final energy demand by sector.

With respect to the projections in the EU Reference Scenario 2020, final energy consumption is 13% lower (compared to nearly 9% in the Fit-for-55 scenario).

In the residential sector, additional energy efficiency measures reduce energy consumption by more than 6% compared to the Fit-for-55 package. The increased gas price delays investments aimed at replacing heating systems using coal and oil resulting in the fuel shift described above. Electrification is only slightly higher as additional demand for electricity is compensated by reduced energy use. Average energy consumption per square meter is slightly lower in the residential sector. Annual renovation rate is higher: 2% in the Fit-for-55 scenario compared to 2.25% in REPowerEU. Energy related expenses for household are higher by almost 60€ per year, this difference being due to the effect of high prices. Energy use in the service sector is similar to the residential sector, but with slightly higher energy savings.

Table 10: Energy consumption in final demand sectors (Mtoe)

Final energy consumption y sector	RePowerEU	Fit-for-55	Difference	Diff. due to high prices
Industry	196	203	-7	-1
Residential	174	186	-12	3
Tertiary	121	130	-9	-2
Transport	221	229	-8	-5
Total	712	748	-36	-4

Source: Modelling using PRIMES.

4. HYDROGEN ACCELERATOR

1. Scaling up the production and import of renewable hydrogen to 20 Mt by 2030

Demand side

The European Commission has already proposed minimum levels of renewable hydrogen uptake in industrial applications and the transport sector in the Renewable Energy Directive (amounting to 5,6 Mt renewable hydrogen by 2030). In view of moving away from the use of Russian fossil fuel imports in the EU, the EU needs to accelerate ramping up both demand and supply of renewable hydrogen. The focus of hydrogen demand should primarily remain on applications in hard-to-decarbonise sectors in industry and transport. European Commission modelling (PRIMES) results show that the scaling up of renewable hydrogen use in the EU to 20 Mt in 2030 creates opportunities for the uptake of higher volumes in certain industry and transport sectors. According to this modelling, upscaling the use of renewable hydrogen, ammonia and other derivatives would accelerate decarbonisation and greatly reduce the EU's dependence on natural gas (by approximately 27 bcm), oil (by approximately 3.9 Mtoe) and coking coal imports (approximately 156 Kt) from Russia^{42 43}.

To unlock investment in renewable hydrogen use in industry, the Commission will double the funding for the Innovation Fund's 2022 Large Scale Call this autumn to around 3 billion EUR, financed by higher revenues expected in 2022 and 2023 from the Emissions Trading System. This year's Call will contain also a window focused on innovative electrification and hydrogen applications in industry. Furthermore, in the review of the EU Emission Trading System it is proposed to allow the Innovation Fund to cover 100% of the relevant costs in the case of competitive bidding. On this basis the Innovation Fund will also be able to support hydrogen uptake by industry through an EU-wide scheme for (Carbon) Contracts for Difference.

According to Commission modelling (PRIMES) the uptake of higher volumes of renewable hydrogen in the priority sectors identified for the Fit-for-55 targets translates into higher shares of renewable hydrogen and renewable fuels of non-biological origin in the industry sector, increasing from 50 to above 75%. In particular, hydrogen production based on natural gas should be replaced in ammonia production and in hydrogen use by refineries by 2030 and the steel industry should see the start of the shift from the use of coking coal to hydrogen. The share of hydrogen and derived fuels (renewable fuels of non-biological origin) in the transport sector would also increase to above 5%. Higher consumption of hydrogen in hard-to-abate transport sectors, especially in heavy duty trucks and through the production of sustainable fuels for aviation and waterborne sectors provides another opportunity to replace Russian fossil fuels. The concept of hydrogen valleys can be further promoted as they are key to igniting and increasing hydrogen supply and demand⁴⁴, especially around industrial clusters where hydrogen applications could be shared amongst multiple users in close proximity. Today there are 23 hydrogen valleys across Europe in 10 Member States. Substantial investment is

⁴² According to Eurostat in 2020 about 12% of coking coal used in the EU was imported from Russia.

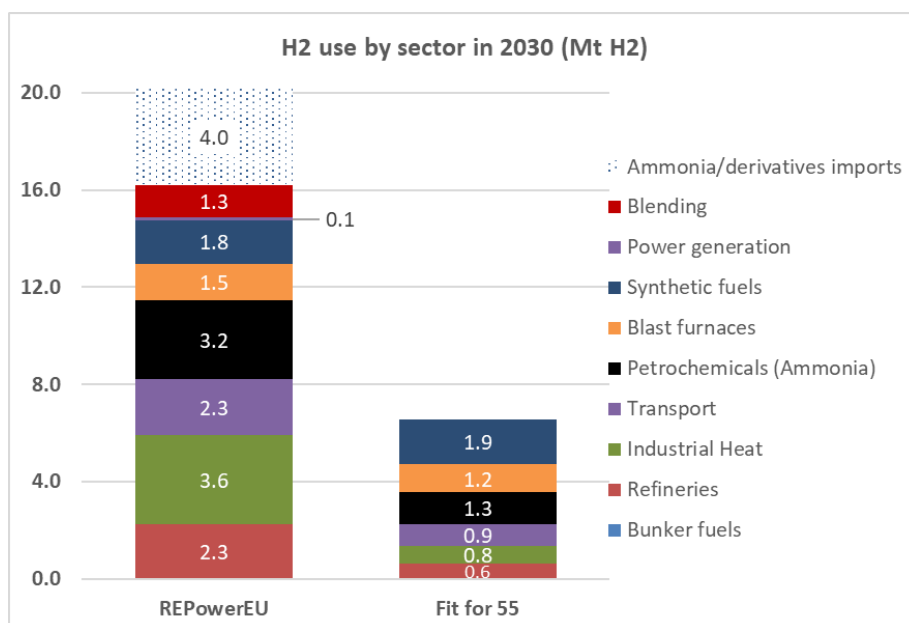
⁴³ Repower EU scenario: the figures correspond to the *increased* use of renewable hydrogen to replace the use natural gas, oil and coal until 2030 in hard-to-decarbonise sectors as initially envisaged under the fit-for-55 scenario as well as an increased role for blending hydrogen in the existing gas grid.

⁴⁴ One of the main priorities of the EU is the development of so-called hydrogen valleys that bring together – in a limited geographical area - all the elements of renewable hydrogen production, storage and end-use into an integrated ecosystem. Hydrogen valleys can vary in size and scope thus proving to be very flexible in adapting to local energy needs.

needed to double the number of hydrogen valleys by 2025 in order to accelerate the energy transition across the EU.

Beyond using renewable hydrogen in industry and transport, it is necessary to look at other sectors where hydrogen uptake could be increased without causing harm. The Commission reiterates its position that **blending hydrogen** into the natural gas grid requires careful consideration as it diminishes gas quality, can increase overall system costs and the costs of heating for the residential sector, and it is in most applications a less efficient alternative to direct electrification. Nevertheless, blending up to around 3% by volume of renewable hydrogen in the gas grid may absorb about 1,3 million tonnes of hydrogen and replace 4,7 bcm natural gas. This requires however considering all consequences and costs of blending, including overall system costs and adaptation costs for household and industrial end-users⁴⁵. For example, the costs for end-users and infrastructure operators to adapt to a 5% blending level (by volume) would amount to around € 3,6 billion per year⁴⁶.

Figure 4: Hydrogen use by sector in 2030



Source: Modelling using PRIMES.

⁴⁵ Blending already low volumes of hydrogen into the natural gas network can cause significant problems and additional costs for end-users. The costs to adapt to a certain level of hydrogen blend include the adaptation costs at end-users (change of end-use appliances, e.g. furnaces, turbines, engines, household boilers), at the level of infrastructure (change of compressor stations and measuring equipment/comptographs), the increased cost of gas quality management and the increased overall system costs (i.e. replacing more efficient applications e.g. for space heating) and higher subsidy needs (in view of lower willingness to pay when cheaper alternatives are available).

⁴⁶ Annex 7, Gas quality: Hydrogen blending cross-border framework of the Commission SWD Impact Assessment Report accompanying the Proposal for a Directive of the European Parliament and of the Council on common rules for the internal markets in renewable and natural gases and in hydrogen (recast) and Proposal for a Regulation of the European Parliament and of the Council on the internal markets for renewable and natural gases and for hydrogen (recasts), <https://op.europa.eu/en/publication-detail/-/publication/23b8497d-5d8b-11ec-9c6c-01aa75ed71a1/language-en>.

The Commission modelling carried out for REPowerEU is based on the assumption of 10 Mt renewable hydrogen produced in the EU and 6 Mt of renewable hydrogen imported from third countries (with the expectation that supply capacity for transporting hydrogen into Europe is established). Higher levels of consumption, up to the 20 Mt of hydrogen announced in the REPowerEU communication is assumed to be delivered from third countries in the form of ammonia and potentially in the form of other hydrogen carriers and derivatives. The chart above shows the results of the REPowerEU modelling compared to the modelling results for the Fit-for-55 package.

To support such an increase of renewable hydrogen use in these sectors, a progress report on the production, transportation and uptake of hydrogen in the different sectors should be prepared regularly starting in 2025, in close cooperation with Member States and strengthening collaboration within the Hydrogen Energy Network (HyEnet).

The EU Strategy for Standardisation of February 2022⁴⁷ identified standards to support the roll-out of the hydrogen value chain as a standardisation priority. This becomes highly relevant because hydrogen quality issues are expected to emerge once hydrogen is injected into the hydrogen network from different production processes and transported through a meshed network, including cross-border. To tackle this issue, a mandate for the standardisation of hydrogen quality in the dedicated hydrogen network to accelerate the uptake of hydrogen in the priority sectors will be developed.

Supply side

Stepping up our renewable hydrogen ambition requires further additional investments in renewable energy production requiring around 500 TWh of additional power generation in 2030. Total investment costs are expected to be in the range of € 335-471 billion, with € 200-300 billion needed for additional renewable electricity production.

Furthermore, the European electrolyser manufacturing capacity must be scaled-up significantly to meet the expected demand for renewable hydrogen production. Electrolyser manufacturers in Europe set the objective to have in place by 2025 a combined annual electrolyser manufacturing capacity in Europe of 17.5 GW, and to further increase that capacity by 2030 in line with projected demand for renewable and low-carbon hydrogen⁴⁸. To support these objectives, the European Commission will put in place enabling regulatory framework, facilitate access to finance and promote efficient supply chains. The upscaling of the electrolyser manufacturing capacities will require investments estimated at up to €2bn.⁴⁹

The Commission **supports renewable hydrogen investments** in the context of the Innovation Fund by mobilising increased financial resources, defining specific windows within the next call to reflect the REPower EU priorities (notably maximizing the impact in terms of decarbonizing industry and moving away from imported fossil fuels) and by initiating specific focus on priority areas, such as

⁴⁷ An EU Strategy on Standardisation - Setting global standards in support of a resilient, green and digital EU single market, <https://ec.europa.eu/docsroom/documents/48598>.

⁴⁸ Electrolyser Summit Joint Declaration 2022, [DocsRoom - European Commission \(europa.eu\)](https://ec.europa.eu/docsroom/documents/48598).

⁴⁹ European Commission services estimate based on actual industry project costs.

renewable hydrogen-based applications in industry and clean-tech manufacturing, such as of electrolyzers..

The Commission will also do its utmost to assess **state aid related to renewable hydrogen**, while ensuring a level playing field and considering technology neutrality, including in the framework of Important Projects of Common European Interest (IPCEIs).⁵⁰

To speed up permitting procedures for renewable electricity generation, renewable hydrogen production and for infrastructure development, on 18 May 2022 the Commission put forward a legislative proposal on permitting and a related recommendation⁵¹. Furthermore, under the hydrogen and gas markets decarbonisation package a number of measures have been proposed to expedite authorisation procedures for the repurposing of existing natural gas infrastructure for the transport and storage of hydrogen as well as procedures for newly constructed dedicated hydrogen infrastructure. Member States are encouraged to work pro-actively on adopting some of these measures, or similar ones, in their national law in view of facilitating the transposition of the hydrogen and gas markets decarbonisation package, once it is finalised in the co-decision process.

To gain further insight in applicable permitting rules and procedures for the construction and operation of future infrastructure dedicated to the production, storage and transport of pure hydrogen, the preparation of a guidance document should be considered. This guidance should support Member States in (further) streamlining and expediting permitting procedures for renewable hydrogen projects. Furthermore, the European Clean Hydrogen Alliance is working to deliver industry recommendations and best practices to accelerate the authorisation procedures for hydrogen projects to be presented at the June 2022 Hydrogen Forum.

Europe's world leadership in clean hydrogen technologies can only be maintained through increased research and innovation efforts at both EU and national level. The Clean Hydrogen Partnership under Horizon Europe is raising the ambition with an EU support of EUR 1 billion for the period 2021-2027, complemented by at least an equivalent amount of private investment (from the private members of the partnership), bringing the total budget to above EUR 2 billion.

The Commission provides technical support to Member States for the implementation of REPowerEU, including for the enhanced roll-out of renewable hydrogen and hydrogen solutions for industry. Emphasizing the additional fresh water needs that correspond to the enhanced roll-out of renewable hydrogen⁵² production, compliance with the Water Framework Directive is of key importance in choosing the location for the roll-out of additional production capacities.

To enable scaling up demand and supply of renewable hydrogen in Europe, the Commission envisages working closely with Member States and stakeholders in a structured way to understand the

⁵⁰ European Commission Communication: REPowerEU: Joint European Action for more affordable, secure and sustainable energy of 8 March 2022, https://eur-lex.europa.eu/resource.html?uri=cellar:71767319-9f0a-11ec-83e1-01aa75ed71a1.0001.02/DOC_1&format=PDF

⁵¹ Proposal for a Directive of the European Parliament and of the Council amending Directive (EU) 2018/2001 of the European Parliament and of the Council as regards the promotion of energy from renewable sources, COM (2022)222 Commission Recommendation on speeding up permit-granting procedures for renewable energy projects and facilitate Power Purchase Agreements, C(2022) 3219, SWD(2022) 149

⁵² Around 20 l of water is needed per Kg of H₂.

developments and barriers to the scale up of hydrogen use on the ground. The temporary Hydrogen Platform could scope topics related to market operation and to technical questions (e.g. capacity allocation, balancing, cyber security, interoperability, quality standards) as proposed in the hydrogen and gas markets decarbonisation package.

2. Scaling up the development of hydrogen infrastructure in the EU

A rapid development of energy infrastructure that connects supply and demand is a key ingredient for the envisaged acceleration of hydrogen production and use in the EU and beyond. This concerns transport via pipelines, as well as non-network based options using, for example, adapted LNG terminals, and storage.

The revised TEN-E Regulation, entering into force in June 2022, is a unique instrument for European energy infrastructure planning. It enables a coordinated and timely development of trans-European hydrogen networks, by selecting key infrastructure projects of cross-border relevance based on a robust methodology, in line with EU policy objectives, including hydrogen pipelines, storage facilities, electrolysers and hydrogen terminals, covering as well hydrogen embedded in other chemicals. The stepped-up renewable hydrogen ambition also requires the identification of a limited number of hydrogen import pipelines in that context. For reaching our long-term decarbonisation goals, it is crucial to ensure that new natural gas infrastructure needed today to become independent from Russian gas imports avoids lock-in into longer-term fossil imports. To support the development of hydrogen infrastructure priorities, the European Commission will work with stakeholders to identify possible challenges for European hydrogen infrastructure development and implementation. Based on the TEN-E Regulation, starting early this autumn, the Commission together with the Member States, national regulatory authorities, the European Agency for the Coordination of Energy regulators (ACER), the European Network of Transmission System Operators for Gas (ENTSOG), promoters and other stakeholders, will discuss trans-European hydrogen infrastructure needs. Work will be organised within three hydrogen priority corridors. This step will be followed by a cost-benefit assessment of candidate hydrogen projects expected to be submitted by early October 2022. The process will deliver preliminary hydrogen infrastructure needs by March 2023. The first list of infrastructure Projects of Common Interest (PCI) between Member States, and Projects of Mutual Interest (PMI), between Member States and third countries, will be in place by the fourth quarter of 2023. The upscaling of the hydrogen transport infrastructure will mainly rely on repurposed pipelines, complemented by newly built ones. This will be prepared by assessment of which gas infrastructure will become available for such repurposing.

The European Clean Hydrogen Alliance identified a pipeline of over 750 investment projects that its members indicated to undertake by 2030. Projects are located in almost all EU Member States and include the production of hydrogen (projects for the installation of over 50 GW electrolysers), transportation and its usage by industry, mobility applications, energy systems and in buildings. The European hydrogen industry estimates a need of around 120 GW of electrolyser capacity in the EU by 2030, which would suffice to meet the objective of producing 10 million tonnes of renewable hydrogen.

With its Communication on Important Projects of Common European Interest (IPCEI), the Commission has set out criteria under which Member States can grant state aid to transnational projects of strategic significance for the EU under Article 107(3)(b) of the Treaty on the Functioning of the

European Union (TFEU). The Commission is in close contact with all interested Member States and facilitating the coordination between Member States towards IPCEIs in the area of new hydrogen related technologies and infrastructure. The Guidelines on State aid for climate, environmental protection and energy (CEEAG) and the state aid general block exemption Regulation (GBER) provide additional important EU frameworks under which Member States may allocate financial aid to infrastructure projects.

The consumption of 20 million tonnes of renewable hydrogen will also require **accelerated investments in hydrogen infrastructure** to bring renewable hydrogen production in areas with high renewable energy resources to the end-consumers. The development of port infrastructure and their connection to both industrial and transport users in the vicinity will be of critical importance. Therefore, the Commission considers as crucial support for the development of necessary port infrastructures to receive imports of hydrogen, including in the form of renewable ammonia and other renewable hydrogen by-products.

Many EU financing sources could be relevant for European hydrogen infrastructure projects, ranging from the RRF as a performance-based instrument, the Connecting Europe Facility (programme specifically dedicated to cross-border infrastructure), the InvestEU Programme, the Innovation Fund, the Life Programme and programmes under shared management such as ERDF, including Interreg, the Cohesion Fund, Modernisation Fund and Just Transition Fund. Estimates for the necessary investments for hydrogen infrastructure vary significantly. To promote investments in hydrogen infrastructure in a cross-border, interregional and transnational context, the Commission, together with Member States, builds on cooperation frameworks such as the EU macro-regional strategies.

A Commission estimate of investment needs for key hydrogen infrastructure categories by 2030 points to about € 50 – 75 bn for electrolyzers, € 28 – 38 bn for EU-internal pipelines and € 6 – 11 bn EUR for storage. Related additional funding needs for cross-border hydrogen infrastructure could require increasing the budget available for CEF Energy by 2 bn EUR.

3. Stepping up our international engagement on hydrogen to scale up renewable hydrogen imports

As set out in the EU external energy engagement strategy adopted on 18 May 2022⁵³, cooperation with third countries is essential, both to accelerate their energy transition, including the transformation and decarbonisation of their energy systems, while enhancing their energy security, as well as to import hydrogen to the EU. International renewable hydrogen cooperation should follow a comprehensive approach supporting partner countries in their energy transition notably by supporting the deployment of renewable energy sources. These renewable energy sources must benefit in priority local populations, in particular in countries where access to electricity is not generalised, while avoiding increasing water stress in third countries to produce hydrogen by electrolysis, a water-intensive technology.

A clear focus should be on renewable hydrogen, both for the domestic market and for export to the EU, as well as on strengthened cooperation with all partners on regulatory issues. This should include in particular certification in accordance with the EU requirements for import to the EU and full life

⁵³ EU external energy engagement in a changing world, JOIN(2022) 23.

cycle GHG emissions approaches, to ensure a level playing field with renewable hydrogen produced in the EU. Geographically, the focus should be on the EU neighbourhood while establishing partnerships with other potential suppliers in the Southern Neighbourhood, Sub-Saharan Africa, the Middle-East, the Gulf, Chile, but also the US and Australia. Studies indicate that until 2030 the imports of hydrogen to the EU are most cost efficient via pipelines from the neighbourhood and in the form of ammonia through ships over longer distances. To support such developments, the Commission could facilitate coordinated EU action in cooperation with industry to develop by 2030 three major import/hydrogen corridors to North Africa, to the North Sea area and as soon as conditions allow to Ukraine.

The situation we face today offers an opportunity to address existing vulnerabilities in our energy security. The current situation in the gas market demonstrates how third country governments can impact EU energy prices simply by limiting the free flow of energy goods. The Commission's aim is to reinforce its partnerships with reliable third countries to ensure open and undistorted trade and investment relations for renewable and low carbon fuels, preventing distortions in these future markets. This will strengthen our energy security as our respective economies transition to these new energy goods.

To support the creation of a regulatory framework for renewable hydrogen partnerships, facilitate EU-wide coordination on international hydrogen projects and incentivise European and global renewable hydrogen production, the **Global European Hydrogen Facility** should be established in cooperation with the Member States. The Global European Hydrogen Facility should create investment security and, hence, business opportunities for European and Global renewable hydrogen production, and, at the same time, reliable supply and transparency for European hydrogen usage. The Global European Hydrogen Facility should be coherent with intra-EU measures and market functioning.

The **Green Hydrogen Partnerships** promote the import of renewable hydrogen from third countries and should incentivise decarbonisation and the development of renewable energy production for domestic use in the partner countries, while encompassing policy dialogue, including on sustainability standards. Together the Green Hydrogen Partnerships and the Global European Hydrogen Facility should deliver a framework to ensure that partnerships established by the Member States and by the industry provide a level-playing field between EU production and third country imports, and that these partnerships are not set up in isolation. At the same time, such EU level coordination should be complementary to the activities of Member States and industry, such as the many agreements and Memoranda of Understanding that they concluded with international partners on hydrogen development, innovation, transport and potential import.

The EU takes a leading role in international cooperation on renewable hydrogen research and innovation through Mission Innovation, the global initiative to accelerate efforts in renewable energy innovation. Under Mission Innovation, the European Commission co-leads the Clean Hydrogen mission that aims at reducing the costs of hydrogen and to develop at least 100 hydrogen valleys worldwide by 2030.

4. Conclusions:

Based on the above

- The Commission considers developing regular progress reports, starting in 2025, on the production, transport and uptake of renewable hydrogen in industry and transport.
- Based on the EU Strategy for Standardisation of February 2022, a mandate for the development of harmonised standards for the quality of hydrogen to support its uptake in the priority sectors will be prepared.
- The Commission stands ready to provide further guidance on applicable rules and procedures for the construction and operation of future infrastructure dedicated to the production storage and transport of pure hydrogen. This would support Member States in expediting and (further) streamlining permitting procedures for hydrogen projects.
- The hydrogen and gas markets decarbonisation package provides for a Hydrogen Platform, which would enable scoping hydrogen market operation and technical issues as a first step towards setting up the European Network of Hydrogen Network Operators.
- Based on the TEN-E Regulation, the Commission will cooperate closely with stakeholders to ensure the development of European hydrogen infrastructure priorities via the TEN-E process, leading to needs identification by March 2023 and a first list of Projects of Common Interest and Projects of Mutual Interest by end 2023.
- To enable increased renewable hydrogen imports, the Global European Hydrogen Facility should be established in cooperation with the Member States. The Facility should be coherent with intra-EU measures and market functioning as well as our trade and investment policy objectives to support the creation of a regulatory framework for renewable hydrogen partnerships, facilitate EU-wide coordination on international hydrogen projects and incentivise European and global renewable hydrogen production.
- Double the number of hydrogen valleys by 2025 through topping up Horizon Europe investments on the Hydrogen Joint Undertaking to offer solutions with citizens' engagement, in regional innovation ecosystems, cutting across the entire hydrogen value chain.

5. ACHIEVING THE BIOMETHANE TARGETS

This section explores the actions that could be envisaged to achieve the target of 35 bcm annual biomethane production by 2030 as set out in the REPowerEU Communication⁵⁴ of March 2022. Therefore, the proposed actions would aim at both supporting production to a sustainable maximum potential volume of biogas with the aim to further upgrade it to biomethane, as well as direct biomethane production from waste and residues. The actions could also aim at creating the preconditions for sustainable upgrading and safe injection of biomethane into the gas grid. The production of sustainable biomethane should be waste-based, avoiding the use of food and feed feedstocks that would lead to land use change problems. In addition, by 2024, Member States have to collect separately organic waste, which can be valorised in anaerobic digestors. This is an opportunity to upscale the production of biogas and biomethane sustainably, creating income opportunities for farmers and foresters.

Area of action	Type of action	Content	Possible actors
<p>Promote the sustainable production and use of biogas and biomethane at EU and national/ regional level and the injection of biomethane into the gas grid</p>	<p>1. Create a biogas and biomethane industrial partnership/ forum promoting their sustainable production and use</p>	<p>The overarching goal of the partnership/ forum is to support the achievement of the EU target on biomethane production for 2030 and to create the preconditions for a further ramp up of its potential towards 2050 through closer involvement of stakeholders.</p> <p>The partnership would create a platform for strategic discussion among key stakeholders along the whole value chain on how to best support the production and use of biogas and biomethane. This would promote stakeholder engagement and public acceptance. The partnership would provide effective support for identifying, further developing and mainstreaming of best practices in policy making and support to the production of biogas and biomethane, and related to that infrastructure development, projects and infrastructure financing and promotion. The</p>	<p>EC, MS, industry representatives, NGOs, ETIP Bioenergy, representatives of primary producers</p>

⁵⁴ COM(2022)108 final.

Area of action	Type of action	Content	Possible actors
		<p>partnership could also discuss policy gaps at EU level and identify support needs as regards infrastructure and RND&I projects.</p> <p>In this endeavour, the platform should take into consideration and create synergies with ongoing complementary work, in particular the work of the European Technology and Innovation Platform Bioenergy (ETIP Bioenergy), the SET Plan Action 8 Integrated Workgroup on Bioenergy and Renewable Fuels (IWG 8) and international cooperation.</p>	
	<p>2. Develop national strategies on sustainable biogas and biomethane production and use or integrate a biogas and biomethane component in the National Energy and Climate Plans (NECPs)</p>	<p>The aim of such national strategies would be to assess the Member States' national potentials for biogas and biomethane production and the effective integration of the latter into the grid. The strategies should provide a trajectory to reach the identified national potentials by 2030 and 2050.</p> <p>The development of the national strategies should focus on the most sustainable paths, based on waste-based production (e.g. agricultural and agro-industry waste and residues, forest and forest-industry waste and residues, food industry waste, energy and chemical industry biogenic CO₂ effluents and waste, industrial wastewater, domestic organic waste), and the evaluation of the preconditions to further promote the potential of sustainable biomass coming from sequential or cover cropping or other innovative sources of biomass including from marginal lands and</p>	<p>MS, EC</p>

Area of action	Type of action	Content	Possible actors
		<p>contaminated lands through phytoremediation and the related technology development needs. This assessment should be done by taking into account the cascading principle of Article 3(3) of the proposal for a revised Directive (EU) 2018/2001 (RED II)⁵⁵. The promotion of sustainable waste-based biogas and biomethane production would contribute to the objective of cutting methane emissions in line with the Waste to Energy communication of 2017⁵⁶ and the Methane Strategy of 2020⁵⁷.</p> <p>The national strategies should evaluate any barriers for the production or injection of the biomethane into the grid in the national or regional context and integrate actions for lifting these barriers. They should further evaluate the standardisation needs and the need for harmonization of market regulation with other Member States.</p> <p>Such national strategies should be closely linked with the integrated National Energy and Climate Plans under Regulation (EU) 2018/1999, and progress in achieving the strategy and its contribution to national and Union targets should be reported as part of the biennial reporting under Regulation (EU) 2018/1999.</p>	

⁵⁵ COM(2021) 557 final.

⁵⁶ COM(2017) 034 final.

⁵⁷ COM(2020) 663 final.

Area of action	Type of action	Content	Possible actors
		<p>The national biogas and biomethane strategies should be reflected in the national Recovery and Resilience Plans (RRPs), in coordination with support envisaged in other strategic planning documents (e.g. Common Agriculture Policy National Strategic plans or National programming documents for EU structural funds).</p> <p>The Commission can support Member States in the development and implementation of these strategies, including through the Technical Support Instrument.</p>	
	3. Consider broadening the scope of the fuel supply obligation in the Renewable Energy Directive	Biomethane is currently eligible to be used as a renewable transport fuel under the fuel supply obligation set out in Article 25 of the Renewable Energy Directive. While maintaining the primary focus of the supply obligation, its scope could be increased to cover all uses of biomethane. This option should be further looked at and could be considered in a future revision of the Renewable Energy Directive.	EC, MS
	4. Promote participatory multi-stakeholder engagement	A number of events, in particular conferences, workshops and trainings, would be organised to raise awareness, provide training and technical assistance, and promote multi-stakeholder involvement in a regional/ local dimension in implementing and promoting European cross-border integrated projects, as for example Integrated Projects of Common European Interest (IPCEIs).	EC, MS, NGOs, Industry, local authorities

Area of action	Type of action	Content	Possible actors
		<p>The Commission might consider the option of developing an EU strategy for energy transition in rural areas as a tool to support the implementation of such integrated energy solutions in rural areas, taking advantage of numerous decentralized small biogas plants operating in the EU and integrating them in the overall renewable energy mix, by also addressing related environmental and social aspects. The existing local infrastructure such as the development and implementation of Local Development strategies (supported through rural development funds of the Common Agriculture Policy or structural and cohesion policy as relevant, e.g. through Community Led Local Development) and of farmers' cooperative structure could be used. In addition, other multi-stakeholder structures, such as energy communities, could be used; the work in this area should build on the Rural Energy Community Advisory Hub.</p> <p>The concept of developing urban-rural linkages would be looked at by trying to enhance synergies between policy support in both areas (e.g. EU and national support in rural and regional development by among others further encouraging Member States and relevant authorities to boost complementarities between the EU's rural development funds on the one hand and structural or cohesion policy funding on the other hand and thereby pooling rural development and structural and cohesion policy resources).</p>	

Area of action	Type of action	Content	Possible actors
	5. Reduce red tape and speeding up permitting	All issues that currently delay the process, including increasing the capacity in local municipalities dealing with permitting as well as streamline good practices as establishing one-stop shops for biomethane related permits and defining a maximum processing time for permitting applications should be assessed, in line with the permitting legislative proposal adopted by the Commission on 18 May 2022 ⁵⁸ .	MS, EC
	6. Promote sustainable biogas and biomethane co-operation with neighbouring and enlargement countries	Biogas and biomethane development in EU neighbourhood and enlargement countries, including through the EU-Ukraine renewable gases partnership and in co-operation with the Energy Community, should be supported. Further explore the possibility of joint projects between Member States and partner countries as RED II currently limits joint projects between EU and third countries to electricity.	EC, UA, EnC
Provide incentives for biogas upgrading into biomethane	1. Reduce the costs for economic operators, which currently prevent biogas upgrading into biomethane	The action would look into the high costs of biogas upgrading as a barrier of entry for individual economic operators into the biomethane production. Part of these costs are the costs of upgrading, grid connection and grid injection. When it comes to the costs related to grid connection, a more proportionate scenario for cost sharing of such costs should be	EC, MS, NRAs, TSOs/DSOs

⁵⁸ Proposal for a Directive of the European Parliament and of the Council amending Directive (EU) 2018/2001 of the European Parliament and of the Council as regards the promotion of energy from renewable sources, COM (2022)222.

Area of action	Type of action	Content	Possible actors
		<p>considered. The lifting of injection costs is already part of the hydrogen and gas markets decarbonisation package of December 2021⁵⁹.</p> <p>The content of existing promotion schemes at national level for electricity production from biogas should also be reviewed to focus on support for biogas upgrading. In this context, the benefits of developing take-off agreement tools or other incentives, to ensure that there are long-term benefits for biogas plants currently providing electricity to be converted into biomethane plants as well as for new biomethane investments, should be considered. This would bridge the price gap with natural gas and would provide an understanding to investors for longer term investments beyond only transitional ones and contribute to the creation of a stable policy and investment framework.</p>	
<p>Promote the adaptation and adjustment of existing and the deployment of new infrastructure for the transport of increased shares of biomethane through the EU gas grid</p>	<p>1. Carry out regional assessment of network development and matching it with the potential of sustainable biomethane production</p>	<p>This action would tackle issues related to the network capacity development in the Member States and at regional level. The outcome should be an assessment of the network development needs, matching them with the potential of increased biogas and biomethane production derived from the national biogas and biomethane strategies. The analysis should be undertaken by the distribution system operators</p>	<p>MS, TSOs and DSOs (in particular for gas), NRAs, ACER</p>

⁵⁹ COM(2021) 803 final and COM(2021) 804 final.

Area of action	Type of action	Content	Possible actors
		<p>(DSOs), in coordination with transmission system operators (TSOs) and national regulatory authorities.</p> <p>As a result, regional maps with the highest potential for biogas and biomethane production due to the availability of raw materials (i.e. waste/ residues), existing operating biogas plants and current connection capacity should be established.</p> <p>This action should take into account the permitting legislative proposal adopted by the Commission on 18 May 2022, in particular the mapping and identification of ‘renewables go-to areas’ as regards biogas and biomethane production plants.</p>	
	<p>2. Assess challenges, bottlenecks and other possible measures from the infrastructure perspective for cost-efficient deployment of biomethane</p>	<p>National (regulatory) authorities, TSOs and DSOs should assess potential investment challenges to increase the uptake of biomethane and connect decentralised production sites with consumption centres over large distances.</p> <p>TSOs and DSOs should assess the capacity and potential cost of injection of biomethane and how to streamline planning and coordination among them as regards the integration of biomethane.</p> <p>In addition, national (regulatory) authorities, TSOs and DSOs should in the framework of the TEN-E smart gas grids thematic area group identify and assess candidate projects for the future lists of Projects</p>	<p>MS, gas TSOs and DSOs, NRAs, ACER, TEN-E smart gas grid thematic area group</p>

Area of action	Type of action	Content	Possible actors
		of Common Interest (PCI) in line with the criteria of the TEN-E Regulation.	
	3. Address gas quality standardisation issues	<p>Barriers exist today preventing or at least hampering cross-border flows of biomethane. The problem is related to the uncoordinated application of existing CEN gas quality standards across borders (e.g. accepted level of oxygen content).</p> <p>Based on the analysis in the national strategies and work on European level, the Commission supports the update of the CEN gas quality standard to ensure the cross-border flow of biomethane (in addition to the strengthened cross-border quality coordination provisions proposed in the Hydrogen and Gas Markets Decarbonisation Package of December 2021) while ensuring the protection of sensitive end-users.</p>	MS, EC, CEN standardisation committee
Address RND&I gaps	1. Provide further support to the development of innovative technologies for the production of sustainable biogas and biomethane	<p>Continue supporting innovative technologies for the production of sustainable biomethane based on gasification of biogenic residues and wastes from all sectors and industries, biogenic CO₂ effluents and waste, organic part of industrial waste waters and municipal sludge, as well as feedstock from marginal and contaminated lands through phytoremediation⁶⁰.</p> <p>Special focus should be given to improving technological efficiency and cost effectiveness of small-scale solutions that would not hamper EU food</p>	EC, MS

⁶⁰ I.e. any technology readiness level (TRL) before commercialisation from 3 to 7.

Area of action	Type of action	Content	Possible actors
		and feed production, as well as to environmental and socio-economic sustainability and looking for alternative materials ⁶¹ where today scarcity might block scaling up.	
	2. Provide further support to innovative technologies for the upgrade of sustainable biogas to biomethane	Continue supporting innovative non-commercialised and small-scale technologies for biogas upgrading, including the biological or catalytic conversion of the biogenic CO ₂ in the biogas to biomethane, with synergies with renewable hydrogen production and use. Special focus should be given to increasing cost effectiveness and efficiency of small-scale upgrading technology (i.e. upgrading technology for small-scale biomethane production) building on UBI project ⁶² .	EC, MS
	3. Provide further support to innovative solutions and research on barriers and integration of sustainable biomethane to the gas grid	This action should focus on integrating results from previous research projects (e.g. Horizon 2020 project REGATRACE on a pan-European methane grid access action plan and project BIOSURF on methodologies and guidelines for certification and registration of biomethane) as well as organising calls on outstanding issues regarding barriers and enablers to the deployment of biomethane. The barriers identified in the national plans should be taken into account and serve as a basis for future research work.	EC, MS

⁶¹ A portfolio of about 20 Horizon 2020 projects adding-up to M€ 120 can provide information on innovative bio-methane production technologies and on barriers and integration of bio-methane into the gas grid. In addition, the 2021 Horizon Europe Call provides a top-up for the innovative bio-methane production topic to support 5 projects of about M€ 50 using reserve-list budget.

⁶² H2020 project on Biological Integral Biogas Upgrading

Area of action	Type of action	Content	Possible actors
	4. Further support the expansion of the sustainable biomass potential to ensure availability of resources for reaching the biomethane production target	<p>This action should seek ways to enlarge the sustainable biomass feedstock for achieving the 2030 target for biomethane without hampering food security.</p> <p>It would identify regions where biomethane production can be sustainably increased from locally sourced secondary feedstock (crop residues, manure, organic waste) and from additional sustainably produced biomass from sequential or cover cropping or biomass from marginal and contaminated lands⁶³, boosting regional bioeconomy development and decentralized renewable energy development and deployment. For sequential crops and cover crops, the impact on the cultivation of e.g. green manure and the subsequent use of mineral fertilizer, should be considered. A case-by-case analysis of the economic, social and environmental factors for the use of a particular area for the production of sustainable feedstock should be undertaken as well.</p> <p>Furthermore, this action should support the development of other innovative sources of biomass including aquatic.</p>	EC, MS

⁶³ H2020 projects FORBIO, BIOPLAT and MAGIC, GOLD and TELEGRAM can provide information on the distribution of such lands, innovative crop growing and utilization methods, case studies, policy recommendations on sustainable growing and utilization of crops on marginal lands and phytoremediation technologies for growing and using crops on contaminated lands.

Area of action	Type of action	Content	Possible actors
Access to finance	1. Provide access to grants and loans	<p>Provide access to grants and loans from existing EU funds, i.e. rural development funds under the Common Agriculture Policy, structural and cohesion policy funds, National Resilience and Recovery Plans, Horizon Europe, Innovation and Modernisation Funds, LIFE funding, and other national funding in line with State aid rules. In particular, Member States and stakeholders can use the opportunities of the current and future programming of the Common Agriculture Policy and of the cohesion policy to include, where relevant, support to biogas and biomethane in their programmes and strategies (e.g. also through financial instruments).</p> <p>The funding under Horizon Europe should be increased by reallocating resources freed up by non-participation of UK partners in the next calls to new biomethane topics (e.g. unlocking community energy potential to support market uptake of biomethane).</p>	EC, MS, EIB
	2. Innovation Fund	<p>Innovative production and use of biomethane and biogas projects can apply for the Innovation Fund financing. Further support for innovative pre-commercial projects (above-mentioned technologies and others) is being considered in the Fund through frontloading and extending the type of support to competitive bidding.</p>	EC, EIB

Area of action	Type of action	Content	Possible actors
	3. Access to other financial instruments	<p>Develop and provide access to financial instruments (e.g. EIB with InvestEU support). Further increase the targeted support for pre-commercial plants under EIB and InvestEU.</p> <p>The EIB Group already launched financial products to finance innovative and green investments. Existing financial products under InvestEU to support investments contributing to REPowerEU goals (renewable energies; energy efficiency; hydrogen; decarbonisation of industry and support of innovative green companies) can be scaled-up if further resources for risk-taking are provided to InvestEU, thus mobilising additional private finance for REPowerEU purposes.</p>	EC, EIB

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7. ANNEX ON PRICE TRAJECTORIES BETWEEN 2020 AND 2050 FOR GAS, OIL AND COAL

Figure 2 shows the price trajectories between 2020 and 2050 for gas, oil and coal. Oil and coal prices are based on historical data for 2020-2021, combined with estimates of prices in 2022 and complemented by a linear interpolation to the long-term trajectory assumed in the EU Reference Scenario 2020 for the following years. The same approach is followed for gas prices except that these are expected to remain higher than in the Fit-for-55-scenario in the long run.

Figure 2: Fuel price trajectories used for REPowerEU and Fit-for-55 analysis

