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ALLIANZ RESEARCH

JOSTLE THE COLOSSAL FOSSIL: A PATH TO THE ENERGY SECTOR TRANSITION

08 December 2021

EULER HERMES

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EXECUTIVE SUMMARY

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The EU faces an implementation gap of six years in cutting greenhouse gas emissions from the energy sector by 2030. Decarbonizing the energy sector is crucial to achieve the net-zero target as nearly three-quarters of the EU's total greenhouse gas emissions originate from the production and use of energy, notably from fossil fuels such as coal, oil and gas. In this context, the EU's Fit for 55 legislation has set a 55% reduction target by 2030 for total emissions (vs 1990 levels). For the energy sector, their proposal would result in a 45% emissions reduction by 2030 (vs 2015 levels). However, while the use of fossil fuels in the EU has been declining, and renewable energy is on the rise, the annual emissions reductions still won't be enough to limit global warming to 1.5°C. To comply with this goal, the EU needs EUR717bn of additional investments per year until 2030, including EUR118bn on the supply side (mainly for new power plants and grids) and EUR599bn on the demand side (mainly for the transport and residential sectors).

Coal, oil, gas: can they be phased out fast enough? In all the proposed Ff55 policy scenarios, electricity generation from coal must be phased out completely by 2030, but this looks highly unlikely. Although most EU member states and the UK have corresponding plans, Germany still lacks a full commitment ("ideally" by 2030) while the remaining Coal-5 countries (Poland, Bulgaria, the Czech Republic, Romania and Slovenia) have made commitments that come after the 2030 deadline. The share of oil in final energy demand is expected to decrease only slightly over the next ten years to 29% (from 37% in 2015) but will fall more dramatically in the following two decades. Yet, natural gas will remain an important fuel source to meet total energy demand for the time being, decreasing by only 13% in 2030 (from 2015 levels), until hydrogen, e-gas and biogas are ramped up.

In this context, companies can take control. The scope and timeframe with which fossil fuel companies plan to decarbonize is an important component in the energy sector transition. Together, these individual plans dictate a collective transition, which should be in line with a 1.5°C future. Looking at the largest firms discloses the magnitude of the challenge: Most have to cut GHG intensities by half by 2035. For the EU as a whole, this implies that GHG intensity should be below the global average and reach negative net-intensities through carbon dioxide removal (CDR) by 2045.

Where do we go from here? Now more than ever, the decisions and actions of private and public corporations will play an increasingly important role in the energy sector's green transition. Overnight action is unrealistic, but fortunately there has never been a better time to ramp up investments in renewable energy: The cost of capital for renewable energy is now a whopping 15pp lower than that of fossil fuel competitors. A key area for investment is (green) hydrogen. The EU already has an ambitious goal to raise the share of hydrogen in Europe's final energy demand to 30% by 2050, which provides European industry with a profitable opportunity in the form of a market worth EUR820bn in 2050. But investment in renewables must be simultaneously undertaken with de-investment from fossil fuels, which means governments need to reevaluate their sizable spending on fossil fuel subsidies.

Investment needs for the EU energy sector transition

Background

~75% Share of the EU's total GHG emissions related to the **energy sector**

"Fit for 55" (Ff55) 2030 Targets:

- 55% GHG emission reduction (total) (vs 1990 levels)
- 45% GHG emission reduction for energy sector (vs 2015 levels)

The Coal Phase-Out

2030 Coal Exit is needed in the EU

6 countries have exit dates after 2030

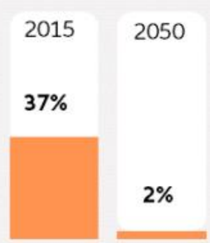
An implementation gap still remains...

Ø annual investments in energy system for Ff55 (in EURbn):

	2021 – 2030	2031 – 2050
Total	€1,039.7	€1,195.0

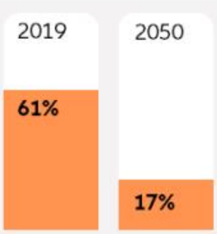
6 years The **implementation gap** that remains between a 1.5°C climate future and the Ff55 proposal... This means an **annual additional investment** by 2030, valued at **EUR 717bn**

Oil – A downfall of demand



Oil products are expected to drop from **37%** of **final energy demand** to **2% by 2050**

Increasing energy security



Switching to renewables from fossil fuels should drop the EU's **energy dependency rate** from **61% to 17% by 2050.**

New alternatives to natural gas

It's role as a transition fuel will begin to phase out after 2030, as **new gaseous fuels dominate the market by 2050.**

- Hydrogen
- E-gas
- Bio-gas

Topics for the EU to explore further:

- Company pathways and private equity
- Hydrogen strategy
- Fossil fuel subsidies

DECARBONIZING THE ENERGY SECTOR: THE IMPLEMENTATION GAP

In December 2020, the EU agreed to strengthen its decarbonization targets to a minimum of 55% greenhouse gas emissions reduction by 2030 (previously 40%), compared to 1990 levels, and to attain net-zero status by 2050. The publication of the European Climate Law in July 2021 proposed to legally bind the member states to meet these targets. However, the UK is more ambitious in this regard, with aims to cut emissions by 68% by 2030 and 78% by 2035[1].

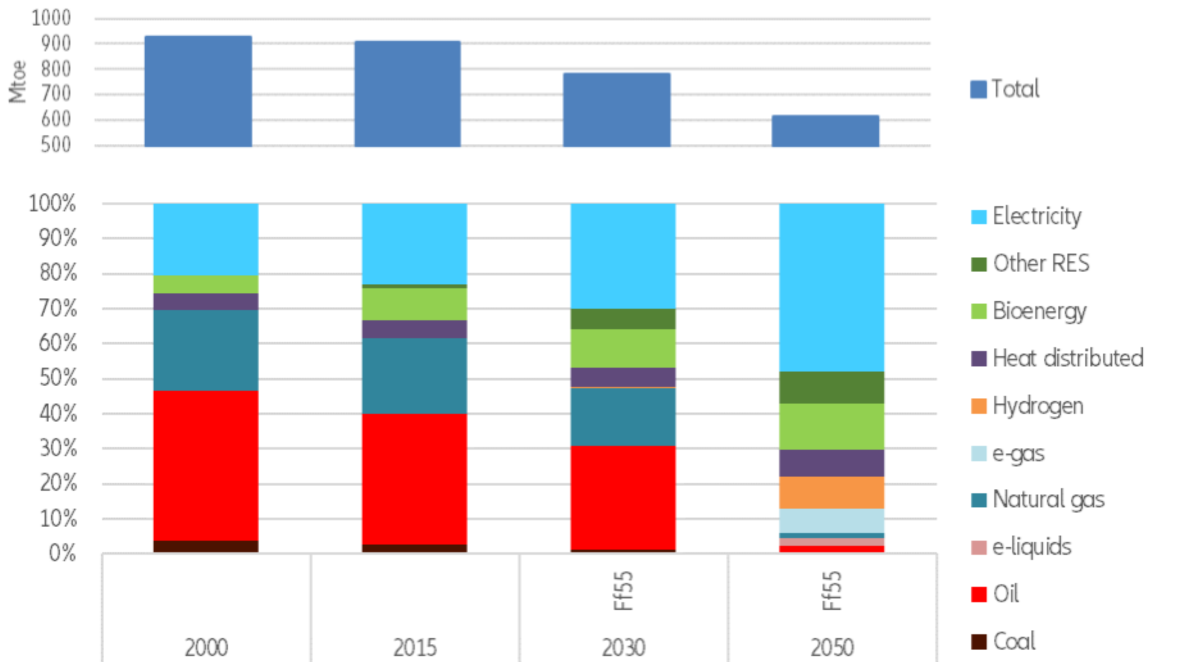
Nearly three-quarters of the EU's total GHG emissions originate from the production and use of energy. Thus, the decarbonization of the entire energy system is crucial to meet the goal of achieving net-zero emissions by 2050, as well as limiting global warming to 1.5˚C. The EU's recently announced Fit for 55 (Ff55) legislation proposes that the previous target of 36% GHG emission reduction from the energy system increases to 45% by 2030.

The good news is that energy consumption in the EU is already transitioning towards the use of renewable sources. Two common measurement parameters to describe energy are gross inland energy consumption (GEC) and final energy consumption (FEC, also referred to as final energy demand). The former measures total domestic energy usage, while the latter refers to what end users actually consume for energy purposes. The difference relates mainly to what the energy sector needs itself, to transformation and distribution losses and to non-energy use of oil, gas and coal. The EU's GEC amounted to 1,449mn tons of oil equivalent (toe) in 2015 while the FEC amounted to 909mn tons, of which petroleum products (oil) boasted the lion's share at 37%, followed by natural gas taking 22% and electricity taking 23%[2] (see Figure 1, opposite).

The GEC has a similar breakdown but this is expected to evolve by 2050 compared to 2030 due to the update of energy-intensive new fuels, such as hydrogen, e-gas and e-liquids (see Figure 2, opposite).

1 Source: The Sixth Carbon Budget -The UK's path to Net Zero, Climate Change Committee (2020).
2 For more information on electricity and the transition of the power sector, please refer to our report The EU utility transformation: Powered by solar and wind).

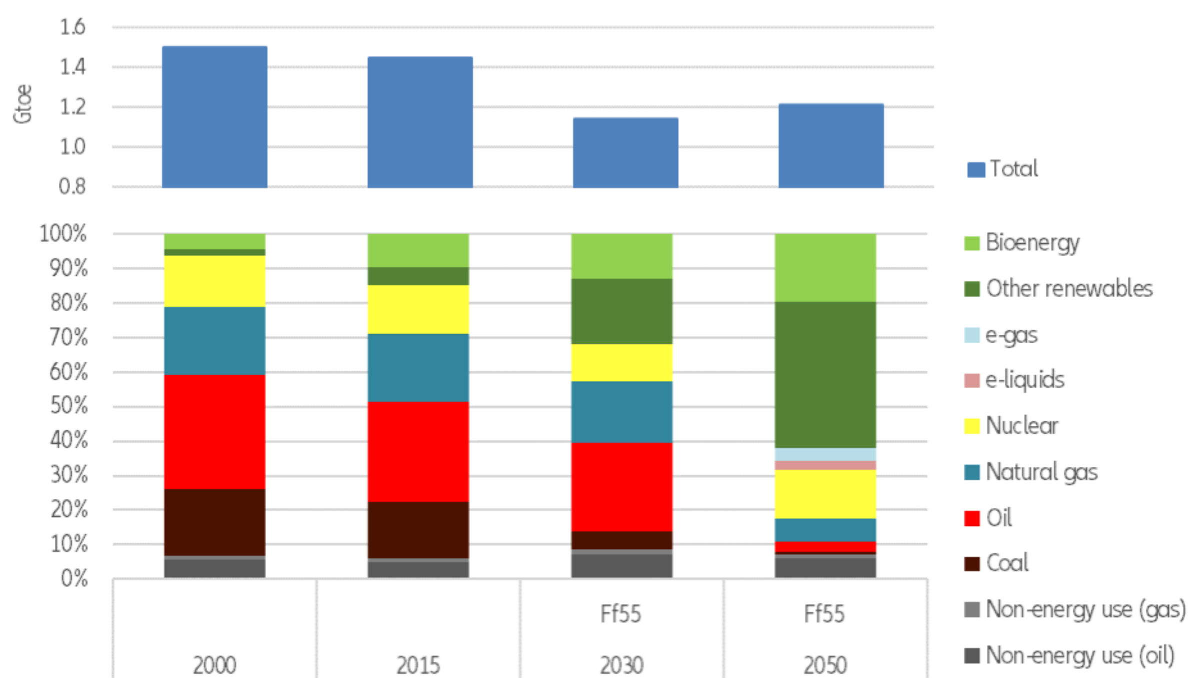
Figure 1: EU final energy consumption



Note: Mtoe = million tons oil equivalent,

Source:s Allianz Research, European Commission.

Figure 2: EU gross energy consumption



Note: Gtoe = giga-tons oil equivalent,

Source:s Allianz Research, European Commission.

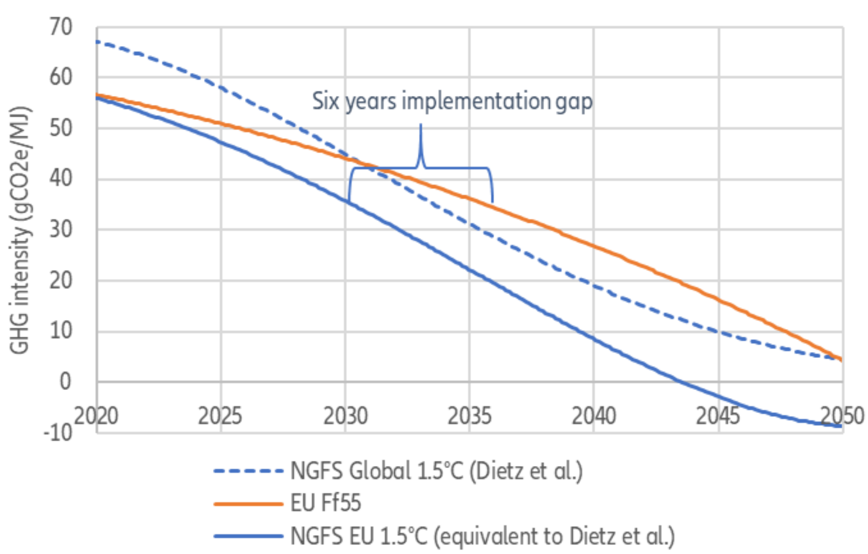
Total primary energy production is also facing a transition. In 2019, renewable energy accounted for more than one third (36%) of the EU's total energy production, driven by the rising trend (+48% since 2009)[3] in domestic deployments of solar, wind and bio-energy projects. On the other hand, energy production from solid fossil fuels (-33.1%), oil & petroleum products (-33.5%) and natural gas (-49.4%) have been on the decline.

But is this transition progressing fast enough? When defining the energy sector transition's pathway, it is necessary to assess the GHG intensity of the sector's products within sensible system boundaries. As we have seen, gross energy consumption will not decline, rather the composition of the underlying product shares will change. Electricity already faces conversion losses and e-fuels face even greater losses, which impacts the total sold energy (and thus the denominator for determining our preferred transition measure, the GHG intensity of sold energy). This should be reflected in the transition path for the products produced by the energy sector. To stay in sensible system boundaries, the scope of products needs to be limited to direct substitutes. Simply switching, say, from oil to renewables will not suffice as it may jeopardize the necessary increase in e-fuels that are essential for certain sectors (i.e., aviation, shipping). Therefore, an adequate policy framework is indispensable to ensure that the marginal profit per dollar of sold energy from different products is equal at the desired product mix. Otherwise, the necessary diversification of energy sources will not be reached.

This cannot be achieved with a single policy instrument, as different products will require different price interventions. Nevertheless, a combination of carbon pricing (either a carbon tax or ETS), mandatory sustainable fuel blend-ins, investment subsidies (focused on CAPEX), carbon contracts for difference (CCfDs, focused on OPEX) and markets for carbon dioxide removal can generate the desired path (Fig. 3)[4].

While oil and gas companies operate globally and the global path should be relevant for them, it is necessary that the regional path in the EU follows a higher ambition to stay within the total global carbon budget. This also highlights the necessity for integrating carbon removal into the energy companies' transition pathways to realize the negative GHG intensity for the EU energy-consumption product mix.

Figure 3: Indicative pathways GHG intensity[5]



Sources: Allianz Research; Dietz et al., EC 2030 Climate Target Plan. Pathway methodology in *Dietz et al. (2021a, 2021b)*

3 *Source: EU Energy in Figures – Statistical Pocketbook 2021, European Commission (2021).*

4 *Carbon dioxide removal (CDR) can for example come in form of technical removal like carbon capture (utilization) and storage CC(U)S or nature solutions like afforestation or other natural carbon sinks. The newly agreed Article 6 to the Paris Agreement provides a base to transition and link voluntary carbon markets and compliance markets for scaling up carbon dioxide removal activities.*

5 *EU Ff55 includes scope 3 emissions down the value chain (category 11), for gaseous, liquid, and solid energy carriers while scope 1+2 are only available for refineries, thus particularly scope 1 emissions prior to refineries are missing*

The shown pathways indicate that although the EU has a head start compared to the global path, the proposed annual reductions are not quick enough to secure a 1.5˚C climate future. With the current pathway, there is a six-year implementation gap from the 1.5˚C secure pathway. This will require a total of EUR717bn of investments per year to be made additionally until 2030, including EUR118bn in supply-side investments (such as power grid, power plants and new fuels production and distribution) and EUR599bn in demand-side investments (such as the industrial, transport or residential sectors).

This would come on top of what is already envisaged in a Ff55 scenario (Table 1).

From 2021 to 2030, the average annual investment needed from the supply side is EUR120bn, with most investment going towards power grids and power plants, followed by investments in production and distribution for new fuels. In this same period, investment needs from the demand side are projected at EUR920bn . After 2031, investment volumes should increase further. From 2031 to 2050, the average annual investment for the supply side in the EU is expected to be EUR197bn, while the demand side (including transport) is expected to be EUR998bn. The composition of these investments hardly changes. To put these investment volumes into perspective, investing in a Ff55 future would require about 9% more investment than what is currently planned from 2021-2030 and about 20% more investment from 2031-2050. Yet, closing the implementation gap between the Ff55 proposed pathway and a 1.5˚C pathway would drive investments over the next decade up by 84% against the base case.

Table 1: Estimated investment needs for the EU energy system for Ff55

	Average annual investment in billion EUR	
Category	**2021 – 2030**	**2031 - 2050**
In power grid	58.2	80.9
In power plants	56.2	88.5
In boilers	3.8	1.3
In production and distribution of new fuels	1.4	26.6
Total supply side	**119.9**	**197.3**
Industrial sector	20.3	14.4
Residential sector	190.0	174.4
Tertiary sector	87.7	80.7
Transport sector	621.8	728.2
Total demand side	**919.8**	**997.7**
Total energy system	**1,039.7**	**1,195.0**

Source: European Commission.

COAL, OIL AND GAS:
CAN THEY BE PHASED OUT FAST ENOUGH?

One of the biggest challenges for the energy system is phasing out the burning of thermal coal by 2030 in the power sector[6]. Coal is primarily used in electricity production, followed by being a critical heat source and reduction agent in steel production. Despite a +27% rise in electricity production between 1990 and 2017, the power sector's GHG emissions actually dropped by -30% due to the steady move away from coal to cleaner combustible fuels and an increase in electricity produced from renewables[7].

However, in all the proposed Ff55 policy scenarios, electricity generation from coal must phase out completely by 2030 to achieve a 55% reduction in GHG emissions by 2030. Yet, solid fossil fuels still account for at least 25% of the total energy mix in Bulgaria, the Czech Republic and Poland; Poland, Germany and the Czech Republic were the EU's top producers of fossil fuels in 2019, totaling 101 Mtoe. And although coal imports are declining, nearly one-third of total imports went to Germany (32.4%) followed by Poland (11.6%), France (8.4%), the Netherlands (6.7%) and Italy (7.6%). Hard coal was chiefly imported from Russia (54.6 Mtoe), the US (21.1 Mtoe), Australia (16.4 Mtoe), Colombia (9.5 Mtoe) and South Africa (3.4 Mtoe)[8].

On a positive note, most EU member states and the UK do have plans to phase out coal by 2030. Germany was previously committed to exit coal by 2038, but its new coalition government has now announced that the exit should "ideally" be by 2030 – a step in the right direction, but still lacking a full commitment. Meanwhile, the remaining Coal-5 countries (Poland, Bulgaria, the Czech Republic, Romania and Slovenia) have not yet committed to phasing out coal by 2030. If the EU would like to completely phase out coal for electricity generation by 2030, approximately 100 GW of additional wind and solar, as well as 15 GW of natural gas power plants, are needed to replace it[9].

At a staggering 37% of final EU energy demand in 2015, oil is expected to remain a significant contributor in 2030 in the Ff55 proposed scenario, decreasing only by -8 pp to 29%. Within the transport sector, we still see a considerable dependence on fossil fuels (see Figure 4, opposite).

Air and maritime transport are nearly 100% dependent on oil, while road transport has a 93.4% dependency factor. Oil products are expected to continue to dominate in 2030. By 2050, however, oil products will need to drop substantially to only 13% of all fuels consumed in transport. The remaining oil products in the fuel mix would be primarily used to support aviation and maritime transport, for which it is more challenging to find sustainable alternatives[10]. Across industry, like in the case of transportation, the fuel mix is expected to remain similar to today in 2030, with the oil share at around 13%. But by 2050, the share of oil in the fuel mix for industry is expected to drop to 3%.

6 For more information on electricity and the transition of the power sector, please refer to our report The EU utility transformation: Powered by solar and wind).

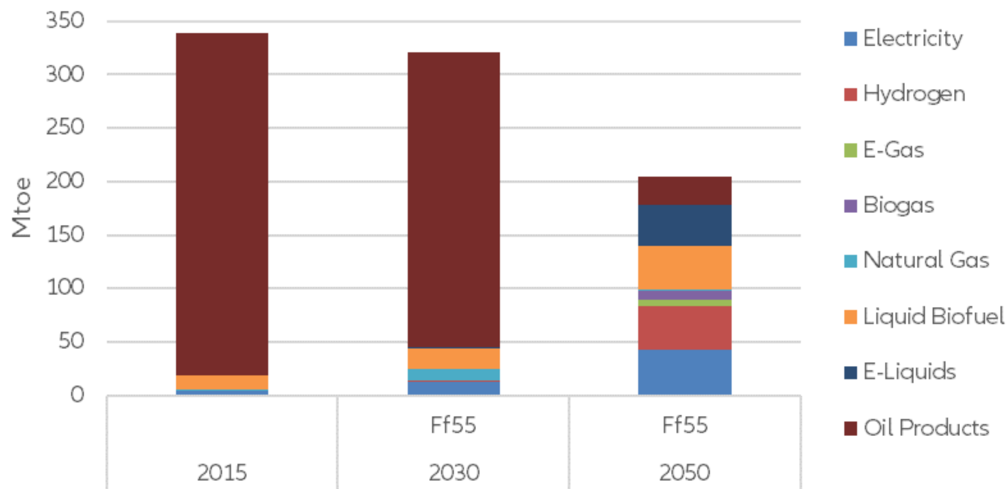
7 Source: Towards net-zero emissions in the EU energy system by 2050, Joint Research Center (JRC) (2020).

8 Source: EU energy in figures - Statistical Pocketbook 2021, European Commission (2021).

9 For more information on the power sector phasing-out coal, please refer to our publication: The EU utility transformation: Powered by solar and wind).

10 For more information on the transport sector and sustainable fuel options, please refer to our publication: Transport in a zero carbon EU: Pathways and opportunities.

Figure 4: Forecast of the fuel mix in the transportation sector



Source:s Allianz Research, European Commission.

The EU's primary production of crude oil reached a record low of 23.6 Mtoe in 2019, with the leading producers being Denmark (5.2 Mtoe), Italy (4.1 Mtoe) and Germany (3.7)[11]. The EU's net import of crude oil was 528 Mtoe in 2019, largely coming from Russia (136.6 Mtoe), Iraq (45.5 Mtoe), Nigeria (39.8 Mtoe), Saudi Arabia (38.9 Mtoe), and Kazakhstan (36.8 Mtoe). The top oil importers were the Netherlands (17.4%), Germany (15.2%). France (11.1%), Spain (10.4%) and Italy (9.4%). The flow of imports is also changing as imports from Russia and Saudi Arabia have been decreasing while those from Iraq, Nigeria and Kazakhstan have been increasing.

The role of gas in the energy system will continue to increase, especially as rising carbon prices promote the switch in power generation from coal to gas. By 2030, natural gas will still be an important fuel source to meet total energy demand, decreasing by only 13% from 2015 levels. Yet, by 2050, hydrogen, e-gas and biogas will overtake natural gas as the majority share of gaseous fuels, with natural gas' share dropping from 93% in 2030 to 32% in 2050 (Figure 5, opposite).

The consumption and replacement of natural gas with (green) hydrogen, e-gas and biogas offers significant CO2 emission-reduction potential. The changes in consumption rates of natural gas will also differ by sector (see Figure 6, opposite).
As previously mentioned, it is expected that the power sector will increase in gaseous fuel consumption, from 30% in 2015 to 40% in 2050, while the largest reductions in consumption will come from the residential, services and agriculture sectors (-23pp from 2015 to 2050), followed by industry (-10pp from 2015 to 2050).

For buildings, the most important single energy use is for space heating and cooling. Over time, the fuel mix for buildings is expected to substantially shift to electricity while fossil-fuel consumption, especially natural gas, will fall. This should be driven by increasing carbon prices, increasing deployment of renewables in heating/cooling and increasing support for heat pumps. But this substantial decrease in natural gas is expected to develop later (after 2030) and be fully observed only by 2050. By this time, more sustainable gaseous substitutes (e-gas, hydrogen, biogas) are expected to dominate (see Figure 7, opposite).

As a result of declining production and rising demand, the EU has become the largest importer of gas globally: Natural gas is the second-largest imported energy product after oil. The EU produced 52.3 Mtoe of natural gas in 2019, primarily in the Netherlands (23.9 Mtoe), Germany (4.4 Mtoe) and Italy (3.9). Net imports reached 301.1 Mtoe, mostly coming from Russia (152 Mtoe), Norway (59 Mtoe), Algeria (28.9 Mtoe) and Qatar (19.9 Mtoe) and going to Germany (21%), Italy (16.1%), France (13.6%), the Netherlands (11.8%) and Spain (9.0%)[12], (see Figure 8, page 12).

11 Source: EU Energy in Figures – Statistical Pocketbook 2021, European Commission (2021).
12 Source: EU Energy in Figures – Statistical Pocketbook 2021, European Commission (2021).

Figure 5: Consumption of gaseous fuels per gas type

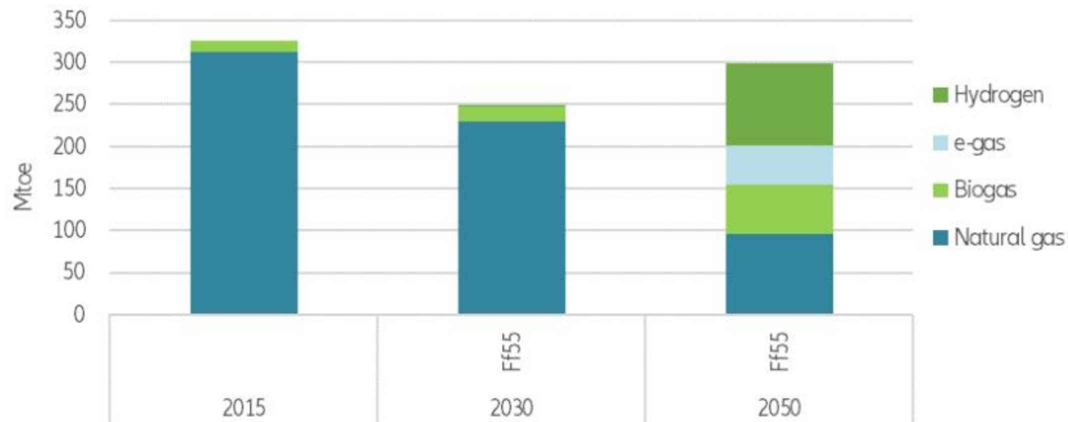


Figure 6: Consumption of gaseous fuels per sector

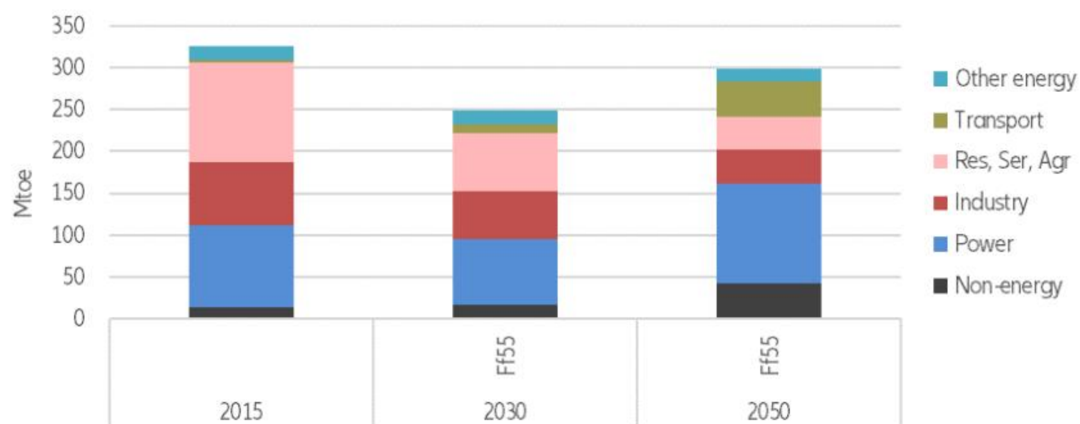
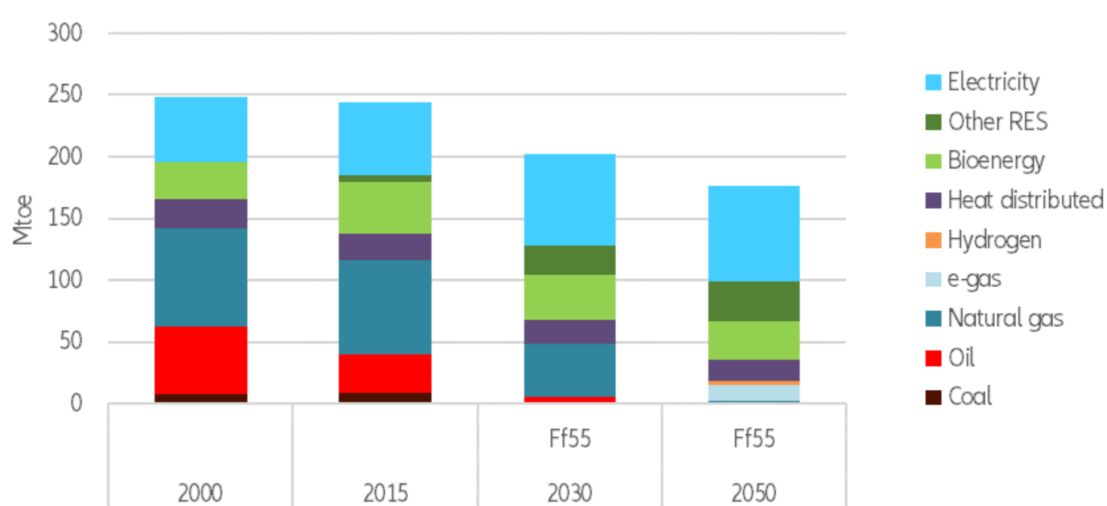
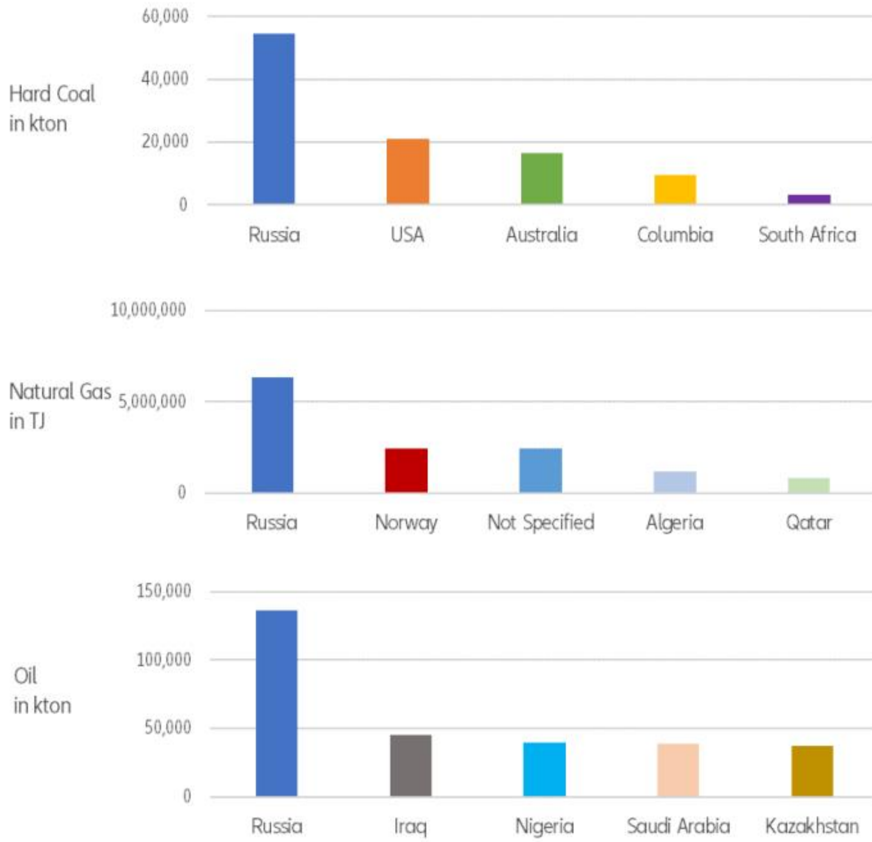


Figure 7: Energy demand in residential buildings

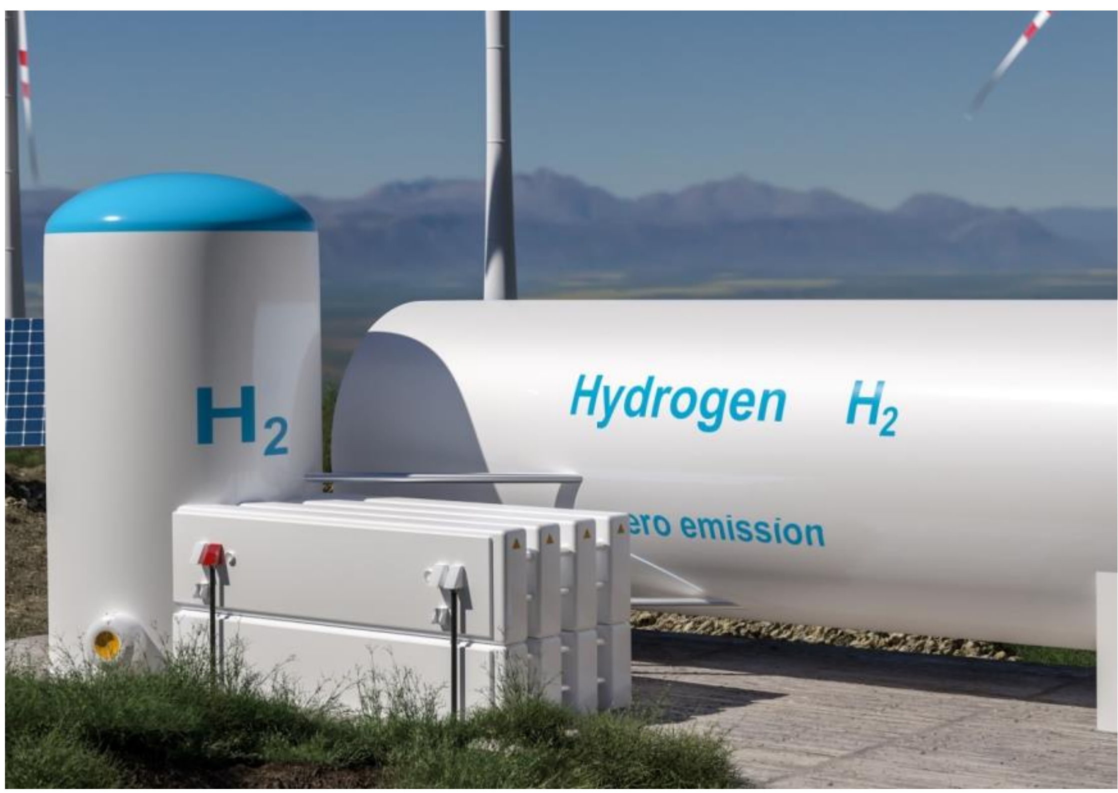


Source:s (for figures 5-7): Allianz Research, European Commission.

Figure 8: Origin of energy imports



Sources: Allianz Research, EUROSTAT.



Box: A closer look at energy dependency and methane leakage

The energy dependency rate is an important metric that reveals an economy's reliance on imports to fulfil energy demands. In 2019, the EU had a dependency rate of 60.7% (Figure 9) for all fuels, which means that a majority of gross inland energy consumption was accounted for by net imports[13]. It goes without saying that such high dependency creates geo-politial vulnerabilities. The recent energy price crisis served as a timely reminder.

Over time, however, overall fuel dependency is expected to decrease to 17% by 2050 due to the decrease of fossil fuel imports and increase in domestic renewable production. Furthermore, by 2050, fossil-fuel imports are expected to nearly disappear for coal and decrease by 62% and 78% for natural gas and oil, respectively, compared to 2015. Thus, transitioning the energy production mix to more renewable energy will not only reduce emissions but also increase energy independence, security and supply resilience[14].

In line with decreasing imports, the cost of imports is also expected to decrease. For all fuels, the cost of imports (as a percentage of GDP) is expected to decrease from 2% in 2015 to 1.8% in 2030 and to 0.6% in 2050. This decrease is expected to result in cumulative savings in net energy imports between EUR83 andEUR133bn compared to the EU baseline scenario.

Another risk with fossil-fuel usage is methane leakage. Methane (CH4) is a more potent GHG than CO2 and ranks second (after CO2) in its overall contribution to climate change. The global warming potential of one ton of methane is assumed to be equivalent to 29.8 tons of carbon dioxide over a 100-year timeframe[15]. The EU 2030 climate target plan impact assessment suggests that CH4 will retain its status as the dominant non-CO2 GHG in the EU. Policies aimed at the overall reduction of CH4 emissions estimate a 29% decrease from 2005 levels by 2030.

The EU contributes to 5% of global methane emissions. Out of the EU's total anthropogenic methane emissions, 19% are from energy. Fugitive emissions of methane, which are (accidentally) leaked, are a by-product of fossil-fuel production and distribution. Estimates suggest that 54% of energy-related methane emissions are fugitive emissions from the oil and gas sector, while 34% are fugitive emissions are from the coal sector [16]. The EU's climate target plan's impact assessment shows that the most cost-effective methane-emission savings can be achieved in the energy sector.

The line of action of the European Commission is to support voluntary initiatives by fostering the widespread implementation of a measurement and reporting framework covering oil and gas upstream companies, framed by the Oil and Gas Methane Partnership (OGMP). The United Nations Environment Programme (UNEP) and the Climate and Clean Air Coalition are cooperating to extend the framework to gas midstream and downstream. Alongside these endeavors, legislation is also being drafted to reinforce these actions, covering the compulsory measurement, reporting and verification for all energy-related methane emissions, which builds on the OGMP methodology. The commission is also encouraging companies in the oil, gas and coal sectors to prepare leak detection and repair (LDAR) programmes in preparation of upcoming legislative proposals that would make them mandatory.

Achieving emissions savings in the energy sector is feasible as at least one third of reductions is possible at no net cost to industry. Reducing methane emissions from venting and flaring, leak detection and repair in natural gas, coal and oil production, transmissions and combustion promise the greatest benefits in economic, environmental, and social terms[17].

13 *Source: EU Energy in Figures – Statistical Pocketbook 2021, European Commission (2021).*

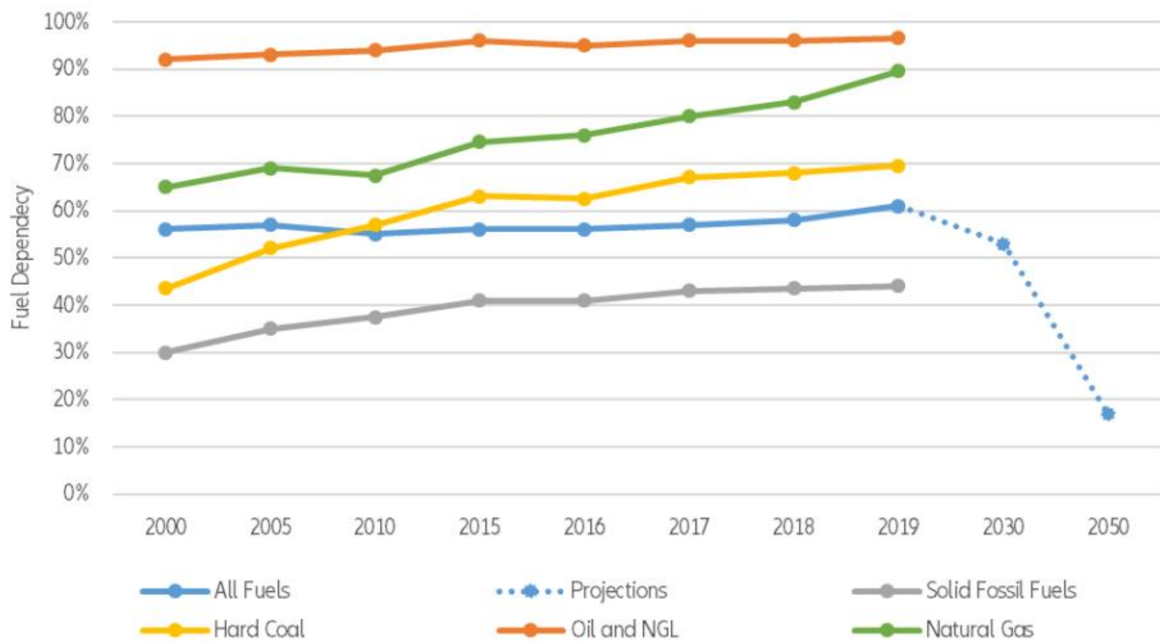
14 *The issue of intermittent energy sources on resilience has been addressed in the previous Utility Sector Transition Pathway publication The EU utility transformation: Powered by solar and wind).*

15 *Source: Sixth Assessment Report, IPCC (2021).*

16 *Source: EU strategy to reduce methane emissions, European Commission (2020).*

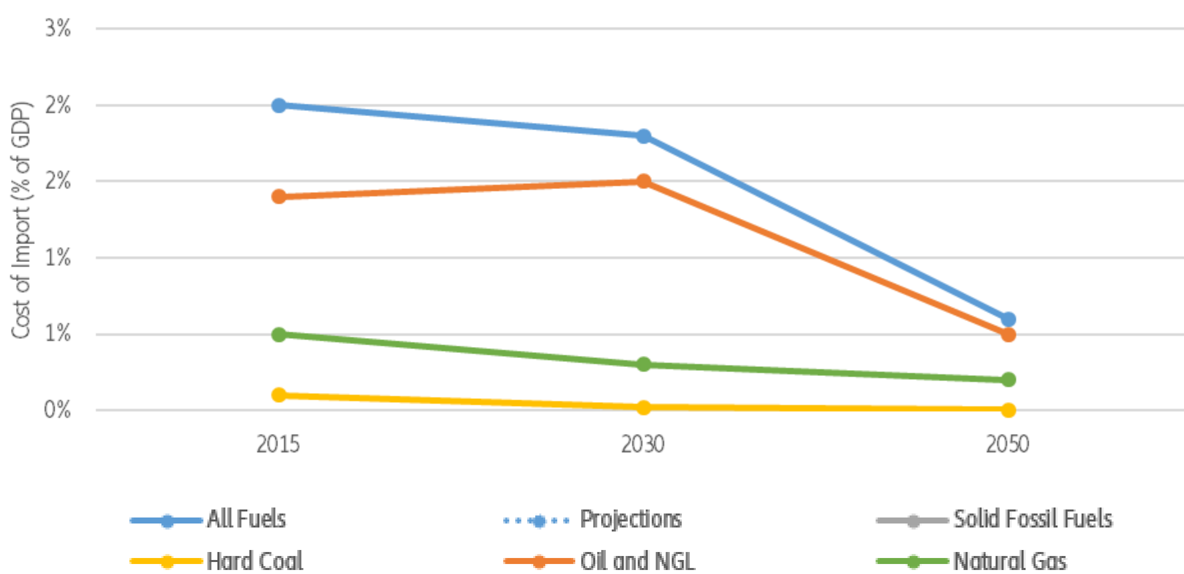
17 *Source: EU strategy to reduce methane emissions, European Commission (2020).*

Figure 9a: Import dependency and cost of imports (as % of GDP) by fuel type—fuel dependency[18]



Sources: Allianz Research, European Commission, EUROSTAT.

Figure 9b: Import dependency and cost of imports (as % of GDP) by fuel type—cost of import (% of GDP)[18]



Sources: Allianz Research, European Commission, EUROSTAT.

18 *Imports from extra-EU.*

COMPANIES TAKING CONTROL

There is no escaping from the clean energy transition for any oil and gas company. The industry needs to have a plan of action to weather through the transition and it should be in line with the anticipated decrease of demand. A key aspect to the decarbonization pathway is the equilibrium between phasing out fossil fuels, while phasing in renewable options. This can best be achieved by looking at the demand and supply sides of fossil fuels simultaneously. Just caring about demand (i.e., through higher carbon prices) could lead to a situation where the supply side might be tempted to slow down the transition, be it by lowering prices or (covert) lobbying activities. Accelerating the transition requires a simultaneous reduction of fossil fuels in both supply and demand. To incentivize this balance is where investors can step in. The capacity of companies to achieve a just transition – environmental and social – is increasingly among the criteria considered by investors. This includes looking at the dialogue a company has with stakeholders such as trade unions and local communities, its track record of successful transformations and corporate responsibility actions. More companies are applying frameworks for sustainable investment, which, from a risk perspective, is a form of future-proofing. Allianz recognizes that the oil and gas sector continues to play an important role in supplying the energy needs of the global economy and aims to support the sector as an insurer and investor if it takes measures to drive the transition. Naturally, with new forms of energy production there can be increasing levels of risk, which can be mitigated with the right technical expertise. In our latest ESG Integration Framework, oil and gas companies are screened on the following risks: biodiversity risks, environmental risks, environmental risk management (such as remediation plans in case of accidents or spills), governance risks, risks to protected areas, reputational risks, resettlement risks and workforce risks.[19]

When assessing a private company's emission reductions, emission scope is an important component that helps us better understand the source of emissions. Although CO2 emissions arising from the burning of fossil fuels are well known, the GHG emissions released during the extraction, processing and transport of oil and gas are often less scrutinised. These emissions are categorized using the scopes defined by the Greenhouse Gas Protocol.:

- Scope 1 consists of GHGs emitted directly from the oil and gas industries such as those from refining, powering drilling equipment, methane leaks or those from fuel transportation.
- Scope 2 emissions account for those coming from the generation of energy bought by the industry.
- Scope 3 emissions occur from the end use (combustion) of the sold fuels (see Appendix for details).

The IEA World energy model provides estimates on GHG emissions by tracking a barrel of oil or cubic metre of natural gas from its site of production to its final consumption. Accordingly, 95kg of CO2-eq is emitted on average during an oil barrel's journey to its user. For gas, the emissions are around 100kg CO2-eq/boe[20].

It is complex to provide an accurate estimate on these emissions, but on average the combined scope 1 and 2 emissions account for about 20% of the total life cycle emissions of oil, while it is a bit higher at 25% for natural gas. Thus, even when scope 3 emissions get the deserved limelight by accounting for the largest share of total emissions, scope 1 and 2 emissions are still significant sources of GHGs. There is, however, a wide range of emission intensities across different sources of production for both oil and natural gas, with methane leakage being the largest source of emissions on the journey from reservoir to consumer.

19 The Allianz ESG Integration Framework includes the oil and gas sector policy under "03.4.12 Allianz ESG Guideline on Oil and Gas".
20 Source: The Oil and Gas Industry in Energy Transitions, International Energy Agency (2020).

Box: The role of private equity firms in the energy transition

While institutional investors push for the transition of the energy sector, private equity seems to move in the opposite direction. Since 2010, private equity firms have invested around USD1.1trn into energy assets. In 2020, these firms owned over 300 portfolio companies across the energy sector, with 80% being fossil fuel and only 20% renewable assets[21]. Under public pressure to decarbonize portfolios, some public companies have sold off their climate-sensitive assets and private equity firms have stepped up to purchase them, which simply shifts the operations (and emissions) from the spotlight to the shadows. A recent report by the Private Equity Stakeholder Project highlights several examples, including the purchase by Hilcorp, a private company backed by the private equity firm Carlyle, of the oil major ConocoPhillips' assets for USD3bn in Colorado and New Mexico, as well as all the operations and interests in Alaska of BP for USD5.6bn. Hilcorp is now thought to be the largest known emitter of methane in the US. To put this in perspective, their operations emit about 50% more GHGs than Exxon Mobil (the largest fossil fuel producer in the US), but the volume of oil and gas produced is only a third of Exxon's[22]. Rather than supporting climate solutions, this private investment is being funneled to sustaining, expanding and dirtying fossil fuel energy, which is environmentally, socially, and arguably economically, unsustainable. There is currently a lack of transparency: There are no regulations forcing private equity firms to disclose their climate impacts. But this could (and should) change in the future as the Securities Exchange Commission (SEC) investigates how climate disclosure requirements should be updated for private equity firms as well.

The energy sector is an amalgam of companies engaged in exploration production, refining, marketing, storage and transportation of coal, gas and oil along with other consumable fuels. The EU has 166,188 enterprises in the energy sector employing 1.69mn people and generating a turnover of EUR1909bn[23]. A selected breakdown on the number of enterprises across the energy sector can be viewed in Table 2.

Table 2: Number of energy sector enterprises in EU-27

Focus	Number of enterprises (2019)	Trend since 2015
Mining of coal and lignite	198	-19%
Extraction of crude petroleum & natural gas	246	+10%
Extraction of peat	910	-8%
Support activities for petroleum and natural gas extraction	1002	+15%
Manufacture of coke and refined petroleum products	841	-3%
Manufacture of gas	3823	NA
Production of electricity	133,975	+46%

Source: EUROSTAT .

21 *Source: Private Equity Propels the Climate Crisis, Private Equity Stakeholder Project (2021).*
22 *Private Equity Funds, sensing profit in tumult, are propping up oil, New York Times (2021).*
23 *Source: EU Energy in Figures - Statistical Pocketbook 2021, European Commission (2021).*

As energy suppliers, the scope and timeframe with which fossil fuel companies plan to decarbonize is an important component in the energy sector transition. Together, these individual plans dictate a collective transition, which should be in-line with a 1.5˚C future. These collective emission-reduction pathways can be approached in two ways: a sector-based approach using convergence or one using contraction (see Figure 10, page 18).

The convergence approach is where the carbon intensity for all companies converges towards the same 1.5°C compatible path, meaning companies can decarbonize at different rates, but towards a common level. This will result in meeting the 1.5°C carbon budget only if companies are (emission weighted) equally distributed above and below the necessary or reference path. If, for example, more companies would have a starting point above the reference path, too much GHGs would be produced until the reference level is reached.

The latter contraction approach, absolute based, is where all companies reduce emissions by the same absolute percentage as in the reference path. This approach also suffers from the same distributional problems as the previous one as most companies are far above the necessary pathway. The problem is increased through self-selection: As companies are free to choose the approach that they like, those above the sector reference path will choose the contraction approach while those below the reference path benefit from choosing the convergence approach, thus further inflating the sector's carbon usage. As the oil and gas sector is on average above the reference path, it seems advisable to recommend a convergence approach as standard procedure if only one choice is allowed[24]. Moreover, pathways differ regionally as well. The regional pathway for the EU GHG intensity is below the global average and the 1.5°C path will even need to reach negative intensities through carbon dioxide removal (CDR; CDR activities differentiate between nature solutions, like afforestation, and the various technical carbon capture (utilization) and storage (CC(U)S) options). The demand intensity should be based on the regional pathway values to be in line with the regional carbon budget. On the other hand, the supply intensity should be based on the average global demand intensity, which needs to be consistent with the aggregate of the regional intensities. The EU pathways and high temperature pathways in Figure 11 (see p. 19) were derived using a methodology similar to that used for the global pathways by Dietz et al. (2021a, 2021b) [25].

24 It should be noted that both approaches can be equivalent, e.g. in this example if an emission intensity of zero was to be reached in 2050.
25 Pathways differ in 2020 as due to data availability the base year is before 2020.

Figure 10a: Emission reduction pathway approaches: contraction vs convergence—contraction

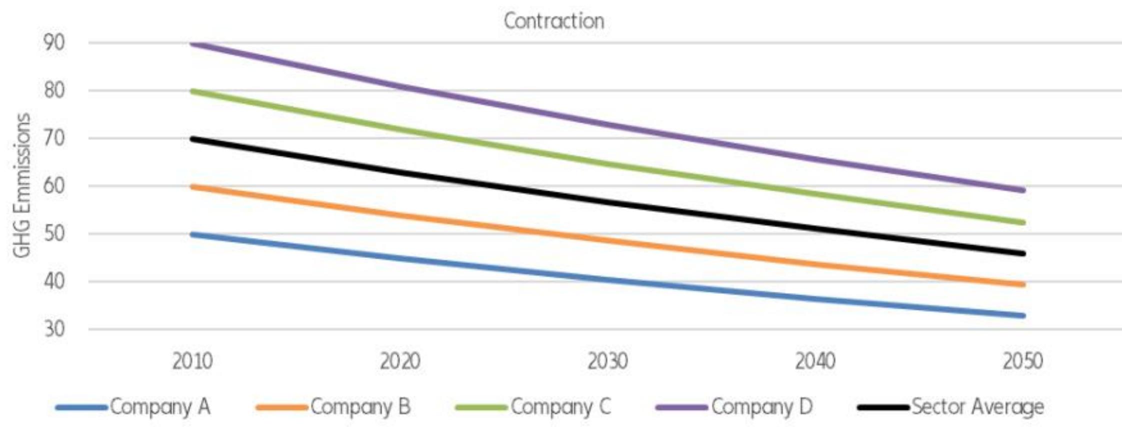


Figure 10b: Emission reduction pathway approaches: contraction vs convergence—convergence

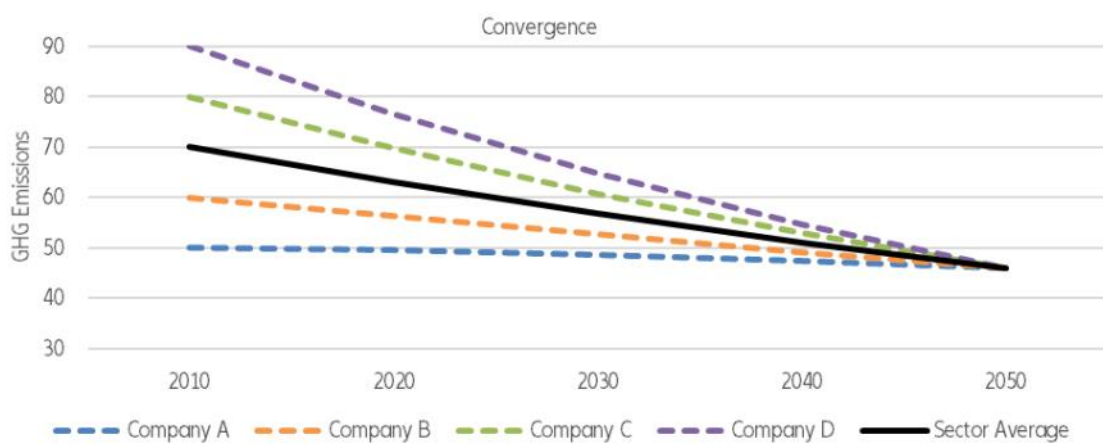
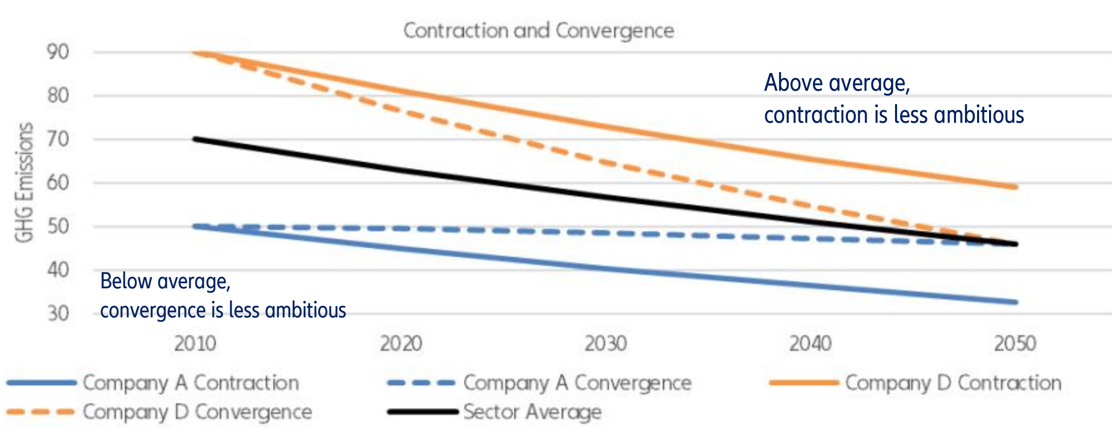
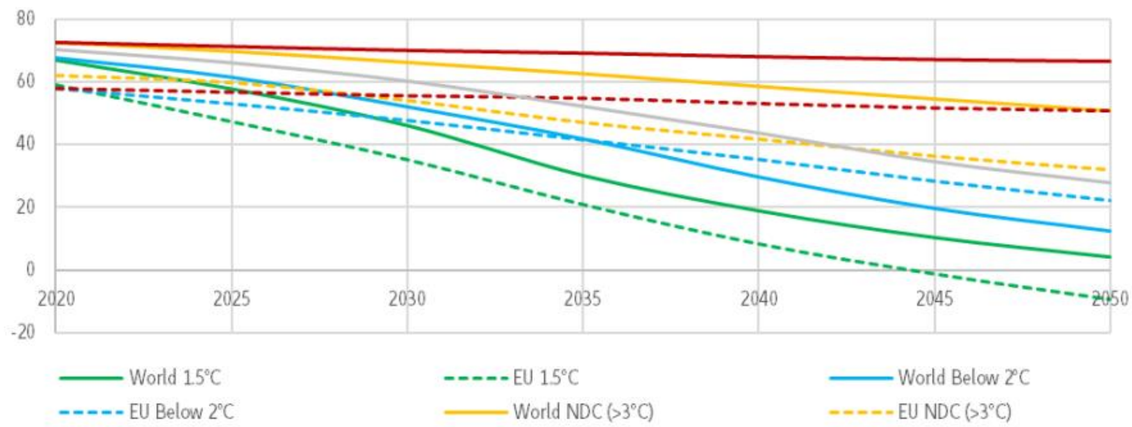


Figure 10c: Emission reduction pathway approaches: contraction vs convergence—contraction and convergence



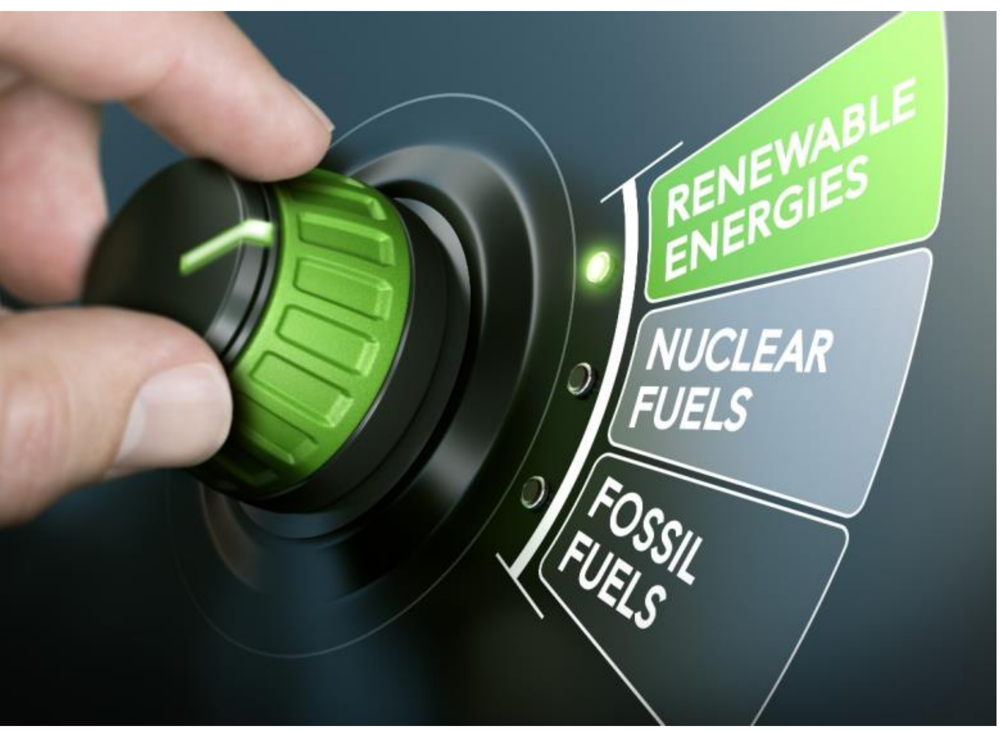
Source: (for figures 10a-c): Allianz Research

Figure 11: Pathway for emission intensity reduction, by climate scenario



Source: Allianz Research..

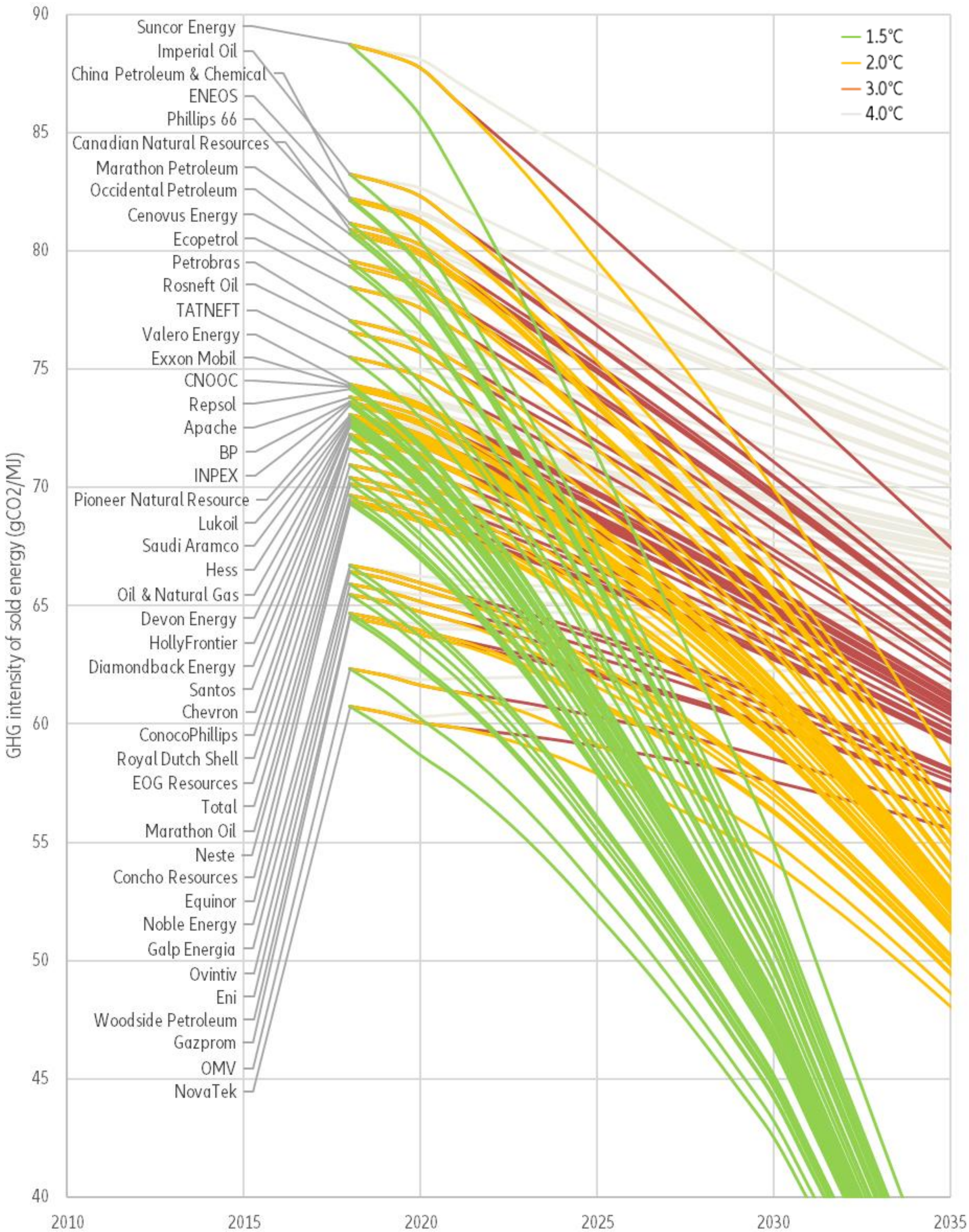
Based on the regional and global pathways across varying warming scenarios, we develop oil and gas company pathways (Figure 12, p. 20) using a general convergence approach. The pathways describe how the GHG intensity of their sold energy products should develop, based on different climate temperature scenarios (1.5˚C to 4˚C) calculated according to Dietz et al. (2021a, 2021b), NGFS and SBTi. These pathways include scope 1, 2, and 3 emissions, details of which can be found in the Appendix (p. 25)[26]. Scope 3 emissions are calculated applying emission factors to the sold products. To achieve better comparability and a more complete company list it would be advisable to have a standardized reporting of the sold products listed in the Appendix.



26 Base year intensities are taken from Dietz et al. (2021a, 2021b) and are subject to confidence intervals that are included in the original publication. Dietz et al. also lists the decomposition in scope 1, 2 and 3 emissions.

Figure 12: Convergence pathways of GHG emission intensity of energy products

1.5°C, 2°C, 3°C and 4°C convergence pathways of combined scope 1+2+3 GHG emission intensity of energy products (convergence according to SBTi, sector pathways and emissions according to Dietz et al. (2021a, 2021b) and NGFS for oil and gas companies.



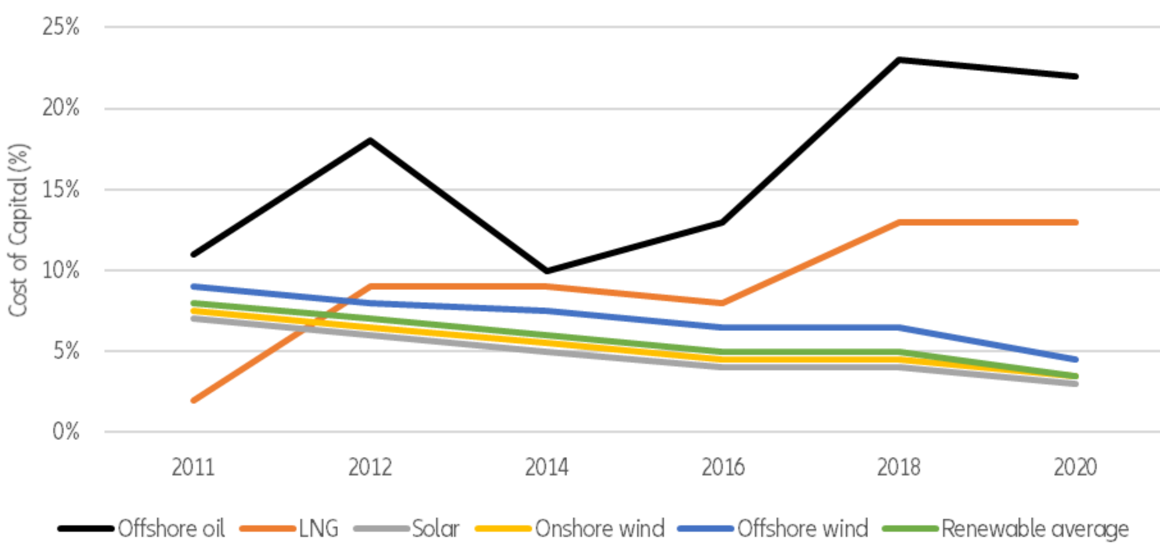
Source: Allianz Research own calculations based on Dietz et al. (2021a, 2021b), SBTi and NGFS

WHERE DO WE GO FROM HERE?

Now more than ever, the decisions and actions of private and public corporations will play an increasingly important role. Overnight action is unrealistic, though, which is why the energy transition is often described as a journey. Fortunately; there has never been a better time to ramp up investments in renewable energy alternatives: The cost of capital, which represents the return a company needs to achieve to justify the cost of a project, is now significantly lower than that for fossil fuel competitors, separated by 15pp (Figure 13).

Finding financing for new fossil fuel projects is becoming more difficult due to the pressure that banks are facing to green their port-folios. This pressure results in more expensive debt financing, which increases the costs of capital for oil companies (now at 20%)[27]. A key area for investment is (green) hydrogen. Hydrogen has one of the highest energy density values, second only to nuclear energy sources, and has three times the energy density of diesel or gasoline while producing zero carbon emissions when produced using renewable sources of energy. Moreover, its versatility in multi-sectoral applications in the form of feedstock, a fuel or for energy transmission and storage make the proposition of adopting hydrogen more lucrative. Hence, hydrogen is a promising energy source to aid in the decarbonization of energy-intensive industries and transport.

Figure 13: Cost of capital: fossil fuels vs renewable energy



Sources: Allianz Research, Goldman Sachs; Bloomberg[27].

27 *Source: Cost of Capital Spikes for Fossil-Fuel Producers (Bloomberg, 2021).*

The EU has an ambitious goal to transform its energy mix by significantly raising the share of hydrogen. Much of the focus has turned to industrial applications, which include the steel and refining sectors as early markets for captive low-hydrogen production. The European Hydrogen Roadmap[28] projects that by 2050, hydrogen could provide approximately 2,251 TWh of energy in the EU, while DNV[29] estimates that hydrogen will meet 1,250 TWh, with varying estimations on the breakdown by sectors (Table 3, opposite). If using the total final energy demand estimated in the Ff55 scenario (7,152 TWh), hydrogen could meet between 17-31% of Europe's final energy demand.

However, it is evident that investment must start now to ramp up production. Although hydrogen demand is expected to only double until 2030 (before potentially increasing sevenfold by 2050), the market must be ready for its production, distribution, and application between 2030 and 2050. The European Hydrogen Roadmap estimates that approximately EUR60bn in total investment is needed by 2030, with 40% of the investment share going towards setting up infrastructure and equipment for hydrogen production and distribution. The remaining investment would be funneled towards storage, buffering and retail in transportation, buildings, and industry application. This provides European industry with a green, profitable opportunity – the market could be worth at least EUR85bn or even more (EUR150bn total) considering potential revenues from exports. By 2050, the market could grow as large as EUR820 bn. Given the European industry's know-how, it could potentially capture 75-90% of domestic market revenues, creating an estimated 1mn jobs by 2030, and 5.4mn jobs by 2050. Hydrogen's cost-competitiveness is low today but expected to increase slowly over time, making investment more attractive in the long-term. Currently, fossil fuel-based hydrogen can be produced for EUR1.5-2 per kg (without and with CCS, respectively), while it is estimated that the current production costs in the EU for green hydrogen average around EUR 5-6 per kg[30]. Over time though, the levelized cost of low-carbon hydrogen is expected to fall below EUR 2 per kg by 2050.

Across the EU, green hydrogen projects produced from renewable electricity are currently insufficient to meet the goal of having 6 GW of renewable hydrogen electrolyzers by 2024 and 40 GW by 2030. Based on the current known list of realized and planned projects (151 total[32]), only 2.16 GW would be achieved by 2024 and 9.2 GW by 2030 – far from the specified goal. If the EU is unable to mobilize the ramp-up of green hydrogen production, or unable to drop the production costs to make it as cost-competitive as blue hydrogen, an alternative is to partner with African countries and utilize the renewable power generation potential there and distribute it to the EU. Yet,, investment in renewables must be simultaneously undertaken with de-investment from fossil fuels for the energy transition to be successful and complete. Public and private investment will play an important role, but governments should also reevaluate their investment in fossil fuels in the form of fuel subsidies. The key reasons for slashing fossil-fuel subsidies include the benefits from the reduction of associated costs for public budgets and for boosting the green transition. The EU is taking steps to gradually get rid of energy subsidies (particularly fossil-fuel subsidies) in line with commitments made in the Paris Agreement, G7 and G20, as well as the Green Deal's principle to "do no significant harm". Despite such ambitions, a 2020 report from the commission showed an increase in the overall amount of energy subsidies (particularly fossil-fuel subsidies) across the EU except for a handful of member states - Austria, Denmark, Estonia and Hungary.

The EU's total energy subsidies reached EUR176bn in 2019, an +8% increase from 201532. Demand subsidies incentivizing energy consumption (such as tax breaks or income support) grew by +8% over the same period. The types of subsidies and their allocation structures also vary across the EU. For instance, Ireland mostly subsidizes oil while Germany focuses its efforts on subsidizing renewables (Figure 14, opposite).

Unfortunately, consumers will pay a price for the elimination of fossil fuel subsidies and impacts are often regressive, with the poorest households being hit hardest. When investments in fossil fuels drop quicker than they can be replaced, the prices for consumers will skyrocket. Although fossil fuels should become increasingly more expensive in the future, short-term spikes and high volatility will cause social and economic harm. To soften these blows, governments should create more buffers in the existing systems and expedite the roll-out of suitable alternatives. The moment when energy prices drop will be the perfect chance to cut off the remaining fossil fuel subsidies.

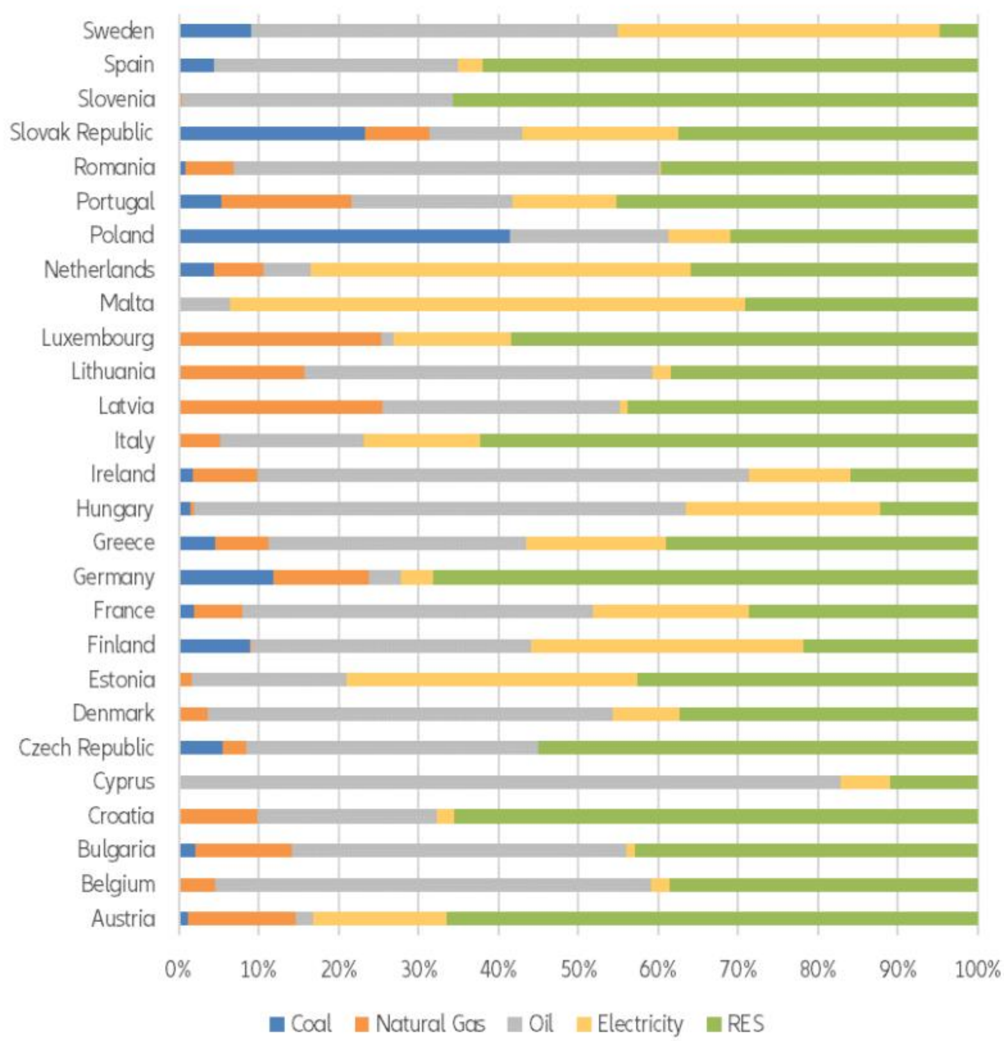
28 Source: The European Hydrogen Roadmap (2019).
29 Source: Energy Transition Outlook, DNV (2021).
30 Source: Energy Transition Outlook, DNV (2021).
31 Source: Clean Hydrogen Monitor (2020).
32 Source: Sixth Report on the state of the energy union, European Commission (2021).
33 Abolishing fuel subsidies in a green and just transition (Allianz Research, 2021).

Table 3: Projections for hydrogen demand by sector by 2050

Sector	European Hydrogen Roadmap	Energy Transition Outlook (DNV)
Transport[34]	30%	40%
Industry	39%	43%
Buildings	26%	17%
Total energy demand	**2,251 TWh = 8.1 EJ**	**1,250 TWh = 4.5 EJ**

Source:s: Allianz Research, European Commission, DNV.

Figure 14: Energy subsidies by fuel in 2019



Source:s: Allianz Research, European Commission.

34 *For more information on the transport sector, please refer to our publication: [Transport in a zero carbon EU: Pathways and opportunities).]*

Appendix: Reporting requirements for scope 3 category 11 direct use-phase emission approximation

GHG protocol scope 3 category 11 - Use of sold products:

This category includes emissions from the use of goods and services sold by the reporting company in the reporting year. A reporting company's scope 3 emissions from use of sold products include the scope 1 and scope 2 emissions of end users. End users include both consumers and business customers that use final products. Calculation of direct use-phase emissions can be done via three distinct methods depending on the product category:

1. Products that directly consume energy (fuels or electricity) during use: involves breaking down the use phase, measuring emissions per product, and aggregating emissions
2. Fuels and feedstocks: involves collecting fuel use data and multiplying them by representative fuel emission factors
3. Greenhouse gases and products that contain or form greenhouse gases that are emitted during use: involves collecting data on the GHG contained in the product and multiplying them by the percent of GHGs released and GHG emission factors.

Method 2 is appropriate for oil and gas companies.

Product categories required to be reported by oil and gas companies with emission factors by Dietz et al. (2021a, 2021b):

Appendix: Reporting requirements for scope 3 category 11 direct use-phase emission approximation

	IPCC Product category	Effective CO2 emissions factor (Tons/TJ)
Unrefined products	Crude oil	73.3
	Natural gas liquids	64.2
	Natural Gas	56.1
	Bitumen	80.7
Major refined / finished products	Motor gasoline	69.3
	Gas/Diesel oil	74.1
	Jet kerosene	71.5
	Residual fuel oil	77.4
Other refined / finished products	Other basket (LPG and Naphtha)	68.2
	Liquified Petroleum Gases	63.1
	Lubricants	73.3
	Refinery Feedstocks	73.3
Other	Oil shale and tar sands	106.7
	Ethane (used to produce plastics)	61.6
	Naphtha	73.3
	Other petroleum products	73.3
	Petroleum Coke	97.5
	Parafin Wax	73.3
	White Spirit & SBP	73.3
	Anthracite	98.3
	Coking Coal	94.6
	Other Bituminous Coal	94.6
	Sub Bituminous Coal	96.1
	Lignite	101.2
	Brown Coal Briquettes	97.5
	Patent Fuel	97.5
	Coke Over Coke and Lignite Coke	107.1
	Gas Coke	80.7
	Coal Tar	44.4
	Gas Works Gas	44.4
	Blast Furnace Gas	259.6
	Oxygen Steel Furnace Gas	181.9
	Municipal Wastes (non-biomass fraction)	91.7
	Waste Oils	73.3
	Peat	106.0
	Wood/Wood Waste	111.8
	Sulphite lyes (black liquor)	95.3
	Other Primary Solid Biomass	100.1
	Charcoal	111.8
	Biogasoline	70.8
	Biodiesels	70.8
	Other Liquid Biofuels	79.6
	Landfill Gas	54.6
	Slude Gas	54.6
	Other Biogas	54.6
	Municipal Wastes (biomass fraction)	100.1
CDR	Additional reporting of CDR activities differentiating between nature solutions and the various technical CC(U)S options	Negative / tbd

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