FitchRatings

Oil & Gas and Chemicals – Long-Term ESG Vulnerability Scores

The Exposure of Global Oil & Gas and Chemical Companies to Long-Term ESG Risks

Oil & Gas and Chemicals– Long-Term ESG Vulnerability Scores

The Exposure of Global Oil & Gas and Chemical Companies to Long-Term ESG Risks

Inside This Report

Contacts

Dmitry Marinchenko
Senior Director, Natural Resources and Commodities
+7 495 956 7016
dmitry.marinchenko@fitchratings.com

Angelina Valavina
Senior Director, Head of EMEA Natural Resources and Commodities
+44 20 3530 1314
angelina.valavina@fitchratings.com

Jakub Zasada
Director, Natural Resources and Commodities
+48 22 338 6295
jakub.zasada@fitchratings.com

Slava Demchenko
Director, Natural Resources and Commodities
+7 495 956 2407
slava.demchenko@fitchratings.com

Guillaume Daguerre
Director, Natural Resources and Commodities
+34 93 323 8404
guillaume.daguerre@fitchratings.com

Alex Griffiths
Managing Director, Head of Corporate Ratings EMEA
+44 20 3530 1709
alex.griffiths@fitchratings.com

Other Analysts
Click here for the full list of analysts

Expanding Fitch's ESG Vulnerability Scores

This is the second in a series of reports that Fitch Ratings will use as a basis for publishing ESG Vulnerability Scores (ESG.VS) that apply to industry sectors, to individual corporates and projects, and to their debt instruments. The inaugural Utilities report was published in October 2020.

ESG.VS measure the relative vulnerability of sectors and entities to long-term ESG-related changes under a scenario that incorporates a global transition to a two degrees Celsius (2°C) warmer climate by 2050. Our analysis extends to 2050 but also provides milestone assessments from 2025.

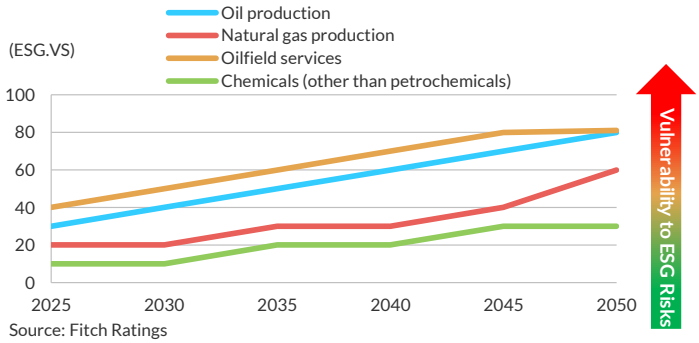
The higher the sector or entity score at a particular point in time, the greater the vulnerability under the scenario. A sector with a score of 90, for example, faces an existential threat from ESG before 2050, whereas one with a score of 10 will experience little disruption and may even see benefits. We provide scores in a time series to 2050 to compare the relative vulnerability of sectors and entities at different stages in the transition.

Our core stress scenario is the UN Principles of Responsible Investment (PRI) Inevitable Policy Response (IPR) *Forecasted Policy Scenario* (FPS). We believe its focus on policy provides a realistic assessment of the core credit risk from ESG to corporate and project debt issuers.

Oil and gas (O&G) companies will be among those most severely affected by the energy transition, and many producers have already started to re-think their strategies in view of potential regulatory changes.

As always, we seek to provide independent and informative opinions and insights that focus on investors' needs. We welcome any comments that you may have on this report and encourage you to engage with the authors to provide feedback.

ESG.VS - Selected Sub-Sectors



Source: Fitch Ratings

Sector ESG.VS Definitions

	Sector ESG.VS				
	10	30	50	70	90
Description of cumulative risks to a point in time (e.g. 2050)	ESG trend neutral to positive for sector prospects	Fundamental demand drivers neutral to positive, despite major changes to existing business models or a need for heavy investment	Solid demand drivers but a need for material changes to products or production methods, which may threaten profitability	Major changes to markets, regulation and business model likely to disrupt profitability for an extended period	One or more ESG factors have the potential in a credible scenario to pose an existential threat to core business activities

Note: Higher scores denote greater vulnerability
Source: Fitch Ratings

ESG.VS in Oil & Gas and Chemicals

O&G companies will be among those most severely affected by the energy transition: the change in the energy mix, which has been dominated by oil, coal and natural gas for several decades, towards electricity generated from low-carbon sources. Many O&G companies, ranging from large integrated international groups (oil "majors") and national oil companies to smaller producers, rely heavily on debt funding. Their sustainability in the medium and long term in the context of the energy transition is a key area of interest for investors.

In this report, we also consider chemicals, including petrochemicals and other chemicals. Petrochemicals use hydrocarbons as a feedstock and are considered a material driver for O&G consumption but have their own sustainability issues. Also, large integrated O&G companies are often integrated into chemicals. We exclude fertilisers from the scope of this report but will address it in future reports.

ESG risks have yet to significantly destabilise the sector. In 2009-2019, before the Covid-19 pandemic, global oil consumption increased on average by around 1.5% a year, and natural gas consumption increased by 3% a year. The penetration of electric vehicles (EVs) has so far been modest. In 2019, according to the International Energy Agency (IEA), EVs of different types, including two- and three-wheel vehicles, displaced consumption of only around 600 thousand barrels of oil per day, or around 0.6% of global demand.

However, analysis of regional trends shows that the energy transition should be taken seriously. In Europe, oil consumption stagnated in the same period, most likely due to the higher efficiency of the internal combustion engine (ICE) car fleet. In Norway, which has the highest penetration of EV globally due to various incentives, the consumption of diesel and gasoline decreased by 2% a year in 2016-2019.

Many O&G producers have publicly recognised climate concerns and European oil majors have committed to rebuilding their business models to adapt to the changing energy mix. Most O&G companies, however, are yet to formulate their response to the energy transition.

While the pace and scope of the energy transition may differ from region to region, oil, gas (due to liquefied natural gas, or LNG) and chemicals are globally traded commodities. This means that regional differences in the level of disruption are likely to be less pronounced compared to those in more domestically focused sectors, such as utilities. For this reason, we will assess ESG.VS and assign scores for the O&G and chemicals sectors on a global basis. We will recognise any significant regional differences (for example, those due to degrees of proximity to end-markets with more stable demand supported by less-punitive policies for hydrocarbons, or access to non-commercial funding options) when we assign scores to entities and transactions through "entity modifiers".

Of the environmental, social and governance factors that constitute ESG, we focus on environmentally targeted policy changes as the key driver of vulnerability for companies in the sectors in the period to 2050. While governance is frequently cited as a relevant issue for the O&G sector, we have omitted it from this analysis due to the difficulty in predicting policy trajectories and its smaller impact compared to the energy transition.

We have based our central stress scenario around the UN's FPS, which we believe provides a realistic basis on which to consider the most significant potential credit impact from long-term ESG risk factors. The FPS highlights a range of policies consistent with a scenario whereby the climate warms by 2°C.

Oil Production, Refining, OFS and Liquids Transportation Are the Most Disrupted

Oil production, refining, oilfield services (OFS) and liquids transportation (oil pipelines, storage and associated infrastructure assets) are the most vulnerable sub-sectors under a 2°C global warming scenario. Each area has an ESG.VS of 80 by 2050, close to the maximum sector vulnerability score of 90 and suggesting disrupted profitability for some companies and an existential threat to others. In light of company positions today, we view the near-term threat as far lower, at 30 in 2025 for oil production and refining, 20 for liquids transportation and 40 for OFS.

Under the FPS scenario, the share of crude oil in the global energy mix and absolute level of consumption could peak in the late 2020s and start falling steadily thereafter, which could result in excess production capacity and lower and more volatile prices. The liquids transportation and refining sub-sectors will also suffer globally due to weaker demand as well as uncertainty as to the cost-effectiveness of converting most liquids pipelines to other uses. Assets near regions with stronger demand will be less affected.

OFS companies have exposure not only to oil but also to natural gas, which will be less affected by the energy transition. However, we believe that exploration and development spending in the upstream sector will fall faster than O&G revenues as many companies will be trying to diversify away from hydrocarbons and return cash to their shareholders. The sector will suffer from overcapacity. Some oilfield services companies may be able to diversify into servicing the renewables sector, particularly offshore windfarms, but many companies will probably disappear. To reflect this risk, the OFS sub-sector score is 10 points higher than that of the oil production sub-

sector over 2025-2045, although they have the same score of 80 for 2050.

Fuel retail will be less severely affected – scoring 60 by 2050 – given the relatively wide range of services that petrol stations can offer, including consumer retail. While EVs are more likely to be re-charged while parked overnight, hydrogen and biofuels consumed by heavy-duty vehicles will probably continue to be distributed through petrol stations.

Natural gas will be less affected than oil. The FPS assumes limited disruption for natural gas until approximately 2040, with consumption increasing until 2025 and broadly stabilising between 2025 and 2040. This is because natural gas, as a cleaner alternative, will continue to displace coal in power generation in many places, including China. However, in the long term, its competition with renewables will intensify, which is reflected in the score increasing to 60 by 2050 from 20 in 2025.

Petrochemicals could become the key consumer of oil as road transport is electrified, and the sub-sector will be less pressured compared to oil production and refining as its greenhouse gas (GHG) intensity is relatively low compared to oil combustion. However, increased plastic recycling rates and changing behavioural patterns due to regulation and environmental awareness could still affect demand and margins in petrochemicals, which scores 20 in 2025 and 50 in 2050, close to the scores of natural gas production.

Oil & Gas and Chemicals Long-Term ESG.VS

(ESG.VS)	2025	2030	2035	2040	2045	2050
Oil & Gas						
Oil production	30	40	50	60	70	80
Liquids transportation[a]	20	30	40	50	60	80
Oil refining	30	40	50	60	70	80
Natural gas production	20	20	30	30	40	60
Fuel retail	20	30	40	50	60	60
Oilfield services	40	50	60	70	80	80
Chemicals						
Petrochemicals	20	20	30	30	40	50
Other chemicals	10	10	20	20	30	30
Integrated O&G producers - Indicative range	20-30	20-30	30-40	30-60	40-60	50-70

[a] Our view on gas transportation and distribution is discussed in *Utilities – Long-Term ESG Vulnerability Scores*
Source: Fitch Ratings

Specialty and other chemicals are the least affected sub-sectors, with scores rising only to 30 by 2050 from 10 in 2025.

Integrated O&G Producers

Many O&G producers are integrated companies with a presence in upstream, midstream and downstream activity, as well as a presence in chemicals and across various geographies. European oil majors have also committed to diversifying into renewables. The vulnerability of such companies to long-term ESG changes will reflect their underlying asset mixes combined with their relatively high flexibility due to greater diversification. We expect this diversification will allow these groups to achieve scores of 70 or below by 2050.

Objectives

Fitch implemented its ESG Relevance Scores (ESG.RS) across all asset classes in 2019. These quantify the effect that ESG factors have on the current credit ratings of entities and debt instruments. However, this assessment is limited by the typical rating horizon. This varies by sector but tends to be weighted towards a time period over which we can reasonably assess relevant risks. In our corporate analysis, for example, we rarely forecast further out than three to five years. These time periods rarely include the more dramatic effects of ESG developments, many of which will occur over a much longer horizon. We seek to address this in this report by looking at the risks to credit quality from ESG factors until 2050.

Macro to Micro

This report focuses on risks at sector and sub-sector levels and is part of a three-layer strategy to allow us to assign ESG.VS to individual entities and debt instruments. In this strategy, we will:

- Identify vulnerabilities at a sector and sub-sector level. We will assign scores between 10 and 90 to each sector, at five-year intervals between 2025 and 2050, with 90 reflecting an existential threat and 10 reflecting a sector where ESG factors do not pose a risk or which will potentially benefit from foreseeable changes.
- Assess differentiating factors at entity level ("entity modifiers"). For example, a state-owned oil producer in a developing country with strong domestic demand may be less vulnerable than an oil producer in a developed market with a powerful green lobby. Entity modifiers are explained below.
- Use the framework set out in this report to assign time-profiled ESG.VS to entities and debt instruments.

Assessing What Could Go Wrong

Forecasting a 30-year period is a highly speculative endeavour. We base our ESG.VS on a broad range of downside risks, incorporating current trends and technology, based around the FPS. The scores are a ranking of the relative risks to sectors and entities based on what we believe could (rather than will) threaten them. Our view is based on credible downside risks drawn from current scientific understanding, policy discussion and commitments, and technological achievements.

In addition to the 2050 assessment, we will provide milestone assessments starting from 2025 at five-year intervals. This will give a cumulative assessment of vulnerability at the various milestones, and allow us to differentiate the progress of risk across different subsectors.

Assumptions

We have adopted FPS as our core scenario. The scenario is credible, publicly available and focuses on the policy outcomes that we see as the key drivers of vulnerability for corporates and projects.

The FPS is based on the premise that there will be a forceful global policy response to climate change in 2023-2025. Its key assumptions include:

- A coal phase-out (by 2030 for first-mover countries);
- An ICE sales ban (by 2035 or earlier for first-mover countries);
- Carbon pricing (initially with some regional differences, but with global convergence by 2050);
- An only modest deployment of carbon capture, utilisation and storage (CCUS) technology, given a lack of proven policies;
- An increase in nature-based solutions, including bioenergy production, reforestation and afforestation;
- The ramp-up of renewables;
- The promotion of energy-efficiency improvements via regulation.

This scenario is far from the only credible long-term scenario in the market but, given the focus of ESG.VS on identifying risks, we believe it gives us a prudent yet credible core scenario around which to base our thinking. Full details of the IPR and FPS are on the PRI website. We discussed FPS's key assumptions and compared them with those of the IEA in our inaugural Utilities ESG.VS report. We have also analysed other scenarios, including those published by BP plc, Royal Dutch Shell plc and the US Energy Information Administration (EIA).

Entity Modifiers

The vulnerability of companies to ESG risks is primarily a function of their business mix. Our initial view on an entity's vulnerability will reflect its business mix, with its score based on the ESG.VS in the following sections and weighted by EBITDA at the end of our financial forecast horizon (typically three to five years). We will complement this by a two-tier system of entity modifiers, which are intended to provide a more granular sub-sector analysis through business-line-specific ESG considerations (e.g. exposure to regulation, cost competitiveness of assets, demand and revenue stability and GHG intensity and quality) and to capture wider group-specific factors, such as the level of diversification and ESG strategy.

Tier 1 – Business-Line-Specific ESG Considerations

Sub-sector factors will be applied across all sub-sectors discussed in this report and will be grouped into four categories. Descriptions of each category will slightly vary from sector to sector and are provided in relevant sub-sections of this report:

1. Local regulation and state support mechanisms
2. Demand and revenue stability in key markets
3. Cost competitiveness, asset complexity and performance
4. Environmental asset efficiency and quality

Tier 2 – Group-Level ESG Considerations

Group considerations will be applied on top of sub-sector-specific and business-line-specific factors and will reflect a company's operational features and ESG strategy. This will help provide a more refined view on a particular company's vulnerability to ESG risks.

Group-Level ESG Considerations

1.	Size and integration	Large integrated companies have more tools to deal with the energy transition, given better access to funding and exposure to a variety of sectors and segments, which will experience different levels of disruption (e.g. natural gas and petrochemicals vs. oil).
2.	Diversification by geography and asset	Allows companies to mitigate the risk of sudden adverse market or regulatory changes in one country or region, gives more optionality in terms of capex deployment, and gives access to more business opportunities and higher growth potential.
3.	Financial access and flexibility	Financial flexibility in the broad sense, including liquidity, steady access to cash for investments, and good-quality assets that can be traded if necessary.
4.	ESG strategy	Long-term strategic views that are clearly driven by ESG considerations represent a positive factor. In particular, in cases where the current business mix is quite vulnerable, the definition and transparent communication of a clear path to a more sustainable business could lead to a better score than the one implied by the current business profile.

Source: Fitch Ratings

Renewables Targets of Selected Integrated O&G Companies

Company	Scope 3 carbon-intensity targets	Renewables-capacity targets	Annual low carbon capex
BP plc	• Upstream: net-zero emissions by 2050 • Net intensity of products sold: -50% by 2050	20GW by 2025; 50GW by 2030	USD5bn by 2030
Eni SpA	• Europe: net-zero emissions by 2050 • Net intensity of products sold: -55% by 2050 • Net absolute emissions: -80% by 2050	15GW by 2030; >55GW by 2050	EUR1bn in 2020-2023
Equinor ASA	• Net intensity of products sold: -50% by 2050	4GW-6GW by 2026; 12GW-16GW by 2035	USD2bn-3bn in 2022-2023
Exxon Mobil Corp	None (Scope 1 & 2 targets only)	None	Negligible
Repsol, S.A.	• Net-zero emissions by 2050	15GW by 2030	EUR0.8bn by 2025
Royal Dutch Shell plc	• Net intensity of products sold: -65% by 2050	Not disclosed	USD2bn-3bn in 2021-2025
Total SE	• Europe: net-zero emissions by 2050 • Net intensity of products sold: -60% by 2050	35GW by 2025	USD2bn-3bn by 2030

Source: Fitch Ratings, companies' data

Integrated Oil & Gas Producers

Integrated O&G producers, including oil majors and medium-scale companies, are active participants in the global bond market. In addition to O&G production, integrated groups may also be involved in refining and retail (downstream); gathering, transportation, and storage (liquids or gas transportation); and petrochemicals. Many national oil companies, such as Saudi Arabian Oil Company (Saudi Aramco) and Petroleo Brasileiro S.A. (Petrobras), are also integrated producers. European majors are trying to re-brand themselves as energy groups and add low-carbon energy generation to their portfolios.

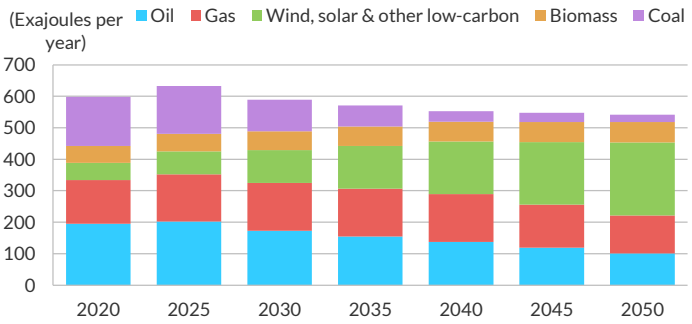
As a general rule, integrated companies have higher ratings, more diversified cash flows and lower earnings volatility compared to pure upstream producers. This was demonstrated in the 2014-2016 oil-market downturn, when the earnings of integrated producers fell slower than those of upstream companies.

Many companies, including oil majors and national oil companies, have deliberately increased exposure to natural gas, refining and chemicals over the past five to ten years to diversify earnings and better position themselves in the energy transition. Shell's acquisition of gas-heavy BG in 2016 is a good example. Middle Eastern national oil companies have invested in refineries or petrochemicals assets to secure long-term demand for their domestically produced oil. For example, Saudi Aramco has bought petrochemicals producer Saudi Basic Industries Corporation (SABIC).

These efforts may not be enough, particularly in the long term, if the energy transition plays out as set in the FPS. We believe that, on average, the refining, OFS and liquids transportation sub-sectors are likely to be as significantly affected by the energy transition as oil production. This includes a squeeze on both volumes and margins as oil demand falls, although the impact on liquids transportation might be slower due to its contracted and in some cases regulated nature.

Natural gas, as a "transition fuel", will be under less stress, as we expect demand to remain broadly stable in 2025-2040, although disruption will accelerate from 2040. However, diversification into natural gas, chemicals and retail, which all will experience a lower level of disruption compared to oil, may not be sufficient to fully replace vanishing demand for crude. European oil majors were the first large companies to recognise that their long-term survival will depend on their ability to mimic the evolving energy mix, which will include a higher share of renewables and other low-carbon solutions.

Primary Energy Mix by Fuel



Source: Fitch Ratings, UN's FPS

Key Areas of ESG Vulnerability

The vulnerability of integrated producers is dependent on the business mix. We believe that OFS, oil production, refining, and liquids transportation (albeit at a slower pace initially) will be the most severely affected, followed by fuel retail operations, natural gas and chemicals. Companies with higher exposure to natural gas, chemicals and renewables will be less affected by the energy transition.

In our analysis, we are focusing on the companies' likely business profile mix by 2025. While some companies, particularly European oil majors, may have long-term strategies to diversify away from hydrocarbons, such plans are subject to execution risks and lack visibility, so our scores would most likely largely ignore potential changes in their business mix beyond 2025. At the same time, clearly articulated, credible ESG strategies can be considered as a

mitigating factor and could be reflected in our final scores for particular companies.

Larger companies, such as oil majors, will find it easier to adapt to the changing energy mix, given better access to funding and larger financial resources. Still, smaller non-integrated companies can also take decisive steps to transform. Orsted A/S (previously DONG Energy) started as a Danish state-owned O&G producer in 1972. However, it has built a substantial green power generation portfolio, particularly in offshore wind, and fully disposed of its hydrocarbon assets.

With regards to upstream activity, companies with cheaper production and lower capital intensity (e.g. producers in the Middle East and Russia) will be less severely affected. With regards to downstream activity, companies with exposure to "lagging" regions with sizeable domestic markets (e.g. where the ICE sales ban does not materialise or happens later, such as Russia, Latin America, the Middle East and Africa) are in a somewhat safer position. Ownership and jurisdictional aspects are also important, as national oil companies could be supported by their respective governments through factors such as non-market access to capital. However, regional considerations should not be overemphasised, given the global nature of the oil and (increasingly) gas markets.

The ESG.VS in the table below provide indicative ranges for integrated companies after applying the two-tier entity modifier system discussed above.

ESG.VS Integrated Oil & Gas

	2025	2030	2035	2040	2045	2050
Indicative range	20-30	20-30	30-40	30-60	40-60	50-70

Source: Fitch Ratings

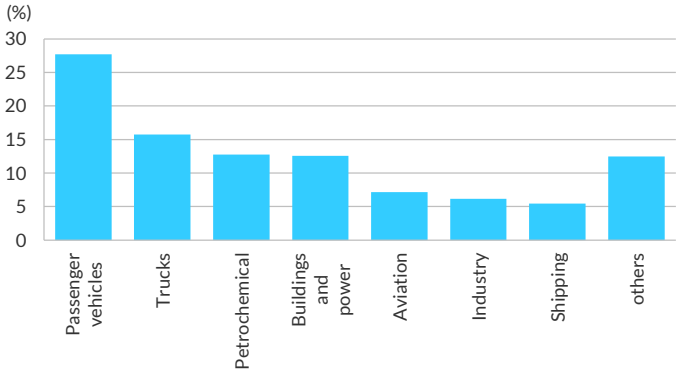
Oil Production

Oil is the second largest contributor to the world's carbon emissions (34% in 2019), preceded by coal (39%) and followed by natural gas (21%), according to Earth System Science Data's *Global Carbon Budget 2020*. The US, the EU and China are the three largest oil consumers globally (responsible for 20%, 15% and 14%, respectively, of global oil consumption in 2019, according to BP). This is despite the fact that their per-capita annual consumption differs dramatically (21bbl in the US, 8bbl in the EU and 4bbl in China), primarily due to different income levels and varying popularity and quality of the public transport.

Road transport is the largest oil consumer (43% in 2019, according to the IEA), followed by industry and petrochemicals (19%), buildings and power (13%), aviation and shipping (13%) and other sectors (12%).

It is clear from the chart on the right that global oil consumption is comprised of many different sub-sectors, though it is dominated by transportation.

Oil Demand by Industry in 2019



Source: Fitch Ratings, IEA (2020)

Prior to 2020, oil consumption was increasing steadily by around 1.5% a year. From 2000 to 2019, global oil consumption increased cumulatively by 28%. Most of the growth (69%) came from Asia Pacific (APAC), mainly China (43%). Oil consumption in North America stagnated in the same period and fell by single digits in Europe, mainly due to improved energy efficiency in road transport and industry.

Key Areas of ESG Vulnerability

ESG.VS Evolution

	2025	2030	2035	2040	2045	2050
Oil production	30	40	50	60	70	80

Source: Fitch Ratings

Oil production will be among the sectors most severely affected by long-term ESG trends, second only to coal. However, compared to coal, oil will be more difficult to replace, particularly in the medium term, meaning that the transition away from oil will be slower and more gradual. The electrification of road transport and improving efficiency of the ICE fleet will be key to reducing oil consumption globally, but it is also important to consider other sectors that represent a significant part of oil consumption, such as aviation, shipping, industry and petrochemicals. We believe that changes in these other sectors will be slower.

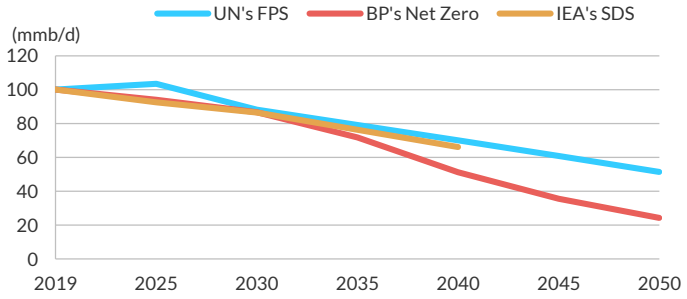
There are two main regulatory forces that will reduce global oil consumption: the ICE car sales ban, which several first-mover countries envisage by 2035 or even earlier, and carbon pricing, which will make owning a conventional car more expensive. For the transition to happen and to contribute to GHG reduction, this needs to be accompanied by car producers' technical ability to satisfy the demand for ultra-low emission vehicles (ULEV), including EVs, and a shift towards green electricity generation.

The FPS assumes that oil demand will peak in 2026-2028 and will decrease to around 50 million barrels per day (mmb/d) by 2050, or by around 50% from 2025 to 2050. This trend is similar to the IEA's *Sustainable Development Scenario* (SDS), which assumes demand of 64mmb/d by 2040, excluding biofuels, versus 70mmb/d in the FPS. The reduction will be mainly achieved by lower oil use in road transport, which, according to the FPS, will peak in 2025, while oil demand from aviation, shipping and petrochemicals (as a feedstock) will be more stable. In petrochemicals, higher demand for plastic,

particularly from the developing world, will be offset by a high rate of plastic recycling. According to the SDS, plastic collection rates could increase to 27% by 2030 from 17% today.

These are not the most radical forecasts. BP's *Net Zero* scenario assumes that oil consumption, excluding biofuels, will fall to 24mmb/d by 2050. This would largely be driven by greater use of hydrogen and biofuels, which help de-carbonise aviation and shipping, as well as greater EV penetration. The scenario also expects petrochemicals demand for oil (as a feedstock) will be 2mmb/d lower in 2050 than today. While the *Net Zero* scenario may seem extreme, it demonstrates that there is both upside and downside risks to the FPS.

Oil Demand by Scenario



Source: Fitch Ratings, IEA (2020), BP (2020), UN's FPS

Our conservative assumption that CCUS technology will not revolutionise the sector is consistent with the FPS. CCUS is technically proven but its large-scale deployment is questionable in the absence of regulatory policies supporting its commercial use. Unexpected technological developments or price falls could potentially improve longer-term prospects for oil and natural gas.

Volume versus Price Risk

We have weighted volume forecasts over price predictions when assigning ESG.VS. Prices are far less predictable than volumes and, apart from demand, will depend on supply response, marginal costs and other factors.

FPS does not attempt to forecast prices. The IEA assumes under the SDS scenario that the oil price will be USD57/bbl in 2025 and USD53/bbl in 2040 (in 2019 currency levels). We believe prices are likely to become lower and more volatile once it is clear that oil consumption is falling. Countries with high oil reserves, such as OPEC members and particularly Middle Eastern producers, many of which benefit from a reserve life of 50 years or longer, may be prompted to maximise capacity and production. As a result, prices would fall and the market share of many higher-cost producers could be wiped out.

Regional Considerations

Lower oil prices mean that all oil producers will be severely affected, including those who potentially manage to maintain or even increase production, such as Middle Eastern producers. We will use entity modifiers to ensure final entity ESG.VS reflect any regional aspects coming from a difference in regulation, access to state funding and exposure to regions with relatively more stable demand.

In the table below, we summarise the FPS view on how quickly different countries and regions will adopt carbon-pricing policies and introduce a ban on ICE sales, and rank them based on their level of exposure to oil-demand destruction.

Carbon Pricing and ICE Phase-Out

	Carbon pricing[a]	ICE ban[b]	Ranking[c]
Western Europe	Leader	Leader	1
China	Leader	Leader	1
Eastern Europe	Leader	Follower	2
North America	Leader	Follower	2
Australia	Follower	Follower	3
India	Follower	Follower	3
Japan and South Korea	Follower	Follower	3
Mexico	Follower	Follower	3
Latin America ex-Mexico	Laggard	Follower	4
Other developing Asia	Laggard	Follower	4
Russia and other CIS	Laggard	Laggard	5
Middle East	Laggard	Laggard	5
Africa	Laggard	Laggard	5

[a] Leaders are countries with carbon prices in place; followers are countries with emerging initiatives; and laggards are countries that do not have any carbon tax plans yet.
[b] Leaders are countries with ICE bans in place; followers are countries that actively support electrification of transport; and laggards are countries that do not have electrification on their political agenda.
[c] Where 1 = most exposed to oil-demand destruction and 5 = least exposed.
Source: UN's FPS, Fitch Ratings

Middle Eastern producers will probably be less affected by the energy transition, given their abundant oil reserves (and resultant ability to increase production at relatively low cost), low production costs, good access to key export markets, access to state-supported funding, and stronger domestic demand, given that the region is likely to lag in terms of the ICE phase-out and carbon pricing.

Russian and CIS producers are relatively well positioned with sizeable domestic markets, but they have weaker reserve positions and higher transportation costs compared to Middle Eastern producers.

APAC and Latin American (LatAm) producers, including state-controlled companies, have weaker cost positions and, in most cases, lower reserves compared to Middle Eastern producers, but can probably count on state support. Both regions are likely to be more proactive regarding ICE bans and carbon pricing compared to the Middle East and Russia.

North American producers do not have access to off-market funding options. Also, non-shale projects, such as oil sands in Canada or deep offshore projects, may be relatively costly. Shale projects, however, should be more resilient in view of lower costs and shorter payback periods.

Western European producers could be the most severely affected, given that Europe will take the lead in both ICE bans and carbon pricing. Projects with higher production costs, e.g. on the UK Continental Shelf (UKCS), will be at risk.

Entity-Level Considerations

Business-Line-Specific ESG Considerations: Oil Production

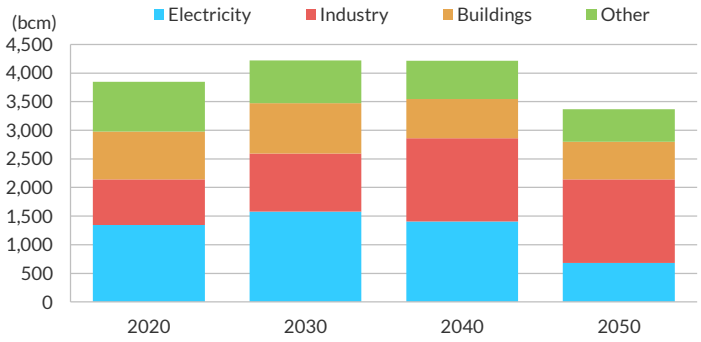
1. Local regulation and state support mechanisms	The degree of aggression of local environmental policies in respect to oil production. The potential for access to finance, independent of capital markets (e.g. state support for national oil companies).
2. Demand and revenue stability in key markets	Demand stability in key markets, including domestic and export markets. Key considerations would include ICE ban plans and carbon taxes.
3. Cost competitiveness, asset complexity and performance	Production costs, transportation cost to key markets, capital intensity and payback periods.
4. Environmental asset efficiency and quality	Asset efficiency, e.g. Scope 1 and 2 emissions, access to CCUS and similar technologies.

Source: Fitch Ratings

Natural Gas Production

Natural gas is among the most heavily used commodities, along with oil, and a key element of energy markets. Natural gas mostly consists of methane as well as other gases. Aside from gas-fired power plants, the main consumers of natural gas include the industrial and building sectors, where it is used as fuel, and the chemical sector, where it can serve as feedstock. Most gas demand comes from outside of the power sector, and the FPS expects industrial customers to provide most of future incremental gas growth.

Annual Gas Consumption by Sector

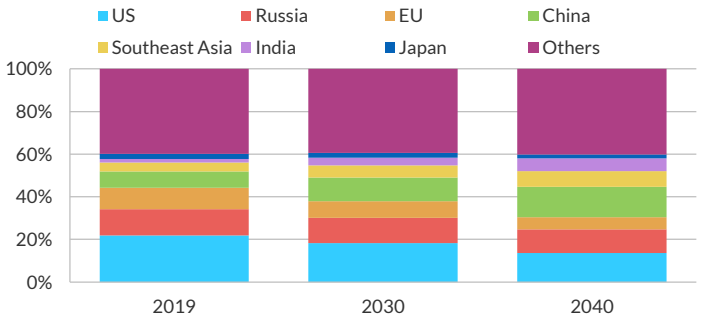


Note: bcm = billion cubic metres. Source: Fitch Ratings, UN's FPS

Global natural gas consumption is equivalent to around two thirds of the oil production volumes when measured by energy value. In the FPS, demand for gas is more robust than demand for oil over the next few decades due to growing use by the industrial sector, gas's lower GHG footprint and its role as a back-up fuel for renewables due to their intermittency issue. However, the "transition fuel" status of natural gas is debated in regions such as Europe and the US, which leads to increased variability in long-term forecasts. For instance, the FPS assumes that global gas consumption will grow by 10% by 2040, while the IEA's SDS projects a fall in demand of more than 10%. We assume the pivotal role of gas as a "bridge" fuel will abate in the 2040s due to competition with low-carbon sources and batteries.

There are few upstream companies that produce purely gas or liquids as hydrocarbon deposits often contain both and many companies operate gas- and oil-focused fields. Our ESG.VS for natural gas will be relevant for companies that are pure gas producers or have gas in their business mix.

Share of Gas Consumption by Region



Source: Fitch Ratings, IEA (2020, SDS)

Key Areas of ESG Vulnerability

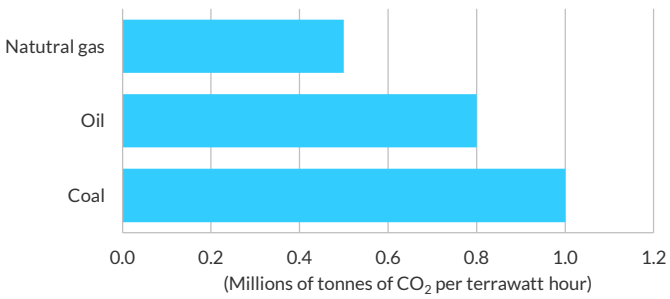
ESG.VS Evolution

	2025	2030	2035	2040	2045	2050
Natural gas production	20	20	30	30	40	60

Source: Fitch Ratings

The weakest point for natural gas, in terms of ESG risk, is the level of GHG emissions associated with burning it. Gas combustion leads to less GHG emissions than oil, which produces roughly 66% more carbon dioxide (CO_2), and coal, which generates twice as much CO_2 when burned for electricity generation. Nevertheless, natural gas has a far larger GHG footprint than renewables or green hydrogen, even on a full-cycle basis that includes all operating activity and production-facility construction. The difference between coal, oil and gas also diminishes when full-cycle emissions are taken into account.

Average CO_2 Emissions in Power Generation in 2019



Source: Fitch Ratings, IEA (2020)

Part of GHG emitted by gas upstream is related to the controlled discharge of raw natural gas into the air, i.e. venting, and unintentional gas leaks. According to the FPS, these two types of methane discharge increased GHG emissions from natural gas by

17% in 2015. We expect gas upstream industry to continue reducing the frequency of these leaks. Other ESG concerns around natural gas include seismic risk from fracking and drilling-related pollution, although the latter is far less substantial than the pollution risks of oil production.

Despite its significant GHG footprint, natural gas is among the best options to back-up solar and wind renewables during peak power consumption as long as battery and hydrogen technologies are not competitive. Additionally, coal-to-gas switching could be driven by the goal of slashing the intensity of non-GHG air pollution. The FPS assumes that global gas consumption will increase until 2030, then stay broadly flat before starting to dwindle from 2040 as it loses market share to low-carbon energy. That said, gas consumption will remain significant even in 2050 as CCUS technology is applied to 72% of gas in power generation and the industrial sector continues to use a small share of gas.

Entity-Level Considerations

Business-Line-Specific ESG Considerations: Natural Gas Production

1. Local regulation and state support mechanisms	The degree of aggression of local environmental policies in respect to gas production. The potential for access to finance, independent of capital markets (e.g. state support for state-owned companies).
2. Demand and revenue stability in key markets	Demand stability in key markets, including domestic and export markets. Key considerations would include coal-to-gas switching, the use of renewables and hydrogen, and carbon taxes. Presence of commercial or regulatory mechanisms to support cash flow stability.
3. Cost competitiveness, asset complexity and performance	Production costs including production taxes, transportation cost to key markets, capital intensity and payback periods.
4. Environmental asset efficiency and quality	Asset efficiency, e.g. Scope 1 and 2 emissions, access to CCUS and similar technologies.

Source: Fitch Ratings

Regional Considerations

The gas market has historically been regional and operated as several different markets due to costly gas transportation. The advent of a large LNG market has changed this, and 2020 was the first year when spot gas prices at major hubs in the US, Europe and northeast Asia converged for several months. LNG still covers just 10% of global gas production, and the balance at regional markets or state regulators continue to set local prices. However, we expect the LNG sector to grow in the long term and to play a key role in bringing dispersed gas markets closer together.

The vulnerability of specific gas producers to ESG risks will vary depending primarily on local carbon pricing, other GHG regulations, energy efficiency gains and improvements in the commercial viability of low-carbon sources of energy. We expect the EU, which has the toughest stance on GHG emissions among the bigger regions and a high dependence on natural gas imports, to be a more difficult market for gas producers. North America is another market where the gas market is already subject to concerns about its ecological profile in several regions, although the US is a net exporter of gas, which makes energy security risks less of an issue. North American gas producers typically have leaner cost structures than their European peers, but the through-the-cycle gas price in Europe is higher.

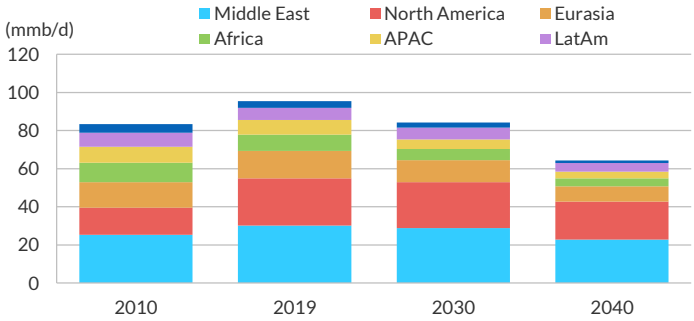
China and India are likely to be drivers of global gas consumption across the industrial, building and power generation sectors. Local gas producers may benefit from more stringent ecological policies and higher investments in the gas infrastructure required to boost gas availability, assuming they materialise. However, carbon pricing could over time erode their margins. Middle East-based companies have diverse prospects due to the significantly different role of gas in their economies.

Russian and CIS gas producers may experience stable domestic consumption and prices but could suffer from less attractive export prices and high transportation costs. LatAm companies could face competition from hydropower, solar and wind energy, but the FPS does not expect LatAm to be an early adopter of carbon pricing. State-owned producers from any emerging economy could also receive government support or expect favourable regulation if gas prices or sales volumes are severely hit by the energy transition.

Liquids Transportation

The liquids transportation includes pipelines for crude oil, refined products, and natural gas liquids (NGLs). Associated assets include gathering and processing as well as storage. Apart from companies focused on natural gas infrastructure assets, the long-term ESG risks of the liquids transportation sub-sector will largely stem from the evolution of oil demand, but revenue-stabilisation mechanisms embedded in some transportation contracts would cushion the energy transition impact for some companies. Gas transportation and distribution companies are addressed in *Utilities – Long-Term ESG Vulnerability Scores*.

Global Oil Production



Source: Fitch Ratings, IEA (2020, SDS)

Transportation companies that operate both oil and natural gas pipelines will have blended ESG.VS that include the risk assessment set out below and the scores for *Gas Transportation and Distribution* entities from the *Utilities – Long-Term ESG Vulnerability Scores* report.

Key Areas of ESG Vulnerability

ESG.VS Evolution

	2025	2030	2035	2040	2045	2050
Liquids transportation	20	30	40	50	60	80

Source: Fitch Ratings

Liquids transportation activities will be subject to some volumetric risks. In contrast to upstream companies, liquids transportation companies typically have lower commodity price exposure and benefit from take-or-pay clauses, contracted volumes or regulated revenues. These business features warrant lower ESG.VS for midstream entities than oil producers until 2045, although we expect midstream companies to be severely affected by reduced oil demand.

Entity-Level Considerations

Business-Line-Specific ESG Considerations: Liquids Transportation

1. Local regulation and state support mechanisms	The degree of aggression of local environmental policies in respect to oil production and liquids transportation activity. The potential for access to finance, independent of capital markets (e.g. state support for national oil companies).
2. Demand and revenue stability in key markets	Demand stability in key markets. Presence of commercial or regulatory mechanisms to support cash flow stability. Commodity exposure.
3. Cost competitiveness, asset complexity and performance	Asset competitiveness, capital intensity and payback periods.
4. Environmental asset efficiency and quality	Asset efficiency, e.g. Scope 1 and 2 emissions, use of CCUS and similar technologies.

Source: Fitch Ratings

Regional Considerations

ESG risks for liquids transportation companies will depend on regional oil production and transportation volumes as well as contract nature. The strictness of regulation will also determine the financial stability of the industry.

North American and European liquids transportation companies will be exposed to the most stringent ESG regulation but might benefit from greater stability of tariff and volume regulation where applicable. We expect crude and NGL production in North America to be more resilient than that in Europe in the long term. North American liquids transportation companies might still process substantially lower volumes in 2040-2050 than in 2019.

In developing economies, where liquids transportation assets are owned by oil companies that are often controlled by the state, state support and benign regulation in terms of GHG emissions and tariff-setting may also play a role. Biofuel production volumes that can take advantage of local liquids transportation assets will also affect overall energy transition risks.

Oil Refining

We see oil refining as one of the most vulnerable industries to long-term ESG trends under the FPS, equal to oil production and slightly less affected than coal-fired electricity generation. Lower demand for refined products will be driven by the improving engine efficiency of new ICE cars and, later on, a ban on the sales of such vehicles as well as increasing penetration of ULEVs such as battery electric, plug-in hybrid and hydrogen fuel cell vehicles.

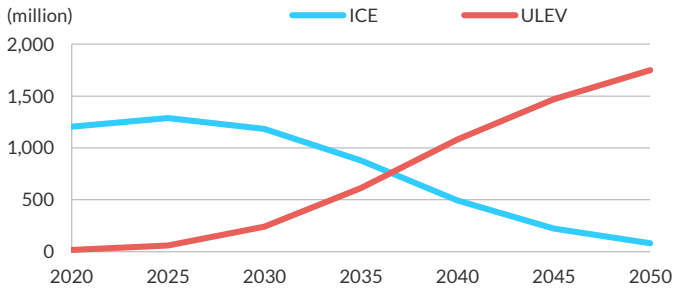
The FPS assumes that oil demand in transportation will peak in 2025 and decrease by 70% in 2050 compared to 2025 versus a decrease of 50% in overall oil demand in the same period. Forecasts for oil demand are more positive for aviation, shipping and as a feedstock for petrochemicals, where oil demand is expected to be more stable.

ULEV Expansion

Lower oil consumption in transportation will be driven by the increasing efficiency of ICE vehicles due to tightening emission standards and higher CO_2 emissions costs being passed on to product prices. BP estimates in its *Rapid* scenario that the efficiency of passenger ICE vehicles will increase by 45% by 2035.

Core assumptions in the FPS include increasing ownership and sales of passenger EVs as well as recent government policies banning the sale of light-duty vehicles powered by ICE. The FPS assumes that 70% of all passenger vehicles will be ULEVs by 2040.

Passenger Vehicles by Powertrain



Source: Fitch Ratings, UN's FPS

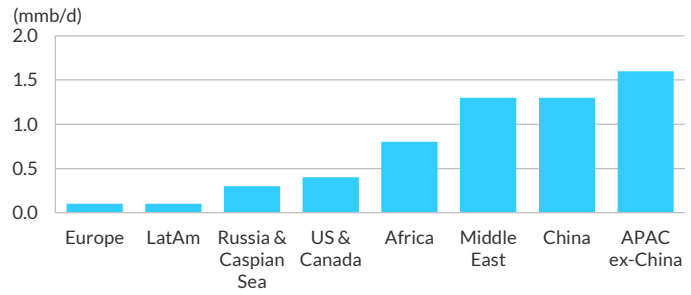
Regional Considerations

Asia (mainly India), the Middle East and Africa will experience the slowest adoption of ULEVs, resulting in a more gradual decline in demand for oil-based fuels. Developed countries and regions, particularly Europe, where the adoption of non-ICE vehicles is quicker and overall environmental regulations are more stringent, will be a challenging market for refiners.

Global refining capacity is expected to increase until 2025, mainly in the Middle East and Asia. Asian and African countries may try to limit their dependence on imported fuels by increasing refining capacity. European and North American refiners would bear the brunt of such an increase. In 2019, refining capacity in the Middle East and Asia increased by 2mmb/d and 5mmb/d, respectively, compared to 2010. The relocation of refining capacity will continue in the 2020s.

Refining Capacity Change

2020-2024



Source: OPEC WOO (2019)

From 2030, changes in regional oil demand and refining capacity will mainly be driven by bans on ICE-powered vehicles. While Norway will be the first to ban the sale of ICE vehicles, in 2025, the number of countries or regions introducing similar measures will grow quickly from 2030 (UK, Sweden and Denmark in 2030, and California in 2035). More generally, the FPS assumes that ICE vehicles will be banned in Europe and China by 2035 and in the US, Japan and other regions by 2040. The IEA's SDS assumes that 35%, 17% and 8% of total European, Russian and North American refining capacity, respectively, will be at risk in 2040.

While risks to the sector are high, many refiners will shift their focus to biofuels and petrochemicals and simultaneously reduce CO_2 emissions through the use of hydrogen. Liquid biofuels and synthetic fuels will become increasingly important in industrial processes, as well as transport modes such as aviation and maritime, where electrification and renewable heat may not be cost-efficient.

Key Areas of ESG Vulnerability

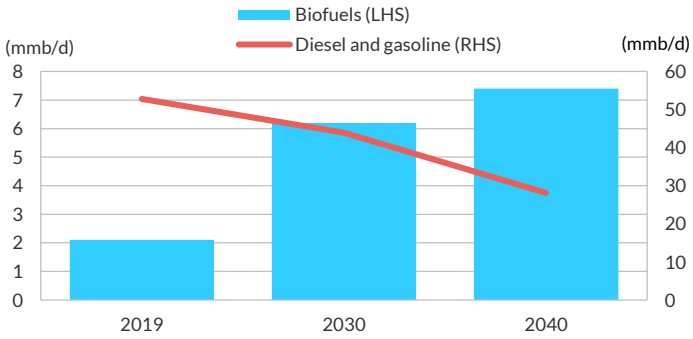
ESG.VS Evolution

	2025	2030	2035	2040	2045	2050
Oil refining	30	40	50	60	70	80

Source: Fitch Ratings

More complex and vertically integrated refiners will be at the forefront of change due to their larger capacity for investment. Smaller refiners lacking diversification to other parts of the O&G value chain, weakened by lower margins as global refining capacity increases in the coming years, will find it more difficult to invest in new technologies. Fuels Europe, a refining industry body, estimated that European refiners would need investments from EUR400 billion to EUR650 billion by 2050 to enable all new and old road transport vehicles, including hybrid or ICE, to be climate-neutral, and for aviation and maritime transport to achieve a 50% cut in GHG emissions by using liquid fuels from non-petroleum origin with very low or no CO_2 emissions.

Demand for Main Tranportation Fuels



Source: Fitch Ratings, IEA (2020, SDS)

The FPS assumes that bioenergy will meet around 10% of global energy demand by 2050. The IEA's SDS assumes demand for biofuels will increase to 7.4mmb/d in 2040 from 2.1mmb/d in 2019. European oil majors, as well as some smaller companies such as Polski Koncern Naftowy OLREN S.A. (PKN) have already announced large investments in the conversion of refining assets to biofuel sites. In the US, Valero Energy Corporation is the largest domestic renewable diesel producer and the second largest producer in the world. Renewable diesel investments have been announced by several US refiners in the past year, including HollyFrontier Corporation, Phillips 66, and Marathon Petroleum Corporation. Regional considerations may also play a role. The IEA notes that the potential for production of advanced biofuels in many African countries is enormous, due to the size of the continent's agricultural sector.

Biofuels and Biogas

Biofuels, such as biodiesel, bioethanol and hydrotreated vegetable oils (HVOs), are a renewable energy source made from organic matter or wastes. In the transport sector, they are blended with existing fuels such as gasoline and diesel. In the future, they could be particularly important to help decarbonise the aviation, marine and heavy-duty road transport sectors.

Biogas is a gaseous mixture (primarily methane and CO_2) produced from biomass (certain residues and by-products from agricultural and forestry activities, industrial and municipal waste and other lignocellulosic material), through the decomposition of organic matter in the absence of oxygen (anaerobically). Biogas can be used directly as a fuel, or be purified or "upgraded" into biomethane, which can thus be used for the same applications as natural gas and injected into the gas grid.

Synthetic methane is produced through the methanation of low-carbon hydrogen and CO_2 from a biogenic or atmospheric source.

Source: Fitch Ratings, Shell, EU Energy System Integration, IEA

Key entity-level considerations will include the ability to invest in new technologies, as well as location and regulatory aspects that drive the pace of change in the sale of oil-based and alternative fuels.

Entity-Level Considerations

Business Line-Specific ESG Considerations: Oil Refining

1. Local regulation and state support mechanisms	The degree of aggression of local environmental policies in respect to fuel products. The stability of the regulatory environment. The potential for access to finance, independent of capital markets.
2. Demand and revenue stability in key markets	The pace of fuel-demand destruction depending, usually, on operating environment developments in key markets of operation. Key considerations would include ICE ban plans and carbon taxes.
3. Cost competitiveness, asset complexity and performance	More complex refiners with higher white-product yields and a growing share of biofuels in total output will be better placed to withstand changing market dynamics.
4. Environmental asset efficiency and quality	The age of asset base and operational efficiency. The need for investment.

Source: Fitch Ratings

Green Hydrogen

Currently, hydrogen is mainly produced industrially from natural gas, which generates significant carbon emissions. This type is known as "grey" hydrogen. A cleaner version is "blue" hydrogen, for which the carbon emissions are captured and stored, or reused. The cleanest is "green" hydrogen, which is generated by renewable energy sources through electrolysis without emitting carbon.

Hydrogen has an important role to play in reducing emissions in hard-to-decarbonise sectors, in particular as a fuel in certain transport applications (heavy-duty road transport, captive fleets of buses, or non-electrified rail transport, maritime transport and inland waterways) and as a fuel or feedstock in certain industrial processes (steel, refining or chemical industries). CO_2 in reaction with hydrogen can be further processed into biomethane or synthetic fuels, such as synthetic kerosene, which is used in aviation.

Source: Fitch Ratings, IEA, EU Energy System Integration

Fuel Marketing

Fuel marketing will need to be significantly reshaped to adapt to the new energy mix. The decline in the sale of oil products will require site operators to invest in fast-charging stations and the distribution of alternative fuel types, such as hydrogen, LNG or compressed natural gas (CNG), and to expand their retail offerings.

Regional Considerations

The change in demand for oil products will be the key determinant of the pace of change in fuel marketing business. We therefore expect that the regional trends affecting the marketing sector will be broadly in line with those affecting the refining business.

Key Areas of ESG Vulnerability

ESG.VS Evolution

	2025	2030	2035	2040	2045	2050
Fuel marketing	20	30	40	50	60	60

Source: Fitch Ratings

Long-haul travellers will need to recharge or refuel and also rest, which will put relatively less pressure on retail sites outside cities. Retailers operating in urban areas will need to transform due to the likelihood of a relatively high penetration of ULEVs and autonomous vehicles (AVs) and the increasing adoption of advanced mobility options such as car-sharing and ride-hailing.

Those trends will reduce petrol demand and petrol-station traffic as many people charge their vehicles either at home or at work, depending on the infrastructure in their city, and as fleets recharge at dedicated hubs. Charging is expected to be more dispersed with more vehicles being "fuelled" at homes and office buildings.

Other alternative fuels are also beginning to gain ground in some markets. Fuel cell electric vehicles (FCEVs) are a type of electric vehicle in which hydrogen combines with oxygen in a fuel cell to generate the electricity needed to power an electric motor. FCEVs

have the potential to be zero-emission vehicles since the utilisation of hydrogen in fuel cells does not emit GHG. In some parts of the world, a sizeable proportion of vehicles already run on alternative fuels such as liquefied petroleum gas (LPG) and compressed natural gas (CNG), and biofuels have an increasing share of the petrol and diesel pools. Vehicles that use an alternative fuel such as LPG or CNG still require refuelling through a traditional fuel retail location, unlike EVs.

The focus on vehicles at retail sites will be substituted with a focus on customers and their needs, with fuel retailers needing to compete for larger "share in life". Charging lasts longer than simple refuelling, giving operators many possibilities, but petrol stations will need to become destination in themselves. Retail customers have become more demanding. They are looking for high-quality, fresh, healthy food options, better value and more attractive store formats. Digitalisation will help improve loyalty programmes and payment solutions.

Cooperation and the establishment of partnerships will also be more prevalent, as will be an expansion to new services related to mobility. O&G companies have already started investing in EV rental businesses. Further expansion into servicing these vehicles when autonomous driving becomes more common is another field of growth for the industry.

A well-articulated strategy that addresses the challenges of the energy transition, the ability to invest in chargers, alternative fuel types distributors and retail offering, and location and regulatory factors will be key determinants of the vulnerability of fuel retailers.

Entity-Level Considerations

Business-Line-Specific ESG Considerations: Fuel Marketing

1. Local regulation and state support mechanisms	The degree of aggression of local environmental policies in respect to fuel products. The stability of the regulatory environment. The potential for access to finance, independent of capital markets.
2. Demand and revenue stability in key markets	The pace of fuel-demand destruction depending, usually, on operating environment developments in key markets of operations. Key considerations would include ICE ban plans.
3. Cost competitiveness, asset complexity and performance	The ratio of non-fuel sales in total sales revenues. The development of infrastructure for alternative fuels (such as hydrogen and electricity).
4. Environmental asset efficiency and quality	The age of asset base and operational efficiency. The need for investment.

Source: Fitch Ratings

Oilfield Services

We consider the outlook for OFS companies to be more challenging than that for oil producers or refiners as O&G companies are focusing on the energy transition and are likely to cut their exploration costs and develop their proved reserves. Regional OFS companies in countries with a more favourable environment for hydrocarbons production, or large, geographically and operationally diversified companies with strong balance sheets, and cost-efficient fleets and positions across value chains, are better placed to address the necessary sizeable investments in energy transition. Smaller, traditional OFS companies, whose credit metrics were adversely affected by the industry downturn due to Covid-19, may be under significant pressure.

Some OFS companies are already shifting their focus to services for hydrogen infrastructure, CCUS, geothermal energy and renewables projects. Halliburton has been a service leader in geothermal technology. Schlumberger, with the acquisition of GeothermEx in 2010, has also strengthened its position in the geothermal industry. Meanwhile, Norway's Aker Solutions has recently spun off Aker Offshore Wind, a deep-water wind power producer, as well as Aker Carbon Capture, a company that focuses on the carbon-capture phase of the value chain. Baker Hughes intends to expand across the gas value chain.

In the short term, OFS companies will continue focusing on products and services that help their customers achieve their emissions-reduction targets through better efficiency and the use of renewable fuels and electric-powered equipment.

OFS companies are also setting clear targets for reducing their own carbon footprints. Schlumberger aims to reduce its carbon emissions by 30% by 2025. Baker Hughes plans to reduce its carbon-equivalent emissions by 50% by 2030 and to achieve net-zero emissions by 2050.

Key Areas of ESG Vulnerability

ESG.VS Evolution

	2025	2030	2035	2040	2045	2050
Oilfield Services	40	50	60	70	80	80

Source: Fitch Ratings

We assess the ESG.VS scores for OFS companies as 10 points higher than those of oil producers over 2025-2045, with the highest score of 80, in 2045, continuing until 2050 (in line with oil production). This is due to the fact that the stronger focus of O&G companies on cost discipline and a more balanced approach to exploration budgets within the long-term context of the energy transition will pressure OFS margins and the sustainability of their current business models. The implementation of ESG-related strategies by OFS companies to support their long-term sustainable growth will also lead to high execution risk and uncertainty.

Entity-level factors and characteristics will incorporate the differentiation among the entities' sector positions, levels of diversification, contracted nature of operations and strategies.

Entity-Level Considerations

Business-Line-Specific ESG Considerations: Oilfield Services

1. Local regulation and state support mechanisms	The degree of aggression of local environmental policies in respect to O&G production. The potential for access to finance, independent of capital markets.
2. Demand and revenue stability in key markets	Demand stability in key markets, including domestic and export markets. Key considerations would include ICE ban plans, use of renewables and hydrogen as well as carbon taxes. The presence of commercial mechanisms to support cash flow stability and consistency of its application.
3. Cost competitiveness, asset complexity and performance	Costs, capital intensity and payback periods.
4. Environmental asset efficiency and quality	Asset efficiency, e.g. Scope 1 and 2 emissions, access to CCUS and similar technologies. Asset quality and necessary investments for business shift.

Source: Fitch Ratings

Regional Considerations

We anticipate some regional differences in the performance of the OFS sector, similar to dynamics in exploration and production. As previously stated, we assume that the pace of the transition to a low-carbon economy will vary by region, which will affect the position of O&G producers and ultimately OFS companies. We expect Middle Eastern and Russian O&G companies to benefit from a more benign regulatory and market environment compared to Western European or North American peers, at least in the short-to-medium term, with a direct knock-on effect on OFS performance in these regions.

However, we expect the industry's long-term fundamental risk landscape to be challenging for all the companies, albeit with a lagging regional effect, with the ultimate survival being driven by the strength of business profiles, ability to quickly adapt to required portfolio evolution and balance sheets' capacity to support this shift.

Chemical Companies

The production of chemicals usually involves large quantities of energy, mostly generated from fossil fuels, for both organic chemicals (e.g. olefins produced from naphtha steam cracking) and inorganic chemicals (e.g. electrolysis of salt to produce chlorine). According to IEA, the chemical industry consumes around 12% of oil and 9% of gas production, which makes it the largest industrial energy consumer. However, as about 50% is used as feedstock, meaning that part of the carbon remains embedded in the product, it is the third largest industrial emitter of CO_2 after the steel and cement industries.

ESG issues are a secular topic for the chemical industry due to its inherent air pollution, water and energy usage, hazardous waste management, and safety risks. Developed countries are leading the global shift in regulation to increasingly stringent standards. For example, chemical production in Europe increased by 84% in 1991-2017 while GHG emissions fell by 57%, according to the European Chemical Industry Council. This performance is partly explained by the natural incentive for chemical companies to develop more efficient technologies and processes. However, further efficiency gains are likely to be harder to achieve as the easier gains have already been achieved, and sector emissions, in contrast, are often described as "hard to abate".

There are many ways to segment the chemical industry given the broad spectrum of products it covers, but virtually all companies are concerned by pressure on supply caused by tightening regulation. However, we have chosen to separate petrochemicals from other chemicals (including inorganic, specialty, consumer and fine chemicals) due to the fact that commodity chemicals are usually produced in larger volumes generating significant emissions, and demand from petrochemical products could face pressure from increased circularity measures. Fertilisers will be covered in a separate report.

Regional Considerations

As the chemical industry is largely globalised, international trade and regional competitiveness play a key role in chemical companies' profitability. Europe has by far the most stringent chemical regulation and its willingness to lead the way in the energy transition has not always been followed, as seen, for example, with the EU's Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) regulation.

Nonetheless, large emerging countries have also implemented drastic measures to tackle industry emissions due to growing health and environmental concerns, as highlighted by China's pledge to be carbon-neutral by 2060.

Large industrial emitters in some regions are already concerned by carbon tax or emission trading systems (ETS), which set the price for carbon. According to the FPS, carbon pricing in countries that lead the energy transition could increase from the current USD10-20 per tonne of CO_2 (tCO_2) to USD100/tCO_2 by 2040 in both leading and following countries. Under the FPS, carbon pricing will develop as follows:

- Leaders: USD60/tCO_2 by 2030, USD100/tCO_2 by 2040
- Followers: USD40/tCO_2 by 2030, USD100/tCO_2 by 2040
- Laggards: USD25/tCO_2 by 2035, USD100/tCO_2 by 2050.

Regional differences in vulnerability will depend on international cooperation and on the effectiveness of carbon border-adjustment mechanisms (CABMs) put in place by energy-transition leaders to avoid carbon leakage (the transfer of production to countries with lower ambitions for carbon reduction). For example, in phase three of the EU's ETS (2013-2020), sectors exposed to "a significant risk of carbon leakage" receive free allowances corresponding to the level of emissions on a benchmark of the most efficient installations. While this system aims to maintain competition, it incurs an additional cost for emitters above the benchmark level, whereas imports are not subject to ETS. This mechanism will remain in place in phase four until 2030 but could concern a narrower list of sectors.

The EU is considering implementing CABMs for 2021, such as the application of a carbon tax to domestic and imported products, a

new carbon customs duty, or extending the scope of its ETS to imports. While this would maintain a level playing field within the region, this does not address the competitiveness of exports from the region.

Petrochemicals

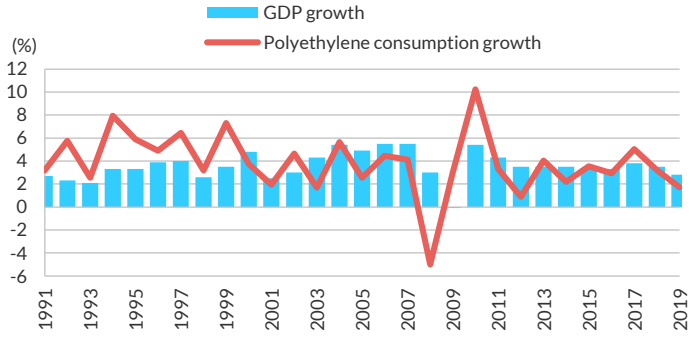
The petrochemical industry manufactures countless products that can be produced using different feedstocks and processes. However, GHG emissions are mainly generated by base chemicals produced in large volumes, such as olefins (ethylene, propylene or butadiene), aromatics, methanol, or ammonia (mainly used for the manufacture of fertilisers).

As their production is energy-intensive, regulation is likely to push towards electrification from renewable sources, for example for crackers, or to the use of green hydrogen. Given the importance of energy cost for petrochemical companies' competitiveness, this could affect supply. Over the past decade, significant petrochemical capacity additions were built in the Middle East and North America to take advantage of low regional gas prices, at the expense of European producers in particular.

Demand Risk

Plastics, the main products of the petrochemical industry, are everywhere in modern society. In recent decades, plastics resin demand has been fuelled by global growth, especially from China and emerging countries where per capita consumption is lower than in developed countries, and by new applications, resulting in demand growth that outpaces GDP growth.

Polyethylene Consumption Growth versus GDP Growth



Source: Fitch Ratings, Bloomberg Intelligence

The petrochemical industry is still expected to benefit from low single-digit demand growth over the long term despite greater societal awareness of the growing plastic waste issue, due to the material's properties, versatility, cost-effectiveness and lack of immediately available substitutes. The FPS assumes that oil demand for petrochemicals will remain significant in 2050. This is confirmed by the IEA's forecast in its *Stated Policies Scenario* (STEPS) that petrochemicals will be the main driver of oil demand growth over the coming decade, representing 60% of demand growth in 2030 and 75% in 2040, with similar proportions in 2050 stated by BP in its *Business-as-usual* (BAU) scenario.

However, what looks like a bright prospect for the industry will be undermined by measures to improve circularity in the value chain in order to tackle plastic waste, potentially affecting demand for virgin plastic. The current global collection rate is estimated to be around 15% and mainly takes place in developed countries. As plastic demand growth is coming from emerging economies where recycling infrastructure is less developed, it is unlikely that the global recycling rate will improve materially in the next decade.

BP's BAU scenario assumes the collection rate will improve to only 33% in 2050 and that oil demand for the manufacture of plastics and fibres will grow to 15mmb/d from about 10mmb/d in 2018. The IEA's STEPS assumes a mild improvement to 20% in 2040 from 17% in 2019, which would not meaningfully reduce the demand growth.

However, under their respective sustainable development scenarios, where recycling rate improves to 40%-50% in 2040-2050, the impact on virgin plastic demand is much more significant, with the growth of energy demand in the petrochemicals sector to 2040 being cut to 1.2% CAGR in IEA's SDS compared to 1.9% in the STEPS, while BP's *Rapid* scenario sees oil demand in petrochemicals decreasing after 2040.

Given that this substitution risk is only likely to reduce the pace of demand growth and will require considerable infrastructure and technological efforts, we consider that it will add moderate pressure from 2040.

Key Areas of ESG Vulnerability

ESG.VS Evolution

	2025	2030	2035	2040	2045	2050
Petrochemicals	20	20	30	30	40	50

Source: Fitch Ratings

We believe the ESG vulnerability of petrochemicals manufacturers will be moderate in the coming decades but will accelerate after 2040 due to increasing and more widespread use of carbon pricing and growing substitution of virgin polymers by recycled materials on a global basis. The ESG.VS of 50 by 2050 reflects a situation where demand drivers remain solid but ESG considerations require material changes in production methods, which affects profitability.

Entity-Level Considerations

Business-Line-Specific ESG Considerations: Petrochemicals

1. Local regulation and state support mechanisms	The degree of aggression towards or support of local environmental policies in respect to chemical production. The potential for access to finance, independent of capital markets.
2. Demand and revenue stability in key markets	The degree of demand disruption in key markets. The risk of product substitution driven by ESG policies.
3. Cost competitiveness, asset complexity and performance	Energy and production costs, transportation costs to key markets, capital intensity and payback periods.
4. Environmental asset efficiency and quality	Asset efficiency, e.g. Scope 1 and 2 emissions, access to CCUS and similar technologies.

Source: Fitch Ratings

We expect companies with concentrated asset bases to be more vulnerable given the major investments that could be required to comply with increasingly stringent regulation, and the production

disruption it could create. We also expect asset diversification by geography to play a key role in mitigating regulation risk or coping with differentials in energy costs across regions.

Adoption of the best available techniques, either proactively or as a result of legal requirements, or the development of in-house technologies will require strong financial flexibility. This in turn places greater importance on having scale, moderate leverage and competitive energy or feedstock access.

We expect local regulation and support to play an important role in ESG vulnerability, affecting the competitiveness of assets. Moreover, companies will need to manage exposure to products whose demand will be influenced by ESG policies, given that they could result in pressure on spreads and utilisation rates. Finally, we expect ESG policies to influence the competitiveness of the least efficient assets from both an operational and environmental perspective.

Other Chemicals

Manufacturers of inorganic chemicals, such as chlorine, will be less vulnerable to ESG risks compared to petrochemicals, despite their exposure to environmental regulations. This is mainly due to their lower demand-substitution risk. We therefore believe that their vulnerability will mainly stem from the lack of level playing fields across regions, absent efficient cross-border adjustment mechanisms.

Further down the value chain, companies that manufacture products tailored to a specific need (be it industrial, consumer or fine chemicals) are also materially exposed to environmental regulation, but to a lesser extent than large, high-volume petrochemical facilities. Although current ETS mainly target large production assets, we expect specialty chemical companies to progressively face stricter regulation and increasing carbon prices as the scope of ETS across the world are extended to smaller production sites.

We see demand risk as lower and more easily manageable for specialty chemicals compared to commodity producers. Firstly, circularity is less of a threat as it is most likely to concern commodity plastic resin rather than technical grades. ESG-related policies could effectively favour easier-to-recycle materials where possible, and an ICE vehicle ban could translate into lower demand for technical heat-resistant plastics, although this would not affect the industry as a whole and would increase demand for substitutes.

Secondly, specialty chemical companies can manage their exposure through portfolio management with more flexibility than large commodity producers, as some segments will be less affected by ESG issues, such as ingredients for food or personal care, which can be bio-sourced.

Thirdly, as they usually have high R&D intensity, specialty companies will play an important role in the development of clean technologies, lightweight materials and new mobility solutions.

Downstream manufacturers are more exposed, however, to potential bans on products based on environmental or societal concerns, although such bans are very hard to predict. We expect ESG-related policies to have a more predictable, indirect impact on the demand of some specific products.

Key Areas of ESG Vulnerability

ESG.VS Evolution

	2025	2030	2035	2040	2045	2050
Other chemicals	10	10	20	20	30	30

Source: Fitch Ratings

We see a moderate ESG vulnerability until 2050 for other chemicals manufacturers, with fundamental demand drivers neutral to positive despite major changes to business models.

Entity-Level Considerations

Business-Line-Specific ESG Considerations: Other Chemicals

1. Local regulation and state support mechanisms	The degree of aggression towards or support of local environmental policies in respect to chemical production. The potential for access to finance, independent of capital markets.
2. Demand and revenue stability in key markets	The degree of demand disruption in key markets. The potential for product bans or boycotts. The offsetting effects of demand for products that support the energy transition.
3. Cost position, asset complexity and competitiveness	The capacity to sustain R&D, and successful product, process or technology development.
4. Environmental asset efficiency and quality	Asset efficiency, e.g. Scope 1 and 2 emissions, access to CCUS and similar technologies.

Source: Fitch Ratings

We view R&D capability and portfolio management as key differentiating factors among specialty chemical companies. While overall chemical regulation will become increasingly demanding, selective state support is likely for technologies serving the energy transition, such as hydrogen. Product positioning, R&D efforts and strategic alliances aligned with sustainable trends can enable specialty companies to hedge demand risk in particular markets or product lines.

Analysts – Corporates

Alex Griffiths
Head of Corporate Ratings EMEA
+44 20 3530 1709
alex.griffiths@fitchratings.com

Angelina Valavina
Head of EMEA Natural Resources & Commodities
+44 20 3530 1314
angelina.valavina@fitchratings.com

Dmitry Marinchenko
Senior Director – EMEA
+ 7 495 956 7016
dmitry.marinchenko@fitchratings.com

Slava Demchenko
Director – EMEA
+7 495 956 2407
slava.demchenko@fitchratings.com

Jakub Zasada
Director – EMEA
+48 22 338 6295
jakub.zasada@fitchratings.com

Guillaume Daguerre
Director – EMEA
+34 93 323 8404
guillaume.daguerre@fitchratings.com

Shalini Mahajan
Managing Director – North America
+1 212 908 0351
shalini.mahajan@fitchratings.com

Dino Kritikos
Senior Director – North America
+1 312 368 3150
dino.kritikos@fitchratings.com

Lucas Aristizabal
Senior Director – Latin America
+1 312 368 3260
lucas.aristizabal@fitchratings.com

Ying Wang
Managing Director – APAC
+86 21 6898 7980
ying.wang@fitchratings.com

Thomas Brownsword
Senior Director – North America
+1 646 582 4881
thomas.brownsword@fitchratings.com

Mark Sadeghian
Senior Director – North America
+1 312 368 2090
mark.sadeghian@fitchratings.com

Analysts – Sustainable Finance

Andrew Steel
Global Head of Sustainable Finance
+44 20 3530 1596
andrew.steel@fitchratings.com

Peter Archbold
Senior Director
+44 20 3530 1172
peter.archbold@fitchartsings.com

Justin Sloggett
Director
+44 20 3530 2671
justin.sloggett@fitchratings.com

David McNeil
Associate Director
+44 20 3530 1942
david.mcneil@fitchratings.com