RYSTAD ENERGY

FOR JOGMEC

THE LONG ROAD AHEAD:
SIZING UP FUTURE UPSTREAM RISK

MARCH 2022

RYSTAD ENERGY UPSTREAM RESEARCH TEAM

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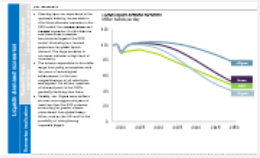
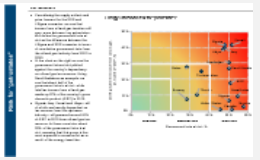

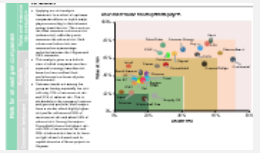


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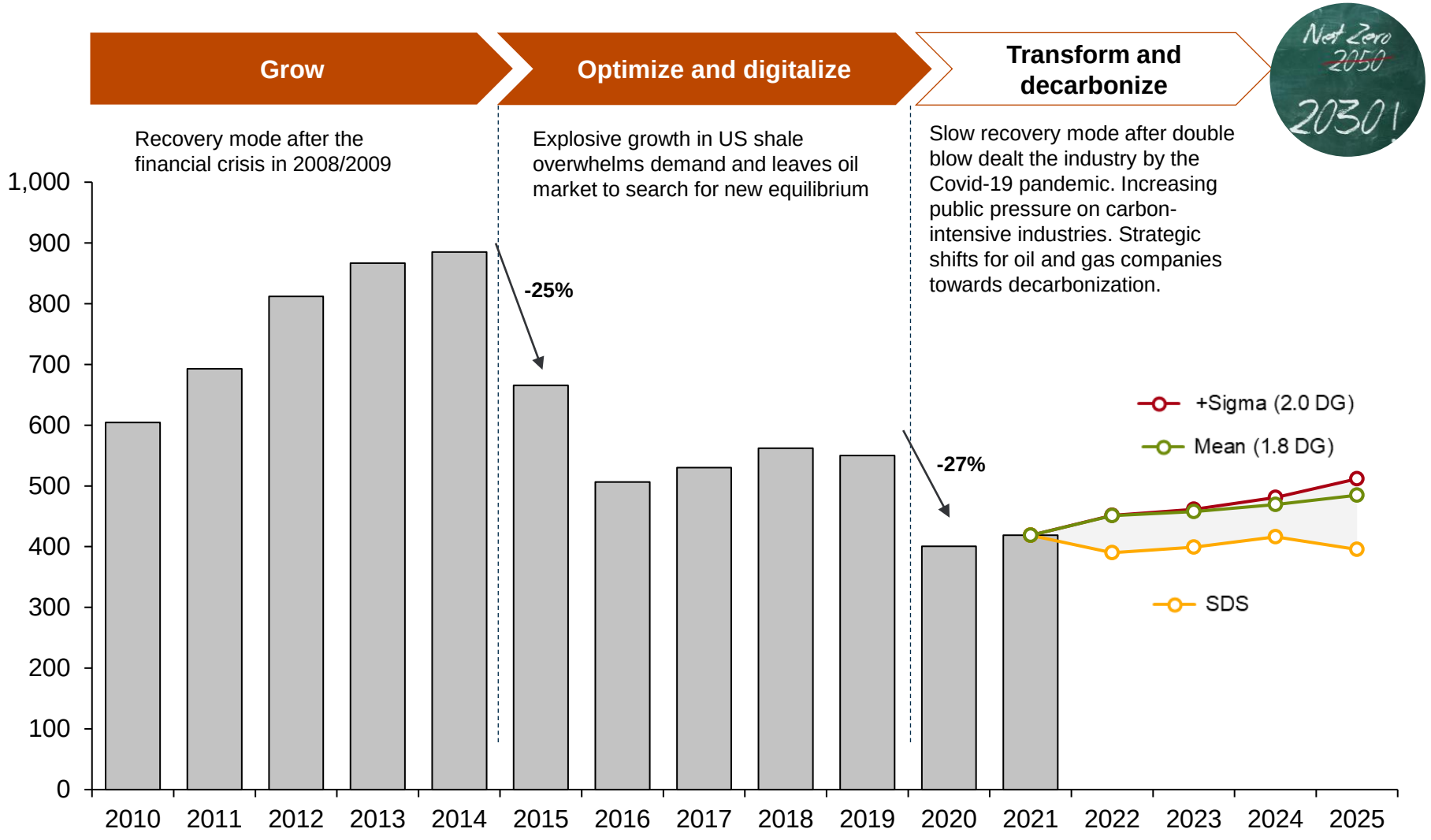
E&P sector is entering a new investment cycle

Priorities shifting towards decarbonization and portfolio resilience

Market overview

E&P investment forecast at different oil demand scenarios
Billion USD



Source: Upstream Energy Transition risk dashboard

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Energy transition risk for the E&P industry can be broken down into two parts

We analyze energy transition risks as granularly as possible

Methodology

Energy transition risk

To accurately account for energy transition risk on a global scale, we must analyze energy transition risks as granularly as possible. Energy transition risk is therefore understood as the risks threatening revenue, which may be impacted by reduced prices or volumes, down to the asset level. These have been quantified and measured in terms of economic value at risk. Our analysis shows that the economic value at risk is highly asset-specific, reflecting the varying risks facing different geographies, costs and revenue structures.

Revenue risk

The risk to future revenues as a result of demand lost due to constraints on total emissions.

Volume risk

The risk of having "stranded assets" that carry no value in a decarbonized scenario.

Price risk

The risk of realizing lower prices than what would have been the case in a business-as-usual scenario.

Focus of this report

Cost risk

The risk of expenses that would otherwise not have occurred in a business-as-usual scenario.

Policy risk

The price of carbon that could be imposed as a tax, incurring an extra expense in oil and gas companies' income statements.

Source: Rystad Energy research and analysis

If the price is right: locating the market clearing price towards 2050

Using UCube asset-level data

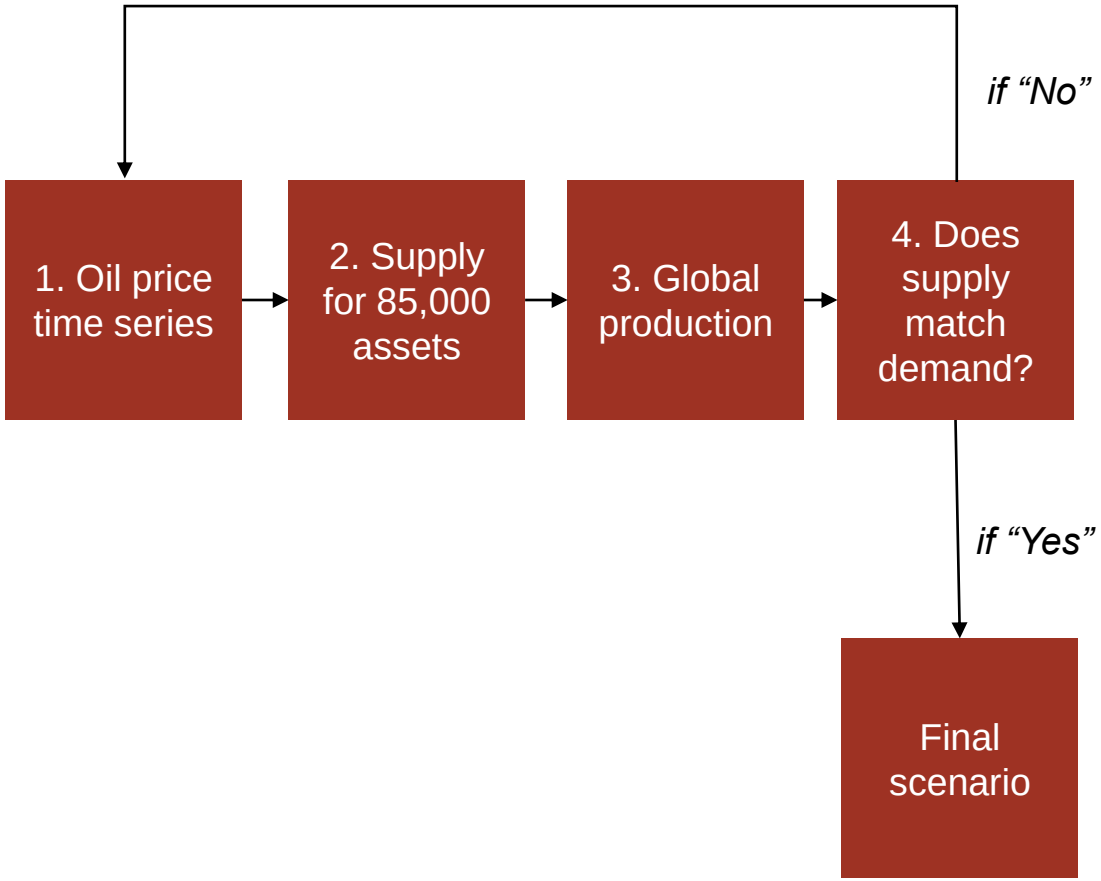
Methodology

Key takeaways

- Price risk (which underlies revenue risk) is a central driver of energy transition risk. To understand the revenue risks arising from the energy transition, it is essential to understand what oil prices to expect within each of the key decarbonized demand scenarios that were outlined in the previous chapter.
- The following methodology was applied to calculate the equilibrium oil price for the global liquids market towards 2050 in the different scenarios that are included in this report.

1) An oil price time series was established for each year until 2050.
2) Using this price, the potential supply, resources and cash flows were calculated for our 85,000-asset data set.
3) Summarizing this, we arrived at the global supply outlook for liquids.
4) Comparing this to our demand outlook for each year, outliers were adjusted until supply matched demand.

This iterative approach allows us to arrive at a pricing outlook within each of our demand scenarios that is reflective of the full impact of all key upstream pricing drivers.



Source: Rystad Energy research and analysis

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Understanding Rystad Energy's liquids demand scenarios

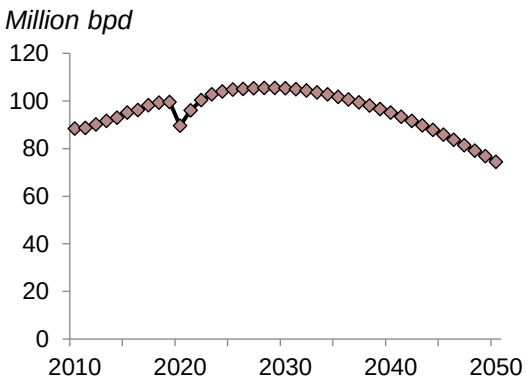
Three scenarios represent different paces of energy transition

Liquids and gas demand scenarios

Demand scenario description

Scenario implications

+σ (+Sigma, 2.0 degrees)



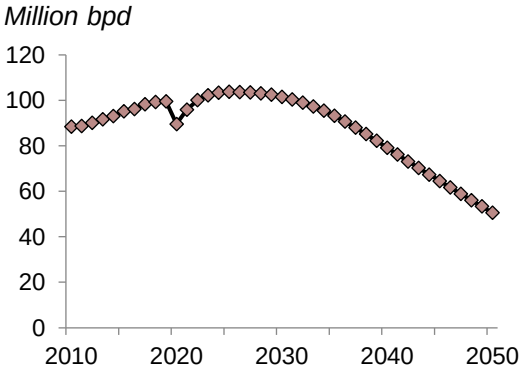
The **+Sigma (2.0°C)** scenario is a reasonable upside probabilistic range from our Mean scenario.

Oil demand peaks in 2028 at 106 million bpd and declines to 74 million bpd in 2050.

Key assumptions:

- Electric vehicle (EV) adoption is slow. In non-OECD countries, more consumer-side headwinds such as a lack of charging infrastructure and a robust market for used ICE* vehicles will support oil demand for longer.
- The plastic recycling rate increases linearly and does not reach the same rate as glass or iron.
- Oil displacement in power generation does not accelerate significantly versus historical decline rates.

μ (Mean, 1.8 degrees)



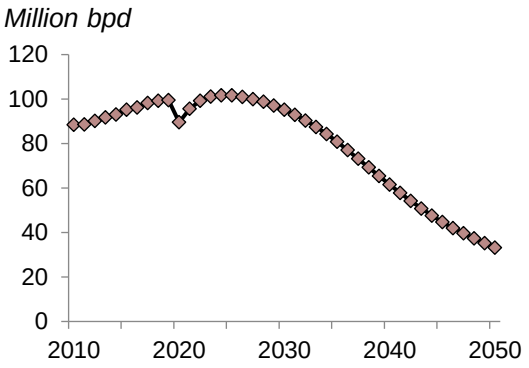
The **Mean (1.8°C)** scenario is the most probable long-term oil demand trajectory.

Oil demand peaks at 104 million bpd in 2025 and declines progressively to 51 million bpd in 2050.

Key assumptions:

- EV adoption develops according to a reasonably risked-down version of current EV manufacturers' targets.
- Recycling for some plastic types converges with the rate for aluminum cans and glass (~75%) by 2050.
- Around 30% of virgin petrochemical feedstock for some plastic types is sourced from green hydrogen by 2050.
- Oil substitution in other sectors develops in line with current policies, accelerating in the power, agriculture and maritime sectors.

-σ (-Sigma, 1.6 degrees)



The **–Sigma (1.6°C)** scenario is a reasonable downside probabilistic range from our Base Case: Mean scenario

Oil demand peaks at 102 million bpd in 2024 and falls sharply to 33 million bpd in 2050.

Key assumptions:

- EV adoption proceeds according to unadjusted EV manufacturers' targets.
- All EV consumer constraints (charging infrastructure, power supply etc.) are supposed to be solved and governments adopt policies to curtail short-distance transport.
- Plastic recycling rises to 90% by 2050 for some plastic types. In addition, green hydrogen accounts for around 70% of feedstock for certain plastic types.
- Oil substitution accelerates markedly in other sectors versus today's trajectory.

*ICE: internal combustion engine. Source: Rystad Energy research and analysis

External benchmarks for liquids demand scenarios

Three scenarios represent different paces of energy transition

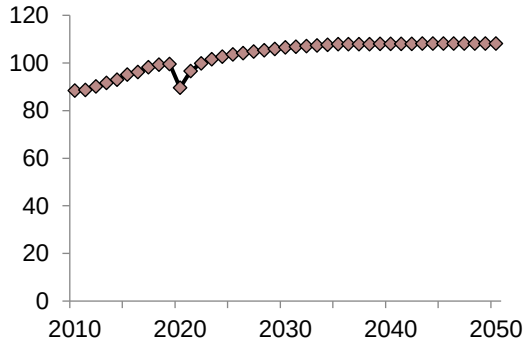
Liquids and gas demand scenarios

Demand scenario description

Scenario implications

OPEC

Million bpd



The **OPEC** scenario sees a bullish liquids demand with gradual increase in demand up until 2045.

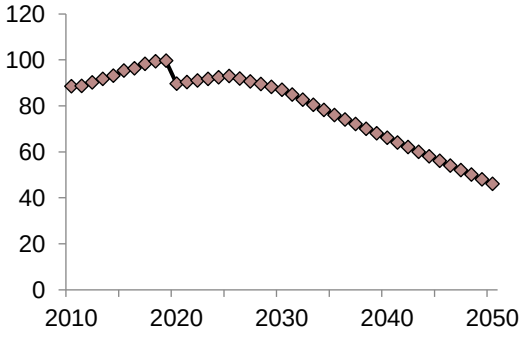
Global oil demand is expected to increase from 90.6 million bpd in 2020 to 108.2 million bpd in 2045.

Key assumptions:

- The transportation sector is set to be the major contributor to future incremental global oil demand, adding around 13 million bpd between 2020 and 2045.
- More than 90% of the demand increase comes from the road transportation and aviation sectors, each contributing around 6 million bpd. However, a large part of this is a rebound from the sharp demand decline in both sectors in 2020.
- The total vehicle fleet is expected to reach 2.6 billion by 2045, increasing by around 1.1 billion from 2020 levels. The EV fleet approaches 500 million vehicles by 2045, representing almost 20% of the global fleet.

SDS (Sustainable Development Scenario)

Million bpd



The **SDS (Sustainable Development Scenario)** by the International Energy Agency (IEA) is the most widely used benchmark, calling for temperature increases well below 2ºC.

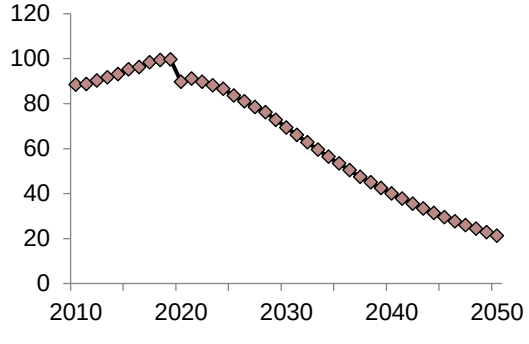
Oil demand peaks at 93 million bpd in 2025 and declines progressively to 46 million bpd in 2050.

Key assumptions:

- SDS meets the conditions set out by the Paris Agreement.
- The scenario achieves key energy-related United Nations sustainable development goals related to universal energy access and major improvements in air quality (like the NZE scenario).
- CO_2 emissions to peak at around 33 Gt in 2018, falling to less than 10 billion tonnes by 2050 and on track to net zero emissions by 2070 (with many countries and regions reaching net zero much earlier).

NZE (Net Zero Emissions by 2050)

Million bpd



The **NZE (Net Zero Emissions by 2050)** from the IEA sets a narrow pathway for the global energy sector to achieve net zero CO_2 emissions by 2050.

Oil demand peaks at 91 million bpd in 2021 and falls sharply to 21 million bpd in 2050.

Key assumptions:

- While the SDS is in line with the Paris Agreement's objective of holding the increase in the global average temperature to well below 2 °C, the NZE goes a step further to match the Paris Agreement's objective of pursuing efforts to limit the temperature increase to 1.5 °C.
- In the NZE, CO_2 emissions are net zero in 2050 globally and there are rapid reductions in all non-CO_2 emissions (such as methane).

Source: Rystad Energy research and analysis

Oil prices fall as decarbonization intensifies

Due to lower demand

Liquids and gas demand scenarios

Demand scenario description

Scenario implications

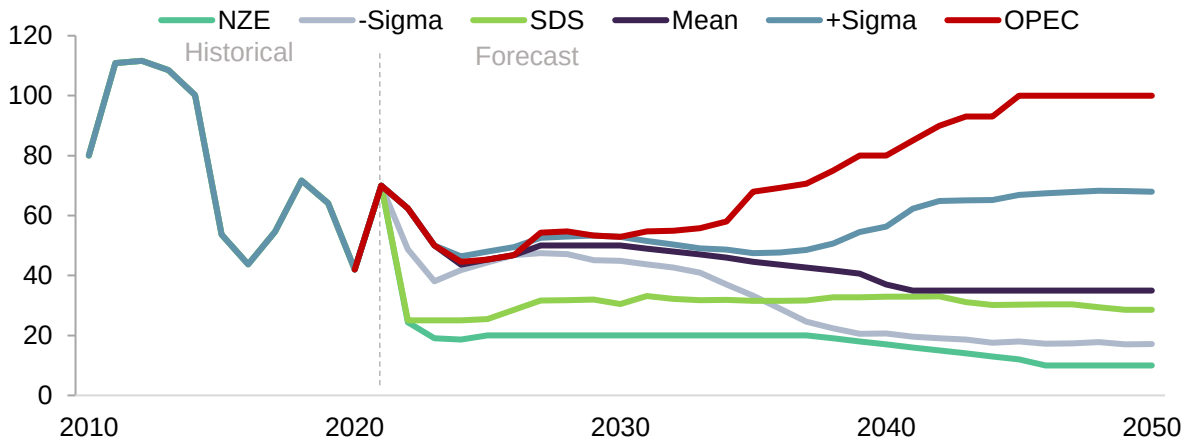
Key takeaways

- Armed with a solid pricing outlook for each of our scenarios, we see that liquids prices are at risk in outcomes with a more aggressive energy transition.
- The SDS scenario, which complies with the Paris Agreement mandate (well below 2ºC, WB2C), is set to see prices around $30 per barrel in 2022-2050.
- In Rystad Energy's internal oil demand scenarios we do not expect any immediate and substantial oil demand decline up until the 2030s, so the oil price in all our scenarios for the next decades stays between $40 and $50 per barrel. After 2034 the oil price starts to drop down to about $17 per barrel in the -Sigma scenario.
- Only in the OPEC scenario may the oil price rise as high as $100 per barrel.
- Gas price assumptions are considered to be interconnected with oil price scenarios and differ depending on the specific gas market. The chart uses Henry Hub gas price assumptions as an example. The spike in gas prices in the 2040s can be explained by rapidly declining supply from shale production.

Global liquids price 2010-2021

Scenario-compliant marginal cost of supply 2022-2050

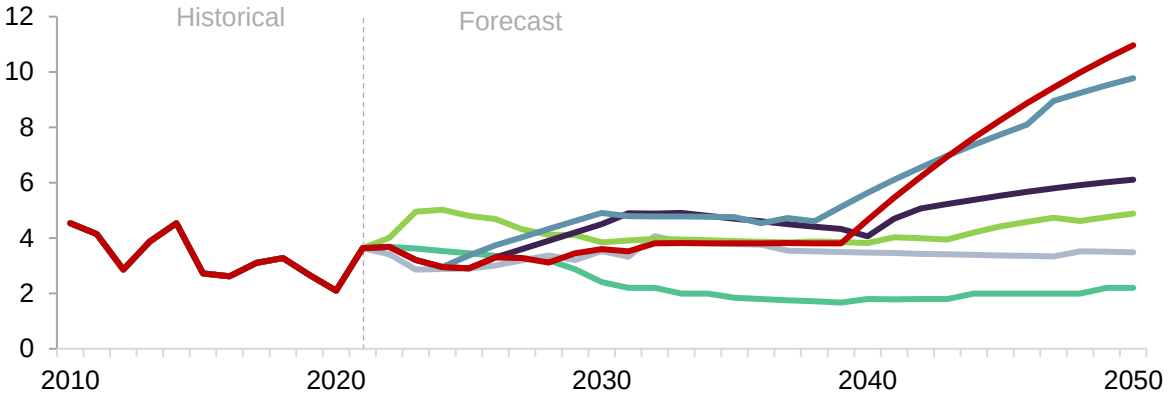
USD per barrel of Brent crude (real terms)



Gas price (Henry Hub) assumptions, 2010-2021

Scenario-compliant: oil price correlation+marginal cost of supply 2022-2050

USD per thousand cubic feet (real terms)



Source: Upstream Energy Transition risk dashboard

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New volumes still needed to counter natural decline

In all scenarios under consideration

Liquids and gas demand scenarios

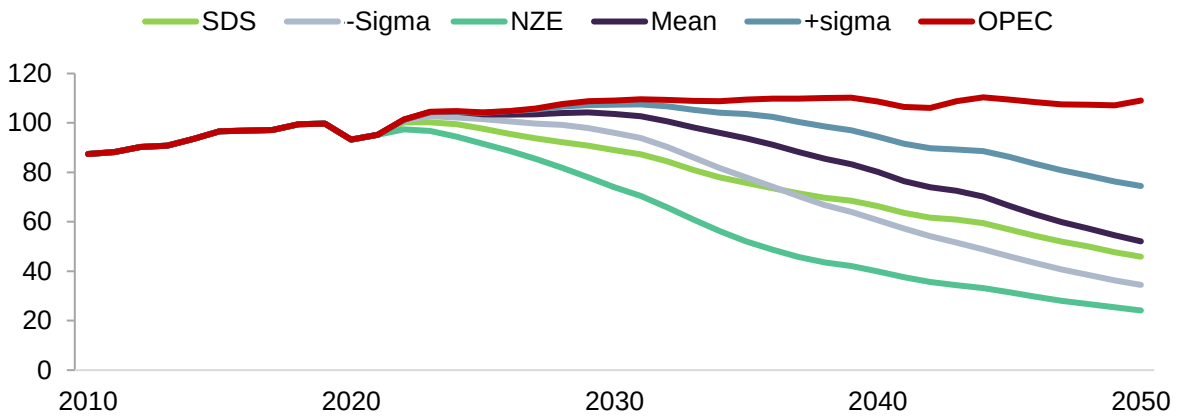
Demand scenario description

Scenario implications

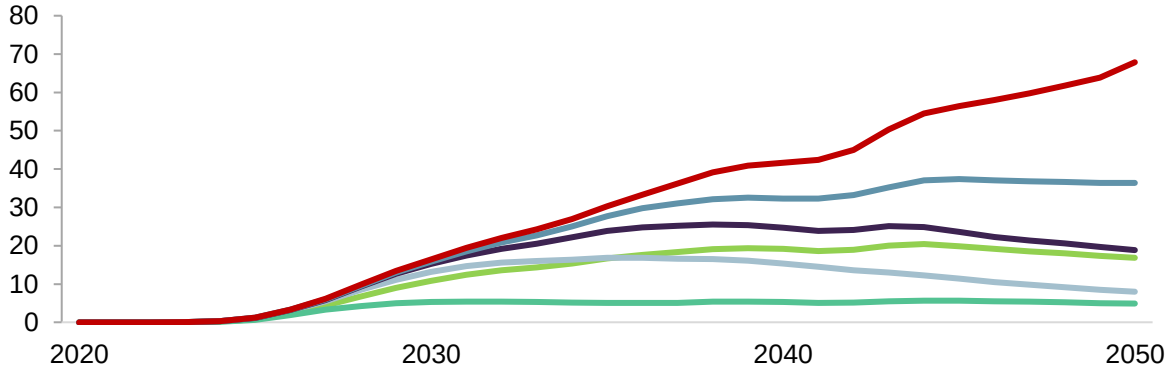
Key takeaways

- Total global liquid supply towards 2050 varies significantly depending on the trajectory of decarbonization. In the +Sigma scenario, total liquids supply slides to 75 million bpd by 2050. In the Mean scenario, supply decreases to 52 million bpd, and in the SDS scenario it falls to 46 million bpd.
- In the bottom chart we see the demand for new volumes, given the natural decline of currently producing assets. New volumes are understood as the production that must come from fields either currently in the discovery phase or that are not yet discovered. The demand for new volumes represents the difference between the production from currently producing or under-development fields and total liquids demand.
- In every scenario included in this analysis there is still demand for new resources. In the SDS scenario, demand for new volumes reaches a peak at around 19 million bpd, while in the Mean case this peak is around 25 million bpd. In the +Sigma scenario, demand for new volumes must peak at 36 million bpd in order to meet sustained demand, while in OPEC scenario it goes up to 67 million bpd.

Global liquids supply
Million barrels per day



Demand for new volumes
Million barrels per day (bpd)



Source: Upstream Energy Transition risk dashboard

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Gas supply shows less aggressive decline rates

As gas has an important role to play in climate scenarios

Liquids and gas demand scenarios

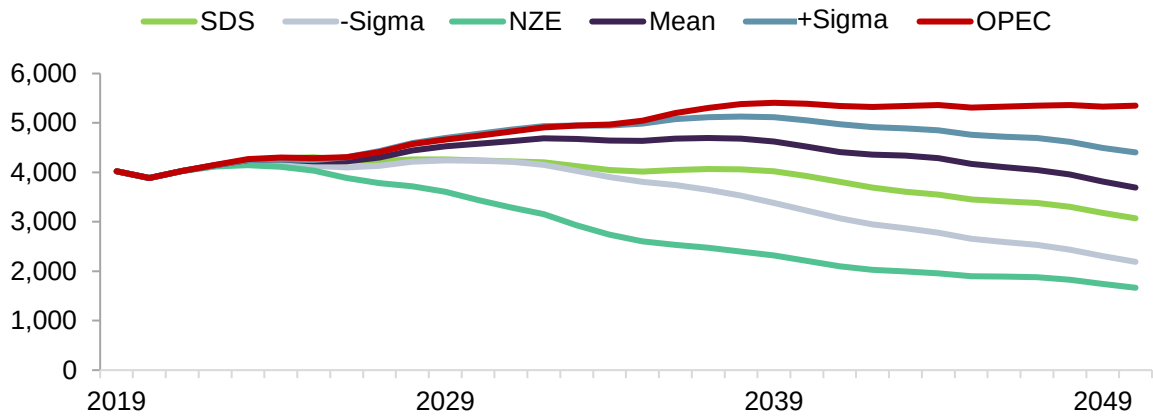
Demand scenario description

Scenario implications

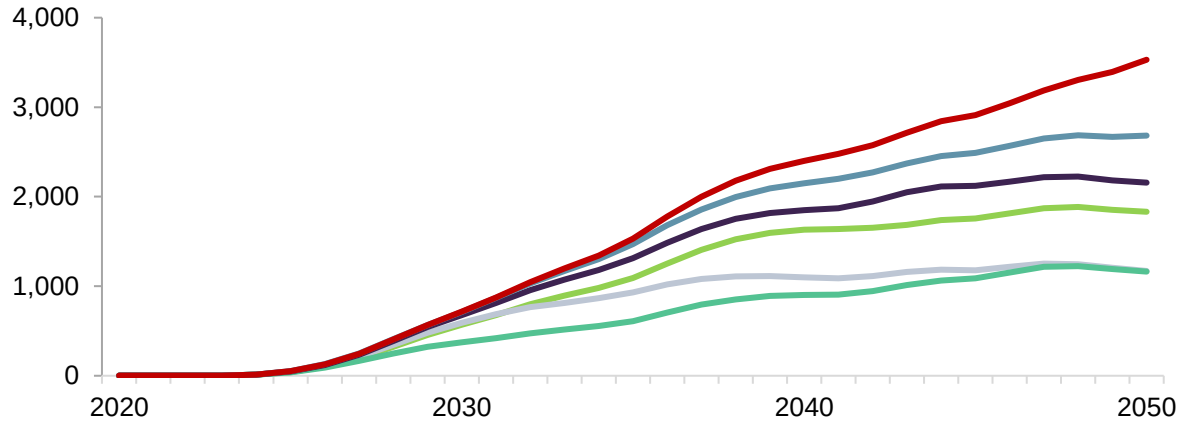
Key takeaways

- Gas supply shows more stable dynamics even in the most aggressive transition scenario NZE. In this scenario the compound annual growth rate (CAGR) for gas in the next 30 years for gas is about -3%, while for liquids the CAGR in NZE is -5%.
- The reason for this is that gas will play an important role in the energy transition as a substitute for coal and fuel oil in many regions. We also see increasing demand for gas to back up renewable power.
- However, the range of potential supply by 2050 still varies from 5,300 Bcm in the OPEC scenario to 1,667 Bcm in NZE. In our Mean scenario, gas supply declines from 4,000 Bcm in 2021 to 3,700 Bcm in 2050.
- The bottom chart shows demand for new volumes, given the natural decline of currently producing assets.
- Given the less aggressive decline rate for gas supply in all scenarios, there is an upward trend for new volumes, with curves starting to flatten in the mid-2040s.

Global gas supply
Billion cubic meters



Demand for new volumes
Billion cubic meters



Source: Upstream Energy Transition risk dashboard

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In Mean scenario liquids production by 2050 declines for all major producers

while gas production may grow for Russia, China and Canada

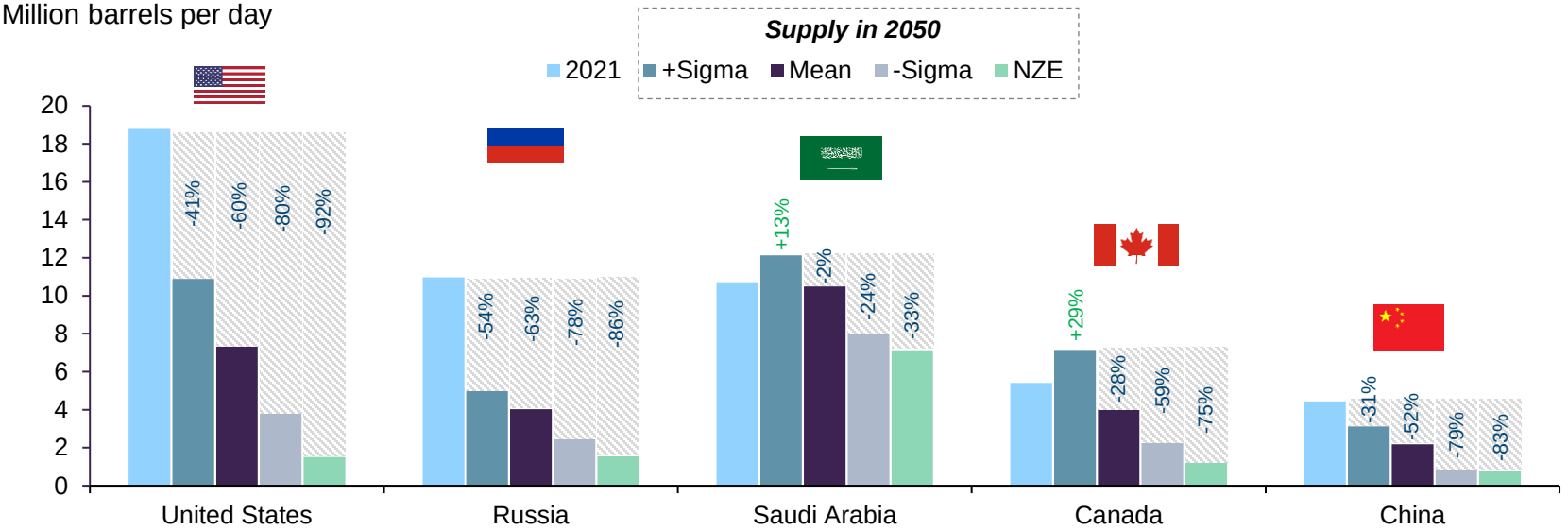
Liquids and gas demand scenarios

Demand scenario description

Scenario implications

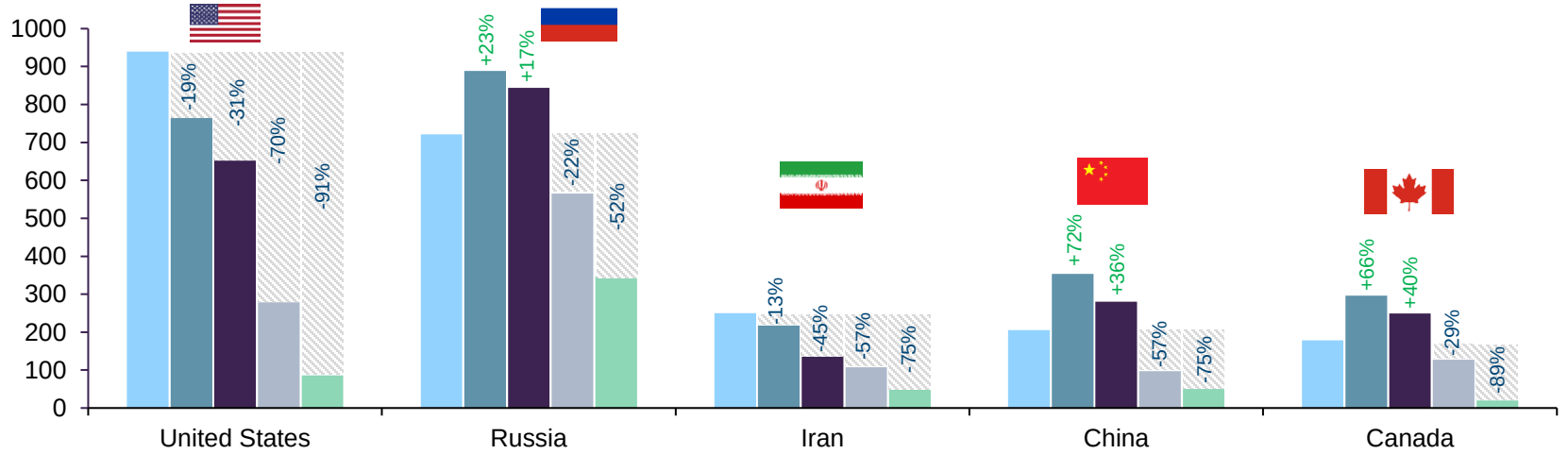
Liquids supply in 2050 by top producers in different scenarios

Million barrels per day



Gas supply in 2050 by top producers in different scenarios

Billion cubic meters



Source: Upstream Energy Transition risk dashboard

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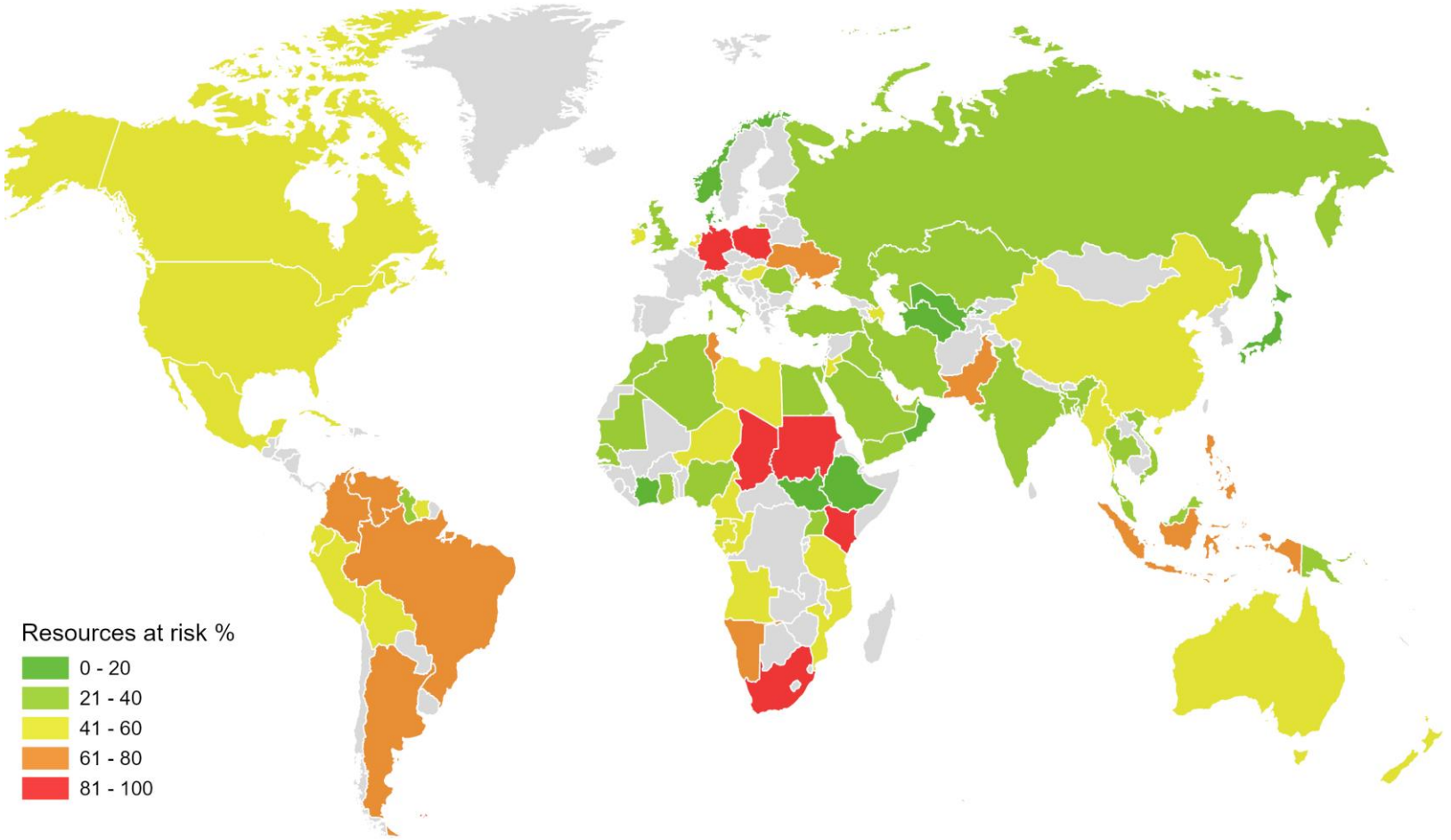
Oil and gas producing countries may face a reduction in commercial resources

Since only the most competitive barrels will stay in demand

Risk for "petrostates"

Energy transition risk while considering –Sigma (low scenario) and +Sigma (high scenario)
Percentages



Source: Upstream Energy Transition risk dashboard

National governments are at risk of losing major revenue streams

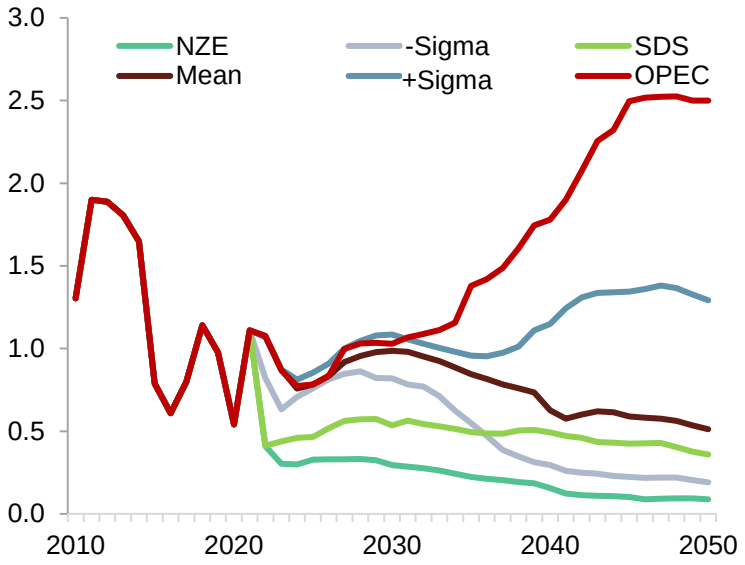
Income to shrink as the world turns away from fossil fuels

Risk for "petrostates"

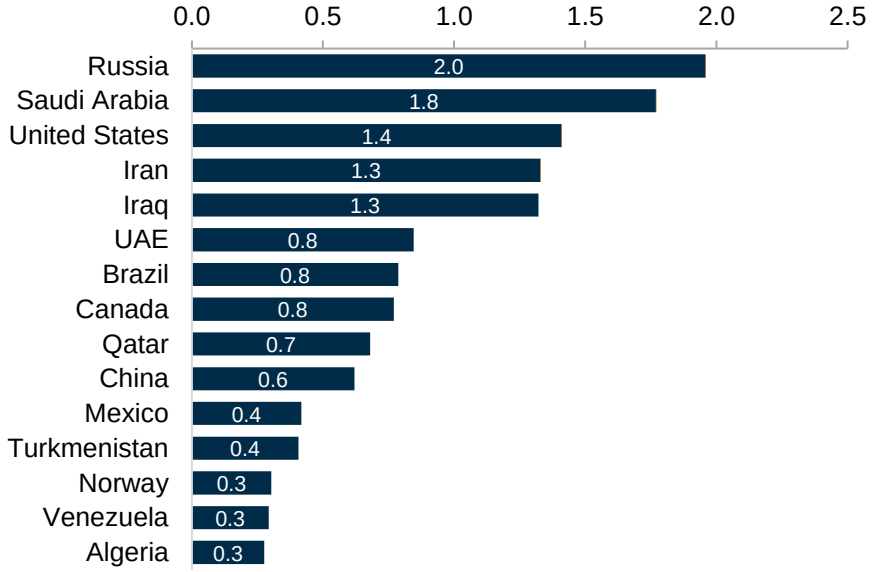
Key takeaways

- Petroleum-rich countries commonly benefit from their natural resources by reaping royalties, profit taxes and income taxes. These forms of government revenue are impacted quite differently across varying scenarios, demonstrating a wide fan of uncertainty.
- A total of $1.1 trillion was paid to governments from oil and gas taxation in 2021. In both the Mean and +Sigma scenarios, yearly government take is expected to be around $1 trillion for the next 10 years. For SDS the government take is expected to fall rapidly, falling to a yearly average around $500 billion per year. The difference in government take between the Mean and SDS scenario begins to narrow significantly after 2035, with the gap growing to $150 billion by 2050.
- In the right-hand chart we see the difference in total government take for the top 15 countries within the +sigma and -sigma scenarios between 2021 and 2050. Russia sees the largest deviation, with a difference between the two scenarios amounting to around $2.0 trillion.
- Average tax income is 53% lower in the -sigma scenario compared to the +sigma scenario. In total, around $18 trillion in potential income to national governments is at risk.

Government income from oil and gas taxation
USD trillion (real terms)



Difference in government income between +Sigma and -Sigma*
USD trillion, 2021-2050 (real terms)



*Government income for the US excludes royalty effects, as this is mainly paid to landowners. Source: Upstream Energy Transition Risk dashboard

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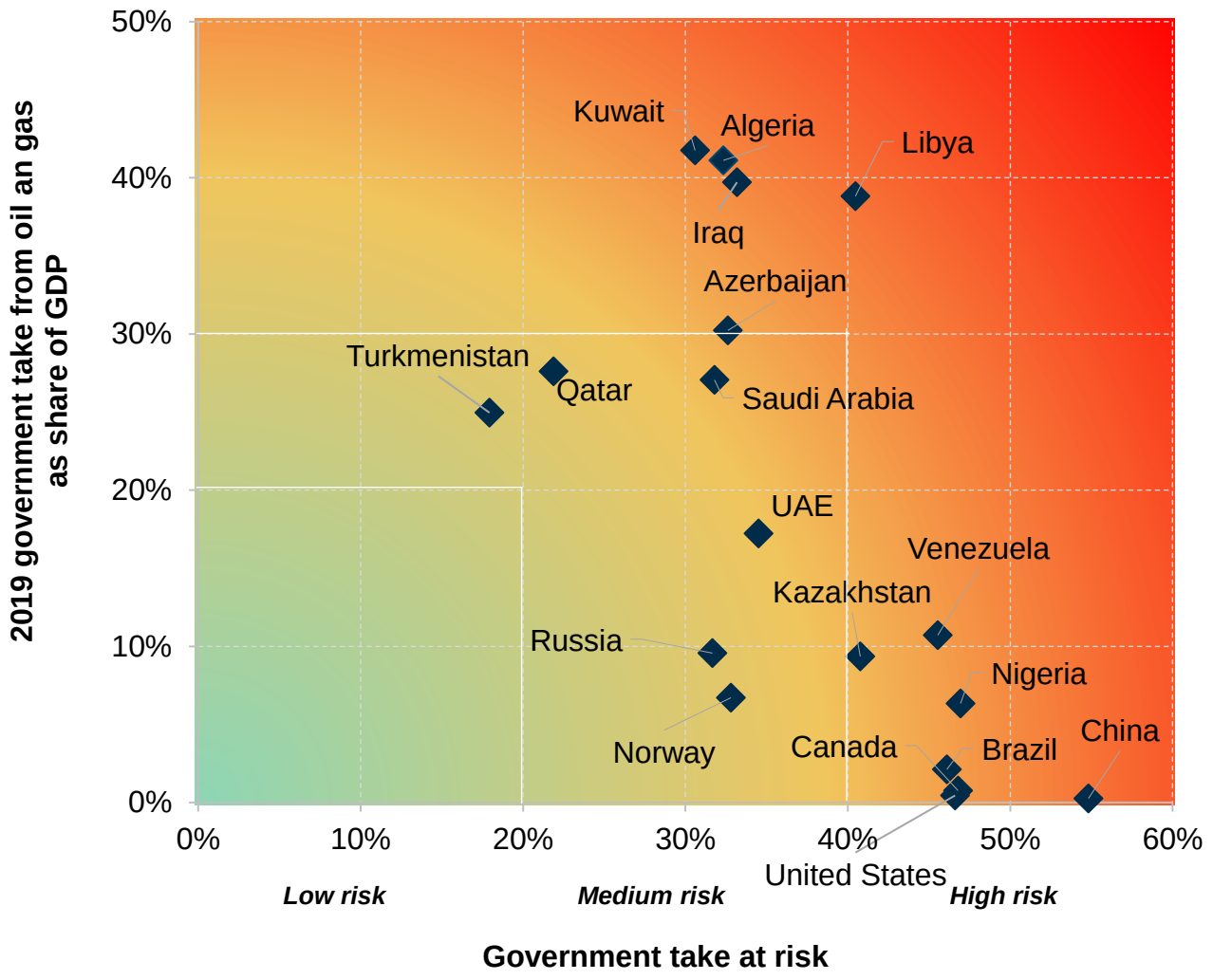
Key producers' exposure to energy transition risk

Risk for "petrostates"

Key takeaways

- Another way to look at the risk is to see the government take at risk plotted against the country's dependence on oil and gas tax revenue. Using Saudi Arabia as an example, we see that about 30% of the government take is at risk, while total tax income from oil and gas made up 27% of the country's gross domestic product (GDP) in 2019.
- Algeria, Iraq, Kuwait and Libya – all of which are heavily dependent on tax revenue from the upstream industry – all garnered around 40% of GDP in 2019 from oil and gas tax revenue. In these countries, about 40% of the government take is at risk, meaning that this group is the most exposed to revenue risk as a result of the energy transition.
- When comparing the government income between -Sigma and the +Sigma scenarios, gas-heavy countries are less exposed. This is the case for countries such as Turkmenistan, Qatar, Russia and Norway.



Source: Upstream Energy Transition risk dashboard

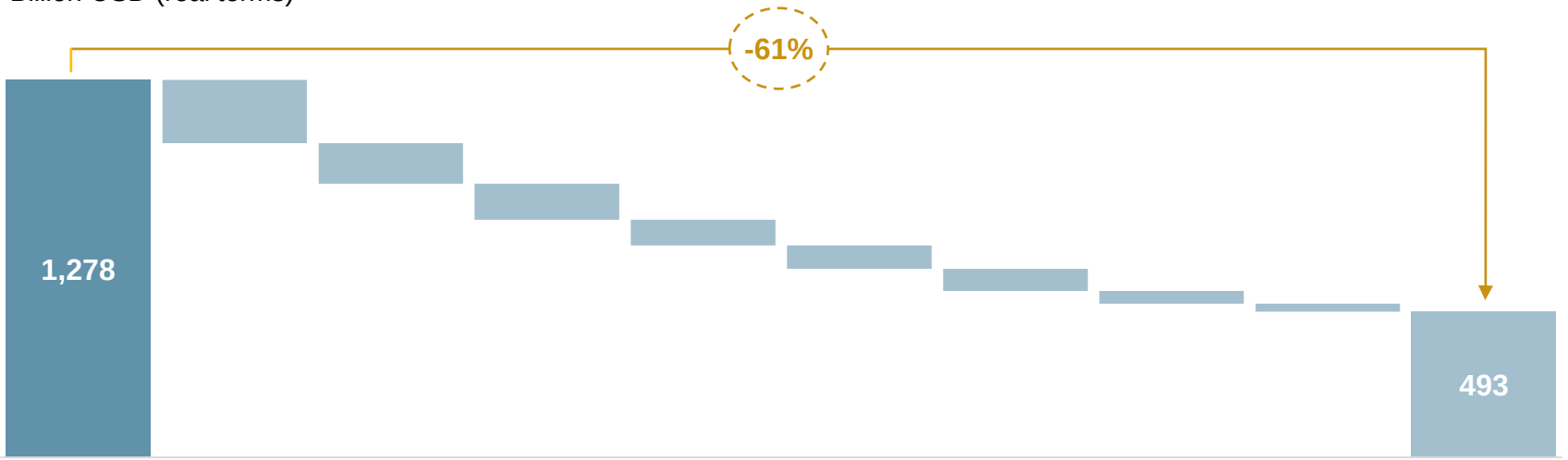
Around 60% of exploration spending is at risk in the -Sigma scenario

Risk for oil service companies

Exploration cost

Capex

Change in cumulative exploration expenditure, 2021-2050
Billion USD (real terms)



Expex +Sigma	Asia	South America	North America	Africa	Russia	Middle East	Europe	Australia	Expex - Sigma
Expex change, %	-56%	-71%	-53%	-67%	-64%	-79%	-52%	-64%	

Key takeaways

- As mentioned before, some new discoveries and exploration activity will be needed even in the -Sigma scenario, but at a much lower level than is seen currently.
- We estimate that total exploration expenditure (expex) in the 2021-2050 period in -Sigma would be about $493 billion, down from about $1.3 trillion in +Sigma – a 61% reduction.
- From a regional perspective, exploration spending towards 2050 could drop by 50% to 80% in the -Sigma depending on the region, with Middle East and South America seeing the greatest declines.
- Substantial reductions in exploration spending mean that a significant number of exploration opportunities would remain either undiscovered or undeveloped in some frontier areas such as those in Africa and Southeast Asia.
- In the SDS, savvy E&Ps would reinvest the saved expex into low-carbon energy technologies such as wind, solar and hydrogen, as well as emission offsets such as carbon capture and storage (CCS) and reforestation.

Source: Upstream Energy Transition risk dashboard

Half of capex at risk in the -Sigma

Shale and conventional greenfield most at risk

Risk for oil service companies

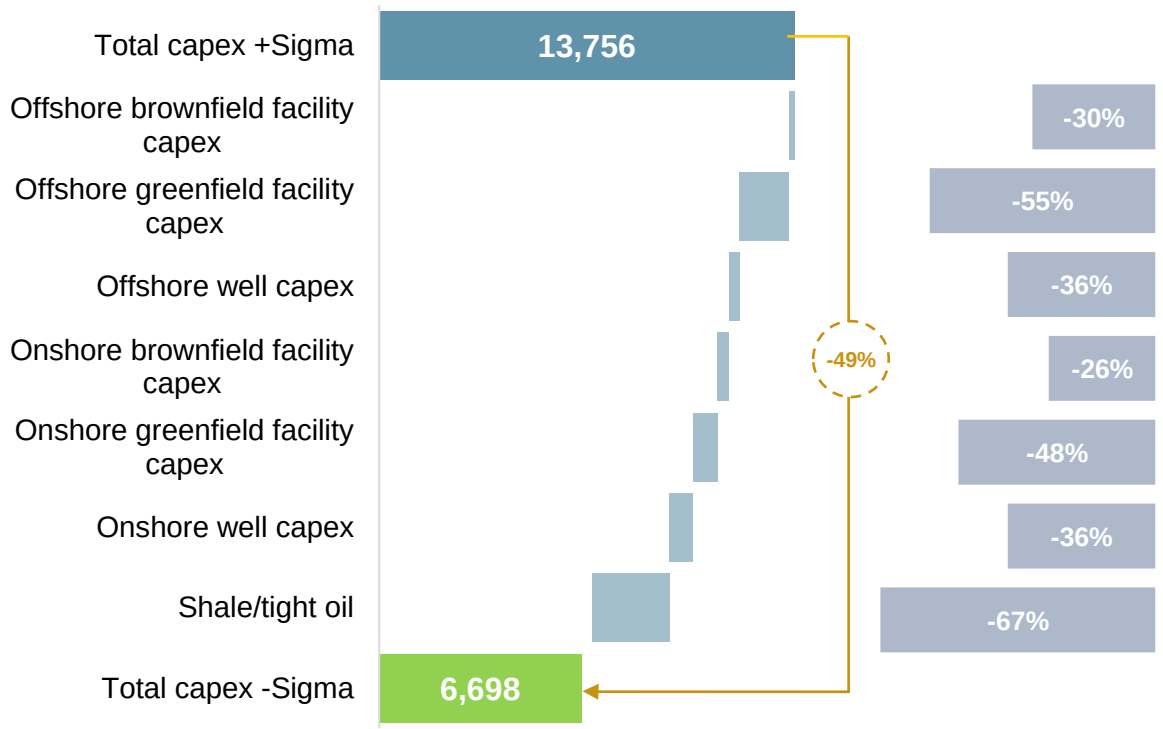
Exploration cost

Capex

Key takeaways

- The expected fall in liquids supply comes with a substantial reduction in capital spending, pointing to real and looming revenue risk for oilfield service companies. However, the outlook varies for different segments.
- Brownfield capex tends to be less cyclical than greenfield capex, hinting at greater resilience. The chart shows the difference in cumulative upstream investments between 2021 and 2050 for the +Sigma and -Sigma scenarios. Compared to +Sigma, only half of the investments are needed in –Sigma, representing a total reduction of $6.7 trillion in upstream investments during this period.
- The lost investments would affect onshore and offshore greenfield spending the most, while brownfield capex would show the smallest relative reduction.
- While upstream investments decline, E&P companies are likely to turn to the service industry to supply their new and greener business areas as the energy transition unfolds.

Reduction in cumulative E&P capex
Billion USD (real terms), 2021-2050



Source: Upstream Energy Transition risk dashboard

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Stricter requirements for projects sanctioning is a “new normal”

Risk for oil service companies

Exploration cost

Capex

Majors communication on portfolio resilience metrics

ExxonMobil

- **Capital flexibility to maintain dividend at ~$35/bbl**
- New developments in Guyana, Brazil & Permian with breakeven < $35
- Lower GHG intensity an important criteria for new sanctioning

Chevron

- Targeting **$40 per barrel oil price** to meet capex & dividend expense
- Reducing capex and opex spending for more resilient upstream
- Targeting 30% IRR for new investment opportunities for the next decade

TotalEnergies

- Already had a resilient business with **pre-dividend breakeven of $26 per bbl** & a lower gearing ratio as compared to its peers

Shell

- Dividend cut by two-thirds last year in response to downturn
- **Targeting average BEP of $30 per boe** and IRR of 20-25% for new projects

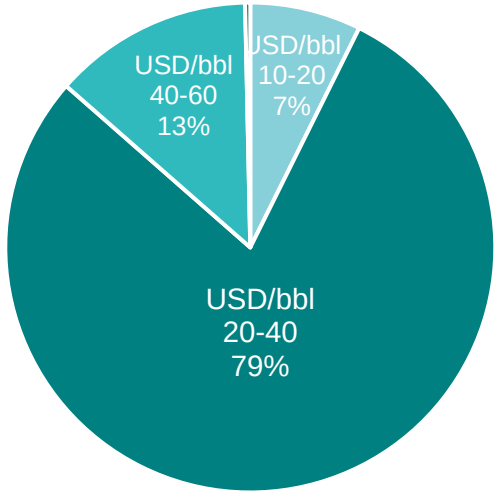
BP

- **Dividend cut by 50% in 2020** to make business more resilient
- Low dividends to continue till 2025, accelerated transition to renewables

Eni

- **Targeting $28 oil price to cover for upstream capex vs $37 earlier**
- Targeting $40 per barrel oil price to cover for both capex and dividends

Resources for new oil projects sanctioning (2021-2025) with Majors as partners by breakeven price
Million bbl



Source: Rystad Energy UCube

E&P companies are at risk of losing major cash flows

Free cash flow highly sensitive to different scenarios

Risk for oil and gas companies

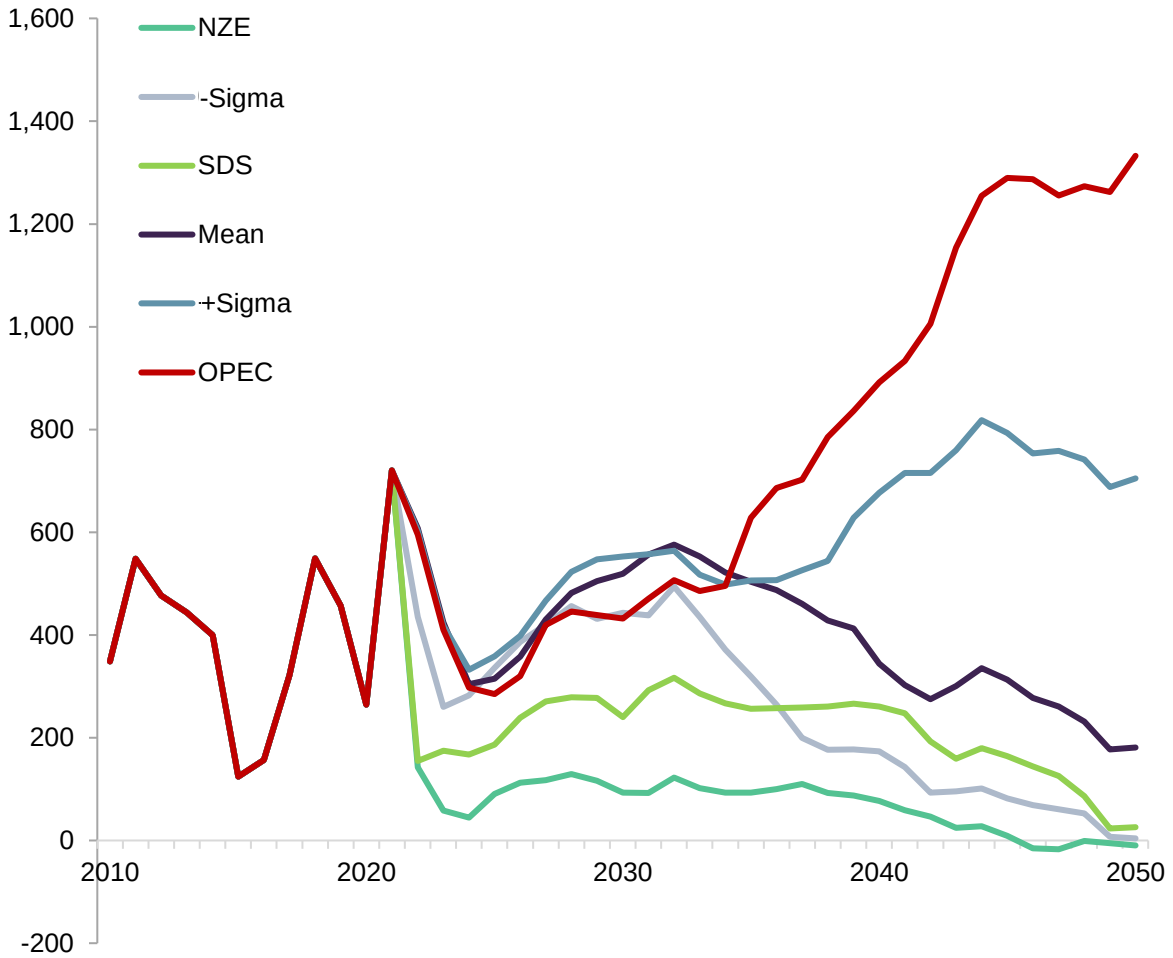
Value and resource risk evaluation

Corporate landscape

Key takeaways

- The different energy transition scenarios pose risks both to upstream companies' resources and to their valuation. The chart illustrates this by displaying the total free cash flow (FCF) generated by the upstream industry, which is at an all-time high of around $700 billion this year due to a combination of high commodity prices and low investment levels.
- As the short-term oil price is expected to fall in all scenarios, FCF is also is expected to drop across the board. In the Mean scenario the FCF is predicted to recover after 2025 and reach about $600 billion by the beginning of the next decade, before rapidly falling from 2035.
- Even in the -Sigma scenario, the FCF is expected to remain modest in the medium term, supported by robust prices and investment activity. However, after 2030 the FCF is expected de decline swiftly.
- In the NZE and SDS scenarios, the FCF is not expected to recover in the medium term. In the SDS it is expected to hover around $300 billion, while the same number for NZE is around $100 billion.
- Shortage of resources available to meet demand projected in OPEC scenario may occur in mid-2030s, which will trigger price uptick and FCF consequently.

Global FCF for the upstream industry for different scenarios
Billion USD (real terms)



Source: Upstream Energy Transition risk dashboard

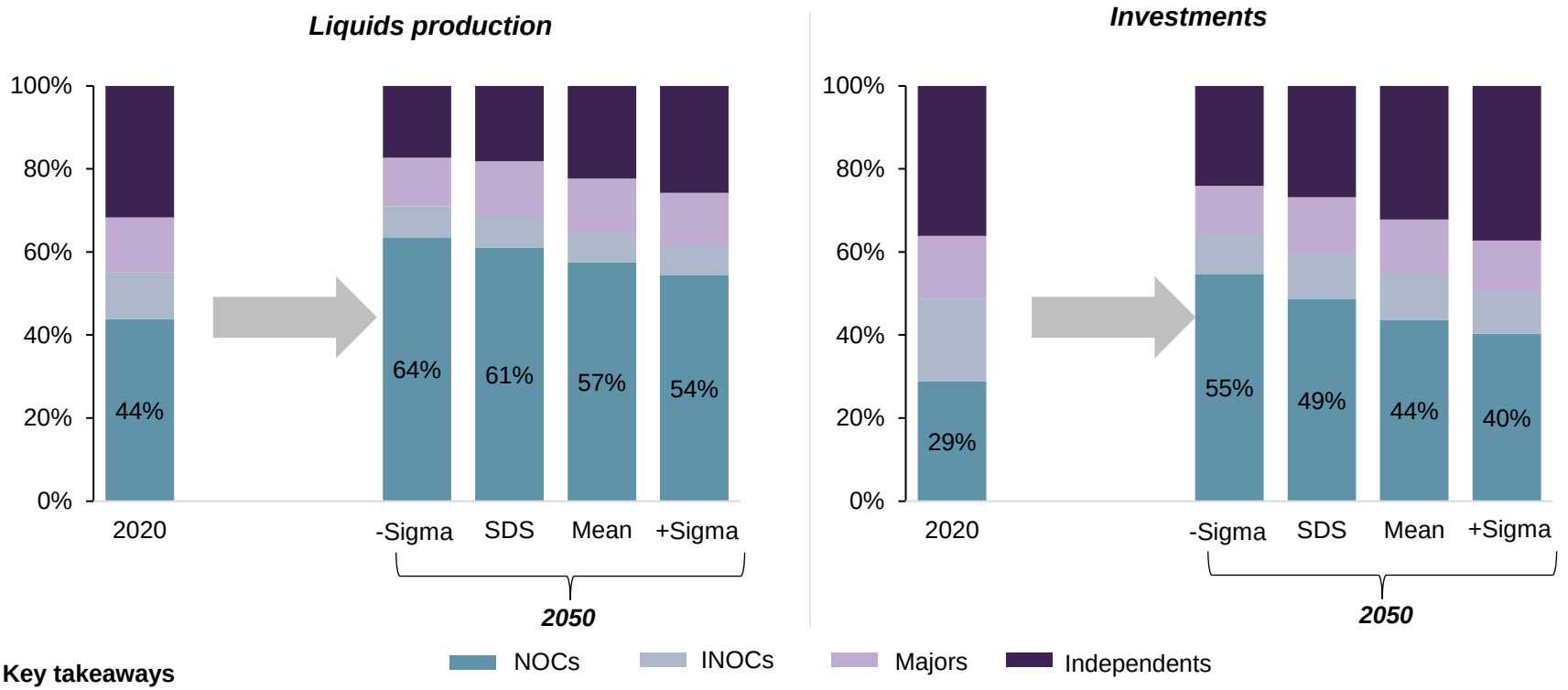
NOCs gain market share in low-carbon scenario

Risk for oil and gas companies

Value and resource risk evaluation

Corporate landscape

Global corporate landscape in different scenarios



Key takeaways

- No oil and gas companies will be able to escape the effects of the energy transition, but some players are better positioned to rapidly embrace change. For public companies, strategic evolution may be spurred on by persistent shareholders or external pressure to embrace lower-carbon operations, while national oil companies (NOCs) may have fewer incentives to change as governments are eager to maintain domestic supply and income from petroleum.
- The national companies hold the most competitive reserves, meaning they would be able to persevere in a low-price oil market environment. We therefore see that towards 2050, NOCs will hold an increasing share of global production and investment in both the +Sigma and SDS scenarios. In the -Sigma scenario they completely dominate the upstream market with 65% of global liquids production. Nevertheless, these companies, too, will have to adapt to decarbonization trends to keep their products competitive in a global market that will encourage lower emission intensity.

Source: Upstream Energy Transition risk dashboard

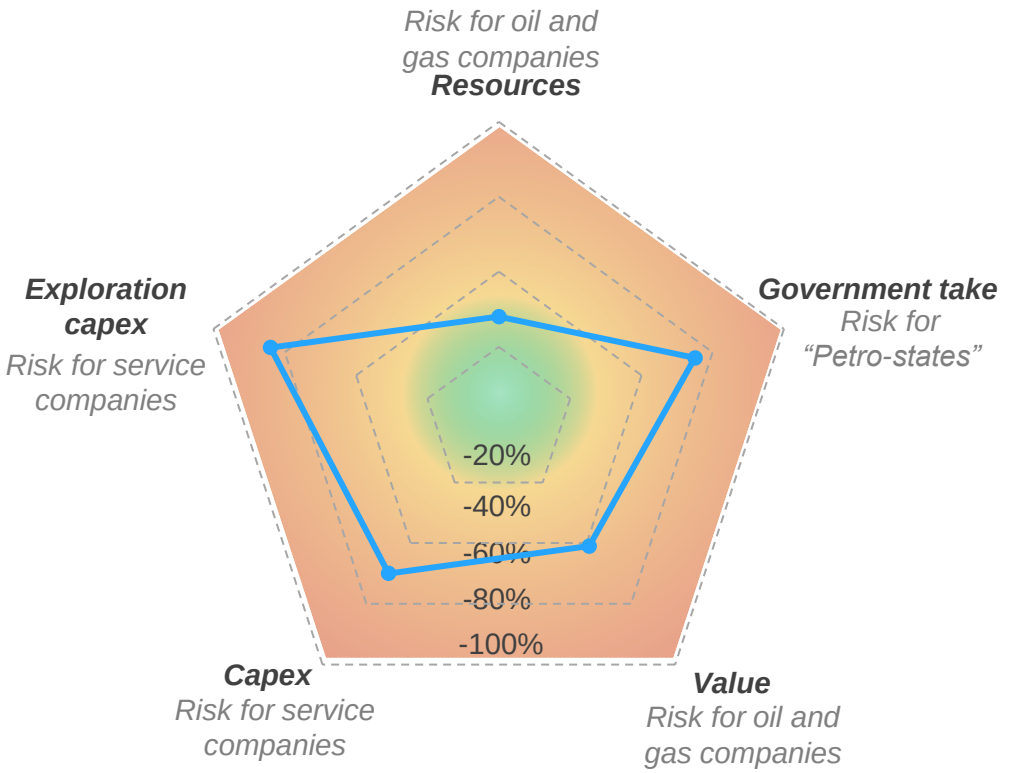
Understanding the risks and seizing the rewards

Results and takeaways

Key takeaways

- Our examination of the upstream industry through the lens of our various scenarios has allowed us to evaluate the potential impact of the energy transition across a variety of key performance indicators – resources, investments, valuation, government take, prices, and more.
- While it is of course difficult to predict the exact combination of levers that must be pulled in order to accomplish the targets of the Paris Agreement, this type of comprehensive scenario modelling illuminates the risks and rewards at every pace of transition.
- Taken as a whole, these insights can be illustrated to map the average global risk facing stakeholders across the entire upstream industry.
- Assuming an aggressive transition path, the picture is clear: towards 2050 capex may be reduced by 50%,valuation by 42%, government take by 46% and exploration spending by an incredible 81%. The road ahead will be unlike any the industry has traveled before and will benefit those who can deftly assess the risks and seize the rewards.

Energy transition risk: the global average (reduction between -Sigma and +Sigma)



Source: Rystad Energy UCube

RYSTAD ENERGY