

Beyond the cycle

Which oil and gas companies are ready for the low-carbon transition?

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This report updates and expands CDP's research and League Table for oil & gas companies, first published in November 2016. It ranks 24 of the largest and highest-impact publicly listed oil & gas companies on business readiness for a low-carbon transition. The companies in aggregate represent 31% of global oil & gas production and 11% of proved reserves.

The oil & gas industry is amongst the most emissions intensive, with the production and use of oil & gas accounting for over half of global greenhouse gas emissions associated with energy consumption. This equates to more than 17 gigatonnes of carbon dioxide equivalent per year,¹ with about 90% of these emissions coming in the downstream use of hydrocarbons (Scope 3 emissions).

Oil & gas companies are coming under increasing pressure to demonstrate portfolio resilience and adapt business models to align with a low-carbon energy transition. Post-Paris they have faced increasing investor scrutiny and with the recommendations from the G20 Financial Stability Board's Task Force on Climate-related Financial Disclosures (TCFD), they now face a new normal in climate risk reporting.

This reflects a turn of the tide for oil & gas companies, made all the more imperative by the IPCC's recent report detailing the impact of 2°C vs. 1.5°C of global warming. The median IPCC scenario for achieving a 1.5°C limit to warming above pre-industrial levels requires net zero global emissions by 2050.

Key findings

- ▼ **Equinor** convincingly retains first place with **Total**, **Shell** and **Eni** all closely ranked together in second, third and fourth respectively.
- ▼ Lowest ranked companies are **CNOOC**, **Rosneft** and **Marathon Oil**.
- ▼ **Transatlantic divide remains** – European companies come out on top across most key areas. They are pivoting portfolios towards gas, setting climate-related targets and investing in low-carbon technologies.
- ▼ **Since 2010 the 24 companies have invested US\$22 billion in alternative energies.** However, spend on low-carbon assets for the sector as a whole remains low, expected to account for only 1.3% of total 2018 CAPEX.
- ▼ **5 companies have divested from oil sands assets.**
- ▼ **18 companies have disclosed Scope 3 emissions** figures alongside Scope 1+2 for 2017.
- ▼ The 24 companies in the study are **losing on average 3.3% of their natural gas production** through flaring, venting and methane leakages – worth almost US\$5bn at the current Henry Hub gas price.
- ▼ **Companies are shifting focus to multi-staged developments and shorter-cycle opportunities** to maintain capital flexibility.
- ▼ **Ten companies are involved in CCUS projects** and collectively account for **68% of current global capacity.** Expertise in this technology may form part of the oil & gas industry's social license to operate in coming years.
- ▼ **Votes for shareholder resolutions relating to 2°C analysis grew** from an average of 21% in 2014 to 53% in 2018.
- ▼ **Lack of disclosure by Chinese companies** – no emissions data reported by Petrochina.

There are four key areas assessed in the League Table, which are aligned with the recommendations from the TCFD:

Transition risks: We assess company portfolios, looking at production and reserve splits by hydrocarbon type as well as looking across various measures of carbon efficiency such as emissions intensity (including methane and flaring levels) and Wood Mackenzie's NPV/tonne metric.²

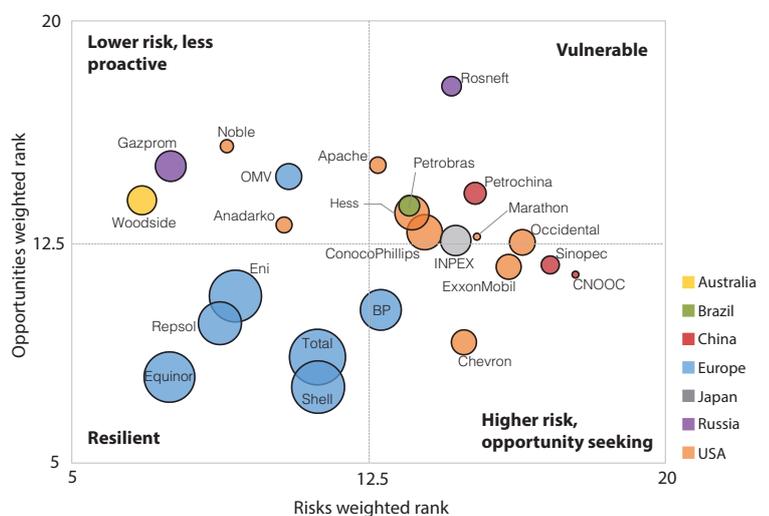
Physical risks: We analyse company exposure to localized water stress issues on a facility-by-facility basis across onshore upstream production and downstream assets. We compare this water stress exposure with companies' fresh water withdrawal intensity and governance frameworks.

Transition opportunities: We examine which companies are investing in low-carbon assets, R&D and embracing innovative technologies. We also analyse levels of capital flexibility; looking across exploration and production costs, reserve life, discretionary future spend, cash margins and financial gearing.

Climate governance and strategy: We analyse companies' governance frameworks including emissions reduction targets and the alignment of governance and remuneration structures with low-carbon objectives. We look at which companies are conducting scenario analysis and stress-testing their portfolios against a low-carbon energy transition.

- ▼ **15 companies have set emissions reduction targets.** The sector has launched a number of initiatives aimed at cutting routine flaring and reducing methane emissions. Repsol, Shell and Total have all set long-term ambitions to reduce their net carbon footprint (which includes Scope 3 emissions).
- ▼ **Only five companies have officially supported the TCFD.**
- ▼ Nine companies have published 2-degree scenario analysis with others looking to do the same. **Under low-carbon scenarios the winning barrels will be low-cost, low-risk and lower-carbon.** Managing the resource theme mix is key to attaining a lower-carbon footprint.

Figure 1: Opportunity vs. risk for low-carbon transition



Bubble size: Larger bubble size = stronger performance on climate governance & strategy
Source: CDP

1. Calculated using IEA and EDGAR carbon and emissions data.

2. Wood Mackenzie: "New metrics for evaluating oil and gas portfolio resilience in a low-carbon future"

The summary League Table below presents headline company findings. It is based on detailed analysis across a range of carbon and transitional indicators which could have a significant impact on company performance. The League Table is designed to serve as a proxy for business readiness in an industry which will undergo significant change as governments increase efforts to implement the Paris Agreement. Companies placed towards the bottom are deemed less prepared for a low-carbon transition.

Figure 2: League Table summary⁽ⁱ⁾

LT rank	Company ^(v)	Country	Average market cap Q3 2018 (US\$bn) ⁽ⁱⁱ⁾	Production 2017 (million boe/d)	2017 Emissions (S1+2 Mt CO ₂)	Weighted rank	Transition risks rank	Physical risks rank	Transition opportunities rank	Climate governance & strategy rank	2017 Adjusted EBITDA split by business area (%) ^(iv)
1	Equinor	Norway	78	1.9	16	6.72	3	4	2	4	Upstream 100%
2	Total	France	152	2.5	40	8.10	10	5	3	1	Upstream 100%
3	Shell	UK / Netherlands	275	3.7	84	8.11	9	14	1	2	Upstream 100%
4	Eni	Italy	64	1.7	43	8.16	6	8	7	3	Upstream 100%
5	Repsol	Spain	29	0.7	23	8.58	5	12	5	5	Upstream 100%
6	Woodside	Australia	22	0.2	10	10.29	2	1	18	11	Upstream 100%
7	BP ⁽ⁱⁱⁱ⁾	UK	139	2.5	56	10.75	11	16	6	6	Upstream 100%
8	Gazprom	Russia	54	9.7	247	10.81	4	3	21	9	Upstream 100%
9	OMV	Austria	19	0.3	11	12.50	7	17	20	12	Upstream 100%
10	ConocoPhillips	USA	72	1.4	21	12.57	15	9	14	7	Upstream 100%
11	Hess	USA	17	0.3	4.1	12.73	14	7	16	8	Upstream 100%
12	Chevron	USA	230	2.6	60	12.89	16	15	4	14	Upstream 100%
13	Anadarko	USA	32	0.7	6.6	12.91	8	6	15	21	Upstream 100%
14	INPEX	Japan	17	0.4	0.9	13.32	20	13	12	10	Upstream 100%
15	Noble Energy	USA	15	0.4	2.5	13.33	1	21	23	22	Upstream 100%
16	Petrobras	Brazil	73	2.5	67	14.08	17	2	17	17	Upstream 100%
17	ExxonMobil ⁽ⁱⁱⁱ⁾	USA	343	4.0	125	14.17	23	20	9	15	Upstream 100%
18	Occidental	USA	56	0.6	16	14.51	22	22	11	13	Upstream 100%
19	Apache ⁽ⁱⁱⁱ⁾	USA	16	0.5	8.9	14.54	13	10	22	20	Upstream 100%
20	Petrochina ⁽ⁱⁱⁱ⁾	China	215	4.0	193	14.84	12	23	19	16	Upstream 100%
21	Sinopec	China	117	1.2	163	15.34	18	24	10	19	Upstream 100%
22	Marathon Oil	USA	15	0.4	3.8	15.85	19	18	13	23	Upstream 100%
23	Rosneft	Russia	61	5.7	76	15.89	21	11	24	18	Upstream 100%
24	CNOOC	China	68	1.3	7.8	16.60	24	19	8	24	Upstream 100%

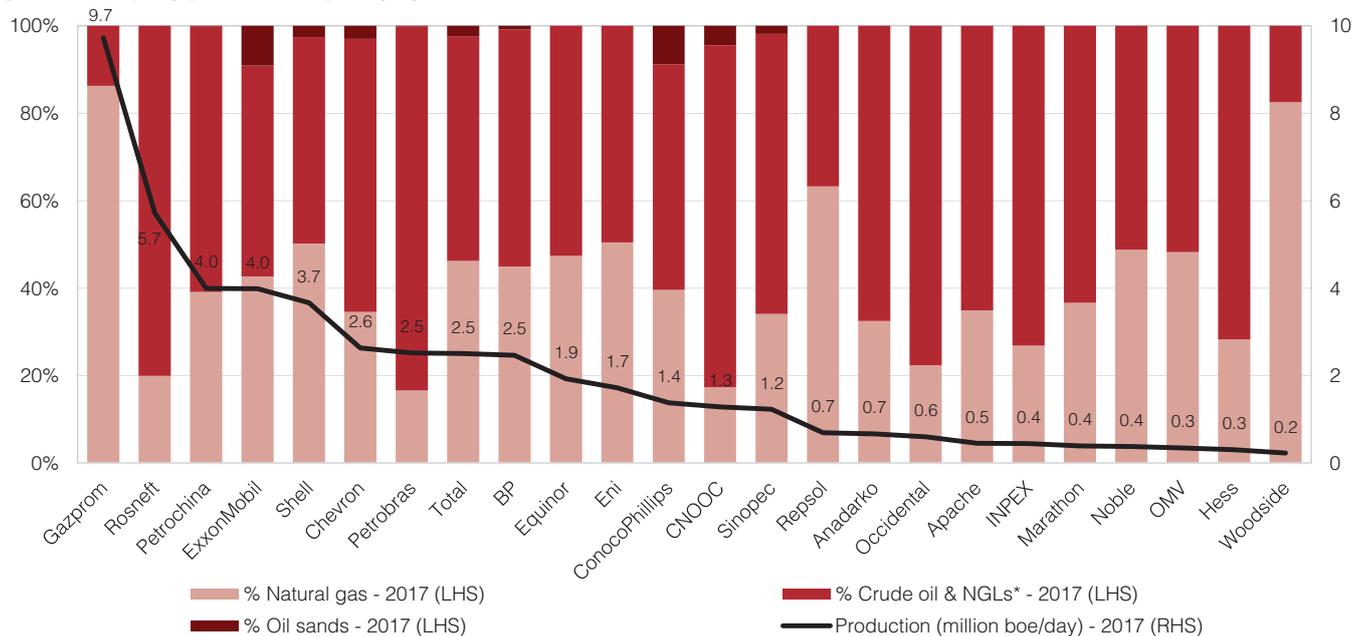
Weighting

35% 10% 30% 25%

- (i) Weighted ranks are calculated for each area. We display non-weighted ranks in this summary for simplicity only.
- (ii) Average market cap for last 12 months up to Q3 2018.
- (iii) Analysis for BP excludes its share in Rosneft. Scope 1+2 emissions figures are for 2016 for Apache and ExxonMobil and is an estimated figure for Petrochina.
- (iv) For Adjusted EBITDA split by business area, Downstream includes Midstream and / or Chemicals if split is not available.
- (v) Apache, BP, Chevron, CNOOC, ExxonMobil and Marathon Oil are non-responders to CDP's 2018 climate change questionnaire. We encourage investors to raise this lack of transparency in discussions with company management.

Source: CDP

Figure 3: Company production split by hydrocarbon



*Natural Gas Liquids (NGLs)
Source: CDP, company reports

Overview

The shift to a low-carbon economy presents the question of what role oil & gas companies will play in this transition, and what their strategic options are in the more immediate and longer term.³

In recent years we have seen unprecedented action from investors on climate change, increasing the pressure on the sector to show portfolio resilience under low-carbon scenarios. Following the recommendations of the Task Force on Climate-related Financial Disclosures (TCFD), oil & gas companies now face a new normal in climate risk reporting.

Identification of hydrocarbon resources and progression to production are at the heart of oil & gas companies' business models. However, this is split across two primary commodities which have different uses, substitutes and roles both now and in the future. Figures 5 and 6 below show the split by sector-use for current oil and gas consumption.

In most low-carbon scenarios gas demand remains in the mix, with the expectation it will displace more carbon-intensive coal as an industry feedstock and in electricity generation. In contrast, oil demand is seen to peak as demand is eroded by improvements in fuel economy and the uptake of electric vehicles and intelligent mobility. Figure 4 illustrates fossil-fuel demand in both the IEA's New Policies Scenario (NPS) and Sustainable Development Scenario (SDS).

Figure 4: Fossil fuel demand scenarios

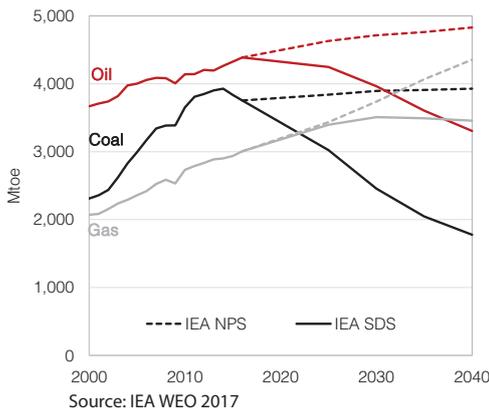


Figure 5: Oil consumption breakdown

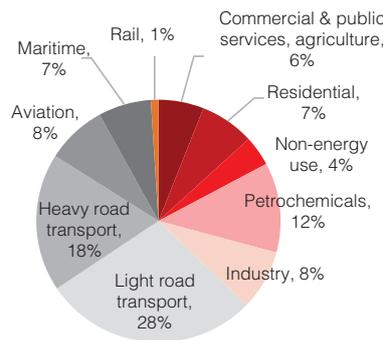
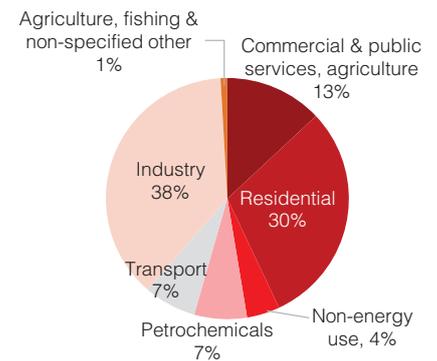


Figure 6: Gas consumption breakdown



The oil & gas industry is cyclical by nature; however, against the backdrop of increasing climate regulation, and ever closer peak oil demand forecasts, the importance for capital discipline is heightened.

Upstream investment declined by over 40% between 2014 and 2016; however, in response to rising oil prices investment has since picked up modestly. Projects that were put on hold are now being sanctioned – with greater appetite for smaller and multi-staged developments, and brownfield expansion projects (see Figure 7).

Companies have shifted focus towards shorter-cycle projects as a way of shortening payback periods and enhancing capital flexibility. This has led to the Majors shifting investment away from offshore and oil sands projects towards North American shale and conventional onshore assets (see Figure 8).

Figure 7: Global Investment in upstream oil & gas

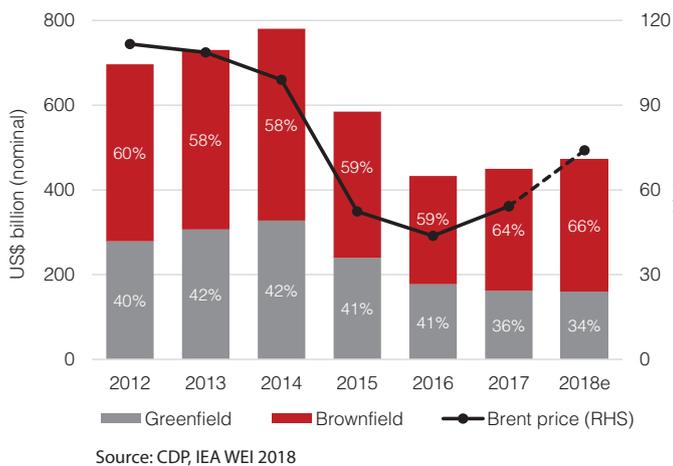
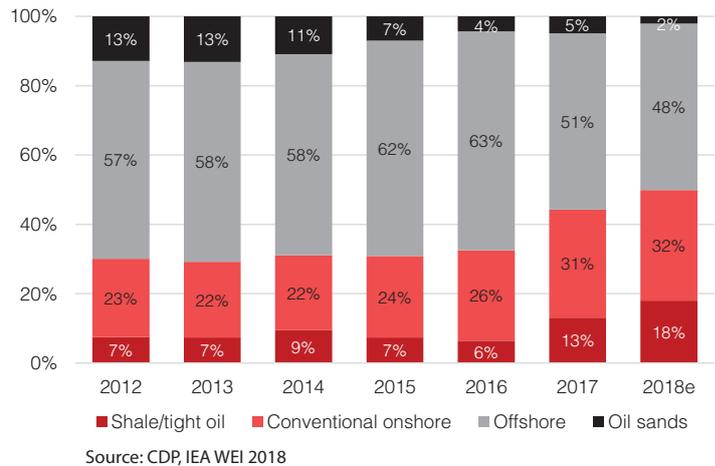


Figure 8: Upstream oil investment by the Majors by asset type⁴



With improved efficiency, lower costs and higher prices, free cash flow for the sector in Q3 2018 was at its highest level since 2012 and some of the largest companies have increased share buybacks and raised dividends. With the Brent price having recovered from its 2016 low but remaining volatile, companies need to remember the lessons learned from previous cycles and focus on delivering value in their long-term strategy.

A growing number of investors are looking for oil & gas companies to demonstrate their ability to adapt to the energy transition and evidence that strategies are being adopted to ensure resilience for the changes ahead.

3. Our previous oil & gas report in 2016 outlined some potential options. For example, re-balancing portfolios towards natural gas or shifting to becoming a diversified energy company (see "What does the future hold for oil & gas majors?" for further discussion).
 4. We use the term 'Majors' to refer to the seven companies: BP, Chevron, Eni, Equinor, ExxonMobil, Shell and Total.

Key report findings⁵

Earnings risks

- ▼ **Companies are pivoting towards gas and reducing exposure to oil sands.** Across the 24 companies the share of production from gas has increased at an average rate of 1.4% p.a. since 2002. 17 companies have increased the proportion of gas in their portfolios over this period. Five companies have recently divested from oil sands assets.
- ▼ **Under low-carbon scenarios the winning barrels will be low-cost, low-risk and lower-carbon.** These 'advantaged' assets should become central to company strategy. De-risking and high-grading the portfolio and managing the resource theme mix is key to attaining a low-carbon footprint.
- ▼ **Upstream emissions intensities have been reduced at an average rate of 2.5% p.a. since 2013.** Over this period 15 of the companies have reduced their emissions intensity.
- ▼ **Current upstream emissions intensities range from 9 to 63 kgCO₂ / boe.** Emissions intensity is closely related to the composition of company portfolios. Companies with a high share of oil sands, heavy oil and LNG tend to have higher Scope 1+2 intensities. Other factors such as recovery mechanism, asset maturity and hydrocarbon composition also play a role.⁶
- ▼ **Operational efficiency remains an issue. Companies are losing on average 3.3% of their natural gas production** through venting, methane leakages and flaring – worth almost US\$5bn at the current Henry Hub gas price.
- ▼ **Disclosure remains a key issue for the three Chinese companies CNOOC, Petrochina and Sinopec.** Petrochina does not disclose any emissions data, and all three do not disclose methane, flaring or Scope 3 emissions data.
- ▼ **18 companies have disclosed Scope 3 emissions figures for 2017.** For the oil & gas sector around 90% of emissions sit in Scope 3 categories, emphasising the importance for improved Scope 3 disclosure and calculation methodologies.
- ▼ **Across the company sample the average NPV/tonne is US\$203 / t CO₂.** However, there is a wide range with Wood Mackenzie forecasting some companies to generate almost 5 times the value per tonne of carbon emitted than others over the remaining life of post-FID assets. Companies with a higher NPV/tonne will be more resilient to future carbon pricing.
- ▼ More than **34% of upstream onshore production** and more than **30% of refining capacity** is currently located in areas of **medium or high water stress**.
- ▼ **In aggregate the company sample currently operates 7.7GW of renewable capacity with a further 10.2GW under development.** (The European Majors account for 70% of current capacity and 94% of capacity under development).
- ▼ **Ten companies are involved in CCUS projects** and collectively account for **68% of current global capacity.** All of the emissions pathways explored by the IPCC in their recent 1.5°C report use some form of CCUS.
- ▼ **The oil & gas sector is embracing innovation across the value chain,** looking to deploy digital technologies to enhance productivity, efficiency and safety. It is estimated that end-to-end digitalisation could cut production costs by up to 20%.⁸
- ▼ **During the recent commodity down cycle focus has been on cutting costs, paying down debt, reducing break-evens and improving capital flexibility.** Companies have cut production costs at an average of 8.3% per year over the period 2014-2017.
- ▼ **The proportion of discretionary CAPEX for companies over the next five years ranges from as low as 4% to as high as 92%** illustrating stark differences in levels of capital flexibility. Some companies have improved their capital flexibility by shifting focus to multi-staged developments and shorter-cycle assets.
- ▼ **Post-CAPEX cash margins over the period 2018-2030 range from US\$5/boe to US\$27/boe.** Companies should focus on controlling costs and improving margins to ensure future resilience to lower hydrocarbon prices.

Governance & strategy

- ▼ **15 companies have set emissions reduction targets.** The sector has launched a number of initiatives aimed at cutting routine flaring and reducing methane emissions. Repsol, Shell and Total have all set long-term ambitions to reduce their net carbon footprint (which includes Scope 3 emissions).
- ▼ Companies are now facing increasing scrutiny from investors to demonstrate resilience under a low-carbon energy transition. **Votes for shareholder resolutions relating to 2°C analysis grew** from an average of 21% in 2014 to 53% in 2018.
- ▼ **Nine companies have published 2-degree scenario analysis** with others looking to do the same. Analysis ranges from quantitative interpretations such as Equinor's NPV assessment to more qualitative discussions.
- ▼ **Sixteen companies have some form of climate-related remuneration** across long-term incentives and short-term annual bonus programs.
- ▼ **Only 5 companies have officially supported the TCFD.**
- ▼ The recent wave of climate-related litigation against oil & gas companies further highlights the importance of companies getting their strategy right. **Engagement, collaboration and innovation will be more crucial than ever.**

5. Summaries for each company, listing strengths and weaknesses can be found in Appendix II on page 54.

6. See Wood Mackenzie's box "Carbon intensity – not all assets are created equal" on page 16 for further insight.

7. CCUS stands for Carbon Capture Utilisation and Storage. Globally there are 17 CCUS facilities in operation with total capacity to store or use 32 million tonnes CO₂ per year. For further insight see our report "Mind the CCS Gap".

8. PwC: "Drilling for data: Digitizing upstream oil and gas"

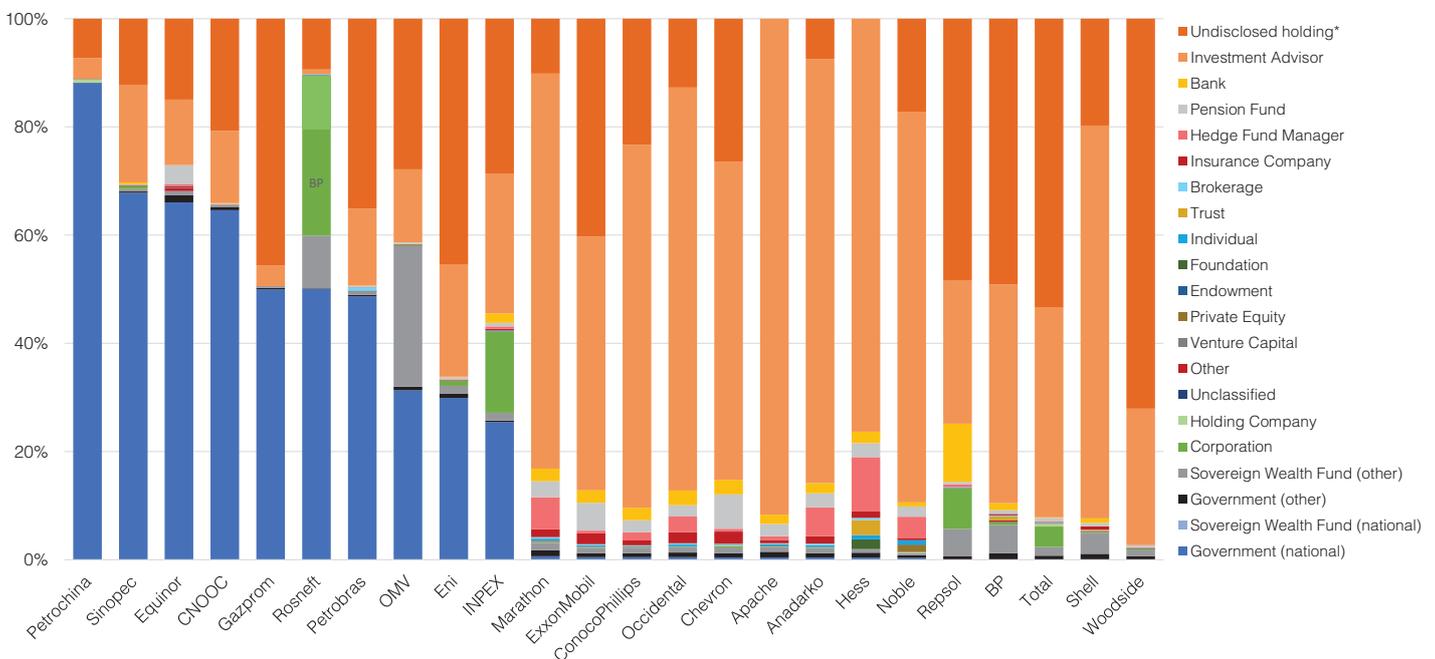
Company selection and classification

Companies were selected from the largest publicly listed companies within the GICS categories 'Integrated Oil & Gas' and 'Oil & Gas Exploration & Production'. We reviewed a number of criteria which included market capitalization, Scope 1 + 2 emissions, upstream production volumes, proved reserve volumes, business activities, international focus and shareholdings.

Unless specified otherwise company analysis encompasses both consolidated entities and share of equity-accounted affiliates. BP has been analysed excluding its 19.75% stake in Rosneft, in line with its previous GHG emissions reporting to CDP.

The chosen 24 companies represent approximately US\$2.2 trillion in market capitalization and in aggregate represent 31% of global oil & gas production and 11% of proved reserves. Company Scope 1+2 emissions account for 2.4% of all global GHG emissions. 18 of the 24 companies are on the Climate Action 100+ list.⁹

Figure 9: Company shares outstanding split by ownership type (Q3 2018)



* Shares not captured by publicly reported holdings, including Nominee accounts
Source: CDP, company reports, Bloomberg

Linking our findings to investment choices

We recognize that investment decisions are based on a multitude of different factors and that some of these can be misaligned with emission-reduction efforts. Our League Table identifies company readiness for the transition to a low-carbon economy and the physical impacts of climate change, meaning that companies towards the bottom of our League Table are potentially higher risk investments from a climate change perspective than those towards the top.

Methodology

We score each company based on a number of metrics which are ranked and then weighted within each key area (see Figure 10 for metric weightings within each key area). We then assign traffic light colours based on these weighted ranks. We calculate the overall League Table score by collating the weighted ranks for each key area. Each of the key areas has a separate chapter within this report.

Data is compiled from multiple sources including: CDP questionnaire responses, company annual reports, SEC filings, CSR reports, websites, investor presentations and third party sources such as Bloomberg and Wood Mackenzie.

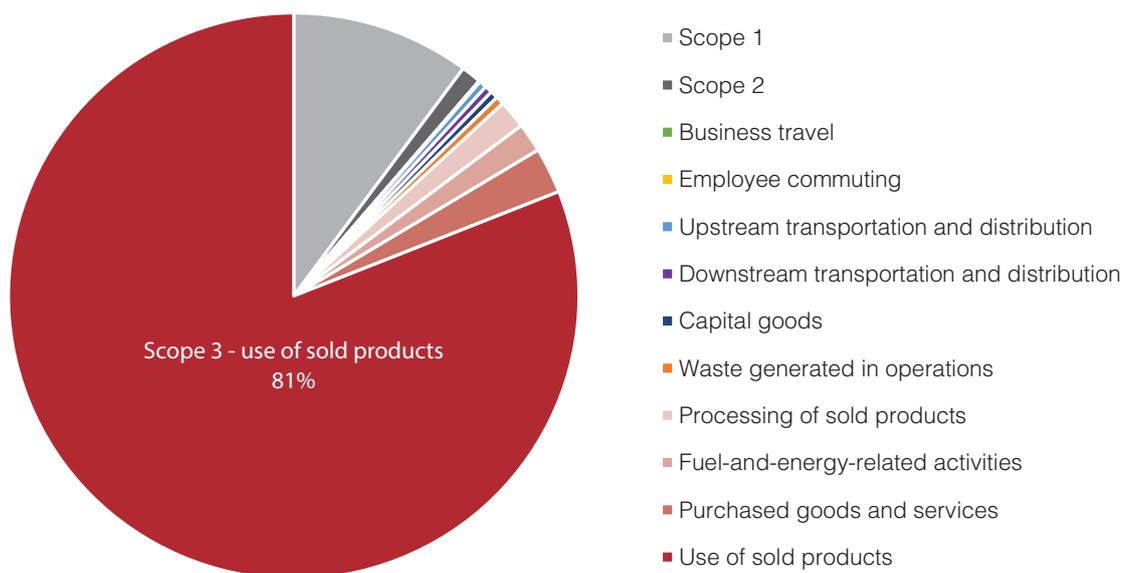
9. <http://www.climateaction100.org/>

Figure 10: A summary of key areas, associated metrics and weights within the League Table

Key area in League Table	Financial impact	Metrics	Metric weighting	Key area weighting
Transition risks	Companies with a portfolio biased towards gas may benefit from its role as a less carbon intensive bridging fuel to displace coal.	<ul style="list-style-type: none"> • Fossil fuel asset mix by hydrocarbon type <i>Production mix (50%), Proved reserves mix (50%)</i> 	60%	35%
	Methane leakage and flaring represents lost revenue and companies with lower emissions and better carbon efficiency have less value at risk from carbon pricing and reputational concerns.	<ul style="list-style-type: none"> • Emissions and resource management <i>NPV/tonne (25%), Upstream emissions intensity (45%), Methane intensity (10%), Flaring intensity (10%), Scope 3 disclosure (10%)</i> 	40%	
Physical risks	Access to fresh water, produced water handling and water stress issues at onshore upstream and downstream assets pose risks to production continuity.	<ul style="list-style-type: none"> • Water stress exposure • Fresh water withdrawal intensity • Water governance & policy 	45% 30% 25%	10%
Transition opportunities	Portfolio resilience to lower hydrocarbon prices and capital flexibility allow companies to remain agile and have optionality in their future capital expenditure and allocation of cash flows.	<ul style="list-style-type: none"> • Capital flexibility & resilience <i>Post-CAPEX cash margin (20%), Discretionary CAPEX (20%), Reserve life & development status (15%), Financial gearing (10%), Diversification (10%)</i> <i>Production costs and CAPEX intensity (15%), Finding and Development costs (10%)</i> 	60%	30%
	Diversifying into clean energy assets provides oil & gas companies a hedge against long-term threats to oil & gas demand. Applying digital technologies across the value chain can enhance productivity, efficiency and safety.	<ul style="list-style-type: none"> • Low-carbon assets and innovation <i>Alternative Energy & CCUS (30%), Low-carbon spend (40%), Patent analysis (15%), Digitalisation strategy & partnerships (10%), R&D (5%)</i> 	40%	
Climate governance & strategy	Ambition level of target setting and strength of climate governance provides insight into companies' strategies in adapting to the energy transition and capitalising on climate-related opportunities.	<ul style="list-style-type: none"> • Targets & ambitions • Scenario analysis • Climate-related remuneration • Board & executive climate management • TCFD and initiative support • CDP score & disclosure 	40% 25% 15% 10% 5% 5%	25%

Source: CDP

Figure 11: Oil & gas industry emissions split by categories⁽ⁱ⁾



(i) Based on company responses to CDP and CDP's modelled emissions dataset. Source: CDP

Transition risks

- ▀ Noble Energy and Woodside Petroleum rank first and second respectively. Noble is forecast to have the lowest upstream emissions intensity over the period 2016-2025 and Woodside ranks well on fossil fuel asset mix with a portfolio heavily biased towards gas.
- ▀ CNOOC ranks last. It has one of the highest exposures to oil sands (19% of proved reserves) and does not disclose any data for methane, flaring or Scope 3 emissions.
- ▀ On average companies are losing 3.3% of their natural gas production through flaring, venting and methane leakages – collectively worth almost US\$5bn at the current Henry Hub gas price.

Overview

Low-carbon technologies and regulatory change is disrupting the established order of the energy industry. The energy transition poses a fundamental strategic challenge to oil & gas companies, who are now facing increasing scrutiny from investors to look beyond the current cycle and demonstrate resilience for the changes ahead.

To manage these transition risks some companies have started to evolve their businesses; selling out of higher cost / higher carbon resource themes (e.g. oil sands), pivoting portfolios towards gas, increasing exposure to short-cycle projects, investing more in downstream operations (e.g. chemicals), as well as investing in renewable and clean energy technologies.

De-risking and high-grading the portfolio has become a central strategy and managing the resource theme mix is key to attaining a lower-carbon footprint.¹⁰

A recent 'Value at Risk' study by Wood Mackenzie found that a US\$40 / tonne carbon price applied to Scope 1+2 emissions could potentially reduce the value of companies' upstream assets by 2-7% (see Figure 93 on page 51 for further insight).

In this chapter we assess company exposure and resilience to transition risks across the following areas:

Fossil fuel asset mix (60%): We assess company portfolios, looking at production and reserve splits by hydrocarbon type.

Emissions and resource management (40%): We look across various measures of carbon efficiency such as upstream emissions intensity (including methane and flaring levels) and Wood Mackenzie's NPV/tonne metric.

Figure 12: Transition risks summary

Company	Fossil fuel asset mix	Emissions & resource management	Overall weighted rank	Transition risks rank
Noble Energy	4	3	7.1	1
Woodside	1	14	7.4	2
Equinor	7	1	7.6	3
Gazprom	2	12	7.8	4
Repsol	3	16	8.2	5
Eni	5	5	9.3	6
OMV	6	7	9.8	7
Anadarko	14	2	11.0	8
Shell	9	6	11.1	9
Total	11	9	12.4	10
BP	10	15	12.8	11
Petrochina	8	24	13.3	12
Apache	13	8	13.6	13
Hess	17	11	15.1	14
ConocoPhillips	19	13	15.4	15
Chevron	15	20	15.6	16
Petrobras	23	4	15.6	17
Sinopec	12	22	15.7	18
Marathon Oil	18	19	15.8	19
INPEX	22	10	15.8	20
Rosneft	21	17	16.0	21
Occidental	20	18	16.1	22
ExxonMobil	16	23	16.7	23
CNOOC	24	21	19.0	24

Weighting

60%

40%

Note: In calculating the weighted rank in this table, we use the weighted ranks for each area. We display non-weighted ranks in this summary for simplicity only.

Source: CDP

10. See box "Carbon intensity – not all assets are equal" on page 16 by Wood Mackenzie for further discussion.

Fossil fuel asset mix

The oil & gas industry holds a key supply role in the wider energy flow system and therefore changing demand and technological dynamics in key fossil fuel use industries such as transport (oil) and electricity generation (gas) will have significant repercussions for oil & gas companies.

As shown in Figure 4 on page 6, in most 2-degree scenarios gas demand remains relatively robust, with the expectation it will displace more carbon-intensive coal as an industry feedstock and in electricity generation.¹¹ In contrast, oil demand is seen to peak as demand is eroded by improvements in fuel economy and the uptake of electric vehicles and intelligent mobility (see box on page 13 for further discussion).

The production and reserve split of companies across hydrocarbons may indicate if they are beginning to align themselves with a low-carbon transition. Companies with a portfolio biased towards gas may benefit from its role as a less carbon intensive bridging fuel in the future.

In this section we assess companies' fossil fuel asset mix using two key metrics:

Metric 1) Production mix between oil and gas (50%): This assesses how companies are aligning themselves differently across their respective current and future relative oil and gas production levels. We look to identify companies which have increased the proportion of gas in their portfolio (either organically or through acquisitions). We further separate out oil sands production from more conventional sources to highlight company exposure to the higher cost and carbon-intensive resource.

Metric 2) Proved reserves (1P) mix by oil and gas (50%): This examines how companies' proved reserve compositions are shaping their respective future production across oil and gas. We also identify oil sands reserves as distinct from more conventional sources.¹²

Figure 13: Fossil fuel asset mix summary

Company	Production mix	Proved reserves mix	Overall weighted rank	Fossil fuel asset mix rank
Woodside	1	2	3.4	1
Gazprom	3	1	4.3	2
Repsol	2	3	4.5	3
Noble Energy	11	4	9.0	4
Eni	5	6	9.4	5
OMV	4	7	9.4	6
Equinor	6	8	10.2	7
Petrochina	9	5	10.3	8
Shell	7	9	11.6	9
BP	10	10	12.3	10
Total	8	12	12.9	11
Sinopec	12	16	14.3	12
Apache	15	13	15.5	13
Anadarko	21	11	15.5	14
Chevron	13	15	15.5	15
ExxonMobil	14	18	16.1	16
Hess	16	17	16.4	17
Marathon Oil	18	19	16.6	18
ConocoPhillips	17	20	16.7	19
Occidental	20	21	17.2	20
Rosneft	22	14	17.2	21
INPEX	19	22	17.7	22
Petrobras	23	23	20.2	23
CNOOC	24	24	21.0	24

Weighting	50%	50%
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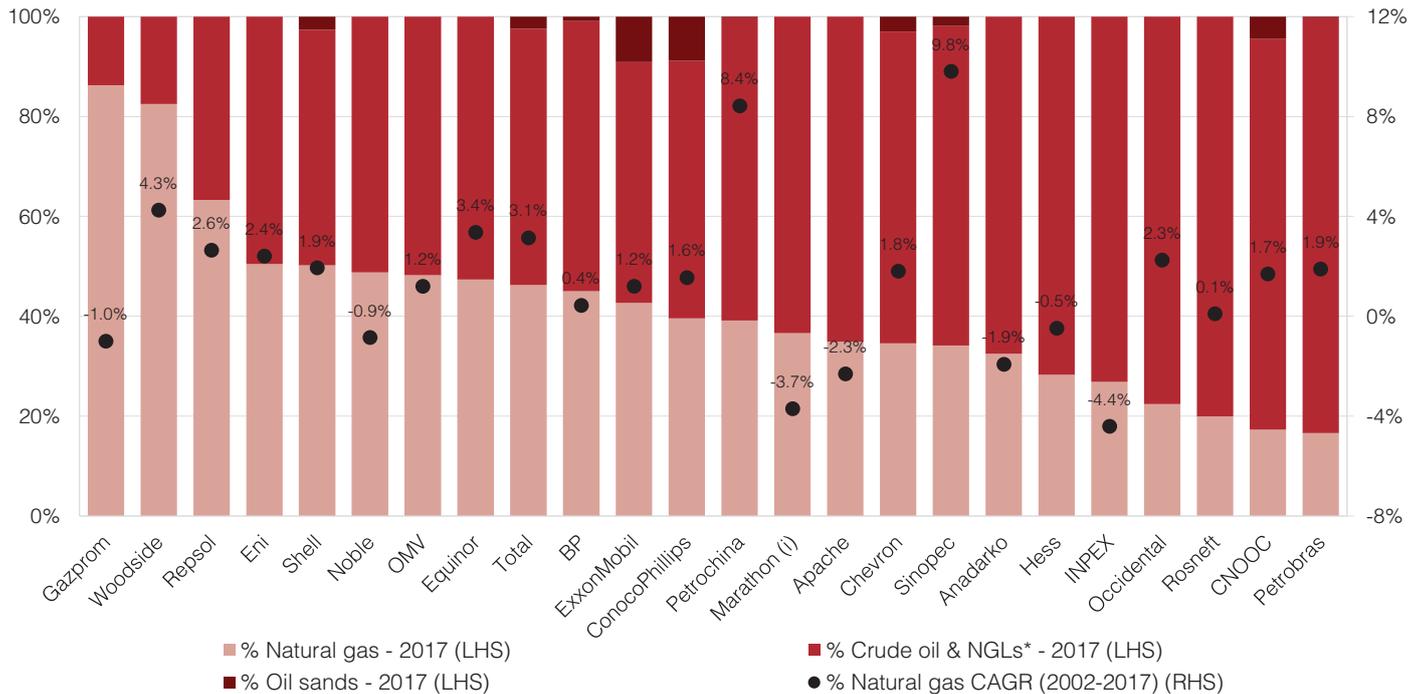
Note: In calculating the weighted rank in this table, we use the weighted ranks for each area. We display non-weighted ranks in this summary for simplicity only.

Source: CDP

11. When combusted as fuel, natural gas releases almost half as much carbon dioxide as coal and a third less than oil.

12. For an explanation of resource classification in the oil & gas sector see box "Resources vs. Reserves" on page 52.

Figure 14: Production mix between oil and gas



*Natural Gas Liquids (NGLs)

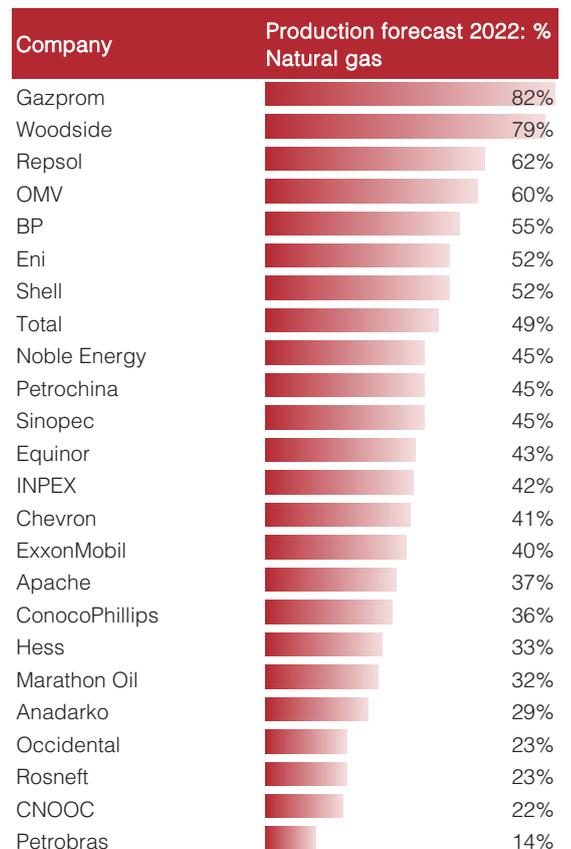
(i) Marathon fully divested from oil sands in March 2017. Production split shown on a continuing operations basis.

Source: CDP, company reports

Highlights

- Only five companies produce more gas than oil; however, 11 companies have more gas than oil in their proved reserves. Portfolios range from gas heavy Gazprom and Woodside, to liquids focused Petrobras, CNOOC and Rosneft.
- ConocoPhillips, Equinor, Marathon, Shell and Total have all divested oil sands assets recently. Ten companies still have exposure to the higher cost, higher carbon resource with CNOOC having 19% of its proved reserves in oil sands.
- Figure 16 shows that Gazprom has by far the highest absolute level of proved reserves, followed by Rosneft, demonstrating the sheer size of some national oil companies (NOCs).¹³
- Across the 24 companies the proportion of production from gas has increased at an average rate of 1.4% p.a. since 2002. 17 of the 24 companies have increased the share of gas in their portfolios (see Figure 14), with Chinese companies Sinopec and Petrochina having shifted towards gas the most aggressively (which is expected to continue).
- Overall, seven companies are forecast to have 50% or more of their production from gas in 2022 (see Figure 15). INPEX sees the highest increase from current levels (up 15 percentage points) primarily due to large-scale LNG projects coming online (e.g. Ichthys in Australia). BP, OMV and Sinopec are also all expected to increase the share of gas in their portfolios by ≥ 10 percentage points from current levels.
- In assessing company portfolios for resilience under low-carbon scenarios we recognise the importance for both top-down and bottom-up analysis. For example, assets of the same resource theme can have very different upstream emissions intensities which can even impact the relative emissions profiles of oil vs. gas on a full life-cycle basis. In our section “Emissions and resource management” on page 14 we make use of bottom-up carbon efficiency metrics developed by Wood Mackenzie.

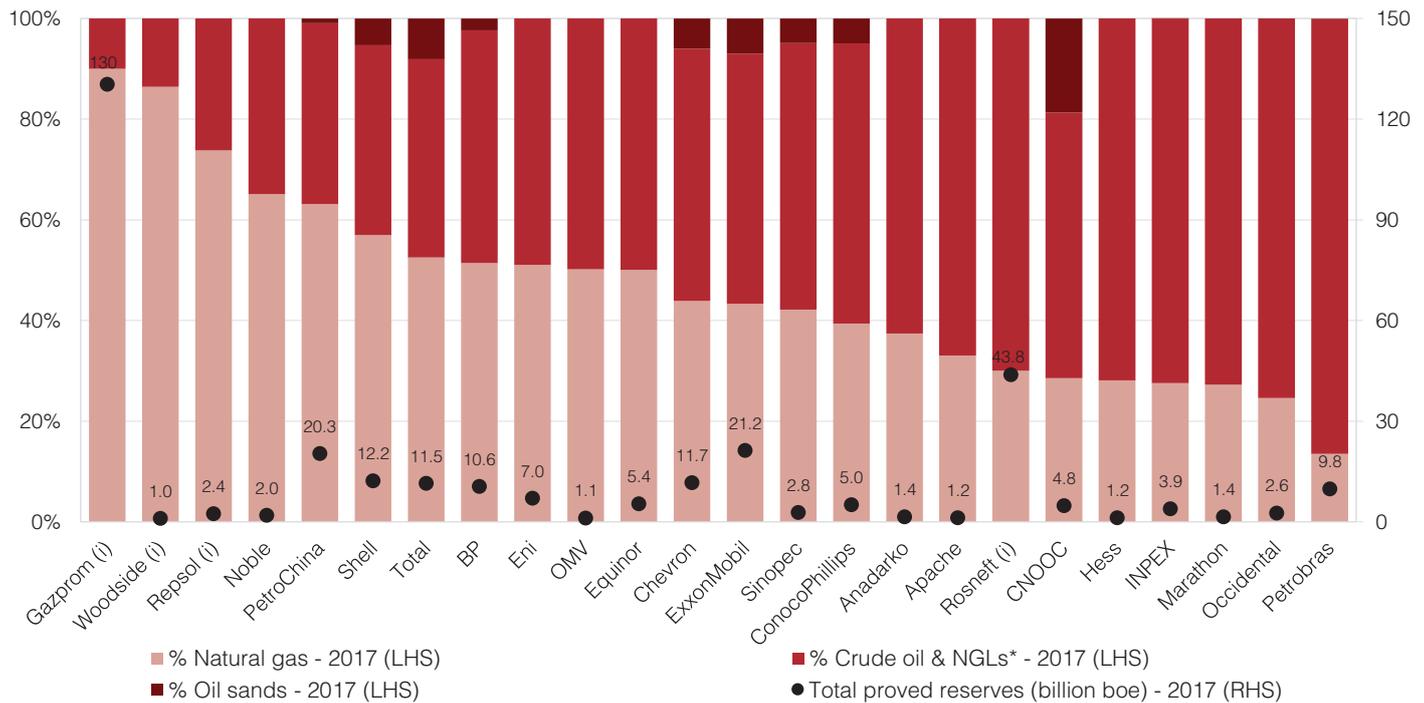
Figure 15: Production forecast 2022: % Natural gas



Source: CDP, company reports, Rystad Energy, GlobalData

13. IPIECA estimate that more than 70% of global oil and gas reserves are controlled by governments and NOCs.

Figure 16: Proved reserves (1P) mix by oil and gas



*Natural Gas Liquids (NGLs)
 (i) Reserves reported using SPE-PRMS system for Gazprom, Repsol, Rosneft and Woodside (instead of SEC). Gazprom discloses using the Russian A+B1+C1 classification but also provides PRMS equivalent figures (see box on page 52 for further insight).
 Source: CDP, company reports

The outlook for oil demand

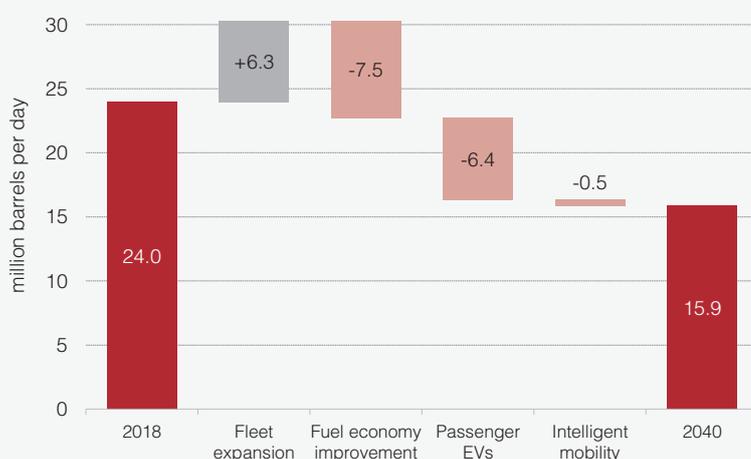
Global oil demand for 2018 is projected to be around 99 million barrels per day. The consensus view of various agencies and oil & gas companies is that total demand is expected to increase between 6-11% by 2040, with petrochemicals being the fastest growing source of demand.¹⁴ However, many of the assumptions used in arriving at this conclusion rely heavily on GDP correlations and are likely to underestimate the impacts from disruptive technologies (such as electric vehicles (EVs) and intelligent mobility) or regulatory action (such as regulation to limit plastic waste).

To capture these uncertainties many agencies and companies conduct scenario analysis, publishing various scenarios that span a wide outcome space (for further discussion see the box on scenario analysis on page 47). However, companies need to avoid being anchored to certain outcomes and should describe the resilience of the organisation's strategy across a broad range of possible futures.

Passenger vehicles currently account for around 24 million barrels per day of global oil demand. With the automotive sector facing disruption from electric vehicles (EVs) and autonomous, shared driving, a significant decline in this demand may occur.¹⁵

As shown in Figures 17 and 18, BNEF expects a 34% reduction in oil demand from passenger vehicles by 2040. It sees a growing demand for vehicles in developing countries offset by improvements in fuel economy and the uptake of EVs and intelligent mobility.

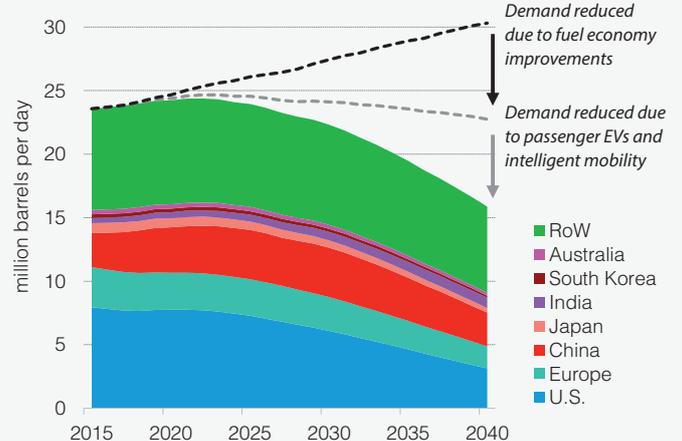
Figure 17: Change in oil demand from passenger vehicles⁽ⁱ⁾



(i) Excludes buses and two-wheelers

Source: CDP, BNEF

Figure 18: Oil demand outlook from passenger vehicles⁽ⁱ⁾



14. Questioning the Consensus on Oil Demand, BNEF.

15. See our automotive report 'Driving Disruption' for further discussion and analysis.

Emissions and resource management

Emissions from the production and use of oil & gas account for over half of global greenhouse gas emissions associated with energy consumption. This equates to more than 17 gigatonnes of carbon dioxide equivalent per year¹⁶, with about 90% of these emissions coming in the downstream use of hydrocarbons (Scope 3 emissions).¹⁷

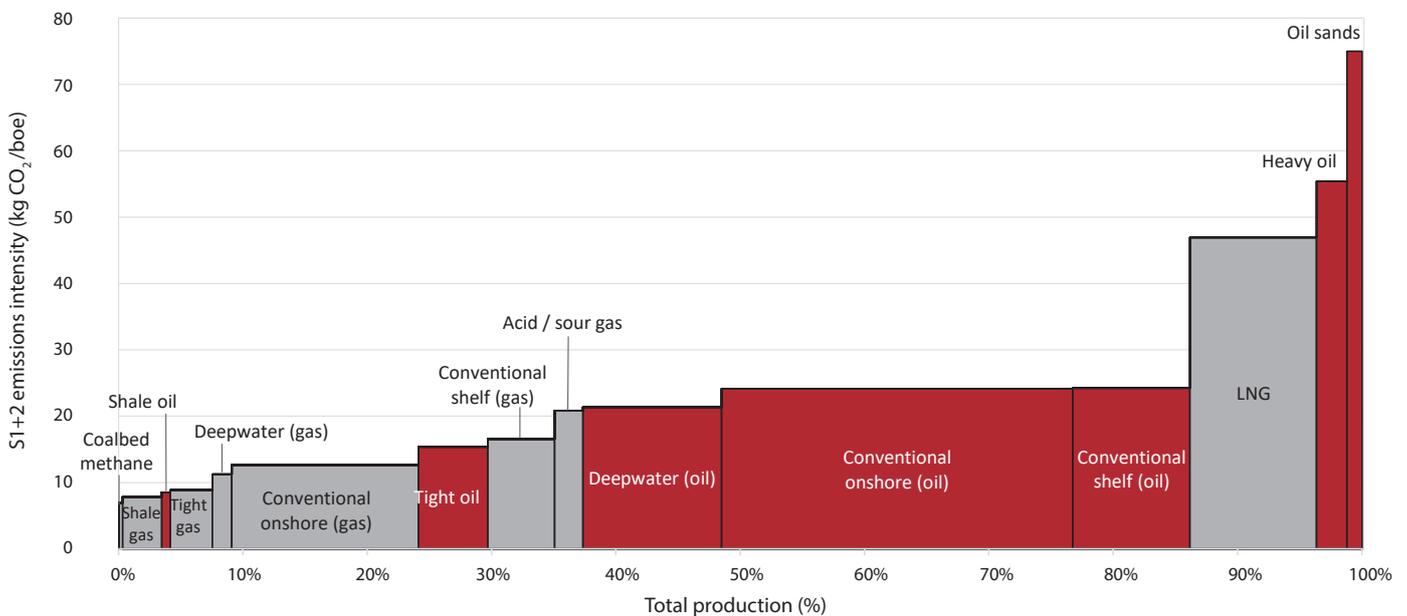
The sector has a huge role to play in the decarbonisation of the economy. To meet the goals of the Paris Agreement, the pace of the energy transition cannot be modest, further highlighted by the IPCC's recent special report on 1.5-degrees of global warming.

In the short-term oil & gas companies need to improve operational efficiency by eradicating routine flaring, reducing the need for venting, and measuring and reducing methane leakages.¹⁸

Under low-carbon scenarios the winning barrels will be low-cost, low-risk and lower-carbon. These 'advantaged' assets should become central to company strategy and managing the resource theme mix is key to attaining a lower-carbon footprint.

Figure 19 below illustrates average Scope 1+2 emissions intensities by resource theme as estimated by Wood Mackenzie. It is evident that on average Oil sands, Heavy oil and LNG assets have higher upstream emissions intensities relative to other resource themes. However, even assets of the same theme can have very different intensities depending on factors such as recovery mechanism, asset maturity and hydrocarbon composition & quality. These factors should also be considered when assessing emissions on a full life-cycle basis. For further insight see Wood Mackenzie's box "Carbon Intensity – not all assets are created equal" on page 16.

Figure 19: The upstream emissions cost curve⁽ⁱ⁾



(i) 2016-2025 Scope 1+2 average upstream emissions intensity by resource theme.

Note: Data is based on Wood Mackenzie's sample of 25 companies (which includes 23 of the companies in this report) and is calculated using cumulative production and emissions volumes over 2016-2025. Data represents Wood Mackenzie's understanding of company portfolios as of 1H2017 and will not reflect changes to portfolio composition or the impact of commodity price increases since that time.

Source: CDP, Wood Mackenzie

In this section we assess companies' carbon efficiency using five key metrics:

Metric 1) NPV / tonne (25%): We use Wood Mackenzie's NPV / tonne metric as a measure of how much value a company is creating for each tonne of carbon emitted from its upstream assets. As well as encapsulating relative carbon intensity, the metric also highlights the ability of a company's underlying assets to absorb additional cost from carbon pricing.¹⁹

Metric 2) Upstream emissions intensity (45%): We identify the companies with the lowest current upstream operational emissions intensity and the extent to which they have reduced this over the period 2013-2017. We also use Wood Mackenzie's 2016-2025 portfolio emissions intensity as an indicator of future emissions performance.²⁰

Metric 3) Methane emissions intensity (10%): We assess companies' methane leakage and venting rates for 2017.

Metric 4) Flaring intensity (10%): We assess companies' natural gas flaring emissions intensity for 2017.

Metric 5) Scope 3 disclosure (10%): We identify which companies are disclosing data for Scope 3 emissions categories.

16. Calculated using IEA and EDGAR carbon and emissions data.

17. This highlights the importance of improved Scope 3 emissions disclosure and calculation methodologies (the majority of Scope 3 emissions sit in category 11 – "Use of Sold Products", see Figure 11 on page 9).

18. See box "Methane Matters" on page 20.

19. Wood Mackenzie: "New metrics for evaluating oil and gas portfolio resilience in a low-carbon future".

20. Wood Mackenzie: "Positioning for the future: Benchmarking upstream corporate carbon emissions and value at risk".

Figure 20: Emissions and resource management summary

Company	NPV / tonne	Upstream emissions intensity	Methane intensity	Flaring intensity	Scope 3 disclosure	Overall weighted rank	Emissions & resource management rank
Equinor	3	3	11	1	10	3.8	1
Anadarko	1	2	2	11	16	4.2	2
Noble Energy	4	1	3	4	17	4.4	3
Petrobras	2	9	19	16	3	8.8	4
Eni	8	6	7	13	2	9.0	5
Shell	6	14	5	12	1	10.3	6
OMV	5	11	17	14	4	10.4	7
Apache	9	5	15	8	19	10.8	8
Total	15	10	12	10	9	11.6	9
INPEX	13	19	20	2	6	13.1	10
Hess	14	13	4	20	15	13.1	11
Gazprom	23	7	10	5	19	13.2	12
ConocoPhillips	19	17	7	3	8	13.3	13
Woodside	7	24	1	6	6	13.3	14
BP	18	12	5	15	11	13.5	15
Repsol	12	20	21	7	4	13.8	16
Rosneft	22	4	18	17	11	14.1	17
Occidental	17	16	14	9	11	14.5	18
Marathon Oil	20	8	7	21	19	14.6	19
Chevron	16	21	12	18	11	15.6	20
CNOOC	10	15	22	21	19	16.0	21
Sinopec	n/a ⁽ⁱ⁾	22	22	21	19	17.7	22
ExxonMobil	21	18	16	19	18	17.7	23
Petrochina	11	23	22	21	19	17.9	24

Weighting **25%** **45%** **10%** **10%** **10%**

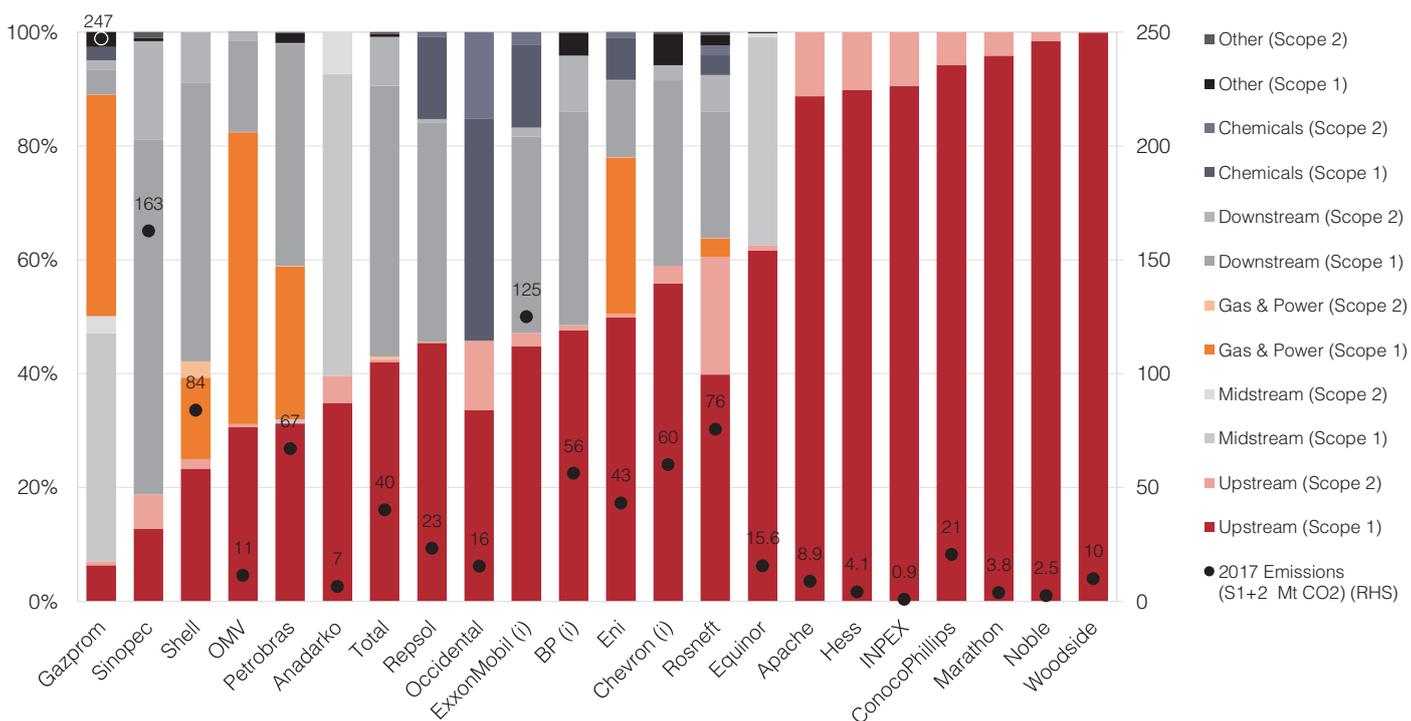
(i) No data available for NPV / tonne for Sinopec. The company has been neutralised for this metric.

Note: In calculating the weighted rank in this table, we use the weighted ranks for each area. We display non-weighted ranks in this summary for simplicity only.

Source: CDP

To compare companies on a level playing field we have focused on upstream emissions profiles and ranked companies on an emissions intensity basis (normalised by upstream production). However, it should be noted that many companies have large emissions footprints across the full value-chain as illustrated in Figure 21.

Figure 21: Absolute emissions split by business segment⁽ⁱⁱ⁾



(i) Emissions data for Chevron and ExxonMobil is on an equity basis. BP is on an equity basis excluding share in Rosneft. Data for all other companies is on an operational basis.

(ii) No split available for CNOOC or Petrochina due to insufficient data available. Data shown for Apache and ExxonMobil is for 2016.

Source: CDP, company reports

Carbon Intensity – not all assets are created equal

When thinking about how to facilitate the transition to a low-carbon future, conventional wisdom dictates that we need to shift away from high-carbon fuels, such as coal and oil sands, towards cleaner burning natural gas and renewables. When combusted as fuel, natural gas releases almost half as much carbon dioxide as coal and a third less than oil. Gas also typically requires less energy to produce, making it less emissions-intensive than oil from an upstream, as well as lifecycle, perspective.

How much less emissions intensive depends on whether the gas occurs in association with liquids, as well as on the type of gas. Gas condensate fields and associated gas have equivalent emissions intensities to oil fields, given the processing required to separate the gas and liquids streams. Similarly, gas with significant CO₂ or Sulphur content typically requires more processing to remove the impurities, resulting in a higher emissions intensity. Liquefied natural gas has an upstream emissions intensity almost equal to heavy oil due to the need to remove all inert compounds, combined with the additional energy required to convert natural gas from its gaseous to liquid form.

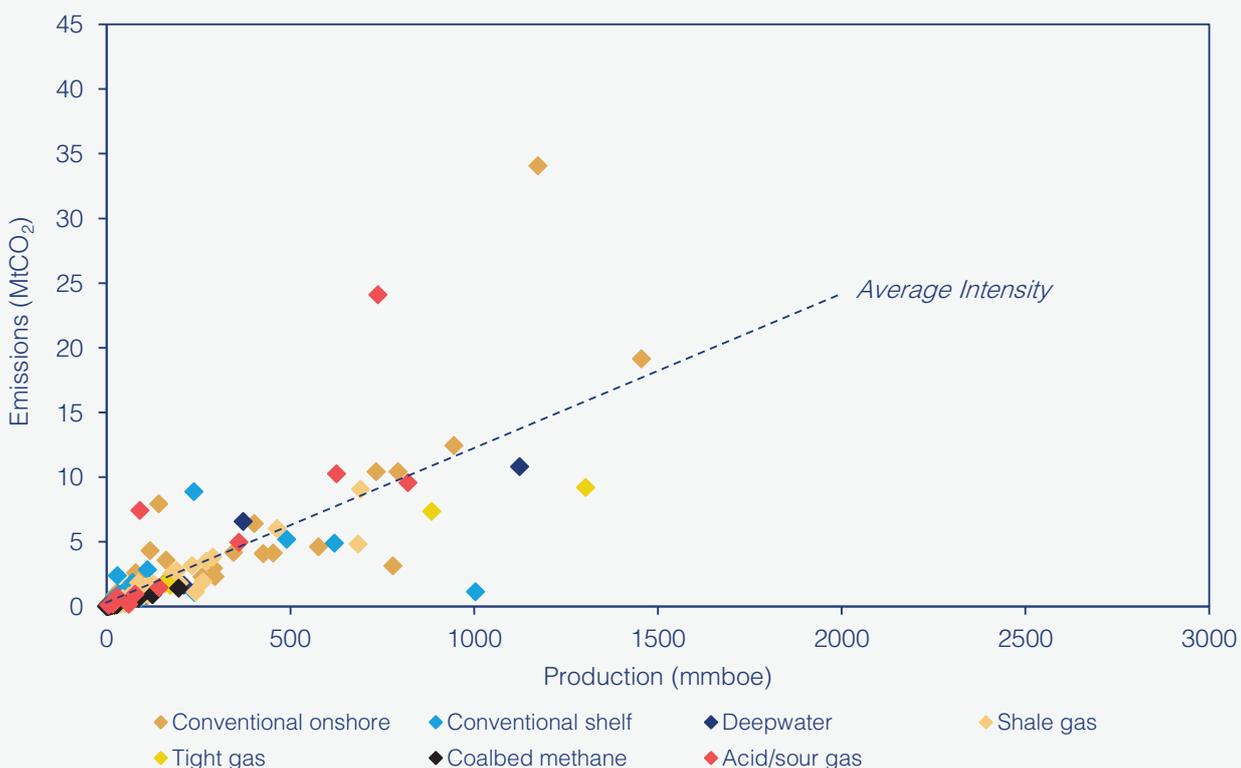
Beyond resource theme

Certainly, even LNG, the most emissions intensive of the natural gas resource themes, still produces less CO₂ than coal when combusted for power. However, variations in upstream emissions intensity become important in considering how companies can reduce their own CO₂ footprints. These variations extend beyond broad resource themes. Even assets of the same theme can have significantly different emissions intensities based on maturity, location and other unique factors.

For instance, even though acid and sour gas assets are, on average, 65% more carbon intensive than conventional gas assets and 165% more carbon intensive than unconventional assets, this average is pulled upwards by a few very emissions intensive assets. At the upper end of the scale, the Tangga Barat cluster in Malaysia has an emissions intensity of 82.3 kgCO₂/boe, reflecting both the high Sulphur (10,000 ppm) and high CO₂ content (average 37%) of the gas. Not only do the CO₂ and Sulphur need to be removed to meet pipeline gas specifications in the country, the excess CO₂ is then vented into the atmosphere, further increasing the asset's intensity. By contrast, even though some fields in the Weser-Ems development in Germany have a CO₂ content as high as 26.5%, production from these deposits can be blended with lower CO₂-content gas to meet pipeline specifications, thereby reducing the processing required and avoiding the need for venting. As a result, the emissions intensity of the development is 10.3 kgCO₂/boe, lower than the average for conventional onshore gas.

There is significant variation amongst conventional onshore gas fields, as well. The Drenthe Concession in the Netherlands has an emissions intensity of 42.6 kgCO₂/boe, largely reflecting the maturity of the assets, while South Russkoye, a relatively early-life dry gas development, has an emissions intensity of only 4 kgCO₂/boe.

Figure 22: Gas assets 2016-2025 cumulative emissions vs. production

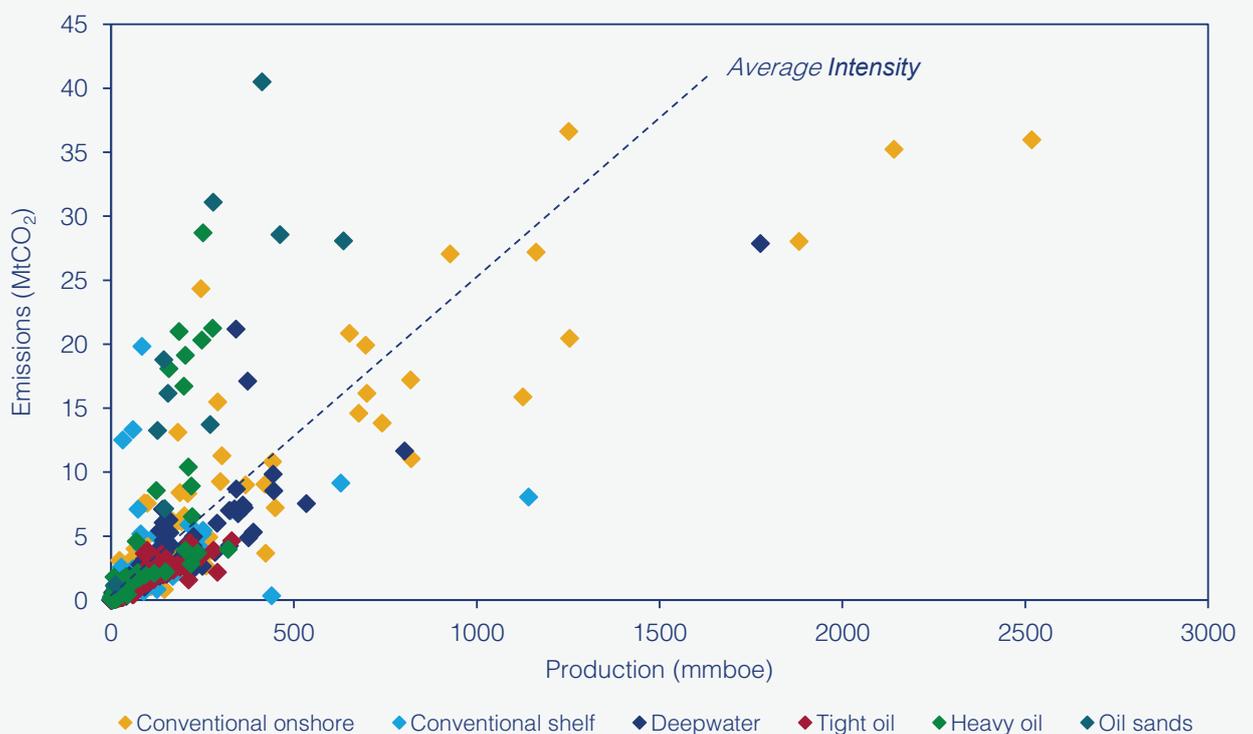


Source: Wood Mackenzie

Oil assets similarly have significant variation in emissions-intensity. While oil sands and heavy oil are the most emissions intensive resource themes overall, with average emissions intensities of 75 and 55 kgCO₂/boe respectively, some conventional assets are equally emissions intensive. For instance, the Likouala licence in the Congo contains two late-life oil fields, on which the operator has performed an extensive workover and water injection programme. In addition, significant volumes of associated gas are flared. All these factors have increased its intensity to 76 kgCO₂/boe. There are examples of conventional oil fields with still higher intensities, with the most carbon intensive having an intensity nearly five times higher than Likouala.

Moreover, not all oil sands projects are alike. Emissions intensities vary from as low as 44 kgCO₂/boe for Kearl to 130 kgCO₂/boe at Long Lake. Several factors explain these differences. First, oil sands deposits developed via steam-assisted gravity drainage (SAGD) or cyclic steam stimulation (CSS) tend to be more emissions intensive than projects where bitumen is mined, given the large amounts of energy required to produce the steam for injection. In general, in situ oil sands development is more than two times as emissions intensive as mining projects. Upgrading then further increases the intensity, as much as doubling it in the case of mined developments. These two factors explain why Long Lake's intensity is more than twice as high as Kearl's. Long Lake is an integrated SAGD development, with onsite upgrading facilities. By contrast, Kearl is a mining project that relies on blending to ship the produced bitumen to market, rather than upgrading. Both projects leverage cogeneration, which reduces fuel consumed on site, thus partially mitigating the emissions intensity of operations. In addition to cogeneration, AOSP has built a first-of-its-kind carbon capture and sequestration (CCS) scheme at its Scotford upgrader. This reduces the emissions intensity of AOSP nearly 65% compared to other integrated mined projects, in another example of asset-specific differences.

Figure 23: Oil assets 2016-2025 cumulative emissions vs. production



Source: Wood Mackenzie

Devil is in the detail

As these examples illustrate, preparing the oil and gas industry for a low-carbon future is not as simple as increasing investments in natural gas and divesting higher emissions resource themes, such as oil sands. Asset-level variations in emissions-intensity mean that some natural gas assets may be just as emissions intensive as oil sands, while some oil sands assets might compete with lower-carbon natural gas assets – at least from an upstream perspective. Where these differences are significant – as in many cases they are – they might also alter the relative difference in lifecycle emissions intensity between oil and gas. When considering how to position their upstream portfolios for a low-carbon future, companies need to understand each asset's specific carbon intensity – both assets they already own, as well as any assets they might acquire. Similarly, investors need to understand the asset-level granularity of companies' portfolios and what is driving future emissions when engaging around climate change strategies.

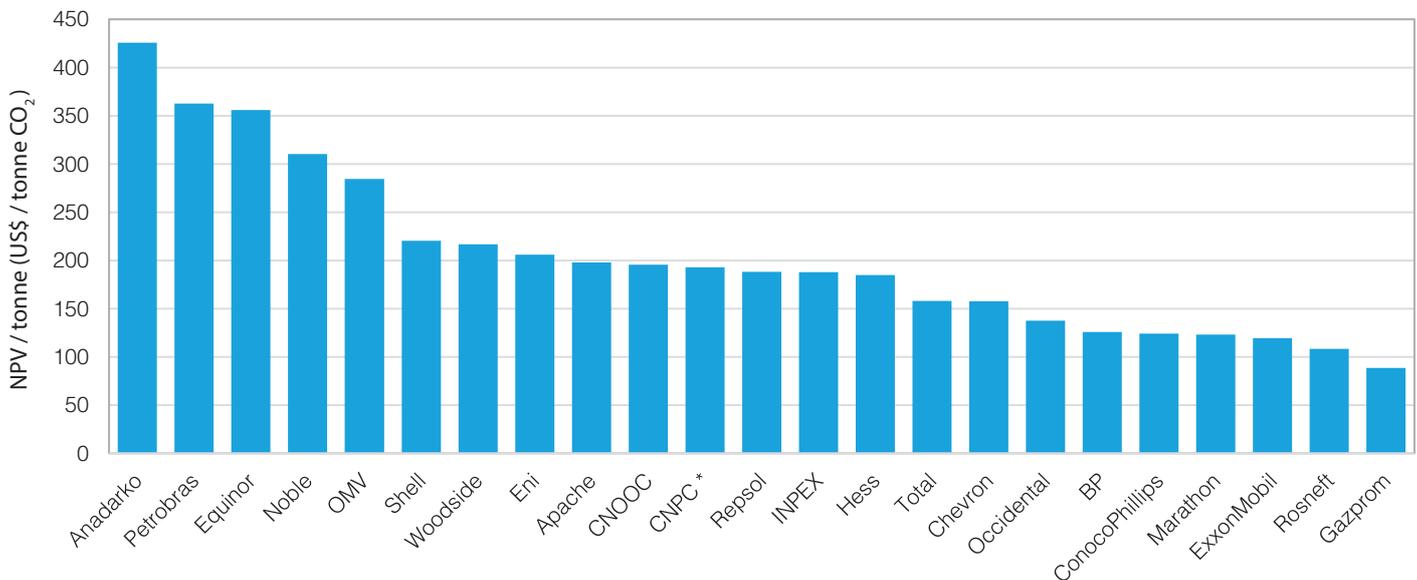
Source: Data and analysis is based on Wood Mackenzie's multi-client study, Positioning for the future: benchmarking upstream oil and gas emissions and value and risk, published in September 2017:

<https://www.woodmac.com/consulting/multi-client-studies/carbon-positioning-for-the-future/>

Highlights

- Equinor, Anadarko and Noble Energy rank well across most metrics. They currently have the lowest upstream emissions intensities (see Figure 25) and are also forecast to have the three lowest intensities out to 2025 (see Figure 26).
- The average NPV/tonne is US\$203 / t CO₂. However, Figure 24 shows that there is a wide range: Wood Mackenzie forecast that Anadarko will generate 4.8 times the value per tonne of carbon emitted than Gazprom over the remaining life of post-FID assets. Values depend on both carbon intensity and project economics and those with a higher NPV/tonne will be more resilient to future carbon pricing.
- Across the 22 companies where data is available, upstream emissions intensities have been reduced at an average rate of 2.5% p.a. since 2013. Over this period 15 of the companies have reduced their emissions intensity (see Figure 25).
- Disclosure remains a key issue for the three Chinese companies CNOOC, Petrochina and Sinopec. Petrochina does not disclose any emissions data, and all three do not disclose methane, flaring or Scope 3 emissions data.
- Upstream emissions intensity is closely related to the composition of company portfolios. Companies with a high share of oil sands, heavy oil and LNG tend to have higher Scope 1+2 intensities (see Figure 26). Other factors such as recovery mechanism, asset maturity and hydrocarbon composition also play a role. For example for Repsol around 65% of current operated E&P emissions take place in just one of the assets acquired from Talisman. The gas produced has an elevated CO₂ content which makes it more difficult to use for energy purposes.

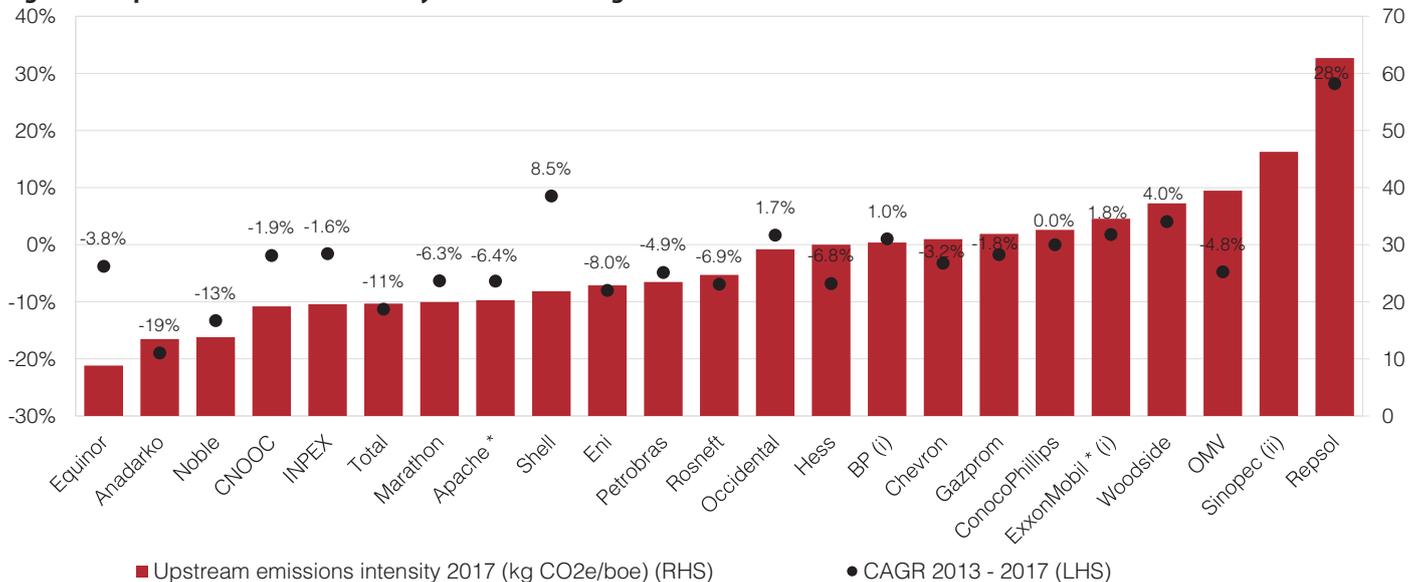
Figure 24: NPV / tonne (post-FID upstream assets)⁽ⁱ⁾



* Petrochina is the listed arm of state-owned China National Petroleum Corporation (CNPC)

(i) Wood Mackenzie's NPV forecast, using a 10% discount rate over the remaining life of an asset, divided by their forecast of total Scope 1 and 2 CO₂ emissions from production over the same period. The corporate-level ratio aggregates the asset NPV10 and CO₂ emissions on a working interest basis. Valuations are based on Wood Mackenzie's base case long-term Brent price assumptions. Post-FID assets only (onstream or under development). Data represents Wood Mackenzie's understanding of company portfolios as of 1H2017 and will not reflect changes to portfolio composition or the impact of commodity price increases since that time. Note: BP analysis includes its stake in Rosneft and no data available for Sinopec. Source: Wood Mackenzie

Figure 25: Upstream emissions intensity and rate of change⁽ⁱⁱⁱ⁾



* 2016 intensity values and CAGR 2013-2016 for Apache and ExxonMobil.

(i) Emissions intensity for ExxonMobil is on an equity basis. BP is on an equity basis excluding share in Rosneft. Data for all other companies is on an operational basis.

(ii) Insufficient data to calculate trend for Sinopec.

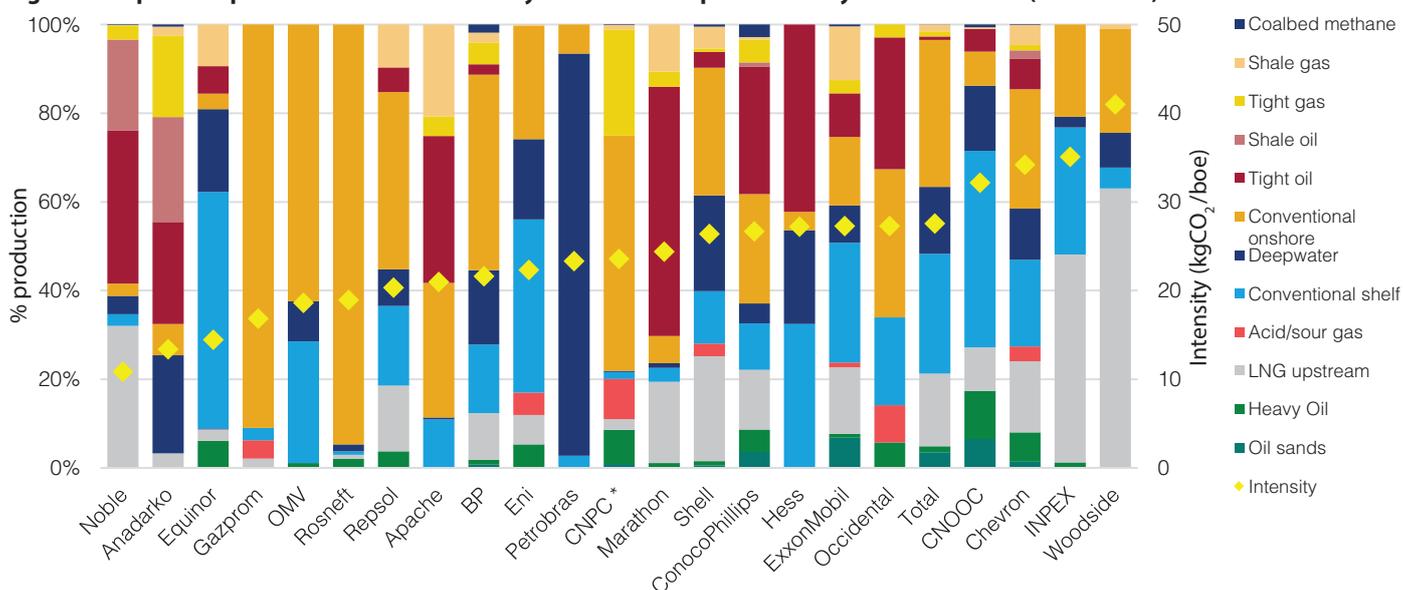
(iii) No emissions data reported by Petrochina

Source: CDP, company reports

- Some sources of emissions are more easily addressable than others. Emissions caused by specific processes such as liquefaction for LNG and steam-assisted gravity drainage for oil sands can be harder to reduce. However, companies can look to improve their efficiency across their operated assets with flaring, venting and methane leakage prime targets for emissions mitigation.
- Repsol has the highest methane intensity, significantly higher than the group average of 0.39% (see Figure 27). This average is encouraging as it is much lower than the 3% required to ensure gas is cleaner than coal on a full life-cycle basis (see box on page 20 for further insight).
- Hess has the highest flaring intensity (see Figure 28). Flaring makes up more than 50% of its total operated Scope 1 emissions.

- The 24 companies in the study are losing on average 3.3% of their natural gas production through flaring, venting and methane leakages – worth almost US\$5bn at the current Henry Hub gas price.
- 75% of companies disclose emissions data for Scope 3 category 11 ‘use of sold products’ (see Figure 29 on page 20). For our company sample this category accounts for 81% of total emissions footprints (Scope 1+2+3) highlighting the importance of disclosure and using tools such as life-cycle emissions analysis within the industry. However, we note that across the Scope 3 categories companies choose very different reporting boundaries, with no company currently disclosing Scope 3 emissions from all energy products sold. This level of inconsistent reporting needs to be addressed by the industry.

Figure 26: Upstream portfolio emissions intensity vs. cumulative production by resource theme (2016-2025)⁽ⁱ⁾



* Petrochina is the listed arm of state-owned China National Petroleum Corporation (CNPC)

(i) Wood Mackenzie's estimate of total Scope 1 and 2 CO₂ emissions from 2016-2025 for pre- and post-FID corporate upstream assets (onstream, under development, probable and good technical assets) divided by Wood Mackenzie's forecast of total production from those assets over the same period. Emissions and production for individual assets are on a working interest basis. Includes both operated and non-operated assets. Data represents Wood Mackenzie's understanding of company portfolios as of 1H2017 and will not reflect changes to portfolio composition or the impact of commodity price increases since that time. Note: BP analysis includes its stake in Rosneft and no data available for Sinopec. Source: Wood Mackenzie

Figure 27: Methane emissions intensity⁽ⁱ⁾

Company	Methane intensity 2017 (% of gas production)
Woodside	0.05%
Anadarko	0.16%
Noble Energy	0.18%
Hess	0.19%
BP	0.20%
Shell	0.20%
ConocoPhillips	0.22%
Eni	0.22%
Marathon Oil	0.22%
Gazprom	0.22%
Equinor	0.23%
Chevron	0.30%
Total	0.30%
Occidental	0.40%
Apache	0.43%
ExxonMobil	0.66%
OMV	0.69%
Rosneft	0.70%
Petrobras	0.75%
INPEX	0.78%
Repsol	1.21%

Figure 28: Flaring intensity⁽ⁱⁱ⁾

Company	Flaring intensity 2017 (kg CO ₂ /boe)
Equinor	1.1
INPEX	1.3
ConocoPhillips	1.7
Noble Energy	2.1
Gazprom	2.7
Woodside	3.1
Repsol	4.5
Apache	4.7
Occidental	5.1
Total	5.5
Anadarko	5.9
Shell	6.1
Eni	6.7
OMV	6.7
BP	7.0
Petrobras	7.5
Rosneft	8.5
Chevron	8.6
ExxonMobil	9.1
Hess	15.5

(i) No data on methane emissions for CNOOC, Petrochina and Sinopec.

We note that companies do not always make reporting boundaries clear when reporting methane intensities (i.e. whether emissions are normalised just by upstream production or also include midstream gas processed through gathering and boosting facilities). There is a need for standardised methodology across the industry in order to have accurate comparability. We recognise this as a limitation in our analysis.

(ii) No data on flaring for CNOOC, Marathon, Petrochina and Sinopec.

Source: CDP, company reports

Figure 29: Scope 3 disclosure⁽ⁱⁱ⁾

Company	Use of sold products	Purchased goods and services	Fuel and energy related activities	Processing of sold products	Waste generated in operations	Capital goods	Downstream transportation & distribution	Upstream transportation & distribution	Employee commuting	Business travel
Shell	✓	✓	✓	✗	✓	✓	✓	✓	✓	✓
Eni	✓	✓	✓	✓	✓	✓	✗	✗	✓	✓
Petrobras	✓	✓	✓	✓	✓	✗	✗	✓	✓	✓
Repsol	✓	✓	✗	✗	✓	✗	✓	✓	✓	✓
OMV	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗
Woodside	✓	✓	✗	✗	✓	✗	✓	✗	✗	✓
INPEX	✓	✓	✗	✗	✗	✗	✓	✗	✓	✓
ConocoPhillips	✓	✗	✗	✓	✗	✗	✓	✓	✗	✗
Total	✓	✗	✗	✗	✗	✗	✓	✗	✓	✓
Equinor	✓	✗	✗	✗	✗	✗	✗	✗	✗	✓
BP	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗
Chevron	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗
Occidental	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗
Rosneft	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗
Hess	✓ ⁽ⁱ⁾	✗	✗	✓	✗	✗	✗	✗	✗	✓
Anadarko	✓ ⁽ⁱ⁾	✓ ⁽ⁱ⁾	✗	✗	✗	✗	✗	✗	✗	✓ ⁽ⁱ⁾
Noble Energy	✓ ⁽ⁱ⁾	✗	✗	✗	✗	✗	✗	✗	✓	✓
ExxonMobil	✓ ⁽ⁱ⁾	✗	✗	✗	✗	✗	✗	✗	✗	✗

(i) Scope 3 disclosure does not account for all company operations.

(ii) No disclosure of Scope 3 emissions from Apache, CNOOC, Gazprom, Marathon Oil, Petrochina and Sinopec

Source: CDP, company reports

Methane matters:

Emissions of methane, which is the primary component of natural gas, are estimated to account for around 25% of current global warming.

Estimates of methane emissions carry a high degree of uncertainty. Top-down methods, such as using dedicated aircraft or satellites to measure concentrations, inherently measure at an elevation or distance from the emissions source, making it difficult to assign emissions to specific sources due to dispersion in the atmosphere. This contrasts to bottom-up approaches, where accurate measurements can be taken at the source but not all sources may be detected.

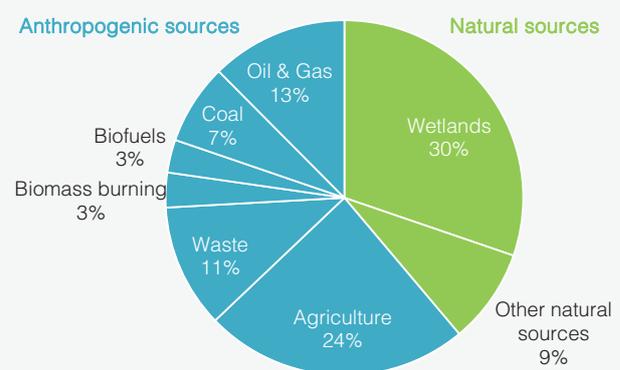
Across the oil & gas sector methane emissions arise from various sources:

- ✦ **Fugitive** emissions occur from unintended leakages e.g. a leaking valve or seal.
- ✦ **Vented** emissions are the result of intentional releases, often for safety reasons e.g. venting a pipeline for inspection.
- ✦ **Incomplete flaring** emissions occur when a small proportion of the natural gas sent to flare is not combusted and is released into the atmosphere.

The majority of emissions sources exhibit low emissions rates. However, it is estimated that on average the top 10% of emitting sources contribute around 70% of total methane emissions, leading to the term 'super-emitter'.²¹

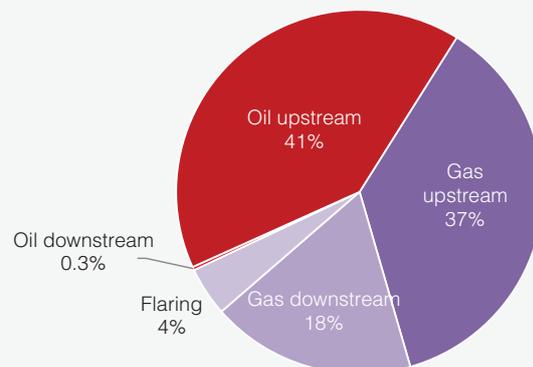
The IEA estimates total oil & gas methane emissions in 2017 to be approximately 79 Mt, with around 60% vented, 35% fugitive and the remainder from incomplete combustion of flares. Approximately 55% of total oil & gas methane emissions are from natural gas operations (see Figure 31).

Figure 30: Sources of methane emissions (2012)⁽ⁱ⁾



(i) Global methane emissions from all sources were around 570 million tonnes (Mt) in 2012 (the latest date where comprehensive data are available). Source: IEA WEO 2017

Figure 31: Oil & Gas methane emissions breakdown by sector

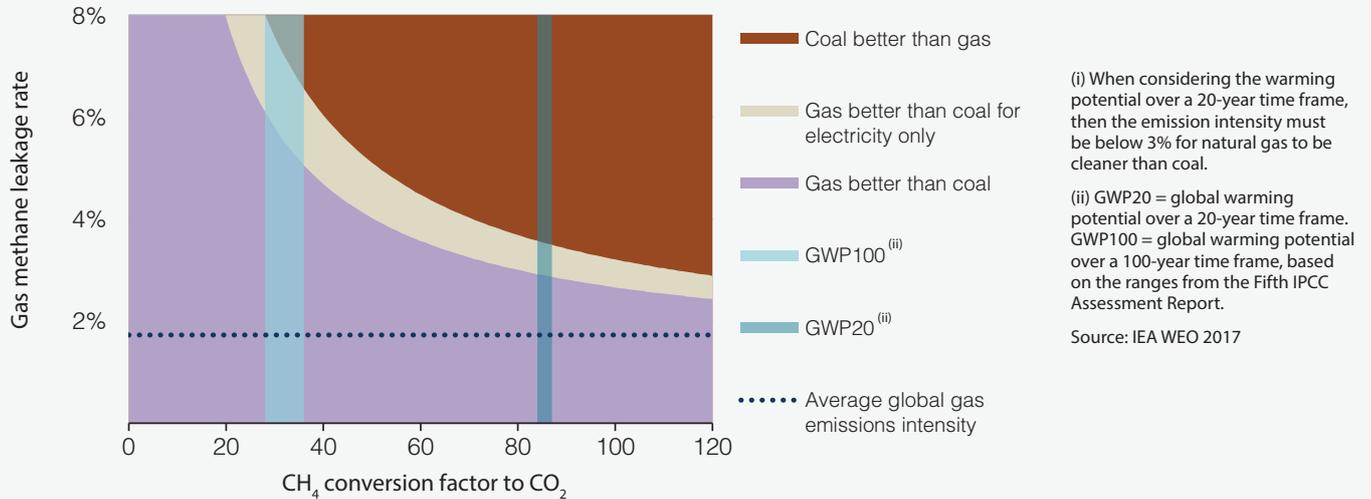


Source: IEA WEO 2017

21. Typical examples include: valves that are stuck open, loss of seal integrity on compressors and human error (such as leaving storage tank hatches open). It is suggested that reducing emissions from 'super-emitters' to normal levels could reduce methane emissions by around 65-85% (Zavala-Araiza et al., 2015).

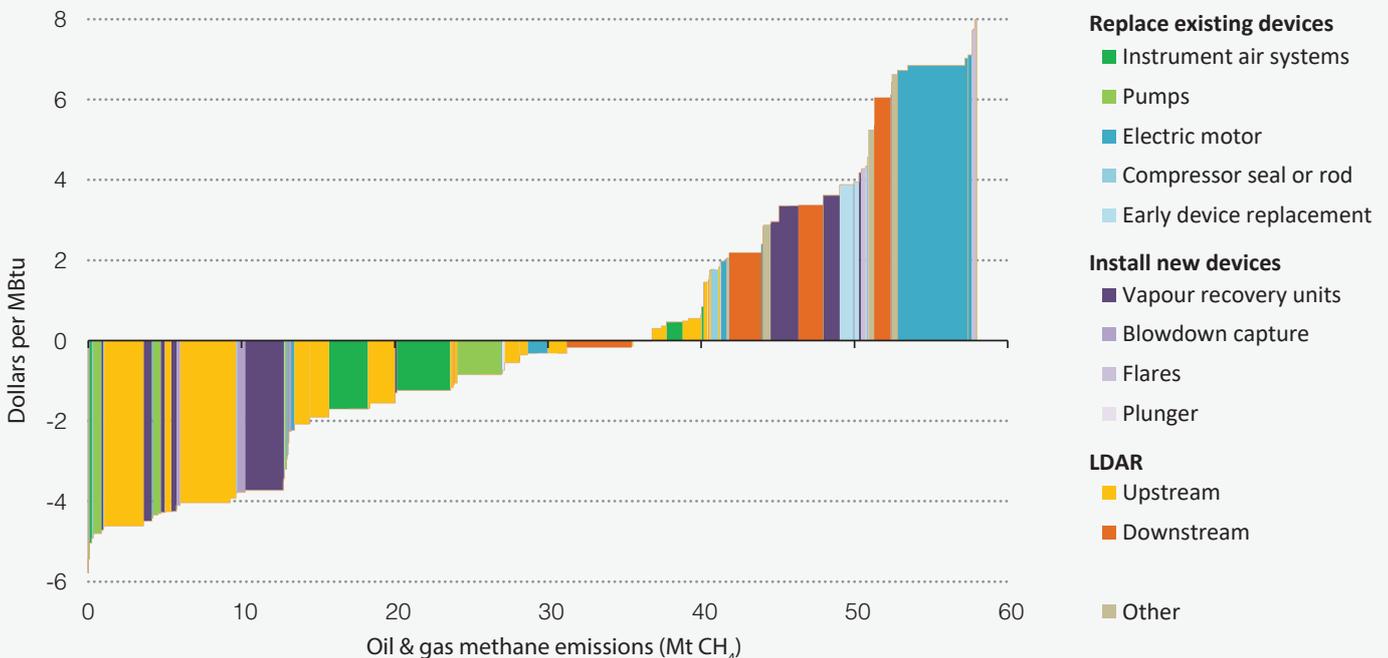
This estimate would correspond to a global average emissions intensity of just over 1.7%.²² Figure 32 illustrates that this estimate would mean that on average gas generates fewer life-cycle GHG emissions than coal regardless of the time frame or global warming potential (GWP) of methane considered. However, methane leakage rates are likely to be much higher in certain regions, emphasizing the need for continued efforts to reduce methane emissions to as low as possible.

Figure 32: Life-cycle GHG emissions intensity of natural gas compared with coal⁽ⁱ⁾



Natural gas is a valuable product and methane that is recovered can often be sold. Deploying abatement technologies can result in overall savings if the cost of the technology is lower than the value received for the methane sold. According to the IEA, it is technically possible to reduce global oil & gas methane emissions by around 75%. Emissions of around 36Mt (45% of current levels) can be mitigated with positive net present values (see Figure 33):

Figure 33: Global marginal abatement cost curve for oil and gas methane emissions, 2017



Source: IEA WEO 2018

Leak detection and repair (LDAR) programmes are among the most cost-effective and are an essential mechanism for reducing fugitive emissions. A number of promising measurement and detection technologies are being developed, including aerial surveys using drones, which could potentially enable continuous detection.

It is clear that both the technical and commercial abatement potential for oil & gas related methane emissions is high. Despite the EPA looking to relax methane regulations in the US, the oil & gas industry has launched a number of initiatives aimed at cutting methane emissions. A first step is to reduce uncertainty by improving measurement, data gathering and reporting. Companies should identify cost-effective mitigation measures and look to set targets to reduce methane emissions.

22. Here emissions intensity is the ratio of the volume of methane emitted to the volume of natural gas produced or transmitted and distributed.

Physical risks: Water resilience

- For the 24 companies more than 34% of upstream onshore production and more than 30% of refining capacity is currently located in areas of medium or high water stress.
- Woodside Petroleum and Petrobras rank first and second respectively. Both companies have low exposure to water stress as portfolios are primarily located offshore.
- Petrochina and Sinopec have the highest exposure to water stressed regions and evidence of water governance and policy is lacking for both companies.

Overview

Global water demand is expected to exceed supply by 40% in 2030,²³ putting particular pressure on the oil & gas sector which is often tied to water stressed geographies such as the Middle East. This is coupled with the fact that the oil & gas sector is among the most water and energy intensive industries alongside energy utilities, chemicals and mining.

Fresh water is used in several elements of the oil & gas industry's upstream operations including: drilling operations, hydraulic fracturing, waterflood, pressure maintenance and enhanced oil recovery (EOR). In downstream operations (e.g. refining and chemicals) the main use of water is for cooling.

For unconventional resources such as shale oil and gas, produced water handling can be the dominant water-related issue (see box on page 23).

CDP's annual water questionnaire aims to gather relevant insights about companies' water strategy and their efforts to mitigate water-related risks. In 2018, of the 24 oil & gas companies in our sample only eight responded. 19 of the companies are members of IPIECA and disclose according to elements of the organisation's water management framework.

In this chapter we assess companies' water resilience and management using three key metrics:

Metric 1) Water stress exposure (45%): We assess localized water stress on an onshore facility-by-facility basis using the World Resource Institute (WRI) Aqueduct mapping tool. Water stress conditions are assessed based on physical water quantity and quality indicators as well as regulatory and reputational risks. Exposure to water stress covers upstream production and downstream refining and chemicals assets. Exposure is scaled by an asset's production over 2017 - 2025 to capture its relative size within a company's portfolio and a weighted water stress index (0 to 5) is produced to rank companies.²⁴

Metric 2) Fresh water withdrawal intensity (30%): We examine companies' current fresh water withdrawal intensity and how this has changed over time (2014-2017).

Metric 3) Water disclosure and governance (25%): We form a ranking based on a range of indicators relating to companies' water risk disclosure, policies and governance frameworks. The assessment includes: response to CDP water questionnaire, water risk assessment / management, water stress assessment, water reduction target and water accounting.

Figure 34: Physical risks summary

Company	Water stress exposure	Fresh water intensity	Water disclosure & governance	Overall weighted rank	Physical risks rank
Woodside	1	4	10	4.7	1
Petrobras	4	12	4	6.1	2
Gazprom	6	11	3	6.3	3
Equinor	3	3	13	7.0	4
Total	9	10	2	7.2	5
Anadarko	19	2	5	8.2	6
Hess	2	6	21	8.4	7
Eni	11	7	7	8.7	8
ConocoPhillips	10	8	9	8.9	9
Apache	13	1	13	9.7	10
Rosneft	7	17	7	9.8	11
Repsol	14	9	10	10.6	12
INPEX	5	16	13	10.7	13
Shell	12	13	13	11.6	14
Chevron	21	5	13	12.5	15
BP	16	19	10	12.8	16
OMV	20	23	1	12.8	17
Marathon Oil	18	14	13	13.2	18
CNOOC	8	21	13	13.2	19
ExxonMobil	17	15	13	13.6	20
Noble Energy	15	18	22	15.1	21
Occidental	22	24	6	17.4	22
Petrochina	24	20	22	21.8	23
Sinopec	23	22	22	22.1	24

Weighting **45%** **30%** **25%**

Note: In calculating the weighted rank in this table, we use the weighted ranks for each area. We display non-weighted ranks in this summary for simplicity only.

Source: CDP

23. Allianz Global Investors White Paper Series – Water: A key 21st Century Growth Opportunity

24. Please note that the methodology for this metric has been changed from the last report. The index is now out of 5 to better reflect WRI's risk categorisation and production profiles across 2017-2025 are used to provide a forward looking view. Furthermore relative exposure of a company's portfolio to onshore / offshore production is taken into account (offshore assets are not considered to be at risk). The ratio of upstream production to refinery throughput for companies is used to produce an overall weighted water stress index.

Permian Basin: Growing pains from produced water

Across America's most prolific oil play, the problem isn't a lack of water but too much. Produced water handling is set to become a major issue for producers operating in the Permian Basin over the next few years.

According to IHS Markit, spending on water management in the Permian is set to almost double to more than \$22 billion over the next five years (see Figure 35).

In conventional fields, produced water can be re-injected for pressure maintenance, waterflood or enhance oil recovery (EOR). However, this is not the case in unconventional, tight formations and produced water must be recycled, re-used or injected into separate saltwater disposal wells.

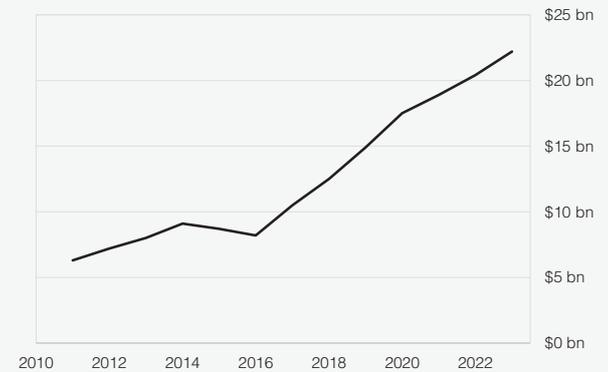
Wood Mackenzie expects over 2 million barrels per day of supply growth over the next five years from the Permian region. However, with more oil comes more water, and many of the disposal formations used for decades are starting to fill up, leading to higher water handling costs.

Part of the problem is that in pursuit of productive well completions, operators are now using more water. Water demand per completion is now 50% higher than in 2015, with over 400 thousand barrels of water used per well in the Midland Basin and Wolfcamp formation. This results in higher volumes flowing back to the surface.

Furthermore, water cuts²⁵ from the targeted formations have risen quickly. For example, in the first four years of production the water cut increased from around 70% to 80% for the Wolfcamp formation in the Delaware Basin (see Figure 36).

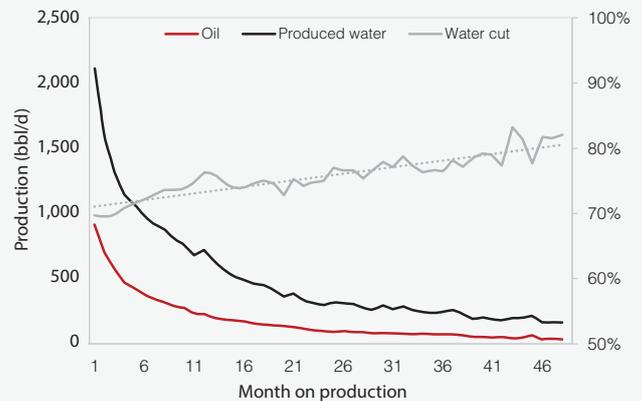
Wood Mackenzie modelled a number of scenarios and found that rising water cuts and increased water management costs could add \$3 to \$6 a barrel to company break-evens by 2025 (see Figure 37).

Figure 35: Spending on water management in Permian



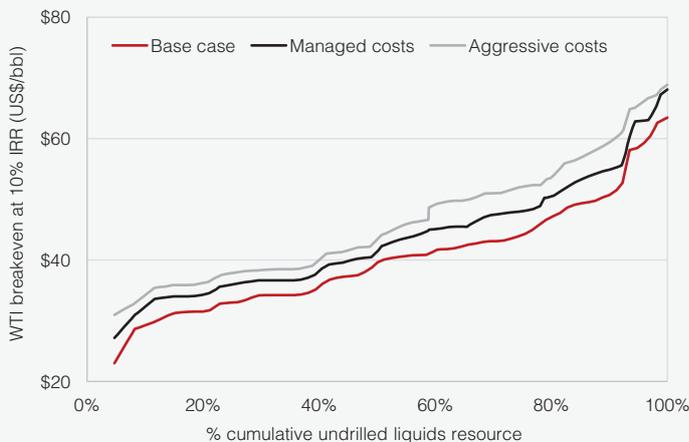
Source: CDP, IHS Markit

Figure 36: Average oil and water production for Delaware Basin Wolfcamp wells drilled since 2014



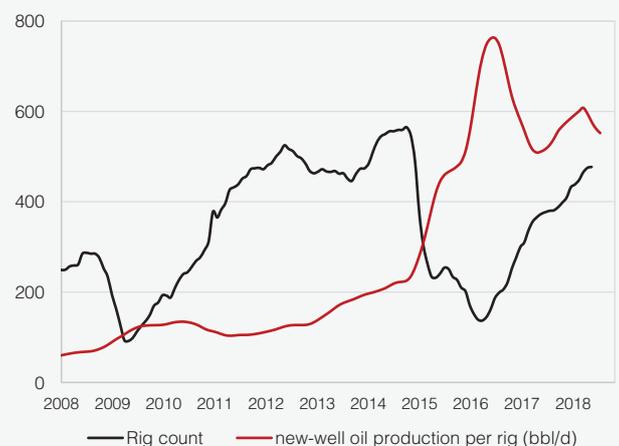
Source: CDP, Wood Mackenzie

Figure 37: Permian tight oil cost curve comparison: two water scenarios



Source: CDP, Wood Mackenzie

Figure 38: Permian new oil production and rig count



Source: CDP, EIA

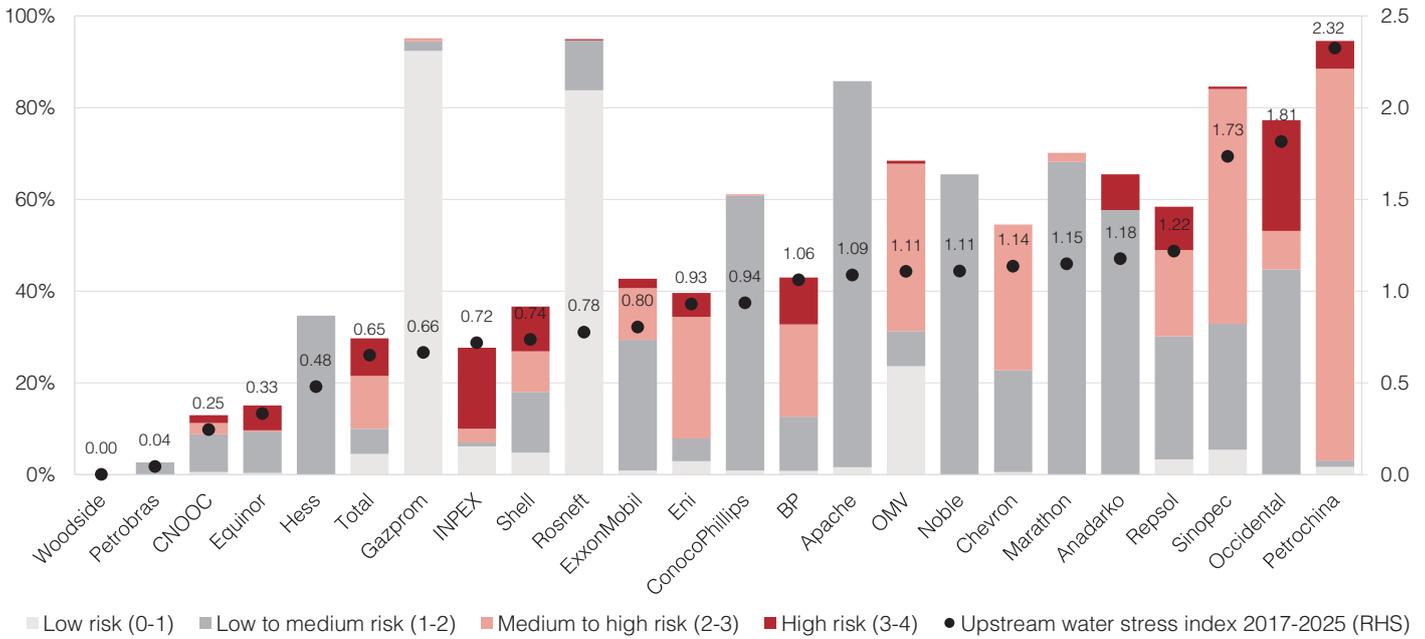
To deal with the increased volumes of produced water a new midstream market is emerging – coordinating a wide range of services including trucking, pipelines, disposal wells, storage ponds and recycling facilities. With drilling activity in the Permian Basin continuing to rise (see Figure 38), producers should look to reduce water costs and invest more in managing water-related risks.

25. Water cut is the ratio of produced water to the volume of total liquids produced (produced water / [oil + produced water]).

Highlights

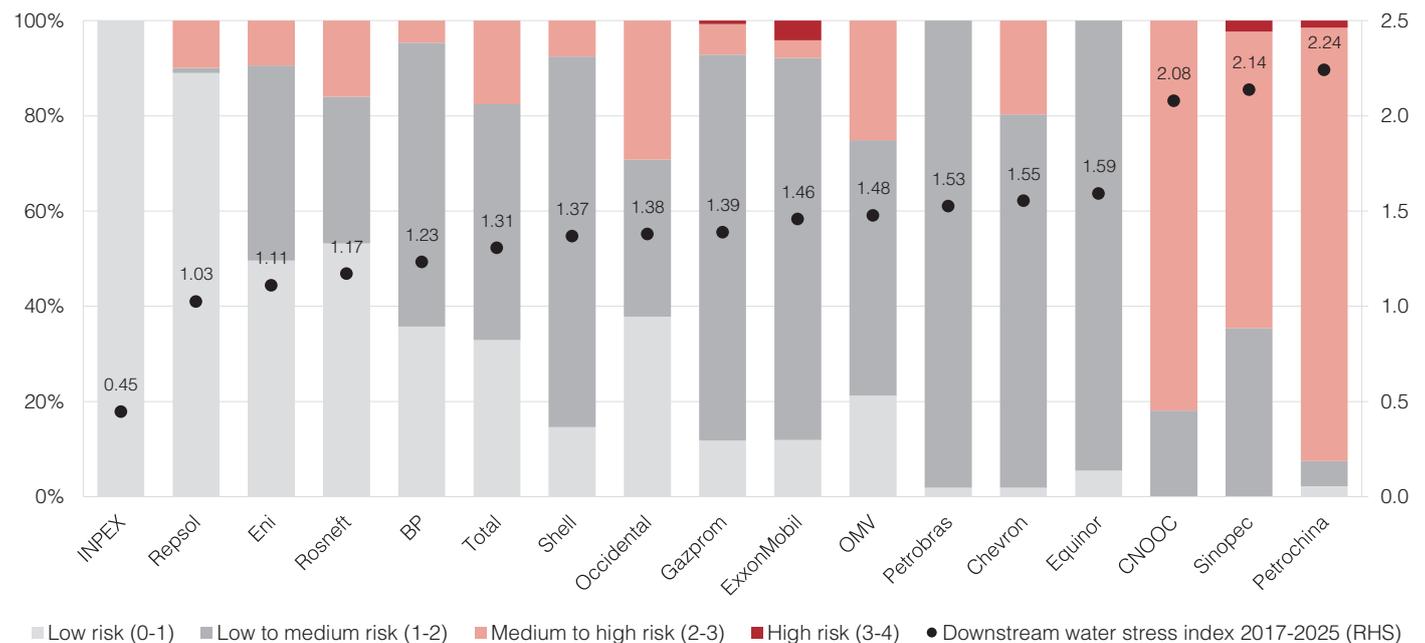
- Woodside Petroleum and Petrobras rank first and second respectively. Both companies have low exposure to water stress as portfolios are primarily located offshore. Fresh water related issues are not as prominent, as desalinated seawater is used in operations.
- For the 24 companies more than 34% of upstream onshore production and more than 30% of refining capacity is currently located in areas of medium or high water stress.
- Sinopec and Petrochina rank in the bottom two. Disclosure of data is poor and evidence of water governance and policy is lacking. Both companies' upstream and downstream assets are primarily located in China and have relatively high exposure to water stressed regions (see Figures 39 and 40).

Figure 39: Upstream water stress exposure (2017-2025)



Source: CDP, WRI, GlobalData

Figure 40: Downstream water stress exposure (2017-2025)

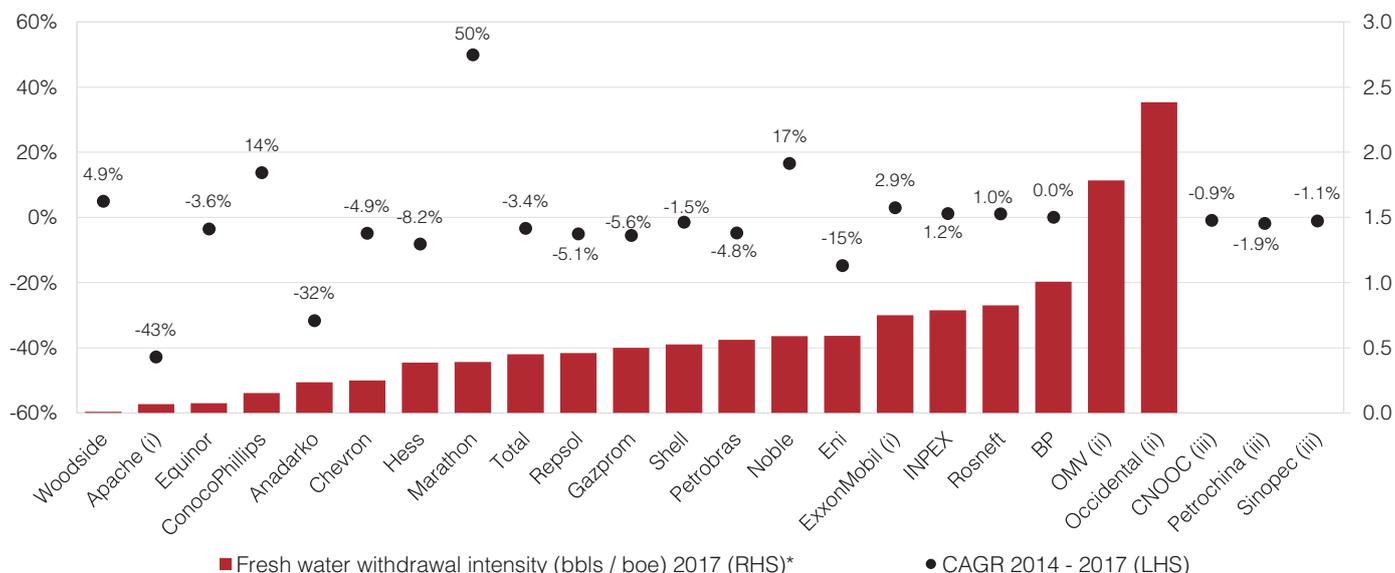


Source: CDP, WRI, GlobalData

Across the 22 companies where data is available, fresh water withdrawal intensities have been reduced at an average rate of 1.8% p.a. since 2014. Over this period 14 of the companies have reduced their withdrawal intensity (see Figure 41).

Only eight companies responded to CDP's 2018 water questionnaire (see Figure 42). The majority of companies are carrying out water stress risk assessment utilising tools such as the WBCSD Global Water Tool developed by IPIECA, the WRI Aqueduct tool or internal water stress monitoring frameworks. Only one company (ConocoPhillips) report a water target outside of the CDP questionnaire.

Figure 41: Fresh water withdrawal intensity



* To calculate an intensity fresh water withdrawal is normalised by upstream production + downstream throughput where applicable.

(i) 2016 intensity values and CAGR 2014-2016 for Apache and ExxonMobil.

(ii) No trend data available for Occidental or OMV.

(iii) CAGR is for fresh water consumption intensity for CNOOC and Petrochina and total water withdrawal intensity for Sinopec. The three companies do not report values for fresh water withdrawal.

Source: CDP, Company reports

Figure 42: Water governance & policy scorecard

Company	CDP 2017 Score ⁽ⁱ⁾	Responded to CDP water questionnaire (2018)	Water risk assessment / management	Water stress assessment	Water reduction target	Water accounting	Rank
OMV	A-	Submitted	Yes	Yes	Yes	Yes	1
Total	A-	Submitted	Yes	Yes	Yes	Yes	2
Gazprom	B	Submitted	Yes	Yes	Yes	Yes	3
Petrobras	B	Submitted	Yes	Yes	Yes	Yes	4
Anadarko	B	Submitted	Yes	Yes	Yes	Yes	5
Occidental	C	Submitted	Yes	Yes	Yes	Yes	6
Eni	Not scored	Submitted	Yes	Yes	Yes	Yes	7
Rosneft	Not scored	Submitted	Yes	Yes	Yes	Yes	7
ConocoPhillips	F	Declined to respond	Yes	Yes	Yes	Yes	9
BP	F	No response	Yes	Yes	Not explicit	Yes	10
Repsol	F	No response	Yes	Yes	Not explicit	Yes	10
Woodside	F	No response	Yes	Yes	Not explicit	Yes	10
Apache	F	No response	Yes	Yes	No	Yes	13
Chevron	F	Declined to respond	Yes	Yes	No	Yes	13
CNOOC	F	No response	Yes	Not explicit	Not explicit	Yes	13
ExxonMobil	F	Declined to respond	Yes	Yes	No	Yes	13
INPEX	F	No response	Yes	Yes	No	Yes	13
Marathon Oil	F	No response	Yes	Yes	No	Yes	13
Shell	F	No response	Yes	Yes	No	Yes	13
Equinor	F	Declined to respond	Yes	Yes	No	Yes	13
Hess	F	No response	Yes	Not explicit	No	Yes	21
Noble Energy	F	Declined to respond	Yes	No	No	Yes	22
Petrochina	F	No response	Yes	No	No	Yes	22
Sinopec	F	No response	Yes	No	No	Yes	22

(i) Companies who are requested to disclose water data and fail to do so receive an F. An F does not indicate failure in environmental stewardship.

Source: CDP, company reports

Transition opportunities

- Shell, Equinor and Total rank first, second and third respectively. All three are investing in low-carbon assets and have allocated proportions of future CAPEX to clean energy technologies.
- Rosneft ranks last. There is little evidence of investment in new energy technologies and it ranks last for capital flexibility & resilience.
- Since 2010 the 24 companies have invested US\$22 billion in alternative energies. However, spend on low-carbon assets for the sector as a whole remains low, expected to account for only 1.3% of total 2018 CAPEX.

Overview

The energy transition is forcing the oil & gas industry to rethink its future. Pressure from consumers, investors and regulation is driving some companies to diversify into clean energy assets, re-branding as 'energy' companies, as illustrated by Statoil's recent name change to Equinor.

Others are embracing digitalisation and innovative technologies to improve efficiency and drive productivity gains, as well as looking to capitalise on the falling costs of renewables, for example using on-site solar instead of fuel gas.

During the recent commodity down cycle focus has been on cutting costs, paying down debt, reducing break-evens and improving capital flexibility. The industry has emerged leaner and more disciplined, and with higher free cash flow companies are now well positioned to take advantage of the opportunities that exist in a low-carbon energy transition.

In this chapter we assess the extent to which companies are capturing these transition opportunities across the following areas:

Capital flexibility & resilience (60%): We analyse levels of capital flexibility; looking across exploration and production costs, reserve life, discretionary future spend, cash margins, financial gearing, and diversification.

Low-carbon assets and innovation (40%): We examine which companies are investing in low-carbon assets (including CCUS) and embracing innovative technologies. We differentiate between leaders and laggards by assessing current and future capacity, historical and planned investment, patents filed, R&D expenditure, and partnerships relating to digitalisation.

Figure 43: Transition opportunities summary

Company	Capital flexibility & resilience	Low-carbon assets & innovation	Overall weighted rank	Transition opportunities rank
Shell	4	2	7.6	1
Equinor	7	1	7.9	2
Total	9	3	8.6	3
Chevron	2	7	9.1	4
Repsol	10	5	9.7	5
BP	19	4	10.2	6
Eni	12	6	10.7	7
CNOOC	3	13	11.4	8
ExxonMobil	15	8	11.7	9
Sinopec	14	9	11.7	10
Occidental	6	16	12.5	11
INPEX	17	12	12.6	12
Marathon Oil	8	17	12.7	13
ConocoPhillips	13	14	12.8	14
Anadarko	1	24	13.1	15
Hess	5	20	13.5	16
Petrobras	22	10	13.7	17
Woodside	11	19	13.9	18
Petrochina	23	11	14.2	19
OMV	20	18	14.7	20
Gazprom	21	15	15.1	21
Apache	16	21	15.1	22
Noble Energy	18	23	15.7	23
Rosneft	24	22	17.8	24

Weighting **60%** **40%**

Note: In calculating the weighted rank in this table, we use the weighted ranks for each area. We display non-weighted ranks in this summary for simplicity only.

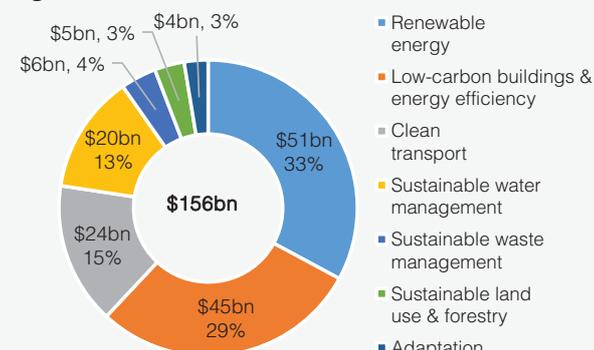
Source: CDP

Oil & gas green bonds: reality or myth?

Green bonds (GBs) are a small but growing niche of the bond market. According to the Climate Bonds Initiative (CBI) ~US\$ 420bn is currently outstanding.

Last year saw global issuance of ~US\$ 160bn with forecasts for 2018 at around US\$ 200-250bn. GBs were created to fund projects that yield positive environmental and/or climate benefits, having their proceeds applied exclusively to specific “green” projects. To be labelled as “green” a bond has to meet minimum transparency and disclosure criteria set by the Green Bond Principles (use of proceeds, process for evaluation and selection of projects, management of proceeds, reporting).

Figure 44: Green Bonds 2017



Source: CDP, Climate Bonds Initiative

Figure 45: Global issuance of Green Bond



Source: CDP, Climate Bonds Initiative

GBs are often seen as a turning point in financing the transition to a low-carbon economy as they broaden the pool of potential investors compared to traditional asset finance and in many cases allow the issuer to access capital at a lower cost. A critical element which is currently lacking, is a universal definition for what constitutes a “green project” that would enable transparency and disclosure while ensuring market integrity. Further progress is still required in this area, and currently the Green Bond Principles take a pragmatic approach, encouraging transparency and letting investors and supporting advisers decide on the issue.

For fossil-fuel and high emitting industries this can represent a particularly thorny issue, as illustrated by the controversy that emerged around the first green bond from a major oil & gas company, the Repsol 2017 Green Bond. The company issued a EUR 500m bond, with the proceeds allocated primarily to the financing and re-financing of energy efficiency projects in the company’s chemical and refinery facilities in Spain and Portugal. Additionally, Repsol will seek (by 2022) additional projects corresponding to “low emission technologies”. Through this bond, Repsol aims to avoid 1.2 million tonnes of CO₂, representing 6.5% of the company’s 2017 direct emissions.

Despite meeting the Green Bond Principles and including an external review, the bond was not included in the CBI listing and was left out of the main green bond indexes. The reasons behind the rejection are related to the “incremental” nature of the improvements targeted by the bond, which are seen as not sufficient to help deliver a sub-2-degree pathway. In similarity to “clean coal” projects (which are excluded from Climate Bond data), investments aimed at making refineries more efficient will likely extend the plants operating lifetime and therefore indirectly increase emissions over time. Given the steep reduction required by the industry to get on a 2-degree trajectory, CBI argues that only investing in clean energy, electrical infrastructure and alternative fuels would deliver the step-change required to earn the “green” label.

In the past there have been green bonds issued by fossil fuel companies, such as the ones issued by Southern Company, a utility heavily reliant on coal. However, Southern’s bonds were primarily aimed at financing renewable power.

These examples set a challenge for oil & gas companies in their balancing act between achieving operational efficiency, re-weighting portfolios towards gas and opening their business models to clean energy sources and infrastructure.

Capital flexibility & resilience

Free cash flow for the oil & gas sector in Q3 2018 was at its highest level since 2012 and some of the largest companies have increased share buybacks and raised dividends. With improved efficiency, lower costs and higher prices, projects that were put on hold are now being sanctioned (see box on page 34).

However, against the backdrop of increasing climate regulation and ever closer peak oil demand forecasts, a focus on value delivery over production growth needs to remain. Companies should target projects which are well positioned on the cost curve and provide competitive break-evens and there is evidence that companies are shifting focus to multi-staged developments and shorter-cycle opportunities to maintain capital flexibility.

Figure 46 illustrates typical project cycle times and relative capital flexibility for different types of oil & gas project. Short-cycle projects such as North American shale have far shorter payback periods and provide discretionary spend optionality. In contrast deepwater and greenfield oil sands projects require large up-front investment and there is a longer period from sanction to first production.

Figure 47 below shows forecast cumulative production split by typical project cycle times for the 24 companies. It is evident that the US E&P companies have a much higher exposure to the more flexible, shorter-cycle projects.

Figure 46: Illustrative capital flexibility and project cycle times

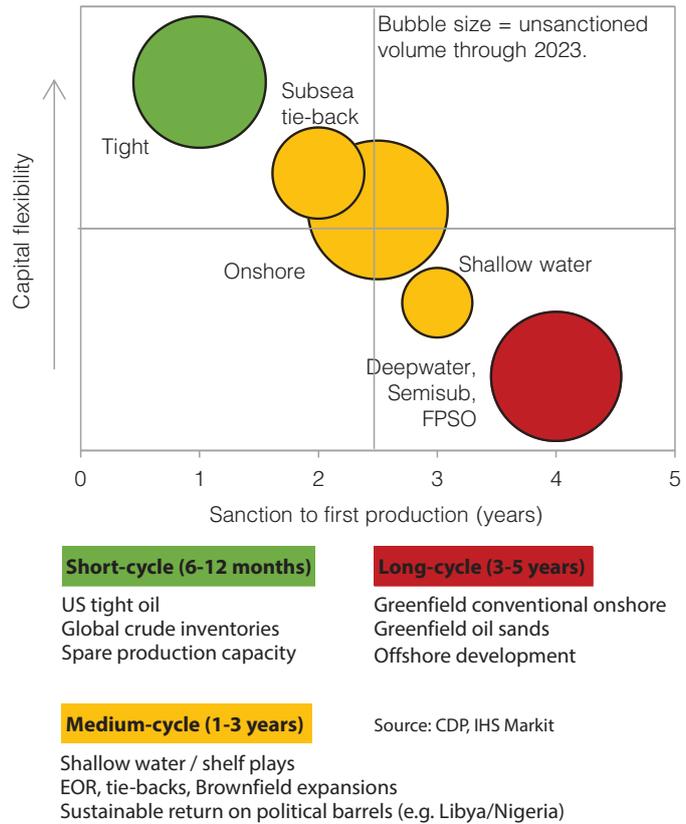
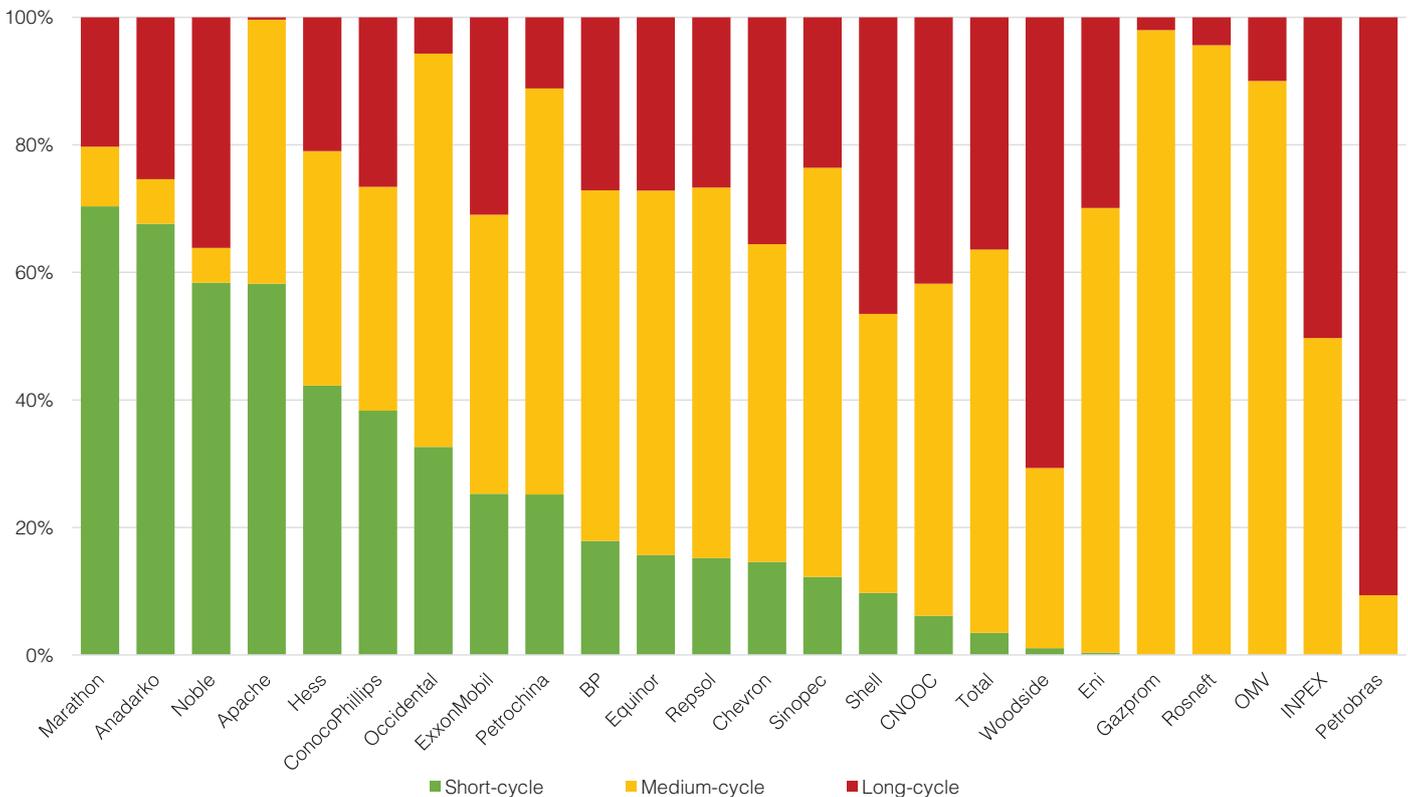


Figure 47: Cumulative production 2016-2025 by project cycle times



Source: CDP, Wood Mackenzie, Rystad Energy, GlobalData

In this section we assess companies' capital flexibility and resilience using seven key metrics:

Metric 1) Post-CAPEX cash margin (20%): This metric from Wood Mackenzie shows the relative level of upstream cash flow generation per unit of production over the period 2018-2030. It captures the resilience of a company's upstream portfolio to lower hydrocarbon prices.

Metric 2) Discretionary CAPEX (20%): We assess the proportion of company CAPEX which is discretionary relative to total planned spend for the period 2018 – 2022. Discretionary CAPEX is considered to be uncommitted and is the proportion associated with projects that are not yet sanctioned (pre-FID), as well as to-be-drilled North American unconventional assets.

Metric 3) Reserve life (R/P) and development status (15%): We use this metric as an indication of future capital expenditure optionality, and the extent to which a company has the freedom to divert capital into other ventures. We weight our scoring in favour of a lower proved reserve life. However, recognising that a higher R/P can also be reflective of historical capital invested we have also ranked this metric in favour of companies with a higher percentage of developed proved reserves relative to those that are undeveloped.

Metric 4) Financial Gearing (10%): We rank companies on their levels of financial gearing for Q2 2018. With lower levels of gearing companies have greater financial flexibility to withstand commodity price fluctuations. It is also an indicator of balance sheet management and company optionality to shape future investment decisions.

Metric 5) Diversification (10%): Companies are ranked based on their diversification across the oil & gas value chain and power sector. Downstream assets and other business segments provide a natural hedge against oil price volatility and help to protect the financial health of integrated companies.

Metric 6) Production costs and CAPEX intensity (15%): Companies operating with a lower cost base are better placed in a lower oil price and climate-conscious environment. We examine company costs per barrel of oil equivalent across the areas of exploration, development and production and assess the extent companies have been able to reduce these costs over the period 2014-2017. Costs are normalized by production to give a US\$/boe figure.

Metric 7) Finding and development costs (10%): We examine the cost to companies of oil and gas reserves added by exploration and development activities over the period 2013 - 2017. Costs are normalized by organic reserve additions to give a US\$/boe figure.

Figure 48: Capital flexibility and resilience summary

Company	Post-CAPEX cash margin	Discretionary CAPEX	Reserve life & development	Financial gearing	Diversification	Production costs and CAPEX intensity	Finding and development costs	Overall weighted rank	Capital flexibility & resilience rank
Anadarko	5	2	2	24	17	19	10	8.7	1
Chevron	2	11	14	8	1	15	13	9.2	2
CNOOC	3	14	11	2	15	16	11	9.9	3
Shell	6	15	6	14	1	11	17	10.0	4
Hess	4	4	7	15	19	23	16	10.4	5
Occidental	8	6	8	19	15	21	7	10.6	6
Equinor	14	13	5	13	11	2	9	10.7	7
Marathon Oil	12	1	17	16	19	10	6	10.8	8
Total	10	16	19	9	1	1	12	11.0	9
Repsol	20	10	9	11	1	5	4	11.3	10
Woodside	1	9	15	5	19	13	24	11.9	11
Eni	16	12	12	7	11	14	5	11.9	12
ConocoPhillips	9	7	10	17	19	8	18	12.2	13
Sinopec	n/a ⁽ⁱ⁾	20	1	1	1	22	23	12.4	14
ExxonMobil	15	8	20	6	1	7	20	12.5	15
Apache	13	5	3	22	19	17	19	12.7	16
INPEX	7	22	22	3	17	9	8	13.0	17
Noble Energy	19	3	18	20	19	20	3	13.2	18
BP	17	18	16	18	1	12	14	13.3	19
OMV	21	17	4	12	1	6	21	13.3	20
Gazprom	23	23	24	4	11	3	1	15.5	21
Petrobras	11	19	13	23	1	18	22	15.6	22
Petrochina	18	21	21	10	1	24	15	15.7	23
Rosneft	22	24	23	21	11	4	2	17.1	24
Weighting	20%	20%	15%	10%	10%	15%	10%		

(i) No data available for post-CAPEX cash margin for Sinopec. The company has been neutralised for this metric.

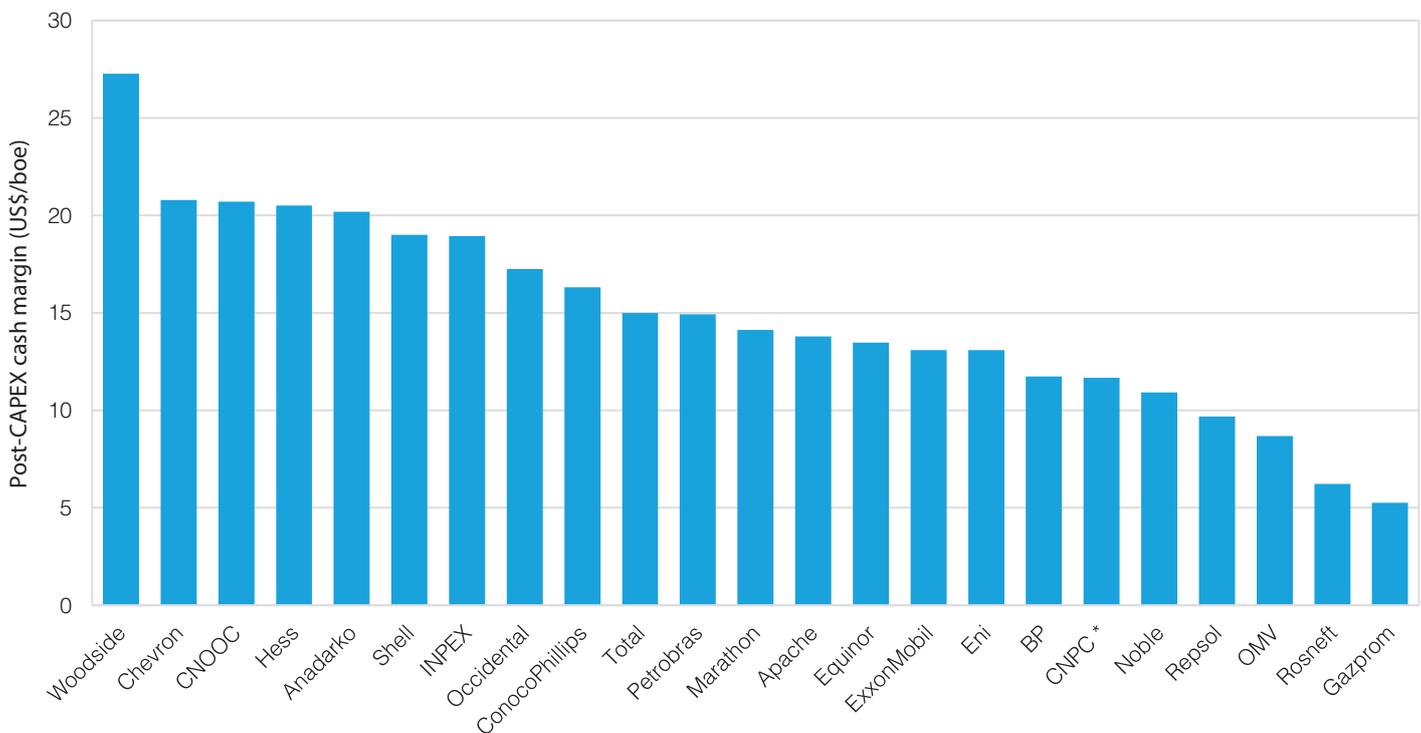
Note: In calculating the weighted rank in this table, we use the weighted ranks for each area. We display non-weighted ranks in this summary for simplicity only.

Source: CDP

Highlights

- ▼ Anadarko, Chevron and CNOOC rank first, second and third respectively. All three are forecast to have strong post-CAPEX cash margins. Anadarko has a very high proportion of CAPEX that is discretionary and CNOOC has the second lowest level of gearing.
- ▼ National oil companies (NOCs) Gazprom, Petrobras, Petrochina and Rosneft make up the bottom four. This illustrates how large NOCs are often less nimble and have less optionality in their future capital expenditure and allocation of cash flows.
- ▼ The average post-CAPEX cash margin over the period 2018-2030 is US\$15/boe. However, Figure 49 shows that there is a wide range: Wood Mackenzie forecast Woodside Petroleum to generate over 5 times the upstream cash flow per unit of production compared to Gazprom. Companies should focus on controlling costs and improving margins to ensure future resilience to lower hydrocarbon prices.
- ▼ Company proved reserve lives (R/P) vary from over 40 years for Gazprom to less than 10 years for eight companies (see Figure 50). Anadarko, Apache and Sinopec all have low reserve lives and a high proportion of developed reserves (reserves that are expected to be recovered through existing infrastructure).²⁶
- ▼ Figure 51 illustrates the proportion of company CAPEX which is discretionary over the period 2018 – 2022. The top eight companies are all from the US mainly due to their high exposure to more flexible, short-cycle shale assets (see Figure 46 on page 28). Many NOCs are seen to have very low levels of discretionary spend.
- ▼ Levels of financial gearing range from cash positive Sinopec and CNOOC to heavily indebted Anadarko with gearing over 50% (as at Q2 2018).

Figure 49: Post-CAPEX cash margin (post-FID upstream assets)⁽ⁱ⁾



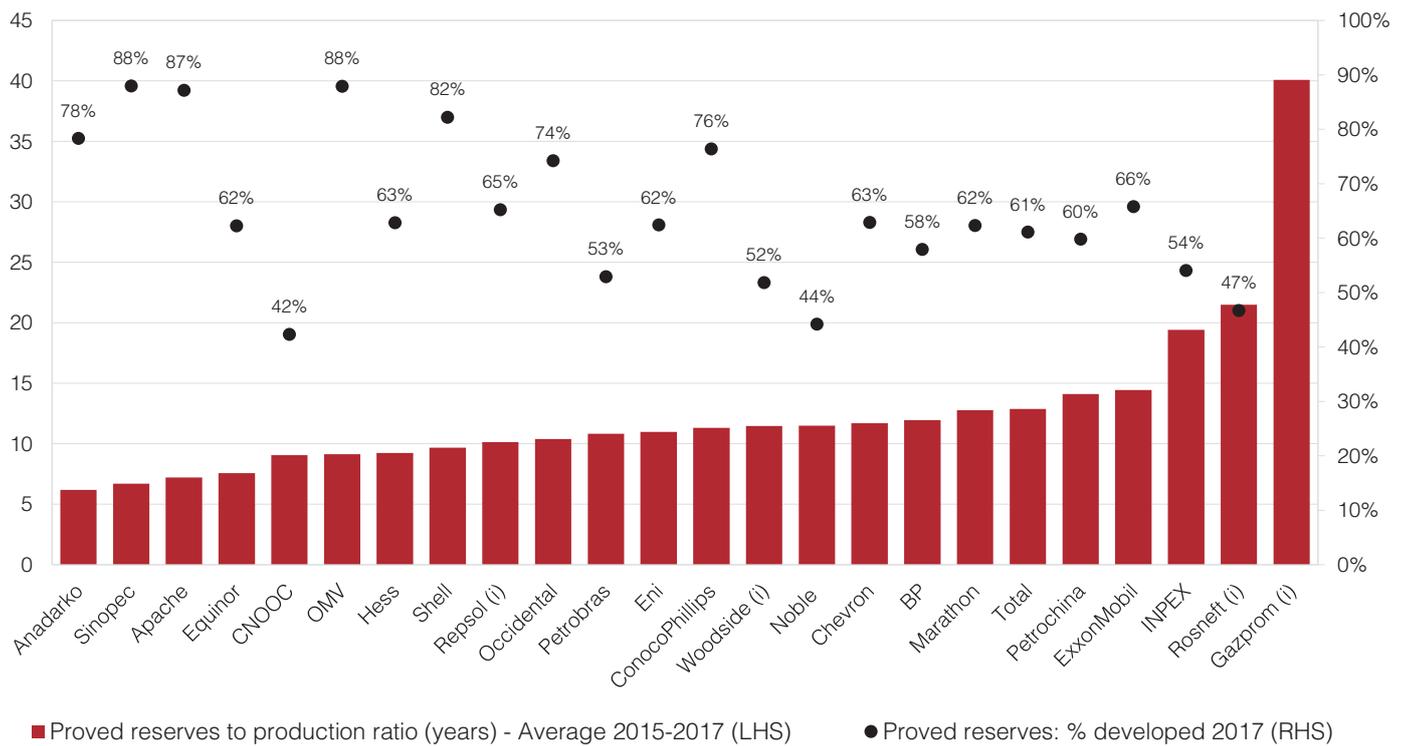
* Petrochina is the listed arm of state-owned China National Petroleum Corporation (CNPC).

(i) Wood Mackenzie's post-capex annual cash flow forecast (real terms), aggregated for the period 2018-2030, divided by entitlement production forecast over the same period. Cash flows are based on Wood Mackenzie's base case long-term Brent price assumptions. Post-FID assets only (onstream or under development). Data represents Wood Mackenzie's understanding of company portfolios as of 1H2017 and will not reflect changes to portfolio composition or the impact of commodity price increases since that time. Note: BP analysis includes its stake in Rosneft and no data available for Sinopec.

Source: Wood Mackenzie

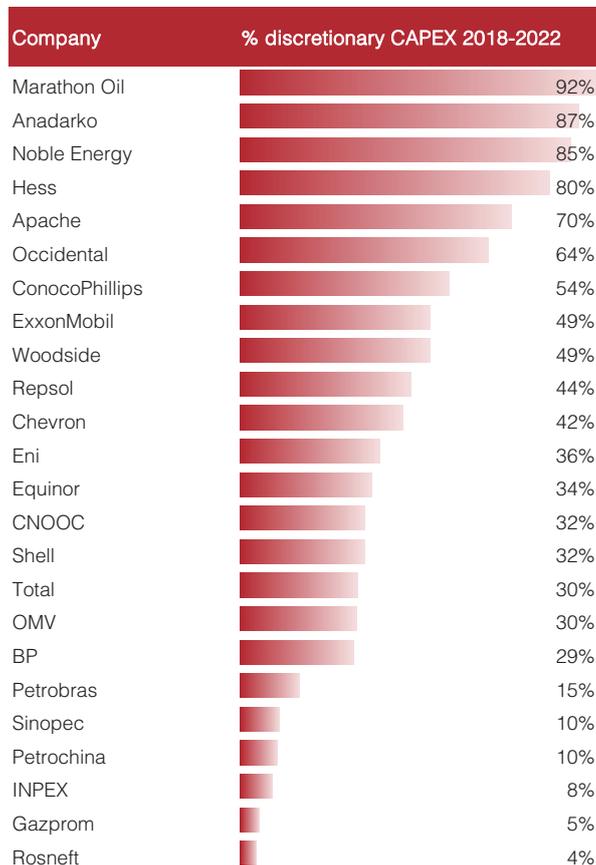
26. For an explanation of resource classification in the oil & gas sector see box "Resources vs. Reserves" on page 52.

Figure 50: Reserve life (R/P) and development status



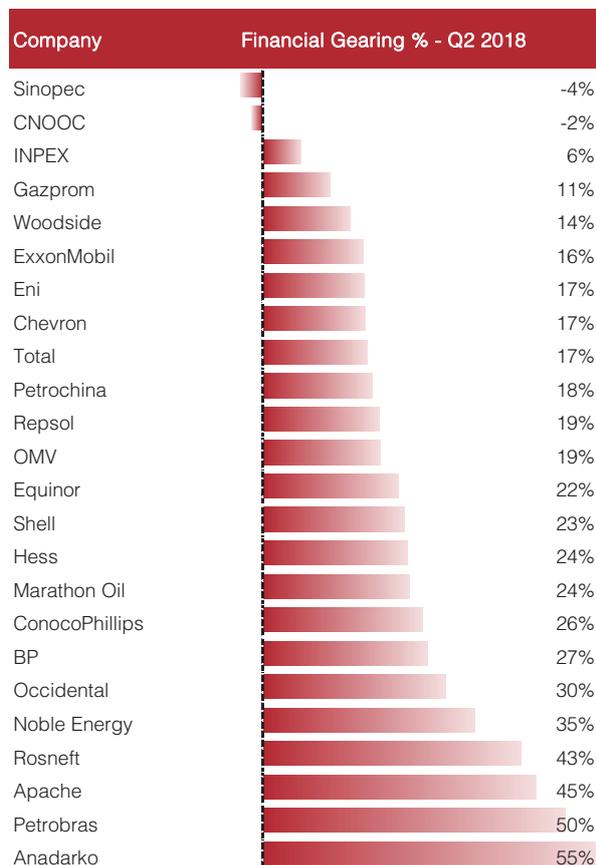
(i) Reserves reported using SPE-PRMS system for Gazprom, Repsol, Rosneft and Woodside (instead of SEC). Gazprom discloses using the Russian A+B1+C1 classification but also provides PRMS equivalent figures (see box on page 52 for further insight).
Source: CDP, company reports

Figure 51: Discretionary CAPEX



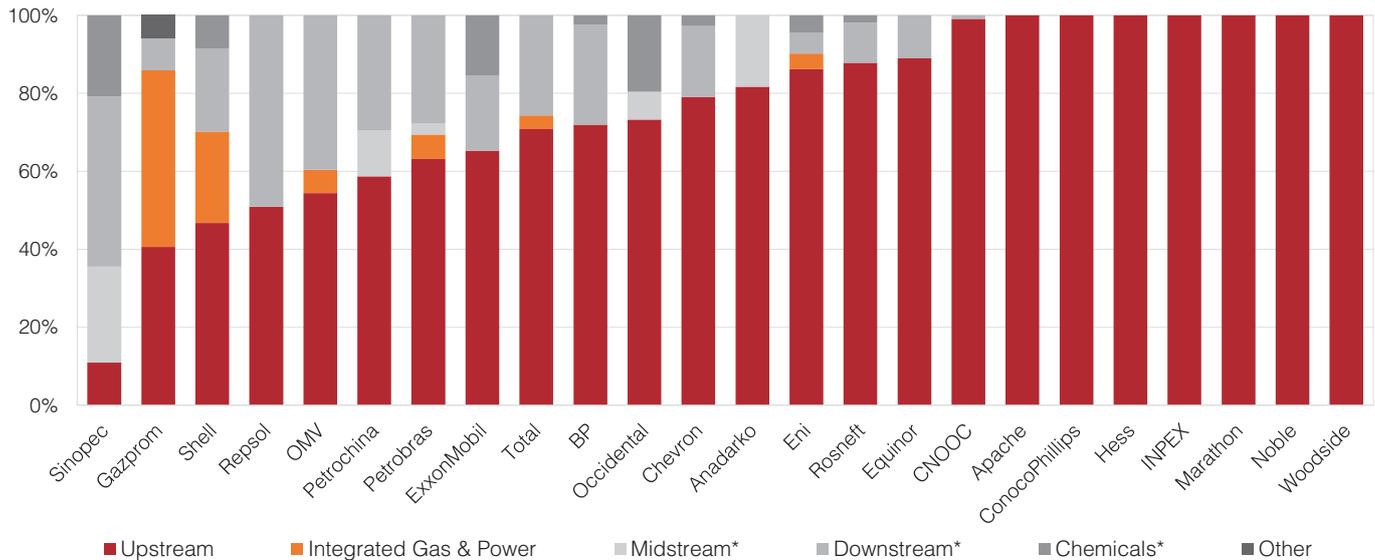
Source: CDP, company reports, Rystad Energy, GlobalData

Figure 52: Financial gearing



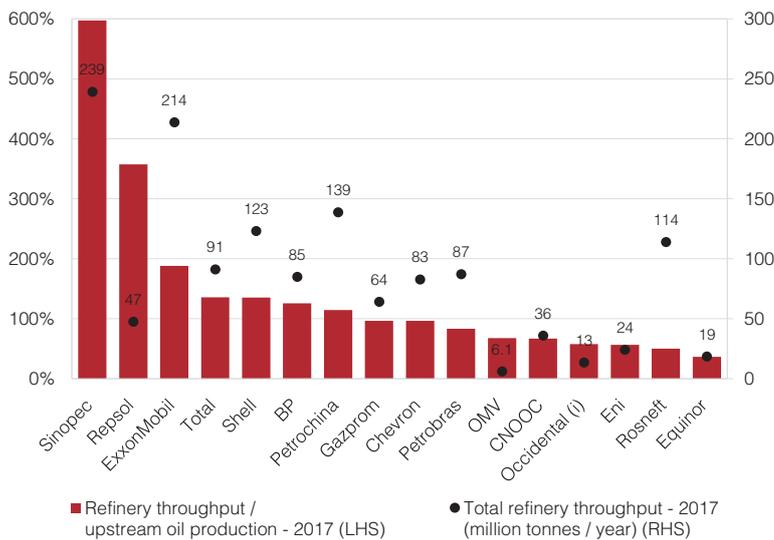
Source: CDP, company reports

Figure 53: 2017 Adjusted EBITDA split by business division



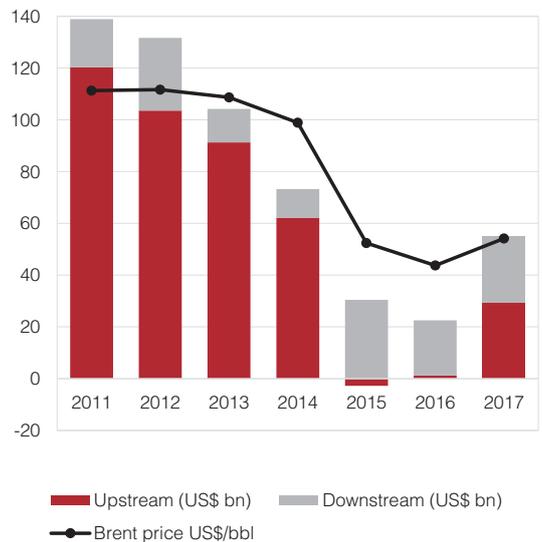
*Downstream includes Midstream and / or Chemicals if split is not available.
Source: CDP, company reports

Figure 54: Upstream vs. downstream balance



(i) Values shown for Occidental are for its chemical production.
Source: CDP, company reports, Bloomberg

Figure 55: Annual earnings by segment⁽ⁱ⁾



(i) Annual earnings data includes BP, ExxonMobil, Shell and Total
Source: CDP, IEA WEI 2018

Our company sample includes both integrated and E&P companies. This is highlighted in Figure 53 which shows the adjusted EBITDA for 2017 split across business divisions. Portfolios range from more downstream orientated companies such as Sinopec, which refines almost 6 times as much crude as it produces (see Figure 54), to pure-play E&P operators.

Having a level of diversification across the value chain provides a natural hedge against commodity price volatility. Figure 55 shows how refining profits increased sharply in response to lower oil prices. Many of the integrated companies are now investing more heavily in their downstream businesses with the expectation that demand for petrochemicals will increase over the long-term.²⁷

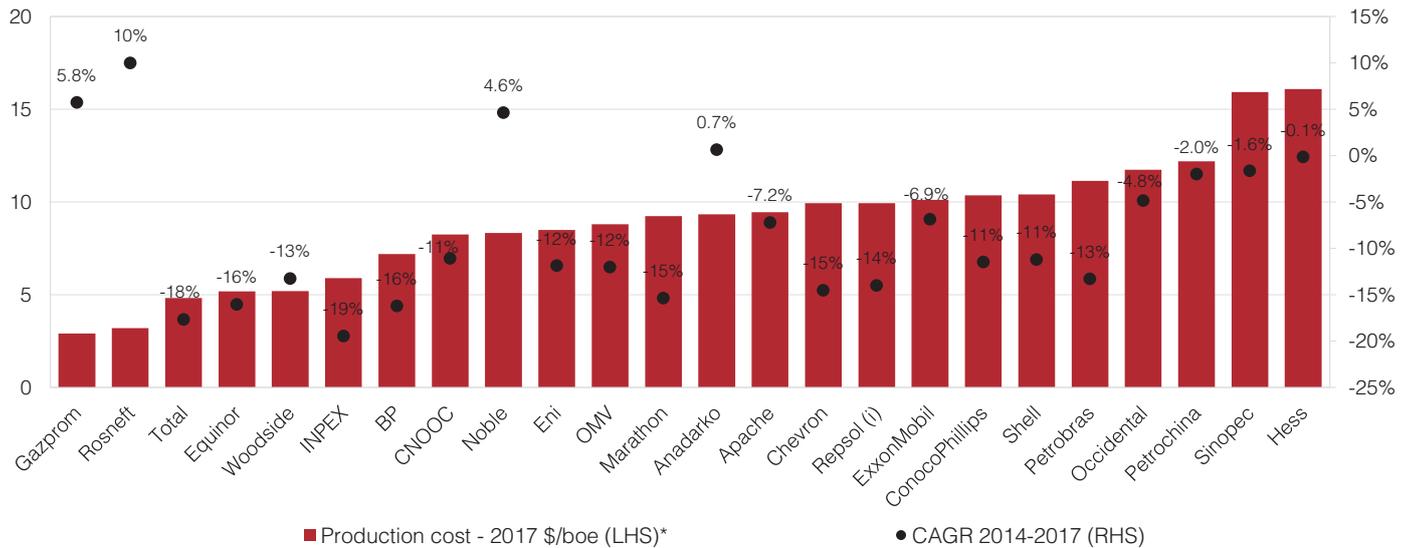
Figure 56 shows production costs of currently operating fields. Gazprom and Rosneft have the lowest operating costs of all the companies and INPEX, Total and BP have reduced costs the most since 2014. Hess and Sinopec have the highest operating costs.

Since 2014 all but two companies (Rosneft and Woodside) have cut their exploration and development spend on a per unit of production basis (see Figure 57). The group average is a reduction rate of 21% per year.

Figure 58 highlights which companies have been most efficient at finding and developing reserves over the last five years. With plentiful access to a large resource base it is not surprising that Russian companies Gazprom and Rosneft perform well on this metric. Petrobras, Sinopec and Woodside perform poorly.

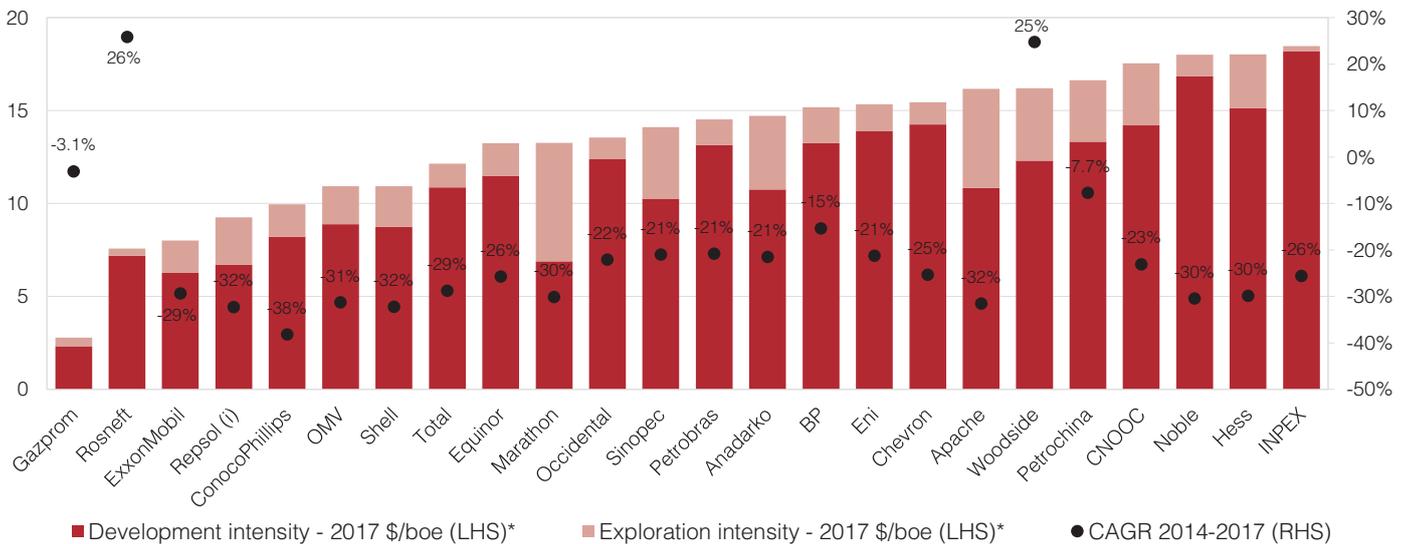
27. In the IEA SDS scenario petrochemicals is the only area of oil demand that is seen to grow out to 2040, adding 4.6 million barrels per day to current demand levels.

Figure 56: Production costs



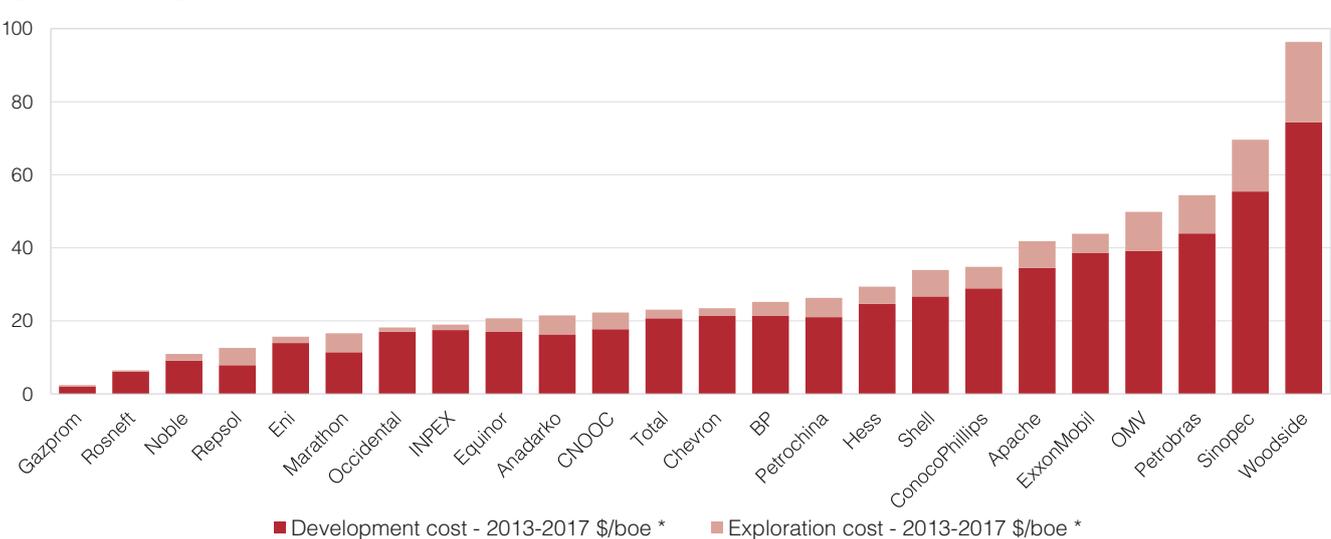
*Costs normalized by total production (boe)
 (i) CAGR 2015-2017 for Repsol due to acquisition of Talisman Energy
 Source: CDP, company reports

Figure 57: Exploration and development intensity



*Costs normalized by total production (boe)
 (i) CAGR 2015-2017 for Repsol due to acquisition of Talisman Energy
 Source: CDP, company reports

Figure 58: Finding and development costs

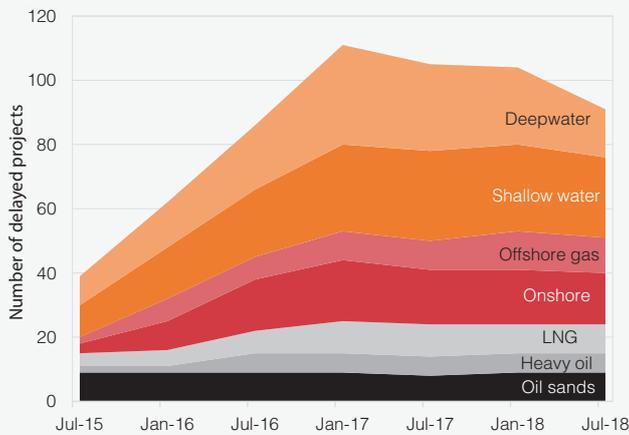


*Costs normalized by total organic reserve additions (boe)
 Source: CDP, company reports

The Final Investment Decision

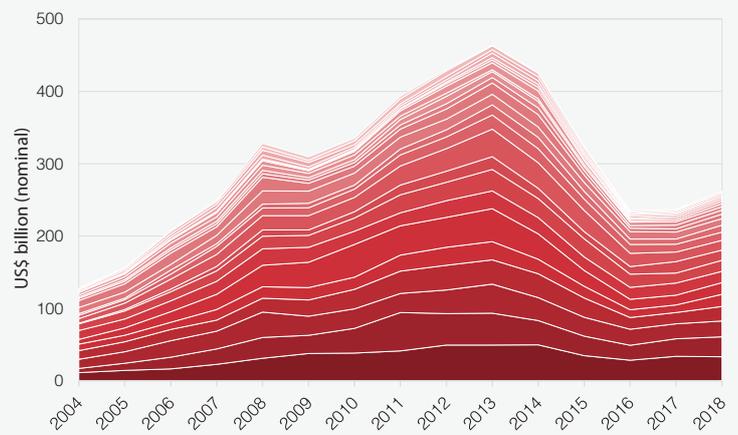
Upstream investment declined by over 40% between 2014 and 2016. Projects that were put on hold are now being sanctioned i.e. reaching Final Investment Decision (FID). The number of delayed upstream projects reached a peak of 111 at the beginning of 2017 (see Figure 59). However, in response to reduced costs and rising oil prices investment has since picked up modestly with total CAPEX for the 24 companies in this report expected to be around \$260 billion in 2018 (see Figure 60).

Figure 59: Delayed FID projects⁽ⁱ⁾



(i) Post-appraisal pre-sanction projects delayed since 2H-2014
Source: CDP, Rystad Energy

Figure 60: Trend in total CAPEX (24 company sample)⁽ⁱ⁾



(i) For the 24 companies in this report total CAPEX for 2014 was US\$426 billion compared to US\$ 235 billion in 2016.
Source: CDP, Bloomberg

Companies have driven down costs, re-worked marginal projects and shown a greater appetite for smaller and multi-staged developments, discovered resource opportunities and brownfield expansion projects.

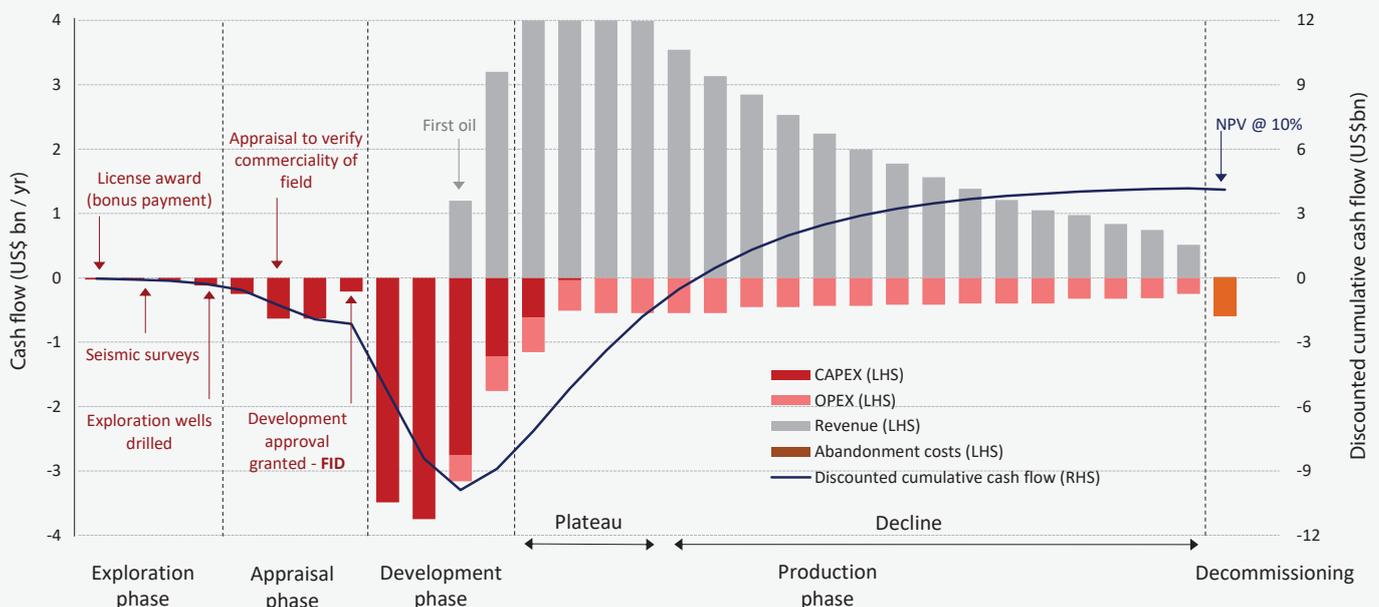
With the Brent price having recovered from its 2016 low but remaining volatile, companies need to remember the lessons learned from previous cycles and focus on delivering value in their long-term strategy. A strong focus by both companies and investors should be on which projects reach FID.

Figure 61 illustrates a typical cash flow profile for a large-scale oil project. The key point is that the costs of exploration and appraisal are relatively cheap in comparison to development costs. The FID triggers project execution and is the point at which significant capital investment becomes fully committed to a project.

Oil & gas companies will typically perform Net Present Value (NPV) analysis on their project inventories, running various sensitivities to variables such as discount rate²⁸, oil price, project delays, reserve volumes, field recovery factor, and even future carbon prices. Risk matrices plotting severity vs. likelihood are used to identify key development risks. Projects can then be ranked across various criteria to help decide which ones should move forward.

It is inherently difficult for companies to internalise the negative externalities of climate change. However, by considering future carbon price scenarios, and reduced demand or lower prices resulting from climate policy, companies can better assess whether specific projects will create value for shareholders under a transition to a low-carbon economy.

Figure 61: Project cash flow example



Source: CDP, Tullow Oil

28. The discount rate used has a significant effect on NPV calculations. For example in Figure 61, on a full cycle basis with a 10% discount rate, the project moves into profit 10 years after the FID date. However, at a discount rate of 15.6% (the Internal Rate of Return, IRR) NPV goes to zero.

Low carbon assets and innovation

The last few years have seen a wave of new energy investments by oil & gas companies. Since the start of 2016 a total of 148 deals have been made in alternative energy and CCUS by the 24 companies in this report, with disclosed investment totalling US\$7.5 bn (see Figure 62).²⁹

Companies have been spreading bets across various technologies, looking to capture the up-side potential of these rapidly growing energy markets.³⁰ Different strategies are evident, with some using asset finance to develop in-house capabilities, others using M&A to quickly establish a market presence, and some using venture capital to gain a foothold in innovative new businesses.

The oil & gas sector is also embracing innovation across the value chain, looking to deploy digital technologies to enhance productivity, efficiency and safety. It is estimated that end-to-end digitalisation could cut production costs by up to 20% (see box on page 41 for further discussion). Companies are forming commercial partnerships with Microsoft, Intel and others to help develop these capabilities.

In this section we assess the extent to which companies are capturing the opportunities available in low-carbon assets and innovation using five key metrics:

Metric 1) Alternative energy and CCUS (30%): We examine which companies currently hold renewable assets or have projects under development. We also assess involvement in biofuel production, advanced fluids & materials, hydrogen projects, e-mobility and CCUS.

Metric 2) Low-carbon spend (40%): We assess each companies' total expenditure since 2010 on low-carbon assets (including asset finance, M&A and venture capital). We also consider which companies' have committed to future low-carbon investment in their capital allocation strategies.

Metric 3) Patent analysis (15%): This metric analyses the number of high quality patent applications submitted by companies across the themes of renewables, CCUS, enhanced oil recovery (EOR), batteries / fuel cells, and digitalisation. We look at the number of patents filed between 2000 – Q3 2018, normalizing by employee numbers for each respective year and calculating a weighted sum of the total patent count. We determine the quality of the patents based on the number of citations received in scholarly publications.

Metric 4) Digitalisation strategy & partnerships (10%): For this metric we use a qualitative approach to determine the quality and completeness of companies' digitalisation strategies. We also credit companies for the number of commercial partnerships they have established to facilitate digitalisation within their business.

Metric 5) Research & development (R&D) (5%): We rank companies on their R&D expense to sales ratio over the period 2015-2017, also assessing which companies give a clear indication of research expenditure allocated to low-carbon technologies.

Figure 62: New energy deals (24 companies, 2016 - Q3 2018)

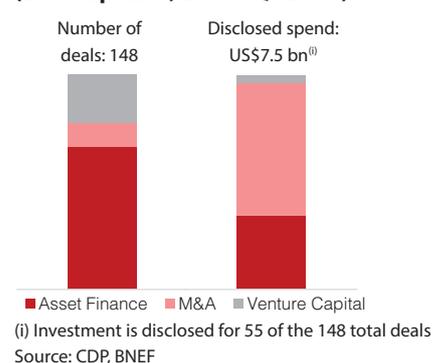


Figure 63: Low carbon assets and innovation summary

Company	Alternative Energy & CCUS	Low-carbon spend	Patent analysis	Digitalisation strategy & partnerships	R&D	Overall weighted rank	Low-carbon assets & innovation rank
Equinor	3	1	4	1	4	3.8	1
Shell	1	3	3	1	13	4.0	2
Total	2	2	10	6	1	5.0	3
BP	5	4	7	3	16	5.5	4
Repsol	4	5	12	3	11	7.3	5
Eni	8	6	9	6	8	8.8	6
Chevron	10	9	5	3	10	8.9	7
ExxonMobil	14	10	2	6	9	10.4	8
Sinopec	7	11	8	12	15	10.7	9
Petrobras	6	7	19	22	2	11.0	10
Petrochina	11	12	11	12	5	11.8	11
INPEX	9	7	21	17	17	11.9	12
CNOOC	13	16	6	17	3	13.6	13
ConocoPhillips	15	15	1	17	7	13.7	14
Gazprom	12	18	17	6	12	14.4	15
Occidental	16	14	15	17	18	15.3	16
Marathon Oil	21	13	13	12	18	15.5	17
OMV	19	17	22	12	14	16.9	18
Woodside	18	19	14	6	18	17.0	19
Hess	20	22	23	6	18	18.1	20
Apache	23	19	16	17	18	18.7	21
Rosneft	22	23	18	12	6	18.9	22
Noble Energy	17	23	20	24	18	19.5	23
Anadarko	24	21	23	22	18	19.6	24
Weighting	30%	40%	15%	10%	5%		

Note: In calculating the weighted rank in this table, we use the weighted ranks for each area. We display non-weighted ranks in this summary for simplicity only.
Source: CDP

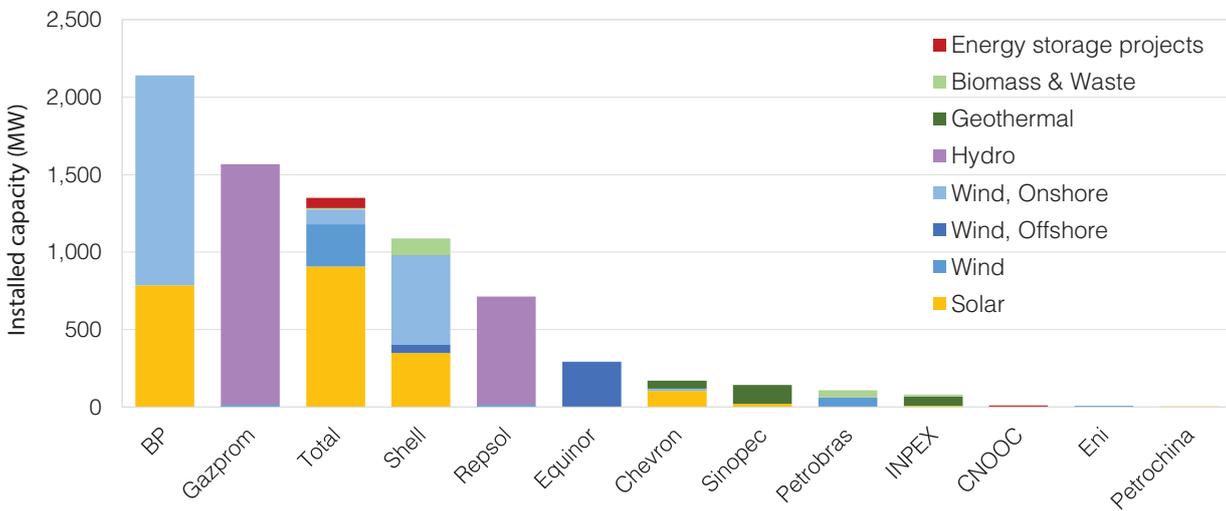
29. Since 2010, there have been a total of 514 deals, with 185 disclosed totalling US\$22 billion.

30. By 2050 BNEF forecast wind and solar to supply 48% of global electricity (up from 7% today).

Highlights

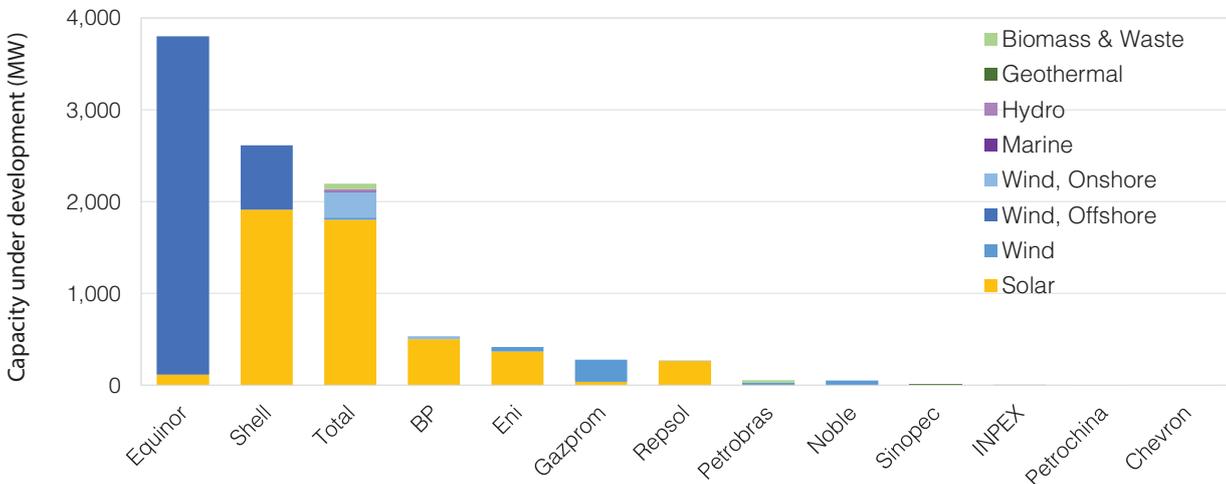
- European companies rank well across most metrics and occupy the top six places (see Figure 63). The five European Majors and Repsol collectively account for 84% of the disclosed US\$22 billion invested in alternative energies since 2010 by all 24 companies.
- BP currently has the largest alternative energy business of the companies (see Figure 64) but has less in the pipeline when compared to Equinor, Shell and Total (see Figure 65).³¹
- All three Chinese companies have a portfolio in biofuels (see Figure 66). Some industry focus has now shifted to e-mobility solutions with BP, Shell and OMV all making recent acquisitions. The number of electric vehicle charging points installed globally is accelerating (see Figure 67).
- Globally there are currently 17 CCUS facilities in operation with a total capacity to store or use 32 million tonnes of carbon dioxide per year.³² 16 of these facilities involve oil & gas companies. The ten companies shown in Figure 68 collectively account for 68% of this capacity.

Figure 64: Current alternative energy capacity (MW)



Source: CDP, company reports, BNEF

Figure 65: Alternative energy capacity under development (MW)

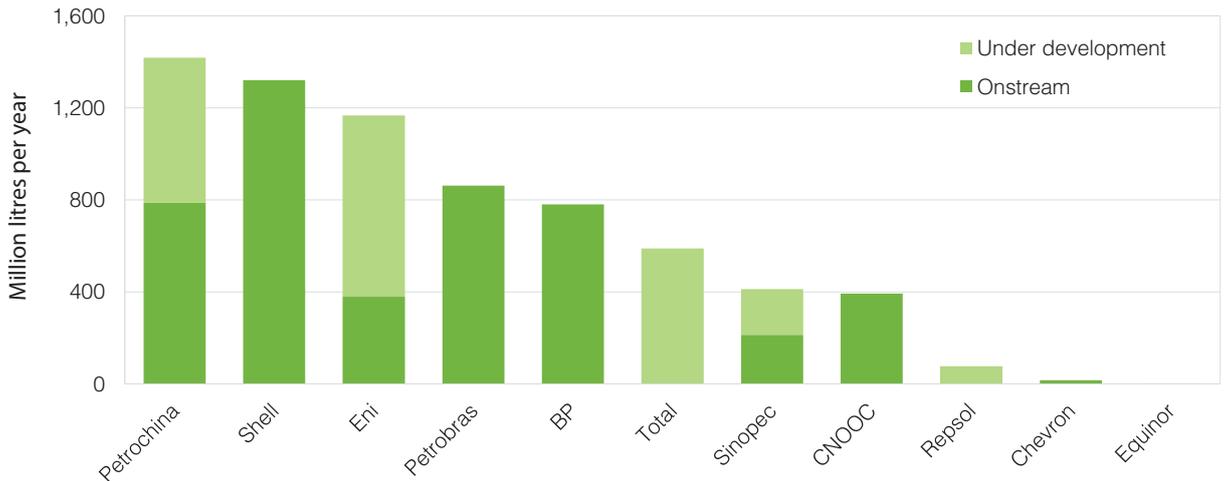


Source: CDP, company reports, BNEF

31. Note: Only companies with alternative energy assets are shown. Capacities are shown on an absolute basis, but companies have been ranked relative to their upstream oil & gas production.

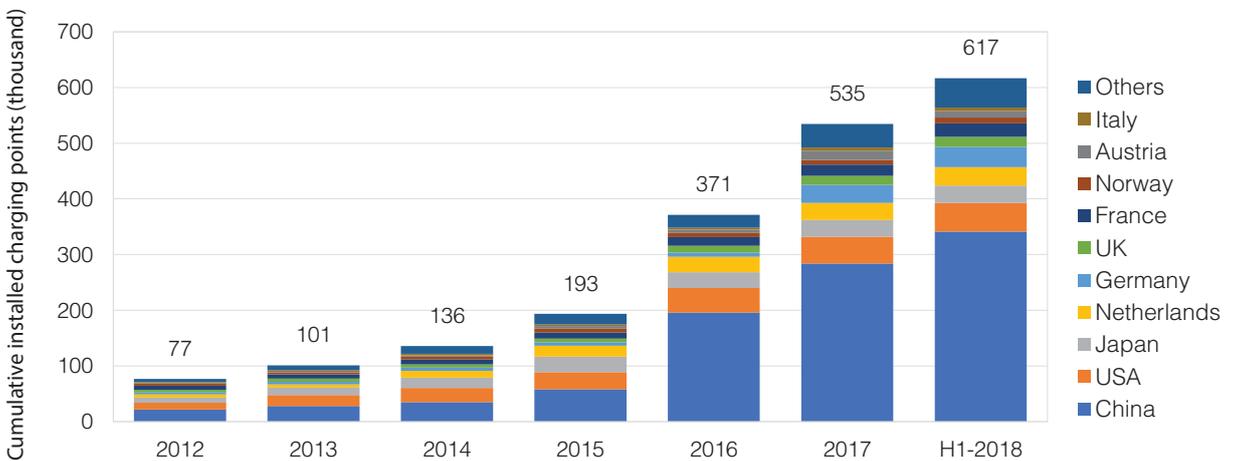
32. Source: Global CCS institute

Figure 66: Biofuel / biodiesel capacity⁽ⁱ⁾



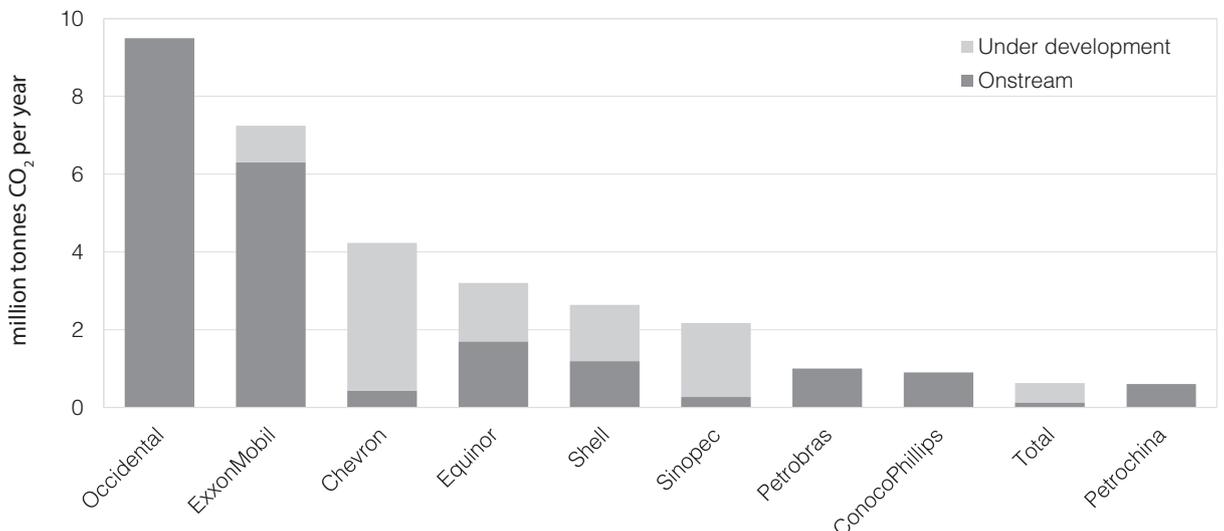
(i) We note that ExxonMobil funds various advanced biofuels programmes and Gazprom offers biomethane to its customers via its 'Eco Gas' scheme. Source: CDP, company reports, BNEF

Figure 67: Electric vehicle charging points installed globally⁽ⁱ⁾



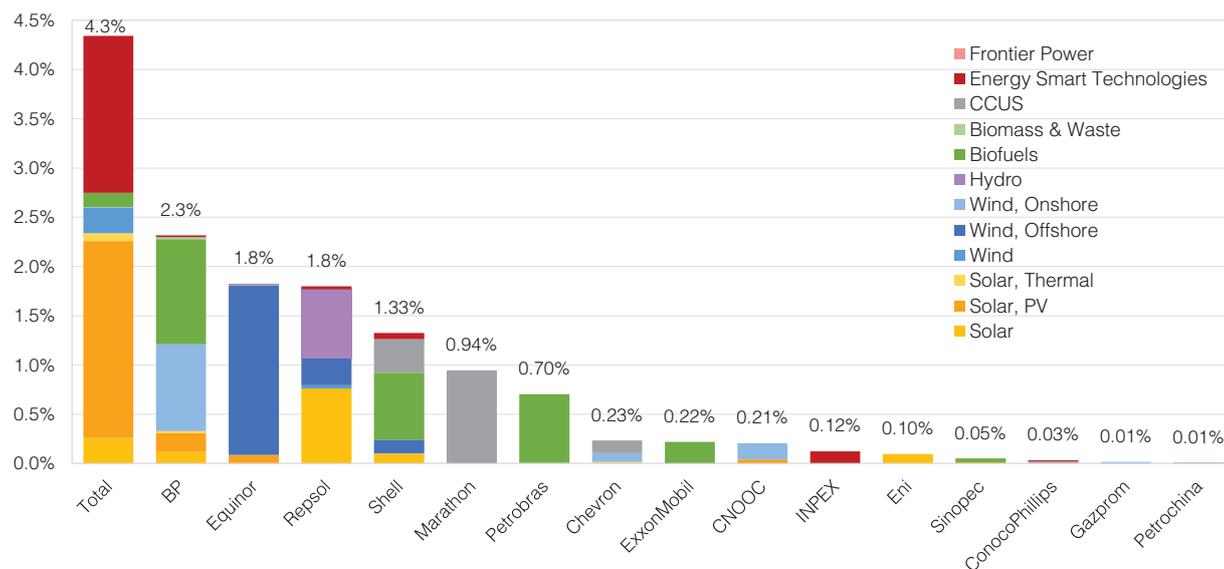
(i) Charging points for companies: Shell > 64,000 (acquired NewMotion), Total > 10,000 (acquired G2mobility), BP > 6,500 (acquired ChargeMaster), Repsol > 1,055 (50% ownership of IBIL), OMV > 435 (acquired share of SMATRICS). Eni - to install 180 (partnership with IONITY). Also unknown numbers for Petrobras, CNOOC, Petrochina and Sinopec. Equinor and Chevron invested in Chargepoint in April 2016 and November 2018 respectively. OMV, Shell and Total are also involved in hydrogen refuelling through the H2Mobility partnership. Source: CDP, company reports, BNEF

Figure 68: Carbon Capture Utilisation and Storage (CCUS)⁽ⁱ⁾



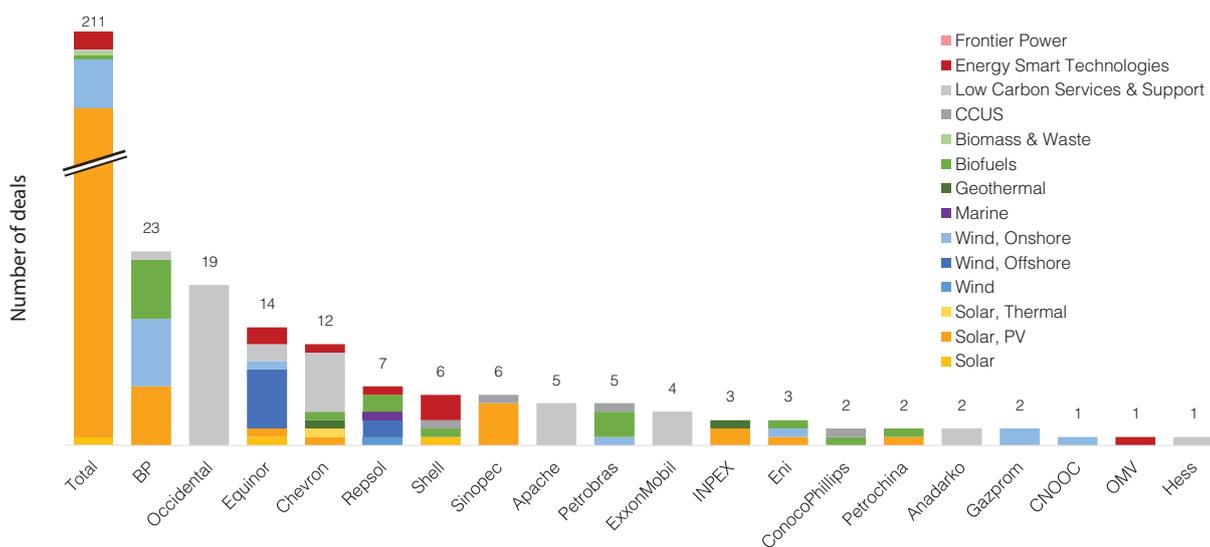
(i) Note: CCUS capacity is shown on an operated basis if applicable and then on an equity basis. We only consider EOR projects that use Anthropogenic CO₂. Source: CDP, company reports, Global CCS institute, MIT

Figure 69: Disclosed low-carbon investment as a proportion of total CAPEX (2010 - Q3 2018)⁽ⁱ⁾



(i) Includes Asset Finance, M&A and Venture Capital spend.
Source: CDP, company reports, BNEF

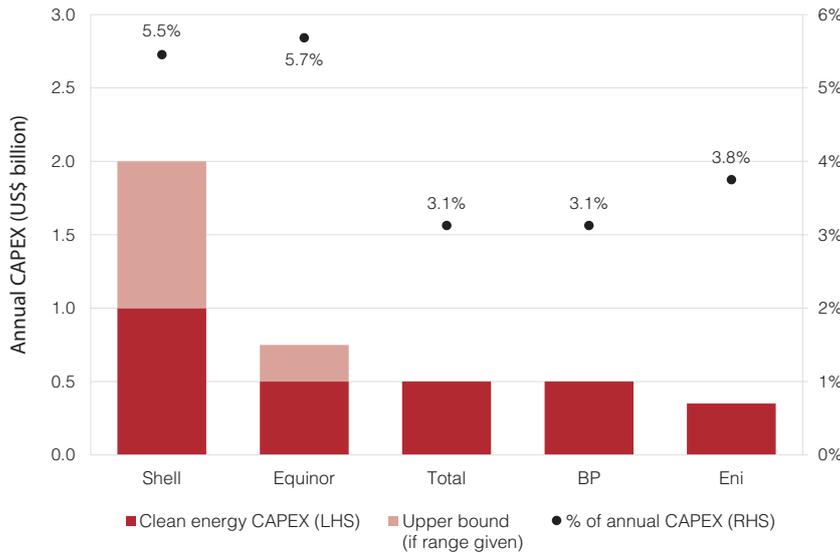
Figure 70: Undisclosed low-carbon investment (number of deals 2010 - Q3 2018)⁽ⁱ⁾



(i) Includes Asset Finance, M&A and Venture Capital spend. No low-carbon investment deals found for Noble Energy, Rosneft or Woodside.
Source: CDP, company reports, BNEF

- With its “20% low-carbon assets in 20 years” ambition it is not surprising to see Total leading on low-carbon spend having made a number of sizeable acquisitions across a range of new energy solutions (see Figure 69).
- The five European Majors have all committed a proportion of their future CAPEX spend to clean energy technologies (see Figure 71). Equinor is also targeting 15-20% of its total CAPEX budget to be in renewables by 2030.
- However, for the sector as a whole low-carbon spend is still low on a relative basis. Expected 2018 total CAPEX for the 24 companies is US\$260 billion, of which only an estimated 1.3% is going to low-carbon assets.
- US companies have not embraced renewables in the same way as their European peers. We note that Chevron does have some exposure but sold its geothermal assets in Indonesia and the Philippines in 2017. With less domestic pressure to diversify and plentiful exposure to short-cycle unconventional, there is less incentive for these companies to capture this new asset class. It can also be argued that it makes less sense for pure-play E&P companies to get involved in what is fundamentally a very different market of the energy sector (see box on page 39 for further discussion).

Figure 71: Planned annual CAPEX in clean energy technologies⁽ⁱ⁾



(i) Based on strategic plans and CAPEX guidance. Midpoint of CAPEX range used for % of annual CAPEX.

Note: Repsol is planning to invest around 17% of its 2018-2020 CAPEX in "low-carbon businesses" which consists of both renewables and gas power generation. The company's goal is to have a generation capacity of around 4.5 GW by 2025, targeting 2.5 million electricity and gas customers in Spain.

Note: With its "Vision 2040" INPEX is expanding renewable energy projects to account for 10% of its entire project portfolio by 2040.

Source: CDP, company reports, Bloomberg

Renewables: and now for something completely different

Most renewable projects are much smaller than upstream oil and gas projects, have very different characteristics and require a different skill set to execute. Oil and gas is a producer led business whereas solar and wind feed into the electricity market which is increasingly led by consumers.

However, synergies do exist. Gas also supplies the power sector and integrated oil & gas companies are already involved in power generation and trading, and are close to consumers with their retail fuels businesses.

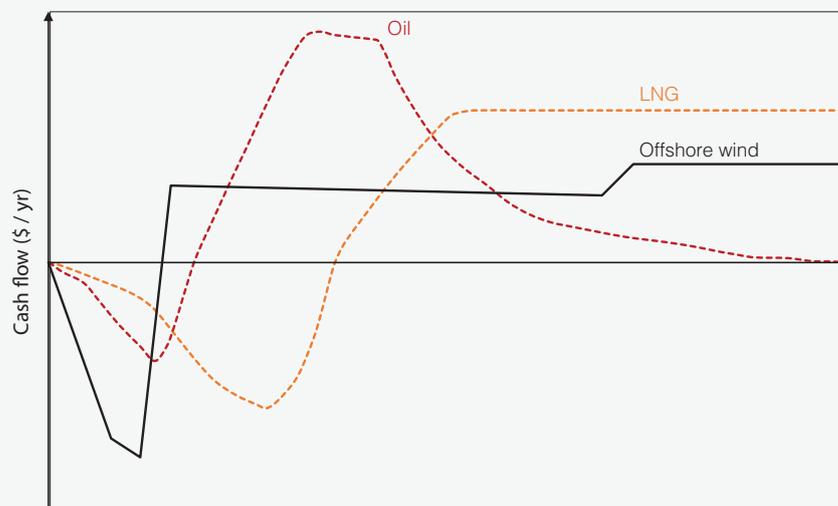
Biofuels (as well as CCUS) are an obvious match to core expertise, and offshore wind allows companies to leverage their offshore upstream capabilities to gain a competitive edge. Solar is a more fragmented industry but does lend itself to on-site generation, allowing for reduction in fuel gas usage.

Returns on solar and wind projects are typically 5-10%,³³ half of what's often expected from upstream oil & gas projects. However, after the development phase there is very little risk, unlike oil & gas where value can be eroded by falling commodity prices.

Figure 72 compares typical cash flow profiles for large scale oil, LNG and offshore wind projects. Offshore wind has some similarities to LNG and some larger developments offer oil & gas companies a scale similar to major upstream developments.³⁴

Adjusting for risk, the economics of renewables become much more attractive. Technological advances are driving costs down³⁵ and long-term revenues and stable cash flows provide oil & gas companies a hedge against long-term threats to oil & gas demand.

Figure 72: Comparing project cash flow profiles



Source: CDP, BNEF, ECOFYS

33. Source: Reuters, BNEF

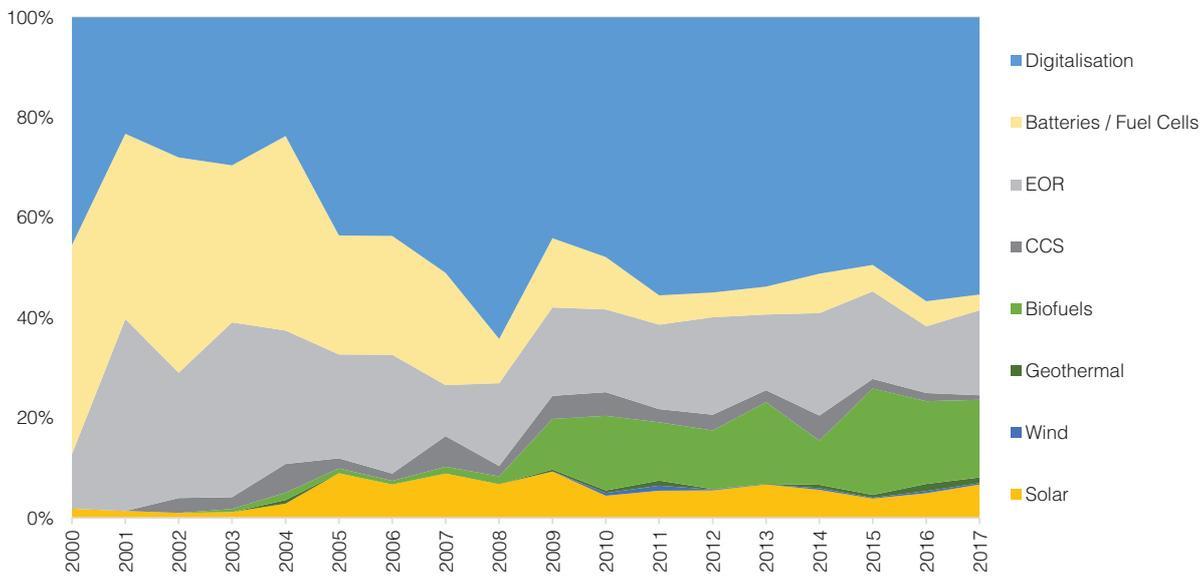
34. Equinor states that investments for a 1GW offshore wind project are typically around US\$3 billion.

35. Some next generation solar and wind projects no longer require the support of subsidies. The first zero-subsidy offshore wind projects were awarded in Q2 2017 to EnBW and Orsted.

- Figure 73 shows the share of patents filed across the themes of renewables, CCUS, enhanced oil recovery (EOR), batteries / fuel cells, and digitalisation by the 24 companies in this report. A notable feature is the growth experienced in the number of patents relating to biofuels as well as digitalisation technologies (with the share relating to batteries / fuel cells significantly declining).
- Digitalisation, EOR and biofuels are the three areas with the largest volume of high-quality patents filed and account for 82% of total high-quality patents across the eight categories analysed.

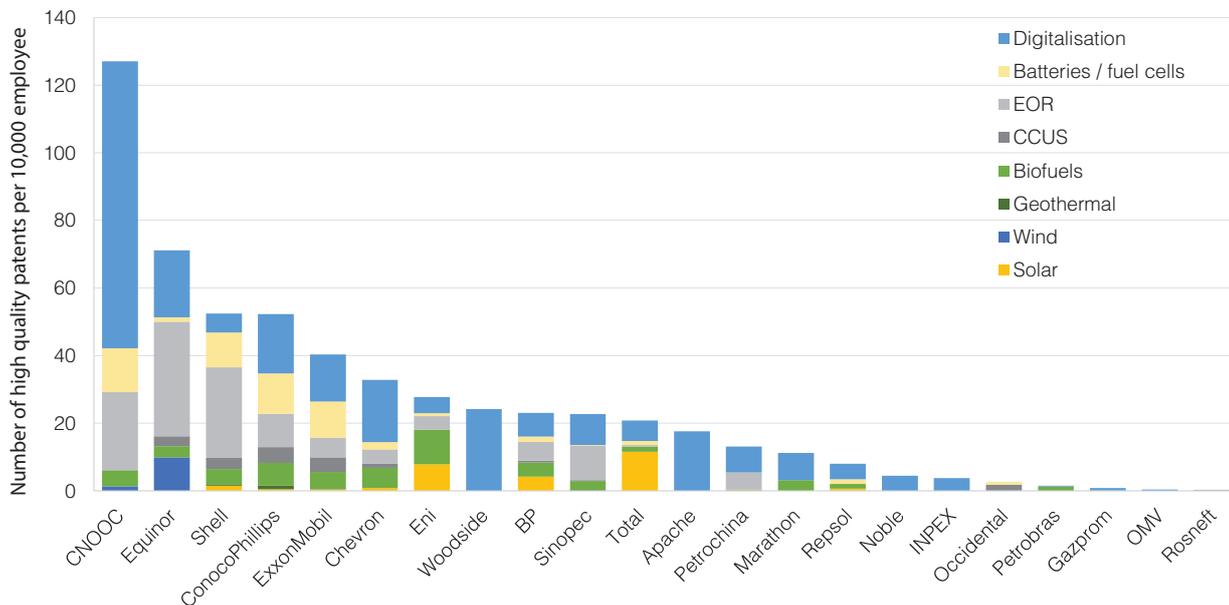
- CNOOC has the highest number of high quality patents per employee in total (see Figure 74). On a normalised basis it ranks first for digitalisation technologies. Equinor ranks first for EOR and Total for biofuels.
- With respect to the development of CCUS technologies eight companies possessed high-quality patents in this area with ConocoPhillips, ExxonMobil and Shell all ranking high.
- ConocoPhillips ranks first overall coming in the top seven across all the categories for which they filed high-quality patents, with CCUS, geothermal and battery / fuel cell related technologies their highest-ranking areas.

Figure 73: Technology share of patents filed by the 24 companies



Source: CDP, LENS.ORG

Figure 74: High quality patents by technology theme (2000 – Q3 2018)⁽ⁱ⁾



(i) No high quality patents found for Anadarko or Hess.

Source: CDP, LENS.ORG

- Digitalisation is a key feature for companies seeking to improve their operational efficiency, with most companies displaying some intent on how they plan to further develop these capabilities (see Figure 77 on page 42).
- Both Equinor and Shell set the benchmark with good detail on their future plans, whilst also forming partnerships with companies like Microsoft, Intel and Honeywell to further develop IoT, data analytics and automation capabilities.
- Most of the partnerships established across the sector relate to the development of IoT capabilities and improved data analytics. These allow for the development of cloud computing platforms which offer greater efficiency and flexibility for conducting data intensive processes whilst also offering improved processing of large datasets for advanced seismic interpretation and reservoir modelling
- CNOOC and Petrochina have the highest R&D expense as a proportion of sales at 0.95% and 0.81% respectively (see Figure 75). However, with average R&D expense to sales of 0.32%, the sector collectively invests very little in research and development.
- One of the TCFD recommendations is that companies should consider disclosing R&D expenditures for low-carbon alternatives and energy / water efficiencies. We found that six companies gave a sufficient level of disclosure in this area.
- With new technologies emerging and increasing focus from companies on smart solutions to optimize operations, companies should look to highlight the actions taken in these areas and present clear indicators of performance to investors.

Figure 75: Research and development (R&D)

Company	R&D / Net sales (2015-2017)
CNOOC	0.95%
Petrochina	0.81%
Total(i)	0.72%
Petrobras(i)	0.64%
Equinor(i)	0.57%
Rosneft	0.54%
ConocoPhillips	0.53%
ExxonMobil	0.46%
Chevron	0.43%
Gazprom	0.40%
Shell	0.38%
Sinopec	0.30%
Eni(i)	0.27%
Repsol(i)	0.20%
BP	0.19%
OMV(i)	0.14%
INPEX	0.09%

(i) Eni, Equinor, OMV, Petrobras, Repsol and Total all give a clear indication of R&D allocated to low-carbon technologies.

(ii) No R&D expenditure by Anadarko, Apache, Hess, Marathon, Noble, Occidental or Woodside.

Source: CDP, company reports

Digital fossils?

End-to-end digitalisation of the oil & gas value chain will transform the sector; enhancing productivity, efficiency and safety.

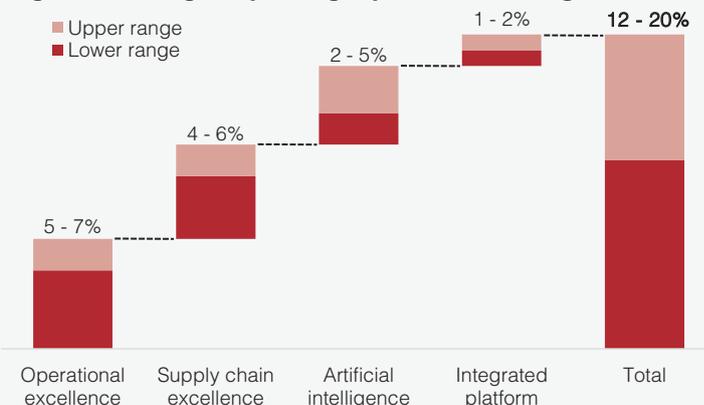
Digitally connected, intelligent operations allow for real-time monitoring and simulation, optimized logistical efficiency and predictive maintenance. Improved data analysis and modelling can advance understanding of the resource base and digitalisation can also help accelerate the industry's historically slow payments process.³⁶

An average offshore production facility can have more than 40,000 data tags³⁷ but currently only around 3% of the data is actually used.³⁸ There is huge scope for the sector to optimize production and continue to drive down costs by fully embracing the digital revolution.

Both the IEA and PwC estimate that the deployment of digital technologies could cut production costs by up to 20% (see Figure 76).

Challenges remain in retrofitting legacy assets. However, short-cycle projects, such as shale-gas production, can look to apply cutting-edge digital technologies in a continuous manner.

Figure 76: Saving on operating expenditure from digitalization



Source: Drilling for data, Digitalizing upstream oil and gas, PwC

36. According to PwC the time from production to payment can be as long as four months.

37. Digitizing oil and gas production, McKinsey.

38. BP Technology Outlook 2018.

Figure 77: Digitalisation strategy & partnerships

Company	Activities	Partners	Year	IoT and data analytics	AI and machine learning	Automation	Rank
Equinor	Clear digitalisation strategy with a 'Digitalisation Roadmap' and the creation of a Digital centre of Excellence designed to develop Equinor's digitalisation capabilities. Has committed to investing up to \$2.5m by 2020 to embed digitalisation technologies into its operations with the goal of significantly increasing utilisation of data, data analytics and robotics.	Accenture	2018				1
		Capegemini	2018				
		Microsoft	2018				
		Emerson	2017				
		SIRIUS Centre	2015				
Shell	Actively working to develop digital technologies in several areas which it believes offer the greatest potential for its business: 3D printing, robotics, computational technologies, advanced analytics and IoT solutions.	Honeywell	Unknown				1
		Microsoft Azure	2018				
		C3 Inc	2018				
		Intel	2008				
BP	Has identified digitalisation as one of five key focus areas critical for its modernisation agenda and future strategy. Actively involved in developing new digital platforms that utilise blockchain, quantum and cognitive computing in order to improve efficiency and productivity across operations.	Amazon Web Services	2017				3
		Oceaneering	2016				
		GE Predix	2016				
Chevron	Digitalisation activities are well integrated into the overall structure of the company and split between its Energy Technology Company, Information Technology Company and Chevron Technology Venture (CTV) arms. The CTV support a number of IT / networking companies that are developing IoT, remote monitoring and data analytic technologies and solutions which are then integrated into company operations.	Microsoft Azure	2017				3
		GE	2014				
		Hadoop	2012				
Repsol	Has made a clear strategic decision to integrate digital solutions into its operations as part of its 'New Efficiency and Digitalisation Program'. Repsol has plans to apply efficiency and digital solutions across its operations to generate EUR 1bn in Free Cash Flow. Some of the solutions identified include improved analytics for predictive maintenance, logistic optimization and improved performance monitoring.	Google	2018				3
		Microsoft	2017				
		IBM	2014				
Total	Total has identified the importance of digitalisation for the future operations of the O&G sector and some internal digitalisation strategy is evident. However, at present there doesn't appear to be a public strategy or detailed plan that has been set out.	Google	2018				6
		Tata Consultancy Services	2018				
		Microsoft	2017				
ExxonMobil	Developing a range of digital solutions designed to improve operational efficiency. In particular the use of seismic imaging and high-performance computing are being used to improve exploration and production.	IBM Cloud	2018				6
		Lockheed Martin	2018				
Gazprom	Established a new digital innovation centre for the development and implementation of digital technologies. Centre focuses on developing and utilising "Big Data" analytics, IoT, AI-based self-learning tools and more. Gazprom also have a strategy which aims to build on 9 key technological trends; all of which rely on an expansion of digital capabilities.	Yandex	2017				6
		IBM	2017				
Hess	Actively seeking to integrate digital technologies into their operations by using technological innovations such as machine learning (including in the areas of seismic and drilling); robotic process automation; and the cloud-based data processing.	Accenture	2016				6
		GE (Baker Hughes)	Unknown				
Eni	2018 - 2021 strategy plans to apply Digital Solutions & Advanced Analytics to reduce production costs. Looks to accelerate digital technologies, focusing on enhanced seismic, data processing & automation.	ENEA	2018				6
Woodside	Developing advanced analytics and cognitive computing. Co-founded the FutreLab, developing next generation digital innovations. Focuses on statistical tools and connectivity to improve operations.	IBM	2016				6
Petrochina	Making steps to digitalise its operations by using cloud computing services, allowing for quicker access and processing of big datasets. Also seeks to develop better data analytics and modelling capabilities to improve operational efficiency. However, there is little evidence of a broader digitalisation strategy.	Huawei & SAP	2014				12
		IHS Energy	Unknown				
Rosneft	Looking to digitalise various aspects of the value chain. Aim to do this by utilising big data analytics, real time modelling and predictive maintenance applications.	Siemens	2017				12
Sinopec	Integrating digitalisation into its operations through its process 'Informatisation and Industrialisation'. Involves developing an array of 'advanced technology platforms' such as big data analytics & IoT.	Siemens	2016				12
Marathon	Launched digital oilfield capabilities at Eagle Ford boosting operational efficiency. Introduced remote monitoring, enhanced data analytics & automation. Will expand these measures to other assets.						12
OMV	Has a global upstream digitalisation program called DigitUP. Working on machine learning and cloud solutions for seismic data processing and 3D visualisation technologies for geological interpretation.						12
Conoco-Phillips	Digitalisation is alluded to throughout company materials with an emphasis on using data analytics to improve operational and cost efficiency. However, is lacking evidence of a clear digitalisation strategy.	DTU, AU, Maersk & Eldor Technology	2018				17
INPEX	Has expressed a desire to apply digital solutions to improve operational efficiency and ensure resilience for the future but detail on its digitalisation strategy is lacking.	ABB	2018				17
Apache	Identifies importance of digitalisation for its business. Developing remote operating capabilities to optimise operations and reducing production downtime through predictive maintenance.						17
CNOOC	Highlights the importance of technology-driven development for improving 'exploration results' but unclear if 'technology' refers to digitalisation capabilities in this context.						17
Occidental	Digitalising operations through data management, field automation and production optimisation. Seeking to further develop data science capabilities as part of its 'Re-imagined Oilfield' (RIO) concept.						17
Anadarko	Digitalisation activities appear to be limited with little reference to digitalisation in company reporting. However, partners with RS Energy Group to integrate intelligent analytics within subsurface modelling.	RS Energy Group	2017				22
Petrobras	Its 2018-2022 strategy identifies the need to prepare its business for digital transformation. States that a more detailed plan for digitalizing their operations is in the pipeline.						22
Noble Energy	Very little reference is made to the significance of digitalisation to its business with references to digital technology seeming to only appear in relation cyber security.						24

Source: CDP, company reports, BNEF

Climate governance & strategy

- ▶ Nine companies have published 2-degree scenario analysis and 15 companies have set corporate emissions reduction targets. The sector has launched a number of initiatives aimed at reducing routine flaring and cutting methane emissions.
- ▶ Total and Shell rank first and second respectively. Both companies have set long-term ambitions to reduce their net carbon footprint (which includes Scope 3 emissions).
- ▶ CNOOC and Marathon Oil are the lowest ranked. Neither company has a corporate emissions reduction target and both perform poorly on board and executive climate management.

Overview

Oil & gas companies used to have a simple goal: to produce, refine and sell hydrocarbon products whilst sustaining or growing the reserve base. However, sustainability now means something very different for the sector.

Companies are coming under increasing pressure to demonstrate portfolio resilience and adapt business models to align with a low-carbon energy transition. Post-Paris they have faced increasing investor scrutiny and with the recommendations from the Task Force on Climate-related Financial Disclosures (TCFD), the mandated disclosure on climate risks and opportunities is likely to become the business norm.

Going forward there can no longer be any difference between overall strategy and climate strategy. Votes for shareholder resolutions relating to 2-degree analysis grew from an average of 21% in 2014 to 53% in 2018 (as illustrated by the thought piece on page 50). Off the back of this, nine of the 24 companies have now published 2-degree scenario analysis with others looking to do the same.

The recent wave of climate-related litigation against oil & gas companies further highlights the importance of companies getting their strategy right. Engagement, collaboration and innovation will be more crucial than ever. Climate-related targets and alignment of governance and remuneration structures with low-carbon objectives may very well form part of the industry's social license to operate in the coming years.

Figure 78: Climate governance & strategy summary

Company	Targets & ambitions	Scenarios analysis	Climate-related remuneration	Board & executive climate management	TCFD & initiative support	CDP Score (2017) ⁽ⁱ⁾	Overall weighted rank	Climate governance & strategy rank
Total	1	1	2	3	2	A-	1.9	1
Shell	1	1	6	5	1	B	3.1	2
Eni	4	1	3	2	4	A-	3.4	3
Equinor	5	1	1	1	2	A-	4.0	4
Repsol	1	11	9	8	4	A-	6.9	5
BP	10	5	5	7	6	A-	7.7	6
ConocoPhillips	14	7	4	4	14	B	9.8	7
Hess	5	11	14	17	13	A-	10.3	8
Gazprom	5	18	7	19	21	C	11.7	9
INPEX	9	10	13	20	18	C	11.7	10
Woodside	11	11	11	15	11	C	12.3	11
OMV	13	15	11	14	12	A-	13.5	12
Occidental	17	7	9	11	9	C	13.6	13
Chevron	17	5	17	13	8	B	13.8	14
ExxonMobil	16	7	17	10	7	C	13.8	15
Petrochina	5	22	17	21	20	Not scored	15.0	16
Petrobras	17	11	17	12	10	B	15.5	17
Rosneft	11	19	17	18	24	Not scored	15.9	18
Sinopec	15	19	17	9	23	Not scored	16.5	19
Apache	17	15	8	22	22	F	17.1	20
Anadarko	22	15	17	6	14	C	17.3	21
Noble Energy	22	21	14	16	14	C	18.4	22
Marathon Oil	21	22	17	23	14	F	20.8	23
CNOOC	22	22	16	24	18	F	20.8	24

Weighting 40% 25% 15% 10% 5% 5%

(i) CDP scores for the 2018 reporting cycle have not yet been published. Apache, BP, Chevron, CNOOC, ExxonMobil and Marathon Oil did not respond to CDP's 2018 questionnaire. Note: In calculating the weighted rank in this table, we use the weighted ranks for each area. We display non-weighted ranks in this summary for simplicity only.

Source: CDP

In this chapter we assess companies on their climate governance and strategy using six key metrics:

Metric 1) Targets and ambitions (40%): We assess the strength of companies' emissions reduction targets including targets for reducing methane and flaring emissions.

Metric 2) Scenario analysis (25%): We look at which companies are conducting scenario analysis, using an internal carbon price and stress-testing their portfolios against a low-carbon energy transition.

Metric 3) Climate-related remuneration (15%): We assess alignment between climate-risk strategy performance and remuneration across long-term incentives and short-term annual bonus programs at the senior executive and board level as well as other practices at broader corporate levels.

Metric 4) Board & executive climate management (10%):

Companies are assessed on a number of factors relating to board and executive climate responsibility performance including: the level of directors on the board with climate related experience, the presence of climate-related committees (at board and/or executive levels) and the overall quality of climate-risk management systems.

Metric 5) TCFD and initiative support (5%): We highlight the companies that have officially supported the TCFD and which other climate organisations and initiatives companies are members of.

Metric 6) CDP Score and disclosure (5%): Companies are ranked based on their 2017 CDP Score and whether they disclosed to CDP in 2018. The CDP Score provides an aggregate measure of the quality of climate-related disclosure and management systems addressing climate risks.³⁹

Figure 79: Scope 1+2 intensity emissions reduction targets (base year indexed to 100)

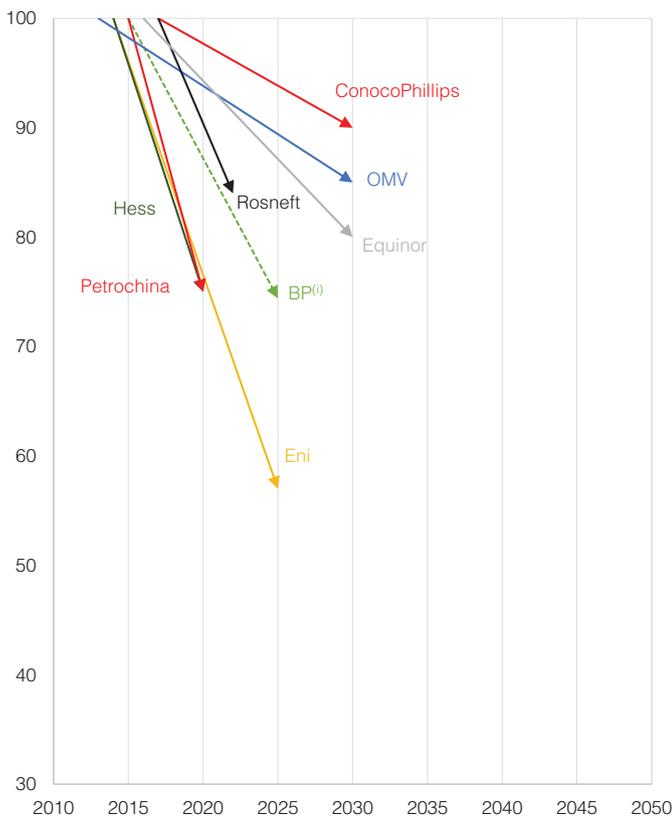
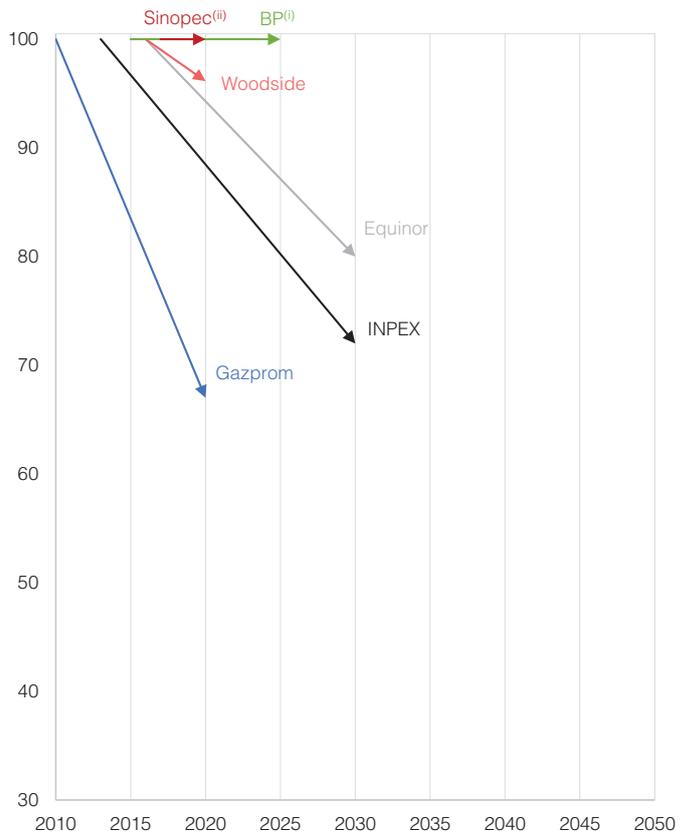


Figure 80: Scope 1+2 absolute emissions reduction targets (base year indexed to 100)



(i) BP's absolute emissions target of "zero net growth in operational emissions out to 2025" has been converted to an equivalent intensity target to aid comparison with other companies. We have assumed an upstream production CAGR of 3% over the period 2015-2025. We note that BP expects upstream production to grow by an average of 5% p.a. between 2016-2021.

(ii) Sinopec state that they have an emissions reduction target for 2020 but do not disclose its details.

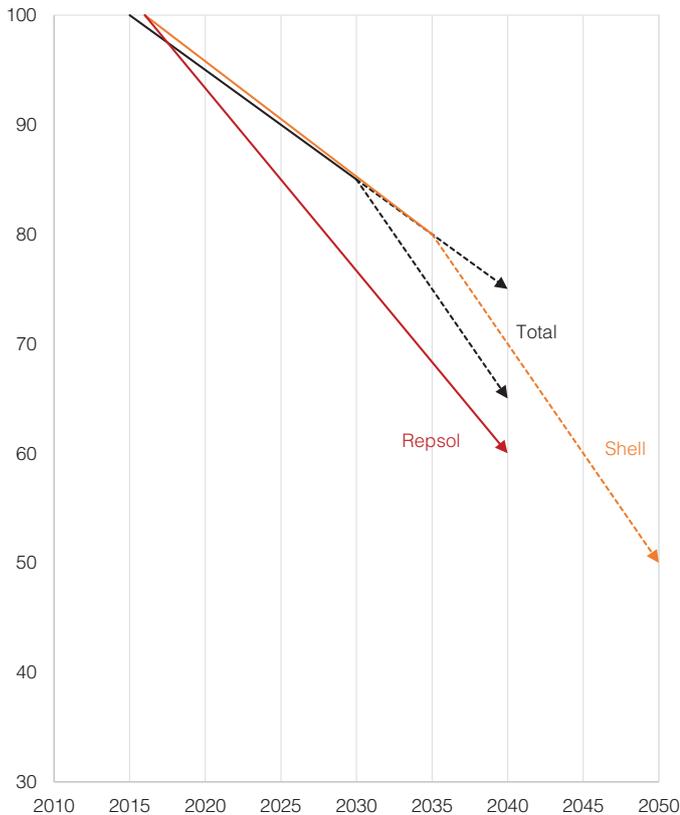
Source: CDP, company reports

39. CDP scores for the 2018 reporting cycle have not yet been published.

Highlights

- ▼ Total and Shell rank first and second respectively. Both companies have set targets / ambitions which look to significantly reduce corporate emissions profiles in the long-term (see Figure 81). These ambitions account for the full range of emissions from energy products sold (Scope 1+2+3). Both companies have assessed the impact of a 2-degree scenario on their portfolios and also have an element of executive remuneration linked to climate-risk.
- ▼ CNOOC and Marathon Oil are the lowest ranked and perform poorly across most metrics. Neither company has evidence of a corporate emissions reduction target, they are not conducting scenario analysis and perform poorly on board and executive climate management.
- ▼ Company Scope 1+2 emissions reduction targets are shown in Figures 79 and 80. 15 companies have set corporate level emissions targets. However, some other companies have also set separate methane and flaring reduction targets (see Figure 82). Only three companies have no evidence of any emissions reduction target (Anadarko, CNOOC and Noble Energy).
- ▼ The sector has recently launched a number of initiatives aimed at reducing routine flaring and cutting methane emissions. Members of the OGCI recently announced an aggregated methane intensity target of 0.25% by 2025 with the ambition of reaching 0.2%.⁴⁰ Thirteen companies are also members of the World Bank's Zero Routine Flaring by 2030 initiative.
- ▼ Figure 83 provides a summary of scenario analysis conducted by the companies in our sample. Nine companies have now published assessments analyzing the impacts of a 2-degree scenario to their businesses, with others looking to do the same. Analysis ranges from more quantitative interpretations such as Equinor's NPV assessment to more qualitative discussions.
- ▼ Conducting scenario analysis to assess how resilient corporate strategy is to a range of climate-related scenarios is one of the TCFD's key recommendations (see box on page 47 for further discussion).

Figure 81: Scope 1+2+3 intensity emissions reduction targets (base year indexed to 100)



Source: CDP, company reports

Figure 82: Emissions reduction targets / ambitions

Company	Emissions reduction target / ambition	Includes Scope 3	Separate methane target	Separate flaring target	Rank
Repsol	✓	✓	✓	✓	1
Shell	✓	✓	✓	✓(i)	1
Total	✓	✓	✓	✓	1
Eni	✓	✗	✓	✓	4
Equinor	✓	✗	✓	✓	5
Gazprom	✓	✗	✓	✓(i)	5
Hess	✓	✗	✓	✓	5
Petrochina	✓	✗	✓(i)	✓	5
INPEX ⁽ⁱⁱ⁾	✓	✗	✗	✗	9
BP	✓	✗	✓	✓(i)	10
Rosneft	✓	✗	✗	✗	11
Woodside	✓	✗	✗	✓	11
OMV	✓	✗	✗	✓(i)	13
ConocoPhillips	✓	✗	✗	✗	14
Sinopec	✓	✗	✗	✗	15
ExxonMobil	✗	✗	✓	✓	16
Apache	✗	✗	✓	✗	17
Chevron	✗	✗	✓(i)	✓(i)	17
Occidental	✗	✗	✓(i)	✓(i)	17
Petrobras	✗	✗	✓(i)	✓(i)	17
Marathon	✗	✗	✓	✗	21
Anadarko	✗	✗	✗	✗	22
CNOOC	✗	✗	✗	✗	22
Noble Energy	✗	✗	✗	✗	22

(i) Separate methane or flaring target is due to support of initiatives such as the World Bank's Zero Routine Flaring by 2030 initiative or membership of OGCI which has an aggregated methane intensity target of 0.25% by 2025 (ambition of 0.2%).

(ii) INPEX is the only company to also have a renewable energy consumption target.

Source: CDP, company reports

40. The OGCI states that this accounts for total upstream methane emissions from all operated oil & gas assets and that emissions intensity is calculated as a share of marketed gas.

Figure 83: Scenario analysis summary

Company	Low-carbon scenarios used	Impact assessment	Comments	Company scenarios	Climate change resilience report	Carbon price US\$/tonne CO ₂ ⁽ⁱⁱ⁾	Rank
Eni	IEA 450 / SDS	4% reduction in fair value of existing oil & gas assets (under assumptions of IEA SDS)	States production and reserves portfolio are resilient, even under decarbonization scenario	No	Path to decarbonization	40	1
Shell	Company - "Sky"	\$10/bbl change in oil price - ≈\$6bn/year impact on cash flow from operations. ⁽ⁱ⁾ \$10/tonne increase in global carbon price - reduces pre-tax cash flows by ≈\$1bn	States there is low risk of stranded assets, or reserves that cannot be produced economically in mid-term (to 2030)	Three main scenarios: Mountains, Oceans and Sky (where Sky looks to achieve the goals of the Paris Agreement)	Energy Transition report	40	1
Equinor	Company / IEA SDS	-13% NPV (IEA SDS vs. base case planning assumptions)	Will actively test resilience of business to ensure competitiveness in low-carbon future	Three main scenarios: Rivalry, Reform and Renewal (Renewal aims to be consistent with 2-degree pathway)	Climate Roadmap	56.5	1
Total	IEA SDS / 450 / 2DS	-5% PV vs. base case (sensitivity to carbon price of \$30 - \$40)	Looks to maintain a resilient portfolio by focusing on competitively priced assets	No	Integrating climate into strategy	55	1
BP	Company - "Even faster transition"	Qualitative - says has enough flexibility in portfolio to reshape business, providing resilience for future scenarios	Portfolio tested against range of oil, gas and carbon prices and scenarios involving faster transition to lower carbon sources	Range of scenarios (6 in BP Energy Outlook 2018. "Even faster transition" follows similar decline in emissions to IEA SDS)	Advancing the energy transition	60	5
Chevron	IEA SDS	Qualitative - states some assets could be exposed if no action taken but company would limit this by adjusting and managing the risks	Portfolio tested against prices projected under IEA SDS	No	Climate change resilience	Yes - price not disclosed	5
Conoco-Phillips	Company - Carbon Scenarios	Qualitative - says has built in optionality to change and adapt in order to mitigate risk	Considers range of future carbon-constraint scenarios and test strategies and asset portfolio under various scenarios	Four decarbonisation scenarios against which it tests its portfolio	Website pages: Climate Change Action Plan Indications that a standalone report will be published	40	7
ExxonMobil	Stanford EMF	Qualitative - reserves face little risk but not all resources would be attractive investments	Tests investments over range of commodity price and market assumptions which align with third-party's 2-degree pathway	Outlook for Energy - Latest version included assessment of 13 2-degree scenarios from Stanford EMF	Energy & Carbon Summary	40	7
Occidental	IEA SDS / 450	Domestic proved reserves decrease <1%, intl. proved reserves decrease ≈ 6%. Carbon price of \$100/tonne adds ≈ \$2/boe cost to operations	Tested proved reserves against IEA 450 scenario	No	Climate-Related Risks and Opportunities	40	7
INPEX	Company - "2-degree scenario"	Qualitative - maintains financial and corporate resilience at US\$50/bbl oil price	In future, looking to further disclose climate risk exposure as per TCFD recommendations	Three scenarios: Technology progress scenario, Wake-up scenario and 2-degree scenario	Vision 2040	35	10
Hess	IEA SDS	Qualitative - high likelihood reserves will be monetized	Currently conducting carbon asset risk scenario planning exercise - results to be published in 2019	No	Website page: Carbon Asset Risk Report	40	11
Petrobras	Company / IEA 450	Not disclosed	States strategy looks to prepare company for future based on low-carbon economy	Three scenarios: Stream, Shoal and Coral (where Coral involves transition to low-carbon energy mix) but no detail given	No	100	11
Repsol	IEA SDS	Not disclosed	States that its risk management system enables identification, management and controlling of risks arising from climate change	Currently developing its own scenarios compatible with a 2-degree future	No	32.5	11
Woodside	Company / IEA SDS	Not disclosed	In 2017, committed to including a 2-degree scenario to understand potential impacts, risks and opportunities from climate change	In the future, plans to further discuss approach for developing long-term energy scenarios.	No	Yes - price not disclosed	11
Anadarko	IEA SDS	Not disclosed	Scenarios are considered as part of company's strategic planning	No	Indications that a standalone report will be published	No	15
Apache	Refer to IEA but no specific scenario	Not disclosed	Consider climate related risks as part of ongoing scenario planning	No	No	Yes - price not disclosed	15
OMV	IEA 450	Not disclosed	IEA 450 scenario used for downside sensitivity analysis	No	No	29.5	15
Gazprom	IEA SDS / 450 / B2DS	Not disclosed	States that analysis revealed the stability of the company's strategy	No	No	Yes - price not disclosed	18
Rosneft	Not disclosed	Not disclosed	Anticipates using climate-related scenario analysis within 2 years.	No	No	No - but anticipate use within 2 years	19
Sinopec	Not disclosed	Not disclosed	Anticipates using climate-related scenario analysis within 2 years	No	No	No - but anticipate use within 2 years	19
Noble Energy	Not disclosed	Not disclosed	-	No	No	No - but anticipate use within 2 years	21
CNOOC	Not disclosed	Not disclosed	-	No	No	No	22
Marathon	Not disclosed	Not disclosed	-	No	No	No	22
Petrochina	Not disclosed	Not disclosed	-	No	No	No	22

(i) Shell considers sensitivity to oil prices, using a range of between \$40 and \$100 / bbl. It states that at a \$40 / bbl price, cash flow from operations is expected to decrease by \$15 billion / year (from a base price of \$65 / bbl) between 2016-2021.

(ii) Carbon price: mid-point taken where there is a range of prices used.

Source: CDP, company reports, CTI - "Under the Microscope"

Scenarios and Science Based Targets

A scenario describes a hypothetical future and a path of development leading to that future. Scenarios are not predictions or forecasts, but are storylines asking “what if?” questions which highlight key risks and opportunities and test the impact of potential outcomes.

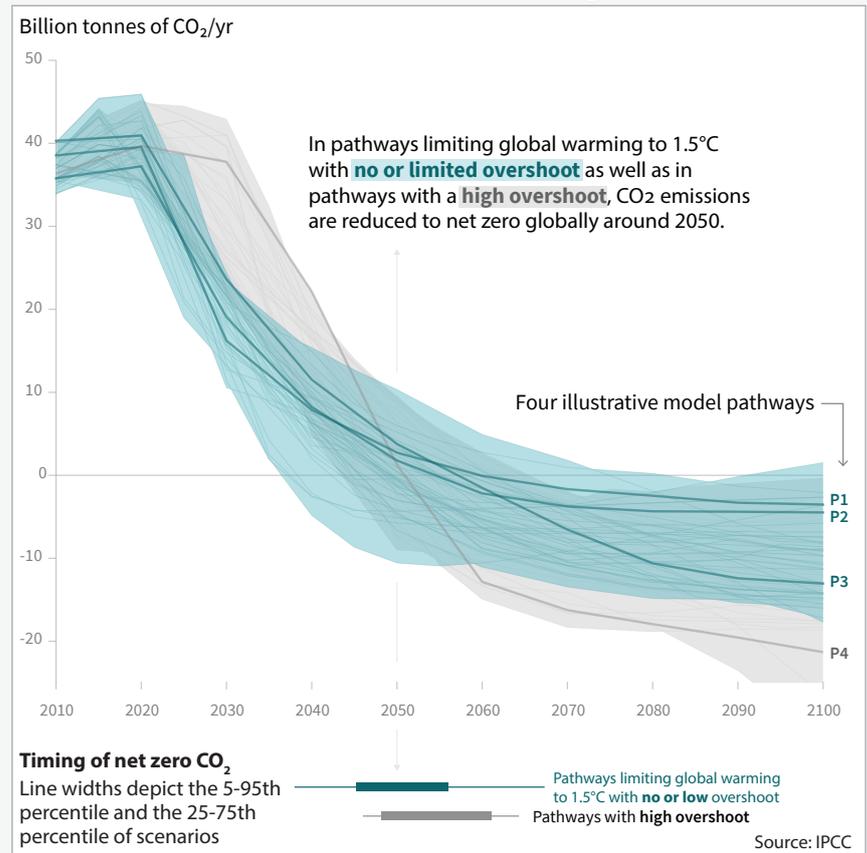
A critical aspect of scenario analysis is to evaluate a variety of alternative futures, both favourable and unfavourable.

One of the TCFD’s key recommendations is for companies to disclose “how resilient their strategies are to a range of plausible climate-related scenarios.” It also further recommends organizations use at least one 2-degree or lower scenario.⁴¹

Over the last few years many oil & gas companies received shareholder resolutions calling for reporting on ‘2-degree analysis and strategy’.⁴² This led to many companies publishing separate climate change resilience reports (an analysis of which can be seen in Figure 83 on page 46).

The oil & gas sector has a huge role to play in the decarbonisation of the economy.⁴³ To meet the goals of the Paris Agreement, the pace of the energy transition cannot be modest. This is further highlighted by the IPCC’s recent special report on 1.5-degrees of global warming (see Figure 84).⁴⁴

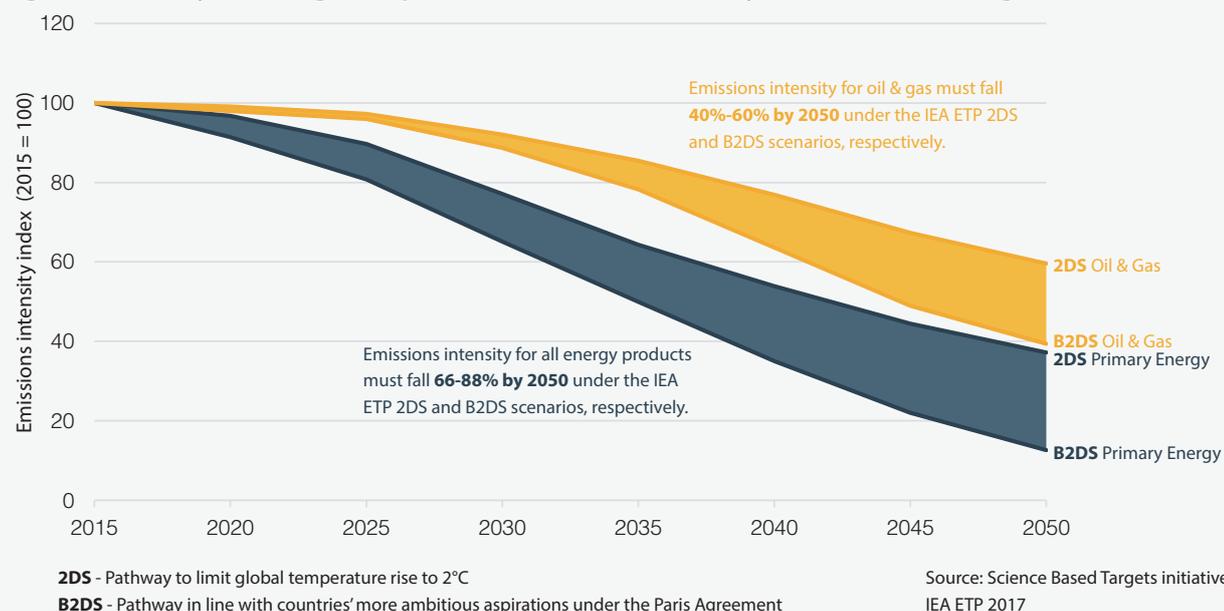
Figure 84: 1.5-degree scenarios for global total net CO₂ emissions



Companies have the opportunity to demonstrate leadership and align themselves with pathways consistent with decarbonisation scenarios. For consistency and comparability companies should look to set targets through the Science Based Targets initiative which is currently developing methodology tailored to the oil & gas sector.

A science-based target (SBT) is a corporate greenhouse gas emissions target that aligns with a future in which the global climate does not exceed an average temperature of 2°C above the pre-industrial level. For the purpose of target setting a 2-degree or below scenario is used. Figure 85 illustrates possible science-based pathways for oil & gas companies. Repsol, Shell and Total have all set ambitions that are similar to this approach, accounting for the full range of emissions from energy products sold (Scope 1+2+3 emissions), see Figure 81 on page 45 for further insight.

Figure 85: Pathways for oil & gas companies to reduce carbon intensity in line with the Paris Agreement



41. TCFD: The Use of Scenario Analysis in Disclosure of Climate-Related Risks and Opportunities

42. See box “Turn of the tide for oil & gas companies” on page 50 for further discussion.

43. The emissions from the production and use of oil & gas accounts for over half of global greenhouse gas emissions associated with energy consumption (more than 17 GtCO₂e).

44. For emissions pathways from a full range of scenarios see Figure 91 on page 51

Figure 86: Climate-related remuneration⁽ⁱ⁾

Company	Short term incentive	Long term incentive	Sub-executive remuneration	Description	Rank
Equinor	✓	✓	✓	For both annual and long term variable pay, executives at Equinor have one of their eight metrics focused on CO ₂ intensity for the upstream portfolio, thus comprising 12.5% of variable pay. The general employee bonus is also linked to this metric.	1
Total	✓	✗	✓	The executive annual bonus has a CSR component, focusing on emission reductions, CCUS and performance in ESG indices. There will also be a renewables element in 2018. Refinery and plant managers also have climate-related incentives.	2
Eni	✓	✗	✓	12.5% of the executive annual bonus is tied to the reduction of CO ₂ emissions relative to operating production. A component of the management bonus is also linked to emission reduction targets.	3
ConocoPhillips	✗	✓	✓	In 2017, as part of the strategic objectives metric for the LTIP, executives were rewarded for climate change scenario planning and the setting of a long term emissions intensity reduction target.	4
BP	✗	✓	✓	As part of the 2018 LTIP, the strategic progress metric is linked to growth of the low-carbon business and renewables. General employees can have remuneration linked to emission reduction projects or reduced flaring initiatives.	5
Shell	✓	✗	✗	10% of the annual bonus is linked to emissions performance which is specifically tied to refining GHG intensity (4%), chemicals GHG intensity (3%) and upstream flaring (3%).	6
Gazprom	✓	✗	✓	2.5% of the executive annual bonus is linked to the reduction of relative rates of GHG emissions. Below the executive level, employees can be paid for gas and electricity savings during gas extraction.	7
Apache	✓	✗	✓	Very small element of annual bonus linked to GHG management. Business unit and facilities managers are financially incentivized to reduce the emission intensity.	8
Occidental	✓	✗	✗	In 2018, the sustainability portion of the annual executive compensation program was broadened to include a climate-related element associated with the advancement of CCUS.	9
Repsol	✗	✗	✓	Business unit and energy managers have emission reduction targets tied to their variable pay. Strategy to 2020 has establishment of objectives for all employees with variable pay linked to social, safety and environmental targets (weight between 10-20%).	9
OMV	✓	✗	✗	Executives can achieve monetary reward as part of their annual bonus based on targets regarding implementation of projects for GHG or energy intensity reduction and new technologies or products to reduce carbon emissions and energy intensity.	11
Woodside	✗	✗	✓	The 2017 company scorecard included an emissions intensity target that cascaded through the bonus structure of the entire organisation.	11
INPEX	✗	✗	✓	The VP for Corporate Strategy & Planning has an emissions reduction element linked to their remuneration.	13
Hess	✗	✗	✓	All employees have a target related to reducing gas release in their variable pay.	14
Noble Energy	✗	✗	✓	Achieving emission reduction and efficiency goals contributes to the calculation of the annual bonus compensation for all employees.	14
CNOOC	✗	✗	✓	State that all employees have remuneration tied to emissions and energy targets.	16

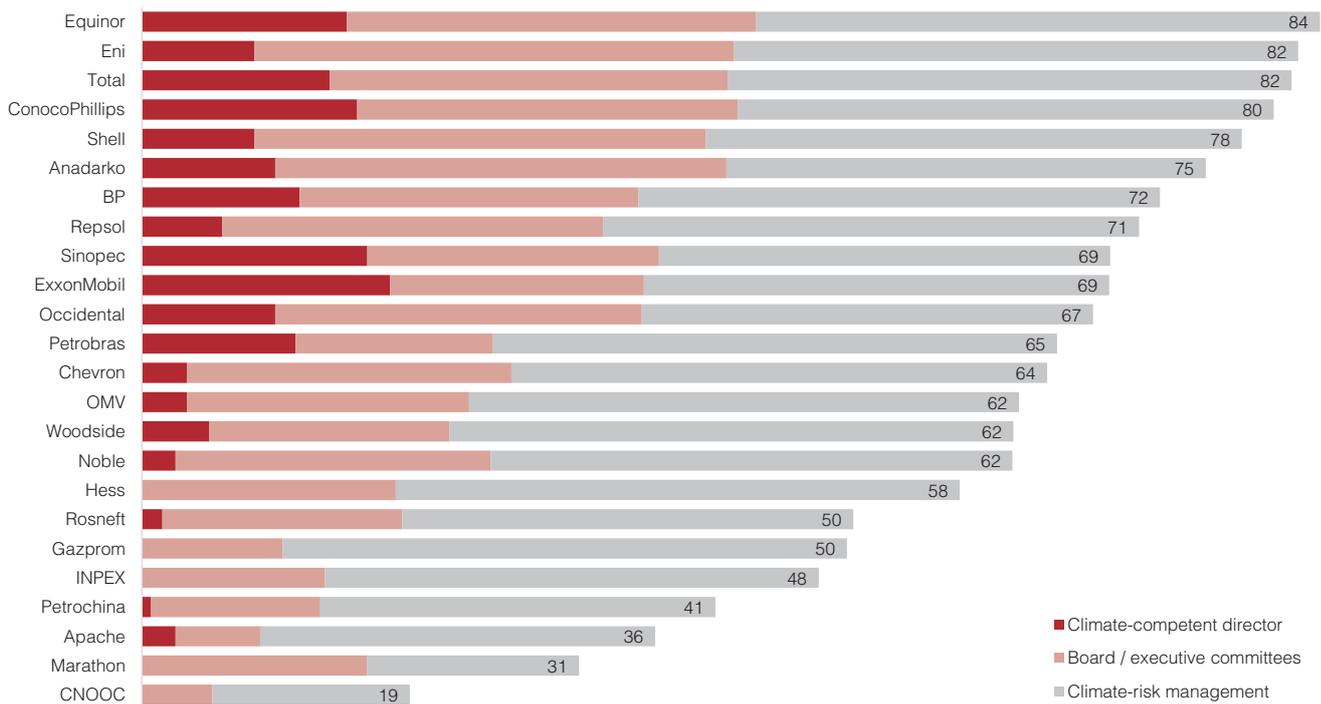
(i) Chevron, ExxonMobil, Petrobras, Anadarko, Marathon Oil, PetroChina, Rosneft and Sinopec do not disclose any information suggesting that climate-risk management is linked to executive or sub-executive pay.

Source: CDP, company reports

- ✗ Sixteen companies have evidence of some form of climate-related remuneration across long-term incentives and short-term annual bonus programs (see Figure 86). ConocoPhillips stands out as performing well relative to its US peers.
- ✗ For board and executive climate management there is strong performance from European companies which occupy six of the top eight positions (see Figure 87). Equinor rank first for this metric with a climate competent board, clear disclosure regarding climate focused committees and detailed climate risk management. Eni ranks second, it has a board committee focused on climate scenarios and an executive level climate change team focusing on the decarbonization strategy.
- ✗ Sinopec performs well on climate management relative to its Chinese peers; ranking ninth compared to 21st for Petrochina and last for CNOOC (see Figure 87). Sinopec has a climate change economics expert on its board and clear disclosure of board and executive level committees focused on climate risk management.
- ✗ Only five companies (all European) have officially supported the TCFD (see Figure 88). Nineteen companies are members of IPIECA⁴⁵, thirteen support the World Bank's Zero Routine Flaring initiative and eleven are members of OGCI. A noticeable development was Chevron, ExxonMobil and Occidental joining the OGCI in September 2018.

45. IPIECA is the global oil & gas industry association for environmental and social issues.

Figure 87: Board & executive climate management⁽ⁱ⁾



(i) Scored out of 100 where companies with higher scores receive higher rankings.
Source: CDP, company reports

Figure 88: TCFD and climate initiative support

Company	TCFD	IPIECA	World Bank Zero Routine Flaring by 2030	OGCI	The Environmental Partnership ⁽ⁱⁱ⁾	Membership of other organisations / initiatives ⁽ⁱⁱⁱ⁾	Rank
Shell	✓	✓	✓	✓	✓	✓	1
Equinor	✓	✓	✓	✓	✓	✓	2
Total	✓	✓	✓	✓	✓	✓	2
Eni	✓	✓	✓	✓	✗	✓	4
Repsol	✓	✓	✓	✓	✓	✓	4
BP	✗	✓	✓	✓	✓	✓	6
ExxonMobil	✗	✓	✓ ⁽ⁱ⁾	✓	✓	✓	7
Chevron	✗	✓	✓ ⁽ⁱ⁾	✓	✓	✓	8
Occidental	✗	✓	✓ ⁽ⁱ⁾	✓	✓	✓	9
Petrobras	✗	✓	✓	✓	✗	✓	10
Woodside	✗	✓	✓	✗	✗	✓	11
OMV	✗	✓	✓	✗	✗	✗	12
Hess	✗	✓	✗	✗	✓	✓	13
Anadarko	✗	✓	✗	✗	✓	✓	14
ConocoPhillips	✗	✓	✗	✗	✓	✓	14
Marathon Oil	✗	✓	✗	✗	✓	✓	14
Noble Energy	✗	✓	✗	✗	✓	✓	14
CNOOC	✗	✓	✗	✗	✗	✗	18
INPEX	✗	✓	✗	✗	✗	✗	18
Petrochina	✗	✗	✗	✓	✗	✓	20
Gazprom	✗	✗	✓	✗	✗	✗	21
Apache	✗	✗	✗	✗	✓	✓	22
Sinopec	✗	✗	✗	✗	✗	✓	23
Rosneft	✗	✗	✗	✗	✗	✗	24

(i) Required to support World Bank's Zero Routine Flaring initiative from 2019 through its OGCI membership.

(ii) The Environmental Partnership is comprised of companies operating in the U.S. oil & gas industry, so membership is not relevant for all companies.

(iii) Other organisations / initiatives include: CCAC Methane Partnership & Guiding Principles, WBCSD, IETA, Carbon Pricing Leadership, Climate Leadership Council, One Future Coalition, and CO2CRC.

Source: CDP, company reports

Turn of the tide for oil & gas companies

We have seen unprecedented action from investors on climate change in recent years. Momentum continues to build and shareholder resolutions addressing climate issues are winning increasing support. This reflects a turn of the tide for oil & gas companies and demonstrates market support for the Paris Agreement.

Over the last five years more than twice as many climate-related resolutions have been filed at oil & gas companies than in the preceding five years (see Figure 89).

We have seen several historic milestones, most notably the votes in 2017 at ExxonMobil and Occidental, where a majority of shareholders (including the two largest fund managers BlackRock and Vanguard) voted against management recommendations and in favour of more climate risk disclosure. This trend is seen across the industry, with resolutions calling for companies to report on portfolio resilience and 2-degree analysis gaining an increasing share of the vote (see Figure 90).

Figure 89: Climate-related resolutions filed at oil & gas companies

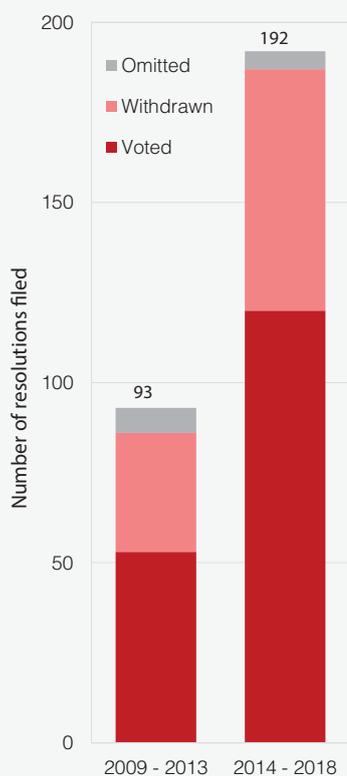
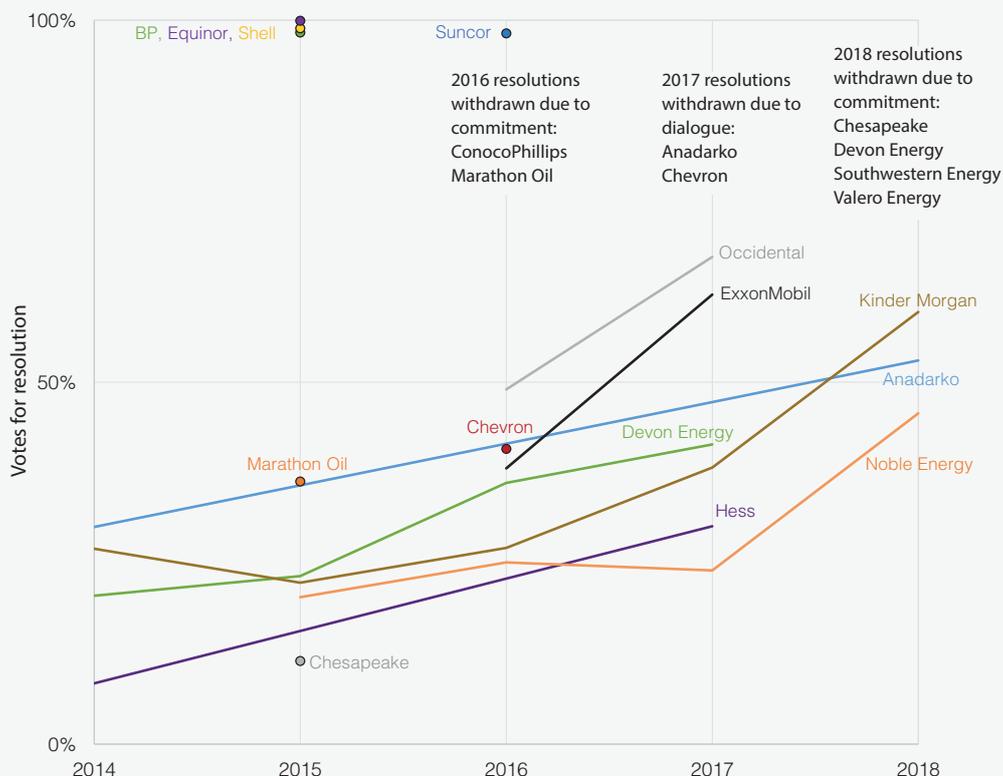


Figure 90: Votes for resolutions relating to 'reporting on 2-degree analysis and strategy'⁽ⁱ⁾



(i) Votes for these resolutions has grown from an average of 21% in 2014 to 53% in 2018 (CAGR of 26%).
Source: CDP, company reports, Ceres

Many investors are stepping up their engagement with companies and are seeking more transparency on the potential risk to earnings presented by climate change. Credit markets also want improved disclosure, for example, Moody's incorporates material ESG issues into its ratings analysis of credit quality.

Investor initiatives addressing climate change are scaling up, as illustrated by Climate Action 100+ and the Investor Agenda.⁴⁶ In July 2018 Climate Action 100+ added an additional 61 companies to the original focus list of 100 (in total there are now 39 companies on the full list that have either upstream or downstream oil & gas operations).⁴⁷ To date 310 investors with nearly US\$32 trillion in assets under management have signed onto the initiative.

In the wake of increasing climate regulation, a growing number of investors are looking for oil & gas companies to demonstrate their ability to adapt to the energy transition. Many leading companies now publicly support the TCFD and its recommendations,⁴⁸ the next step is translating ambition into meaningful action and the industry demonstrating resilience for the changes ahead.

46. The Investor Agenda: <https://theinvestoragenda.org/>

47. 18 of the 24 companies in this report are on the Climate Action 100+ list: <http://www.climateaction100.org/>

48. Within the oil & gas sector this currently includes: Eni, Equinor, Galp, Repsol, Royal Vopak, Shell, SNAM SPA, Suncor and Total. <https://www.fsb-tcfd.org/tcfd-supporters/>

Supplementary figures

Figure 91: Emissions pathways and temperature outcomes in the IPCC's RCP scenarios

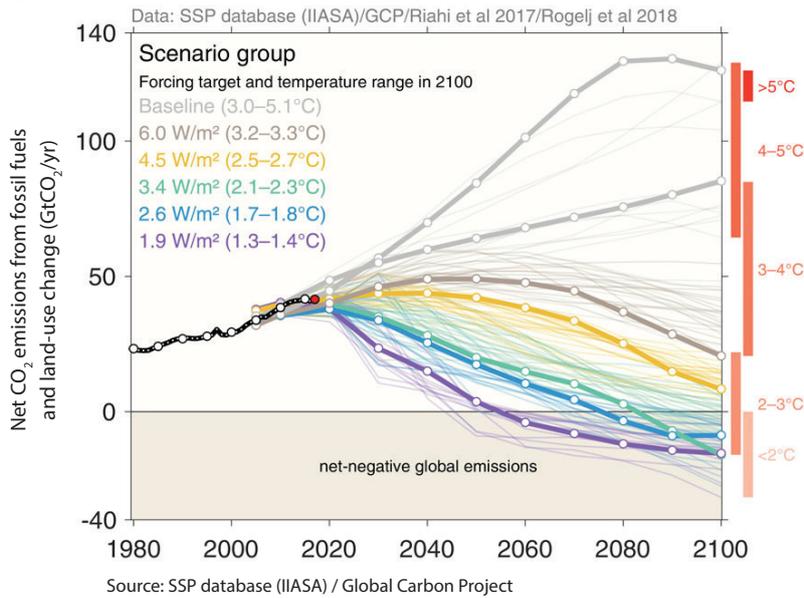


Figure 92: Company production split by region

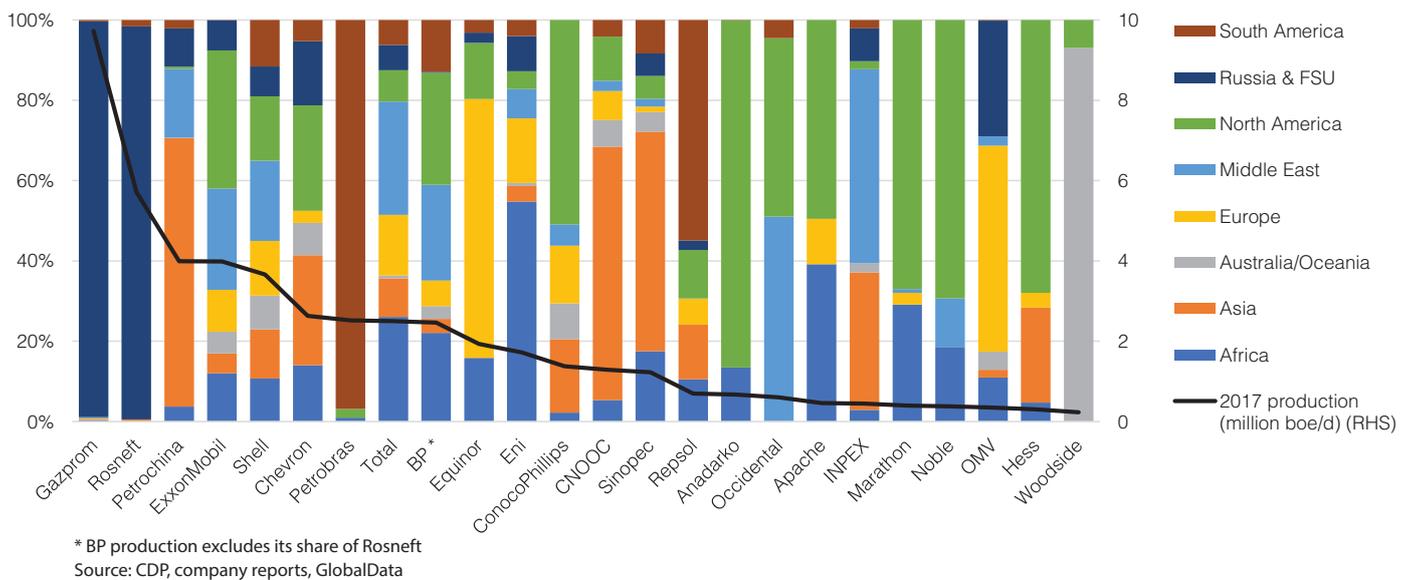
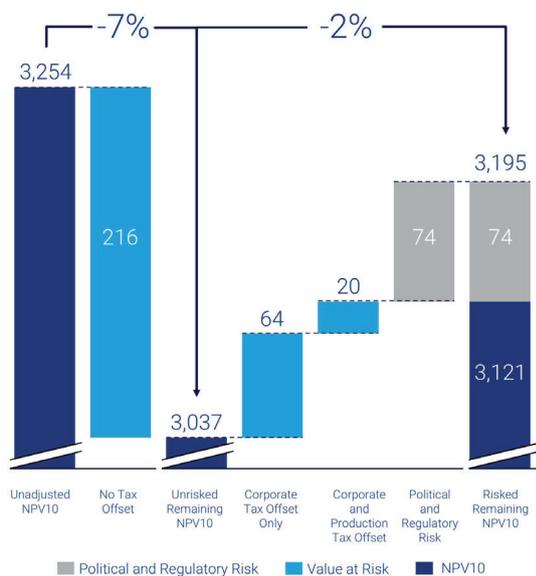


Figure 93: Corporate 'Value at Risk' (US\$bn) at a US\$40/tonne carbon cost for Scope 1+2 upstream emissions⁽ⁱ⁾



(i) The 'Value at Risk' study by Wood Mackenzie found that a US\$40/tonne carbon price applied to Scope 1+2 upstream emissions could potentially reduce the value of companies' upstream assets by 2-7% depending on fiscal and regulatory treatments as shown.

Note: Data is based on Wood Mackenzie's sample of 25 companies (which includes 23 of the companies in this report). Data represents Wood Mackenzie's understanding of company portfolios as of 1H2017 and will not reflect changes to portfolio composition or the impact of commodity price increases since that time.

Source: Wood Mackenzie:

'Beyond Paris: benchmarking upstream emissions to 2025'

Resources vs. Reserves

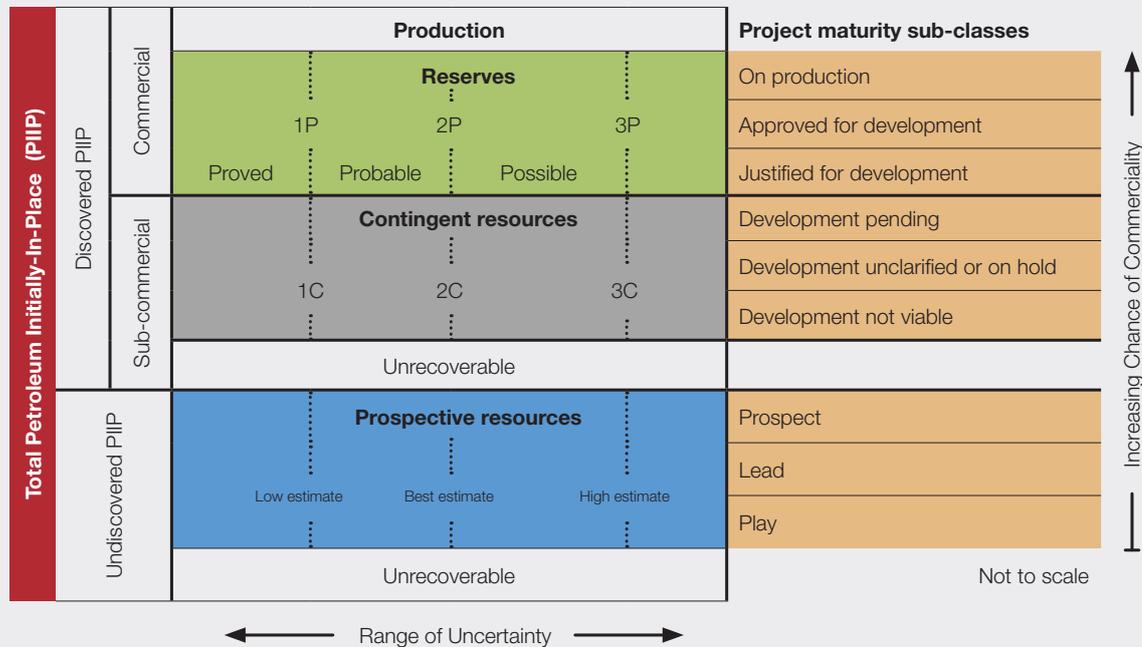
There is considerable confusion surrounding the various terms used to describe hydrocarbon assets. It is important to understand the difference between reserves and resources and distinguish between the different categories that exist, as well as the information companies are obligated to report.

Reserves refer to an estimate for the amount of technically and economically recoverable oil and gas.

- Contingent resources are potentially recoverable from known hydrocarbon accumulations but the projects are not yet mature enough to be considered commercial.
- Prospective resources are potentially recoverable from undiscovered hydrocarbon accumulations and require future development projects.

Figure 94 illustrates the classification framework as defined by the Society of Petroleum Engineers (SPE) Petroleum Resources Management System (PRMS).⁴⁹

Figure 94: Graphical representation of the PRMS Resource classification framework



Source: CDP, SPE Petroleum Resources Management System

Statements of reserves and resources are forward-looking and by definition carry uncertainty. Estimates are made either deterministically or stochastically and quantities estimated are part of a continual revision process as more geoscience and engineering data becomes available.

Reserves are further classified by their degree of uncertainty:

- Proved (1P) – Reasonable certainty of being produced (90% confidence if probabilistic methods are used, hence the alternate identification term of ‘P90’)
- Probable – Additional reserves less certain to be recovered, and in sum with proved reserves there is a 50% chance that actual quantities produced will equal or exceed this estimate i.e. 2P reserves = Proved + Probable (often referred to as P50).
- Possible – Less certain than probable. 3P = Proved + Probable + Possible. There is a 10% chance that actual quantities produced will equal or exceed 3P (hence the term P10).

Reserves are also subcategorised as developed or undeveloped. Developed reserves are expected to be recovered through existing wells and infrastructure, whereas undeveloped reserves require significant capital expenditure to be extracted, i.e. further drilling operations.

Companies disclose their reserves in accordance with strict criteria outlined by various different resource classification systems. Although the terminology varies, there is a high degree of commonality between the systems; however, some are more restrictive than others.

In this report 20 companies disclose under the guidelines of the U.S. Securities and Exchange commission (SEC)⁵⁰, which is broadly consistent with the PRMS definitions described above. Three companies (Repsol, Rosneft and Woodside Petroleum) use the PRMS system, and Gazprom discloses using the Russian A+B1+C1 classification but also provides PRMS equivalent figures. However, most companies are only obligated to report their proved (1P) reserves. Companies have the option to declare probable and possible reserves but most choose not to officially disclose this information.

For companies in this report and where information is available, proved reserves made up an average of 30% of a company’s total resource base in 2017. Although many of these resources will never see production due to economic, political or technical barriers, the absence of robust data on probable and possible reserves as well as the wider resource base is a significant loss of valuable information to investors. Estimates do exist within third-party datasets such as Wood Mackenzie; however, access to this data comes at a price and is therefore not available to the whole market. Some companies do provide broad details of their total resource base in investor presentations (e.g. ExxonMobil gives resource information in their ‘Financial and Operating Review’); however, the data is not presented consistently or periodically which makes detailed analysis and comparison across companies challenging.

With standardised reporting in addition to improved detail surrounding future project inventories, production forecasts (split by hydrocarbon type, resource play, geography), and in depth detail of portfolio stress testing against various decarbonisation scenarios, investors will be in a far better position to assess company readiness for a low-carbon transition.

49. <http://www.spe.org/industry/reserves.php>

50. <https://www.sec.gov/rules/final/2008/33-8995.pdf>

Appendix I: Company engagement traffic light system

Company performance overview

League Table rank	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Weighting Metric Area
Companies	Equinor	Total	Shell	Eni	Repsol	Woodside	BP	Gaspmom	OMV	ConocoPhillips	Hess	Chevron	Anadarko	INPEX	Noble	Petrobras	ExxonMobil	Occidental	Apache	Petrochina	Sinopec	Marathon	Rosenet	CNOOC	
Transition risks rank	3	10	9	6	5	2	11	4	7	15	14	16	8	20	1	17	23	20	13	12	18	19	21	24	35%
Production mix	6	8	7	5	2	1	10	3	4	17	16	13	21	19	11	23	14	20	15	9	12	18	22	24	30%
Proved reserves mix	8	12	9	6	3	2	10	1	7	20	17	15	11	22	4	23	18	21	13	5	16	19	14	24	30%
NPV / tonne	3	15	6	8	12	7	16	23	5	19	14	16	1	13	4	2	21	17	9	11	n/a	20	22	10	10%
Upstream emissions intensity	3	10	14	6	20	24	12	7	11	17	13	21	2	19	1	9	18	16	5	23	22	8	4	15	18%
Methane intensity	11	12	5	7	21	1	5	10	17	7	4	12	2	20	3	19	16	14	15	22	22	7	18	22	4%
Flaring intensity	1	10	12	13	7	6	15	5	14	3	20	18	11	2	4	16	19	9	8	21	21	17	21	21	4%
Scope 3 disclosure	10	9	1	2	4	6	11	19	4	8	15	11	16	6	17	3	18	11	19	19	19	11	19	19	4%
Physical risks rank	4	5	14	8	12	1	16	3	17	9	7	15	6	13	21	2	20	22	10	23	24	18	11	19	10%
Water stress exposure	3	9	12	11	14	1	16	6	20	10	2	21	19	5	15	4	17	22	13	24	23	18	7	8	45%
Fresh water withdrawal intensity	3	10	13	7	9	4	19	11	23	8	6	5	2	16	18	12	15	24	1	20	22	14	17	21	30%
Water disclosure & governance	13	2	13	7	10	10	10	3	1	9	21	13	5	13	22	4	13	6	13	22	22	13	7	13	25%
Transition opportunities rank	2	3	1	7	5	18	6	21	20	14	16	4	15	12	23	17	9	11	22	19	10	13	24	8	30%
Post-CAPEX cash margin	14	10	6	16	20	1	17	23	21	9	4	2	5	7	19	11	15	8	13	18	n/a	12	22	3	12%
Discretionary CAPEX	13	16	15	12	10	9	18	23	17	7	4	11	2	22	3	19	8	6	5	21	20	1	24	14	12%
Reserve life	5	19	6	12	9	15	16	24	4	10	7	14	2	22	18	13	20	8	3	21	1	17	23	11	9%
Financial Gearing	13	9	14	7	11	5	18	4	12	17	15	8	24	3	20	23	6	19	22	10	1	16	21	2	6%
Diversification	11	1	1	11	1	13	1	11	1	19	19	1	17	17	19	1	1	15	19	1	1	19	11	15	6%
Production costs & CAPEX intensity	2	1	11	14	5	13	12	3	6	8	23	15	19	9	20	18	7	21	17	24	22	10	4	16	9%
Finding & Development costs	9	12	17	5	4	24	14	1	21	18	16	13	10	8	3	22	20	7	19	15	23	6	2	11	6%
Alternative energy and CCUS	3	2	1	8	4	16	5	12	19	15	20	10	24	9	17	6	14	16	23	11	7	21	22	13	12%
Low-carbon spend	1	2	3	6	5	19	4	18	17	15	22	9	21	7	23	7	10	14	19	12	11	13	23	16	16%
Patent analysis	4	10	3	9	12	14	7	17	22	1	23	5	23	21	20	19	2	15	16	11	8	13	18	6	6%
Digitalisation strategy & partnerships	1	6	1	6	3	6	3	6	12	17	6	3	22	17	24	22	6	17	17	12	12	12	12	17	4%
R&D	4	1	13	8	11	18	16	12	14	7	18	10	18	17	18	2	9	18	18	5	15	18	6	3	2%
Climate governance & strategy rank	4	1	2	3	5	11	6	9	12	7	8	14	21	10	22	17	15	13	20	16	19	23	18	24	25%
Targets and ambitions	5	1	1	4	1	11	10	5	13	14	5	17	22	9	22	17	16	17	17	5	15	21	11	22	40%
Scenario analysis	1	1	1	1	11	11	5	18	15	7	11	5	15	10	21	11	7	7	15	22	19	22	19	22	25%
Climate-related remuneration	1	2	6	3	9	11	5	7	11	4	14	17	17	13	14	17	17	9	8	17	17	17	17	16	15%
Board & executive climate management	1	3	5	2	8	15	7	19	14	4	17	13	6	20	16	12	10	11	22	21	9	23	18	24	10%
TCFD & initiative support	2	2	1	4	4	11	6	21	12	14	13	8	14	18	14	10	7	9	22	20	23	14	24	18	5%
CDP Score & disclosure	6	1	7	4	3	14	10	15	4	9	2	16	19	17	18	8	21	20	22	11	11	22	11	22	5%



Source: CDP

This heat map is designed to help investors pinpoint priority areas for engagement.

We have not assigned a uniform number of green, yellow, orange and red colours across the metrics according to rank. Instead, we have reviewed the results of each metric in detail and assigned the above colours according to the underlying values for each metric.

Appendix II: Company summaries

CNOOC

Average market cap Q3 2018: US\$ 68 bn
 Free-Float: 35.6%
 Upstream production 2017: 1.3 million boe/d
 Scope 1+2 emissions 2017: 7.8 Mt CO₂

2017 Adjusted EBITDA split by business area (%)



Country: China

Ticker	League Table rank	Transition risks rank	Physical risks rank	Transition opportunities rank	Climate governance & strategy rank
883 HK	24 / 24	24	19	8	24

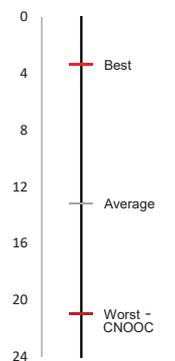
Company strengths

- CNOOC (China National Offshore Oil Corporation) ranks third for capital flexibility & resilience. It is one of only two companies to be cash positive (gearing of -1.7% at Q2 2018) and has relatively low production costs (US\$ 8.2 / boe).
- It is forecast by Wood Mackenzie to have the third highest post-CAPEX cash margin for the period 2018-2030 (US\$20.7 / boe).
- It performs well on innovation. It has the highest R&D expense as a proportion of sales (0.95%) and has the highest number of high quality patents per employee, ranking first in the areas of digitalization and batteries / fuel cells.

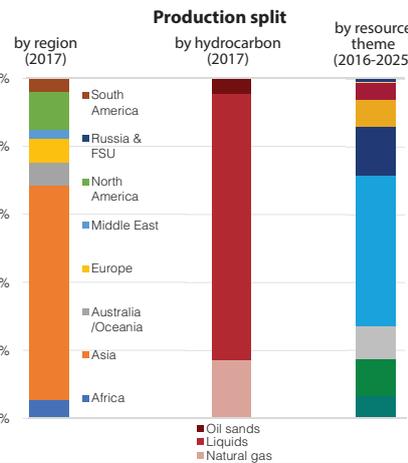
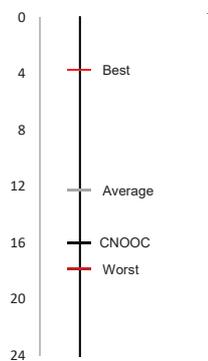
Company Weaknesses

- Ranks last for transition risks. Its portfolio has a low proportion of gas (17% of current production and 29% of proved reserves) and it is one of the only companies looking to expand its position in oil sands, with the resource theme currently making up 19% of its proved reserves, the highest within our company sample.
- Ranks poorly for emissions & resource management. It does not disclose data for methane, flaring or Scope 3 emissions and it is forecast by Wood Mackenzie to have the fourth highest upstream emissions intensity over 2016-2025 (32 kg CO₂ / boe).
- Ranks last for climate governance & strategy. It has no disclosed emissions targets, does not conduct scenario analysis, very limited disclosure of board level climate management, does not respond to CDP's questionnaire and lacks support for climate initiatives.

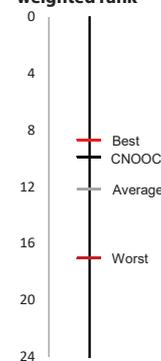
Fossil fuel asset mix weighted rank



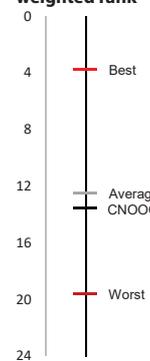
Emissions management weighted rank



Capital flexibility & resilience weighted rank



Low-carbon & innovation weighted rank



Rosneft

Average market cap Q3 2018: US\$ 61 bn
 Free-Float: 10.6%
 Upstream production 2017: 5.7 million boe/d
 Scope 1+2 emissions 2017: 76 Mt CO₂

2017 Adjusted EBITDA split by business area (%)



Country: Russia

Ticker	League Table rank	Transition risks rank	Physical risks rank	Transition opportunities rank	Climate governance & strategy rank
ROSN RM	23 / 24	21	11	24	18

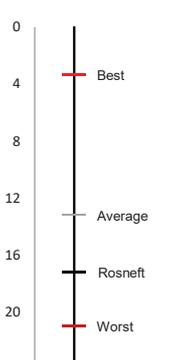
Company strengths

- Rosneft states that it is looking to make major improvements in the way it communicates ESG to external stakeholders. It is now starting to disclose more data and has responded to CDP for the last two years.
- It has the second lowest production costs (US\$3.2/boe), second lowest exploration and development intensity (US\$7.6/boe) and the second lowest finding and development costs (US\$6.5 / boe) of all 24 companies.
- Has reduced its upstream emissions intensity at the fifth quickest annual rate since 2013 (reduction rate of 6.9% p.a.) and is forecast by Wood Mackenzie to have the sixth lowest intensity over 2016-2025 (18.9 kgCO₂ / boe)
- It has set an emissions reduction target, anticipates using scenario analysis within two years and unlike its Russian peer Gazprom, it has disclosed Scope 3 emissions data.

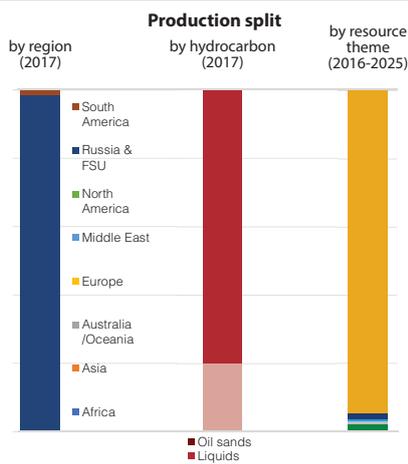
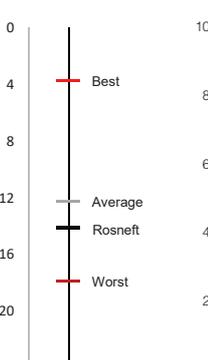
Company Weaknesses

- Ranks last for transition opportunities. It is not active in alternative energy and it ranks last for capital flexibility & resilience. We estimate it to have the lowest discretionary CAPEX over the next 5 years, at only 4.2% and it has the fourth highest level of gearing (43% at Q2 2018).
- It is forecast by Wood Mackenzie to have the second lowest post-CAPEX cash margin for the period 2018-2030 (US\$6.2 / boe) and to have the second lowest NPV/tonne over the remaining life of post-FID assets (US\$108 / t CO₂).
- Portfolio is heavily biased to oil. Gas share of its portfolio is 20% of current production and 30% of proved reserves.
- Has no evidence of any climate-related remuneration and shows a lack of support for climate initiatives in the industry.

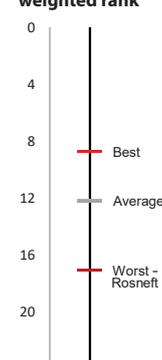
Fossil fuel asset mix weighted rank



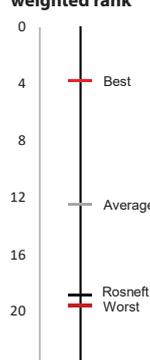
Emissions management weighted rank



Capital flexibility & resilience weighted rank



Low-carbon & innovation weighted rank



Marathon Oil

Average market cap Q3 2018: US\$ 15 bn
 Upstream production 2017: 0.40 million boe/d
 Scope 1+2 emissions 2017: 3.8 Mt CO₂

Free-Float: 99.7%

2017 Adjusted EBITDA split by business area (%)



Country: USA

Ticker	League Table rank	Transition risks rank	Physical risks rank	Transition opportunities rank	Climate governance & strategy rank
MRO US	22 / 24	19	18	13	23

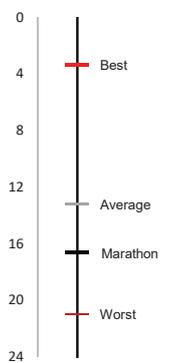
Company strengths

- Marathon Oil ranks eighth for capital flexibility & resilience. It has the highest exposure to short-cycle US unconventional providing it with optionality in capital allocation (discretionary CAPEX over 2018-2022 estimated to be 92%).
- It has reduced production costs the fourth quickest since 2014 (reduction rate of 15% p.a.) and has also significantly reduced exploration and development intensity (reduction rate of 30% p.a. since 2014). It has been the sixth most efficient at adding reserves over the period 2013-2017 with finding and development costs at US\$17 / boe.
- It fully divested its Canadian oil sands business in March 2017 and now has no exposure to the higher cost, higher carbon resource theme.

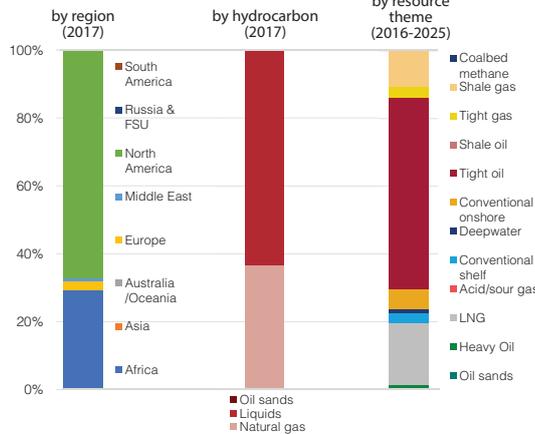
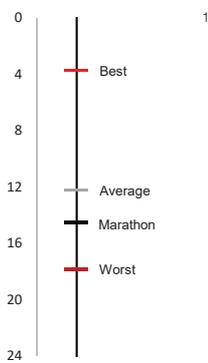
Company Weaknesses

- Ranks second last for climate governance & strategy. It has no climate-related remuneration, has very limited disclosure of board level climate risk management and does not respond to CDP's questionnaire.
- It does not conduct scenario analysis and has not set a corporate emissions or flaring target. However, we note it does have a methane intensity target.
- It does not disclose flaring or Scope 3 emissions data and it is forecast by Wood Mackenzie to have the fourth worst NPV/tonne over the remaining life of post-FID assets (US\$123 / t CO₂).
- Performs poorly for low-carbon assets & innovation. It does not have any alternative energy assets and has no R&D budget. However, it has recently launched digital oilfield capabilities at Eagle Ford.

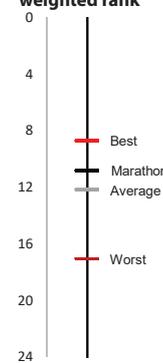
Fossil fuel asset mix weighted rank



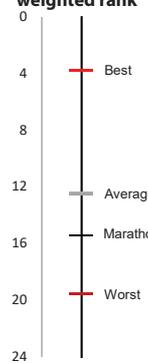
Emissions management weighted rank



Capital flexibility & resilience weighted rank



Low-carbon & innovation weighted rank



Sinopec

Average market cap Q3 2018: US\$ 117 bn
 Upstream production 2017: 1.2 million boe/d
 Scope 1+2 emissions 2017: 163 Mt CO₂

Free-Float: 28.1%

2017 Adjusted EBITDA split by business area (%)



Country: China

Ticker	League Table rank	Transition risks rank	Physical risks rank	Transition opportunities rank	Climate governance & strategy rank
600028 CH / 386 HK	21 / 24	18	24	10	19

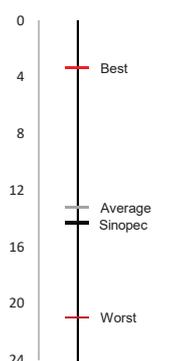
Company strengths

- Sinopec (China Petroleum & Chemical Corporation) has a diversified portfolio and is the most downstream orientated company in our sample. It ranks relatively well for low-carbon & innovation with a portfolio in solar, geothermal, biofuels and CCUS.
- It has leading balance sheet strength (is cash positive with gearing of -3.7% at Q2 2018). However, proportion of discretionary CAPEX is low (estimate of only 10% for 2018-2022).
- It has increased the share of gas in its production at 9.8% p.a. since 2002. We expect its gas share of production to increase further to around 45% by 2022 (current share is 34%).

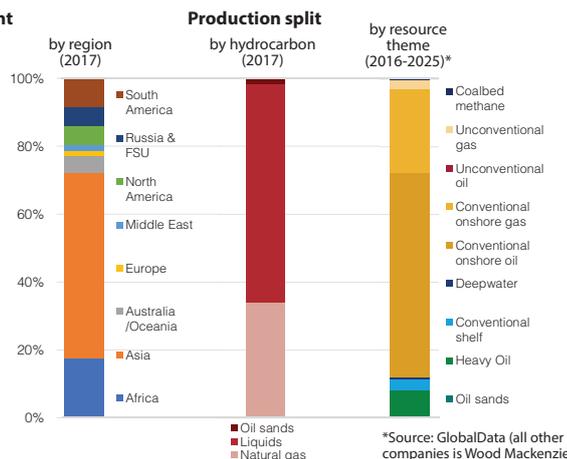
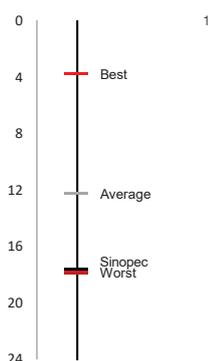
Company Weaknesses

- Ranks third last for emissions and resource management. It does not disclose any data for methane, flaring or Scope 3 emissions and 2017 was the first year it disclosed any emissions data. It has the second highest upstream emissions intensity (46 kgCO₂e / boe).
- Ranks last for physical risks. Disclosure of data is poor and evidence of water governance & policy is lacking. Both its upstream and downstream assets have relatively high exposure to water stress risk.
- Has no disclosure suggesting climate-related remuneration, shows limited support for climate initiatives within the sector and does not disclose the details of its emissions reduction target. However, we note that it anticipates using climate-related scenario analysis within two years.

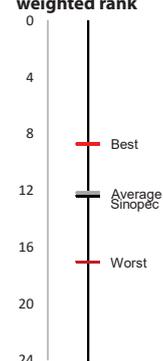
Fossil fuel asset mix weighted rank



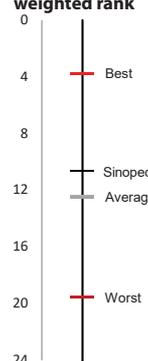
Emissions management weighted rank



Capital flexibility & resilience weighted rank



Low-carbon & innovation weighted rank



Petrochina

Country: China

Average market cap Q3 2018: US\$ 215 bn

Upstream production 2017: 4.0 million boe/d

Scope 1+2 emissions 2016: 193 Mt CO₂ (estimate)

Free-Float: 12.7%

2017 Adjusted EBITDA split by business area (%)



Ticker	League Table rank	Transition risks rank	Physical risks rank	Transition opportunities rank	Climate governance & strategy rank
601857 CH / 857 HK	20 / 24	12	23	19	16

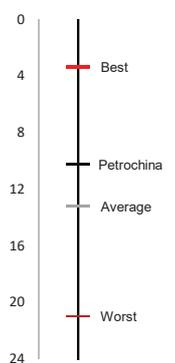
Company strengths

- Petrochina is the listed arm of state-owned China National Petroleum Corporation (CNPC). It has a diversified portfolio across upstream, downstream and chemicals. It has one of the largest biofuels portfolios and is a member of the OGCI.
- It has a high share of gas in its proved reserves (63%) and it has increased the share of gas in its production at 8.4% p.a. since 2002. We expect its gas share of production to increase further to around 45% by 2022 (current share is 39%).
- Despite not disclosing emissions data its Scope 1+2 emissions reduction target is relatively ambitious, aiming to reduce emissions intensity by 25% from 2015 to 2020.

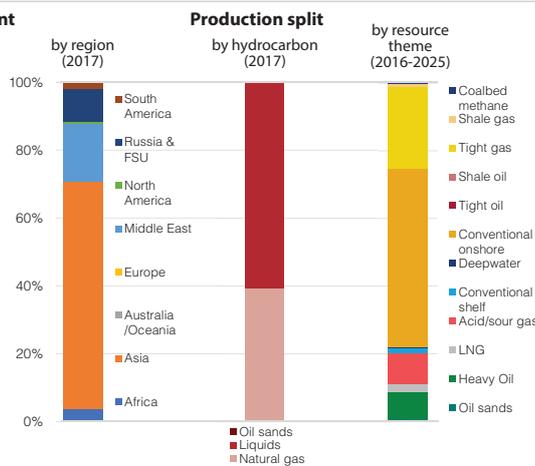
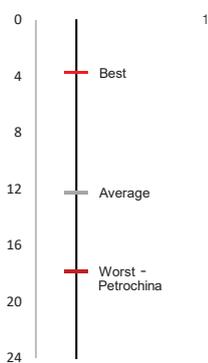
Company Weaknesses

- Disclosure of data remains a key issue. It does not yet disclose any emissions data.
- Ranks second last for physical risks. It has the highest exposure to water stress for both its upstream and downstream assets and ranks poorly for water disclosure, governance and policy.
- Ranks second last for capital flexibility & resilience. It has the fourth lowest proportion of discretionary CAPEX (estimate of 10% for 2018-2022) and is forecast to have a low post-CAPEX cash margin for the period 2018-2030 (US\$11.7 / boe).
- It does not have any climate-related remuneration and has not conducted any scenario analysis.

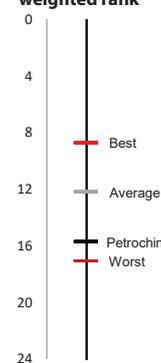
Fossil fuel asset mix weighted rank



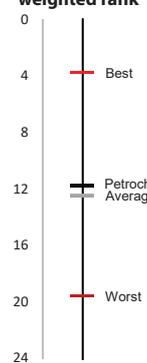
Emissions management weighted rank



Capital flexibility & resilience weighted rank



Low-carbon & innovation weighted rank



Apache

Country: USA

Average market cap Q3 2018: US\$ 16 bn

Upstream production 2017: 0.46 million boe/d

Scope 1+2 emissions 2016: 8.9 Mt CO₂

Free-Float: 99.8%

2017 Adjusted EBITDA split by business area (%)



Ticker	League Table rank	Transition risks rank	Physical risks rank	Transition opportunities rank	Climate governance & strategy rank
APA US	19 / 24	13	10	22	20

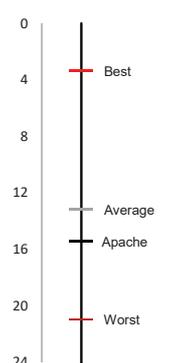
Company strengths

- Apache's upstream emission intensity is relatively low (20 kgCO₂e / boe) and it is forecast by Wood Mackenzie to also have a relatively low intensity over 2016-2025 (21 kgCO₂ / boe).
- Its flaring intensity is below the sample average (4.7 kgCO₂e / boe). However, it is one of only six companies to not disclose any data for Scope 3 emissions.
- It has reduced its fresh water withdrawal intensity the most since 2014 (reduction rate of 43% p.a.) and now has the second lowest intensity (0.07 bbls water / boe).
- Has the third lowest reserve life (7.2 years) with a high proportion of developed reserves (87%). It is estimated to have the fifth highest proportion of discretionary CAPEX (estimate of 70% for 2018-2022).

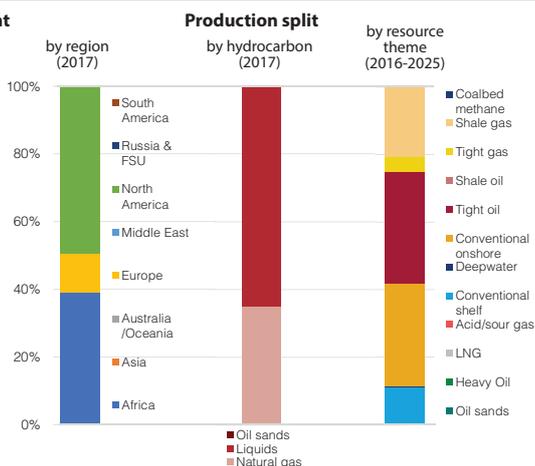
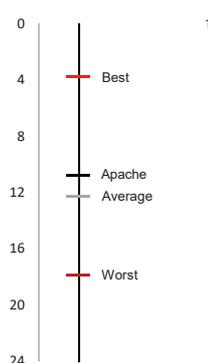
Company Weaknesses

- Apache ranks in the bottom five for climate governance & strategy. It did not respond to CDP's 2018 questionnaire, has not supported the TCFD and is not a member of IPIECA. It also performs poorly for board & executive climate management.
- It has not assessed the impacts of low-carbon scenarios on its portfolio and has not set a corporate emissions or flaring reduction target; however, it does have a methane target.
- It has the third highest level of gearing (45% at Q2 2018).
- Ranks fourth last for low-carbon & innovation. It does not have any alternative energy assets and has no R&D expenditure.

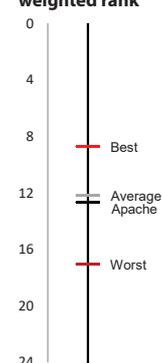
Fossil fuel asset mix weighted rank



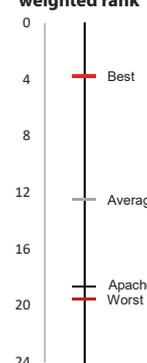
Emissions management weighted rank



Capital flexibility & resilience weighted rank



Low-carbon & innovation weighted rank



Occidental

Country: USA

Average market cap Q3 2018: US\$ 56 bn

Free-Float: 99.7%

Upstream production 2017: 0.60 million boe/d

Scope 1+2 emissions 2017: 16 Mt CO₂

2017 Adjusted EBITDA split by business area (%)



Ticker	League Table rank	Transition risks rank	Physical risks rank	Transition opportunities rank	Climate governance & strategy rank
OXY US	18 / 24	22	22	11	13

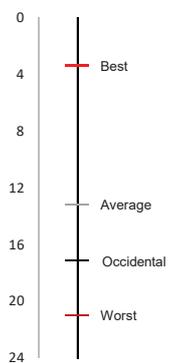
Company strengths

- Occidental ranks sixth for capital flexibility & resilience. Its relatively high exposure to short-cycle US unconventional provides more optionality in capital allocation (discretionary CAPEX over 2018-2022 estimated to be 64%).
- It is forecast by Wood Mackenzie to have a relatively high post-CAPEX cash margin for the period 2018-2030 (US\$17.3 / boe).
- Has strong expertise in CCUS for enhanced oil recovery (EOR) and in 2018 an executive compensation metric related to the advancement of CCUS was added.
- It assessed impacts to its portfolio under a 2-degree scenario, published in its "Climate-related risks and opportunities" report. This followed the majority shareholder vote in 2017 (votes for: 67%).

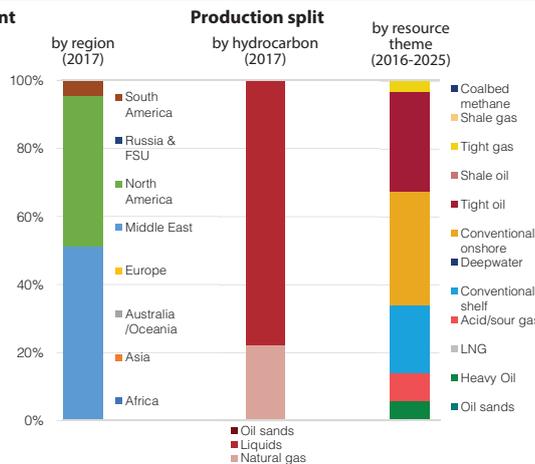
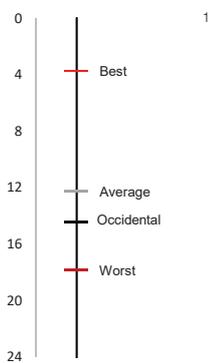
Company Weaknesses

- Ranks third last for transition risk. Its portfolio is heavily biased to oil (gas share of 2017 production only 22%) and performs relatively poorly for emissions & resource management.
- Its upstream emissions intensity has increased by 1.7% p.a. since 2013. It is forecast by Wood Mackenzie to have the sixth highest intensity over 2016-2025 (27.3 kgCO₂/boe) and the seventh worst NPV/tonne over the remaining life of post-FID assets (US\$138 / t CO₂).
- It has not set a corporate emissions reduction target. However, it looks to end routine flaring by 2030 and recently joined the OGCI.
- It has a relatively high level of gearing (30% at Q2 2018) and has the fourth highest production costs (US\$11.7 / boe).

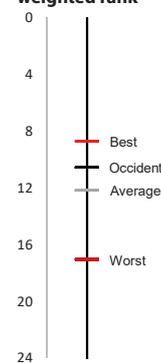
Fossil fuel asset mix weighted rank



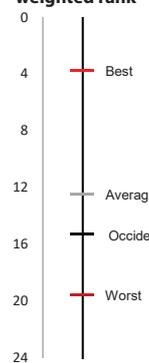
Emissions management weighted rank



Capital flexibility & resilience weighted rank



Low-carbon & innovation weighted rank



ExxonMobil

Country: USA

Average market cap Q3 2018: US\$ 343 bn

Free-Float: 99.8%

Upstream production 2017: 4.0 million boe/d

Scope 1+2 emissions 2016: 125 Mt CO₂

2017 Adjusted EBITDA split by business area (%)



Ticker	League Table rank	Transition risks rank	Physical risks rank	Transition opportunities rank	Climate governance & strategy rank
XOM US	17 / 24	23	20	9	15

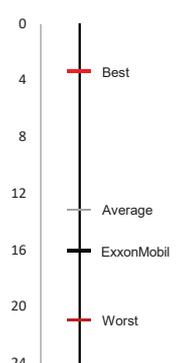
Company strengths

- ExxonMobil has a diversified portfolio across upstream, downstream and chemicals. It performs relatively well for low-carbon & innovation (ranks 8th) with strong expertise in CCUS and advanced biofuels. It ranks second in our analysis of high quality patents and is partnering with companies such as IBM to integrate digital solutions in operations.
- Compared with the integrated Majors, it has the highest proportion of discretionary CAPEX (estimate of 49% for 2018-2022) and also has a relatively low level of gearing (16% at Q2 2018).
- Exploration and development intensity is the third lowest of the company sample (US\$8 / boe).
- It has assessed impacts to its portfolio under 2-degree scenarios, published in its "Energy & Carbon summary". This followed the majority shareholder vote in 2017 (votes for: 62%).

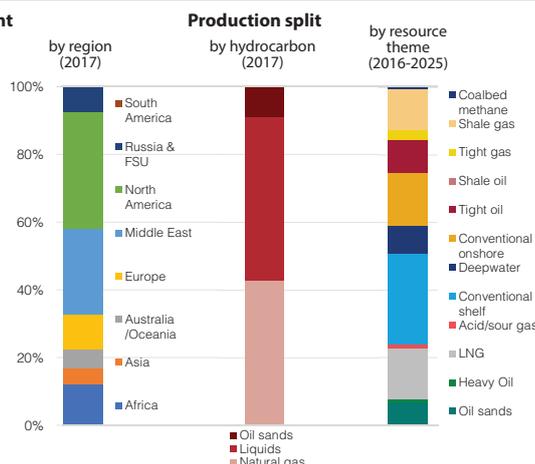
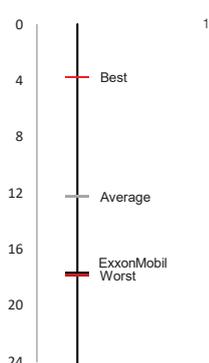
Company Weaknesses

- Ranks second last for transition risks. It has a relatively high share of its portfolio in oil sands (9% of current production and 7% of proved reserves) and ranks second last for emissions & resource management.
- Its upstream emissions intensity has increased by 1.8% p.a. since 2013. It is forecast by Wood Mackenzie to have the seventh highest intensity over 2016-2025 (27.3 kgCO₂/boe) and the third worst NPV/tonne over the remaining life of post-FID assets (US\$119 / t CO₂).
- Ranks in the lower half for climate governance & strategy. It has no climate-related remuneration and has no overall corporate emissions reduction target. However, we note that it has recently set methane and flaring targets (looking to reduce methane emissions by 15% and flaring by 25% by 2020). It did not respond to CDP's 2018 questionnaire, has not officially supported the TCFD but has recently joined the OGCI.

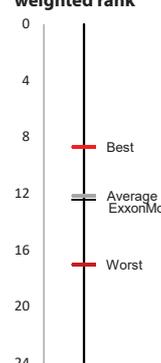
Fossil fuel asset mix weighted rank



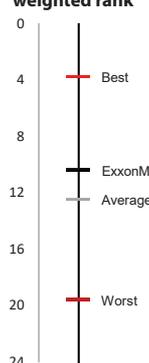
Emissions management weighted rank



Capital flexibility & resilience weighted rank



Low-carbon & innovation weighted rank



Petrobras

Average market cap Q3 2018: US\$ 73 bn
 Upstream production 2017: 2.5 million boe/d
 Scope 1+2 emissions 2017: 67 Mt CO₂

Free-Float: 51.3%

2017 Adjusted EBITDA split by business area (%)



Country: Brazil

Ticker	League Table rank	Transition risks rank	Physical risks rank	Transition opportunities rank	Climate governance & strategy rank
PETR3 BZ / PETR4 BZ	16 / 24	17	2	17	17

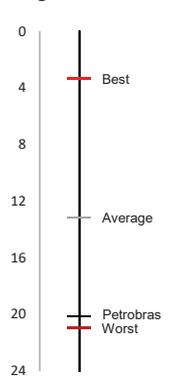
Company strengths

- ▶ Petrobras states that a transition to a low-carbon economy is a key strategy in its 2018-2022 business plan. It is looking to resume investment in renewable energy after reducing debt levels and has recently signed MOUs with Total and Equinor for possible development of solar and wind technologies in Brazil.
- ▶ Despite selling out of biofuel production (it still has some biodiesel plants) it ranks in the top half of our company sample for low-carbon assets and innovation. It has experience in CCUS and has a relatively high R&D spend (it is one of only six companies to give a categorized breakdown of low-carbon R&D).
- ▶ It is forecast to have the second best NPV/tonne over the remaining life of post-FID assets (US\$363 / t CO₂).
- ▶ Has low exposure to water stress risk with an upstream portfolio primarily focused offshore and downstream assets in low to medium risk areas.

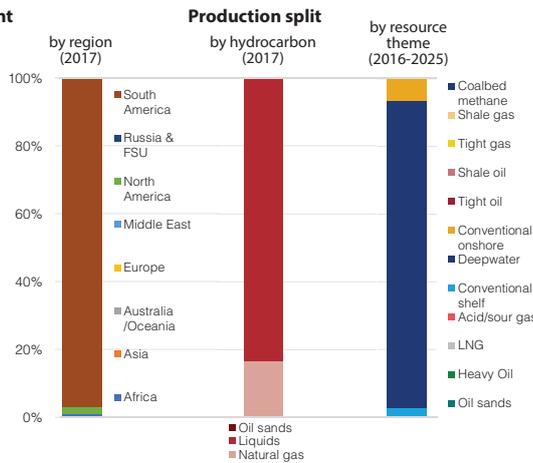
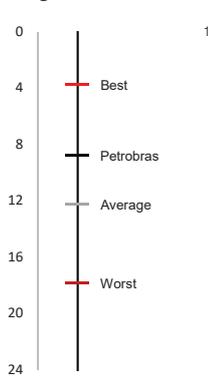
Company Weaknesses

- ▶ Ranks second last for its fossil fuel asset mix. It has the lowest proportion of natural gas for both production and proved reserves (only 17% of current production and 14% of proved reserves).
- ▶ Ranks in the bottom three for capital flexibility & resilience. It has heavy exposure to longer-cycle assets giving it less optionality in capital allocation (we estimate discretionary CAPEX over 2018-2022 to only be 15%).
- ▶ Company strategy remains focused on reducing levels of debt - it has the second highest level of gearing of the company sample (50% at Q2 2018).
- ▶ Has no corporate emissions reduction target, has not officially supported the TCFD, and has no evidence of climate-related remuneration.

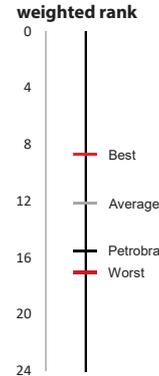
Fossil fuel asset mix weighted rank



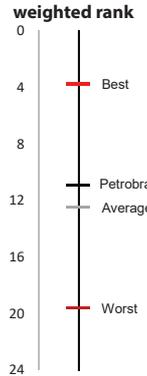
Emissions management weighted rank



Capital flexibility & resilience weighted rank



Low-carbon & innovation weighted rank



Noble Energy

Average market cap Q3 2018: US\$ 15 bn
 Upstream production 2017: 0.38 million boe/d
 Scope 1+2 emissions 2017: 2.5 Mt CO₂

Free-Float: 98.9%

2017 Adjusted EBITDA split by business area (%)



Country: USA

Ticker	League Table rank	Transition risks rank	Physical risks rank	Transition opportunities rank	Climate governance & strategy rank
NBL US	15 / 24	1	21	23	22

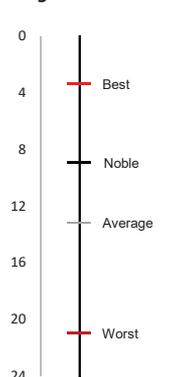
Company strengths

- ▶ Noble Energy ranks first for transition risks, ranking fourth for fossil fuel asset mix and third for emissions and resource management. It has a high share of its proved reserves in gas (65%), relatively low methane and flaring intensities and third lowest current upstream emissions intensity (14 kg CO₂e/boe).
- ▶ It is forecast by Wood Mackenzie to have the lowest upstream emissions intensity over 2016-2025 (10.8 kgCO₂ /boe) and fourth best NPV/tonne over the remaining life of post-FID assets (US\$310 / tCO₂).
- ▶ Has the third highest proportion of discretionary CAPEX (estimate of 85% for 2018-2022).

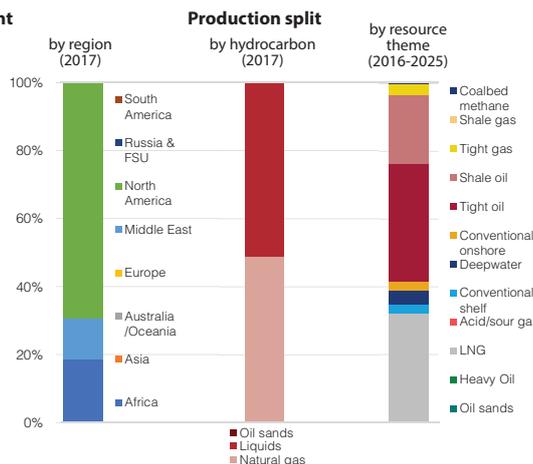
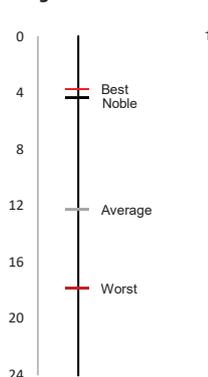
Company Weaknesses

- ▶ Ranks third last for climate governance & strategy. It has not set any corporate emissions, methane or flaring reduction targets and shows limited support for other climate initiatives within the industry. However, we note that achieving emission reduction and efficiency goals contributes to the annual bonus for employees.
- ▶ It does not conduct scenario analysis, and in 2018 narrowly avoided a majority vote for reporting on 2-degree analysis (votes for: 45.7%). However, it says it anticipates using an internal carbon price within 2 years.
- ▶ Ranks second last for transition opportunities. It is forecast to have a relatively low post-CAPEX cash margin for the period 2018-2030 (US\$10.9 / boe) and has a high level of gearing (35% for Q2 2018). Ranks poorly for innovation, with no R&D spend and lacks evidence of a digitalization strategy.

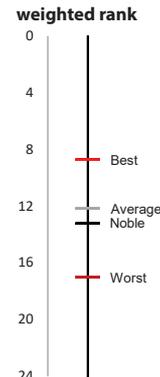
Fossil fuel asset mix weighted rank



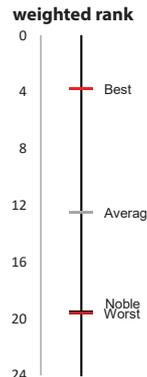
Emissions management weighted rank



Capital flexibility & resilience weighted rank



Low-carbon & innovation weighted rank



INPEX

Country: Japan

Average market cap Q3 2018: US\$ 17 bn

Free-Float: 66.2%

Upstream production 2017: 0.45 million boe/d

Scope 1+2 emissions 2017: 0.9 Mt CO₂

2017 Adjusted EBITDA split by business area (%)



Ticker	League Table rank	Transition risks rank	Physical risks rank	Transition opportunities rank	Climate governance & strategy rank
1605 JP	14 / 24	20	13	12	10

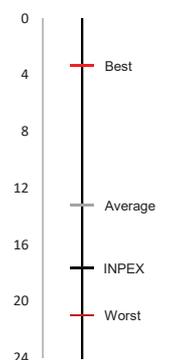
Company strengths

- With its "Vision 2040" INPEX aims to be a leading, sustainable energy company and is looking to expand its renewable projects to account for 10% of its portfolio by 2040.
- Share of production from gas is expected to increase significantly from current level of 27% to 42% by 2022, primarily due to large-scale LNG projects coming online (e.g. Ichthys in Australia).
- Has a strong balance sheet relative to peers with the third best gearing (6% at Q2 2018) and is forecast to have a relatively high post-CAPEX cash margin over 2018-2030 (US\$18.9 / boe).
- Has one of the lowest production costs (US\$5.9 / boe) which has declined at the steepest rate of all companies (reduction of 19% p.a. since 2014).

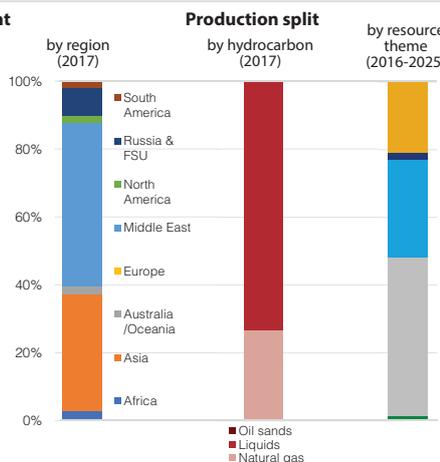
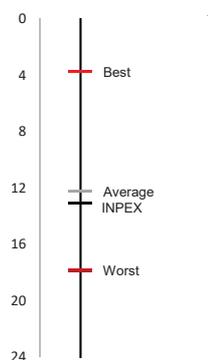
Company Weaknesses

- Lacks exposure to shorter-cycle assets such as US unconventional, has the third highest reserve life (19 years), and we estimate its discretionary CAPEX over the next five years to be only 8%, the third lowest of our company sample.
- It has the second highest methane intensity (0.78% of gas production) and it is forecast by Wood Mackenzie to have the second highest upstream emissions intensity over 2016-2025 at 35 kgCO₂ / boe. However, we note that it currently has the second lowest flaring intensity (1.3 kg CO₂ / boe).
- Has the highest 2017 exploration and development intensity of the company sample (US\$18.5 / boe).

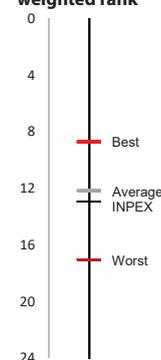
Fossil fuel asset mix weighted rank



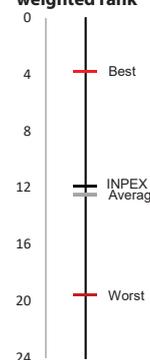
Emissions management weighted rank



Capital flexibility & resilience weighted rank



Low-carbon & innovation weighted rank



Anadarko

Country: USA

Average market cap Q3 2018: US\$ 32 bn

Free-Float: 99.7%

Upstream production 2017: 0.67 million boe/d

Scope 1+2 emissions 2017: 6.6 Mt CO₂

2017 Adjusted EBITDA split by business area (%)



Ticker	League Table rank	Transition risks rank	Physical risks rank	Transition opportunities rank	Climate governance & strategy rank
APC US	13 / 24	8	6	15	21

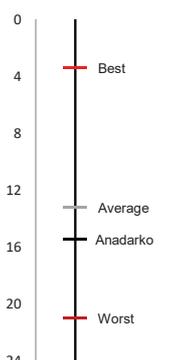
Company strengths

- Anadarko ranks first for capital flexibility & resilience. It has the lowest proved reserve life (6.2 years), with a high proportion of developed reserves (78%). It has high exposure to short-cycle US shale assets and we estimate its discretionary CAPEX over 2018-2022 to be 87%. It is forecast to have the fifth highest post-CAPEX cash margin over the period 2018-2030 (US\$20.2 / boe). However, we note it has the highest level of gearing (55% at Q2 2018).
- Ranks second for emissions & resource management. It has the second lowest current E&P emissions intensity (13kgCO₂e / boe), having reduced it the most since 2013 (reduction rate of 19% p.a.), and is also forecast to have the second lowest intensity over 2016-2025 (13 kgCO₂ / boe).
- It has the second lowest methane intensity (0.16%) and is forecast to have the highest NPV/tonne over the remaining life of post-FID assets (US\$426 / t CO₂).

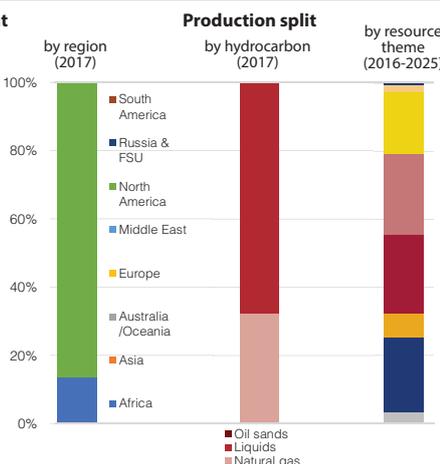
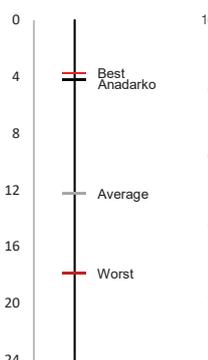
Company Weaknesses

- Ranks fourth last for climate governance & strategy. It has not set any corporate emissions, methane or flaring reduction targets, has no evidence of climate-related remuneration, and shows limited support for other climate initiatives within the industry. We note that following a majority shareholder vote in 2018 for reporting on 2-degree analysis (votes for: 53%) it is likely to publish a standalone climate risk report.
- Has a relatively low share of gas in its portfolio (33% of current production and 37% of proved reserves).
- Ranks last for low-carbon assets & innovation. It is not active in alternative energy, has no R&D budget and no high quality patents. Its digitalization activities and strategy also appears to be limited.

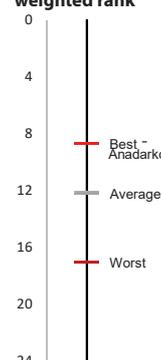
Fossil fuel asset mix weighted rank



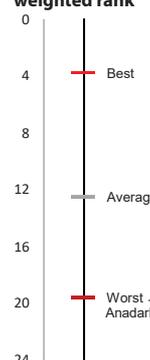
Emissions management weighted rank



Capital flexibility & resilience weighted rank



Low-carbon & innovation weighted rank



Chevron

Country: USA

Average market cap Q3 2018: US\$ 230 bn
 Upstream production 2017: 2.6 million boe/d
 Scope 1+2 emissions 2017: 60 Mt CO₂

Free-Float: 100%

2017 Adjusted EBITDA split by business area (%)



Ticker	League Table rank	Transition risks rank	Physical risks rank	Transition opportunities rank	Climate governance & strategy rank
CVX US	12 / 24	16	15	4	14

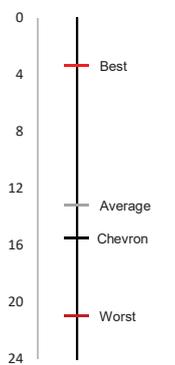
Company strengths

- Chevron ranks fourth for transition opportunities, ranking second for capital flexibility & resilience. Its discretionary CAPEX is higher than the group average, it has a relatively low level of gearing (17% at Q2 2018) and it is forecast by Wood Mackenzie to have the second highest post-CAPEX cash margin over 2018-2030 at US\$20.8 / boe.
- It ranks in seventh place for low-carbon assets and innovation. In 2017 it sold its SE Asia geothermal assets and now has a relatively small but diverse renewable portfolio across solar, wind, biofuels and geothermal. It is active in CCUS, (operates Gorgon project) and has a strong digitalization and innovation strategy through its integrated Energy Technology Company.
- Has now published two standalone reports assessing climate risk and impacts of 2-degree scenarios to its portfolio.

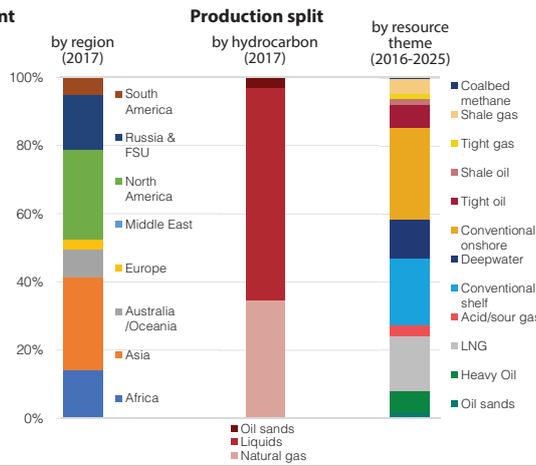
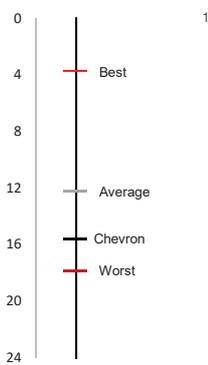
Company Weaknesses

- Ranks in the bottom half for climate governance & strategy. It lacks a company-wide emissions reduction target and has no evidence of climate-related remuneration. It did not respond to CDP's 2018 questionnaire and has not officially supported the TCFD; however, we note that it recently joined the OGC.
- Its current portfolio is oil heavy, with only 35% of production in gas, but this is expected to rise to 41% by 2022 as large LNG projects Gorgon and Wheatstone ramp up.
- Ranks in the bottom five for emissions & resource management. Its current flaring intensity is the third highest (8.6 kgCO₂e / boe) and it is forecast by Wood Mackenzie to have the third highest upstream emissions intensity over 2016-2025 (34 kgCO₂ / boe).

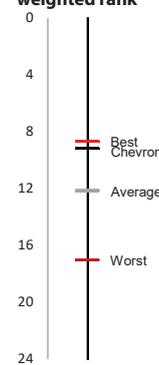
Fossil fuel asset mix weighted rank



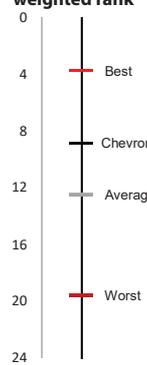
Emissions management weighted rank



Capital flexibility & resilience weighted rank



Low-carbon & innovation weighted rank



Hess

Country: USA

Average market cap Q3 2018: US\$ 17 bn
 Upstream production 2017: 0.31 million boe/d
 Scope 1+2 emissions 2017: 4.1 Mt CO₂

Free-Float: 93.5%

2017 Adjusted EBITDA split by business area (%)



Ticker	League Table rank	Transition risks rank	Physical risks rank	Transition opportunities rank	Climate governance & strategy rank
HES US	11 / 24	14	7	16	8

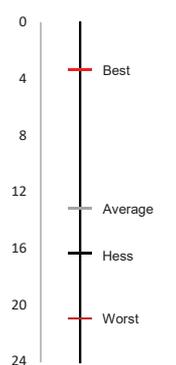
Company strengths

- Hess ranks fifth for capital flexibility & resilience. Its relatively high exposure to short-cycle US unconventional provides more optionality in capital allocation (discretionary CAPEX over 2018-2022 estimated to be 80%) and it has a relatively low reserve life (9.2 years).
- It is forecast by Wood Mackenzie to have the fourth best post-CAPEX cash margin for the period 2018-2030 (US\$20.5 / boe).
- It has the fourth lowest current methane intensity (0.19% of gas production) and has reduced its upstream emissions intensity by 6.8% p.a. since 2013. It has set corporate emissions, methane and flaring reduction targets, and is currently conducting carbon asset risk scenario analysis with results to be published in 2019.

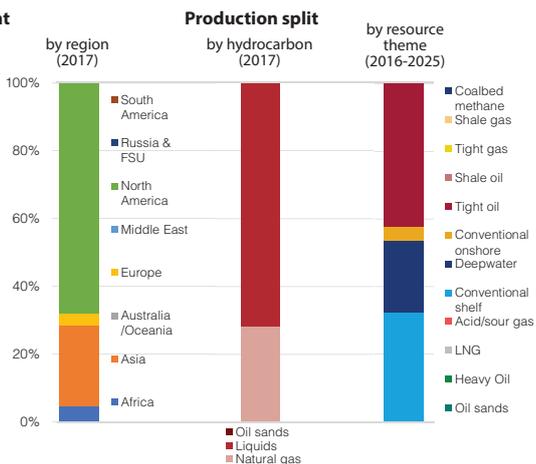
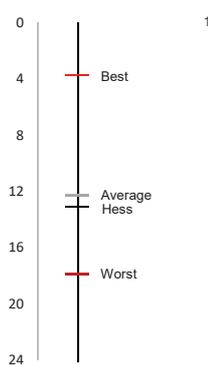
Company Weaknesses

- Hess has the highest flaring intensity at 15.5 kgCO₂e / boe, with flaring making up more than 50% of its total operated Scope 1 emissions.
- Has a relatively low share of gas in its portfolio (28% of current production and 28% of proved reserves).
- It has the highest product costs (US\$16 / boe) and second highest exploration and development intensity (US\$18 / boe) of the 24 companies.
- Ranks poorly for low-carbon assets and innovation. Does not have any low-carbon assets, has no R&D budget and no high quality patents. However, we note that it is looking to incorporate digital technologies into operations and targets purchasing at least 10% of net electricity from renewables each year.

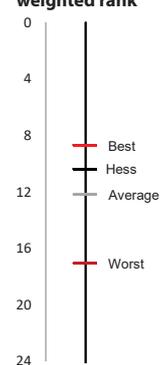
Fossil fuel asset mix weighted rank



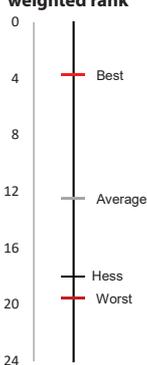
Emissions management weighted rank



Capital flexibility & resilience weighted rank



Low-carbon & innovation weighted rank



ConocoPhillips

Average market cap Q3 2018: US\$ 72 bn
 Upstream production 2017: 1.4 million boe/d
 Scope 1+2 emissions 2017: 21 Mt CO₂

Free-Float: 99.9%

2017 Adjusted EBITDA split by business area (%)

Country: USA



Ticker	League Table rank	Transition risks rank	Physical risks rank	Transition opportunities rank	Climate governance & strategy rank
COP US	10 / 24	15	9	14	7

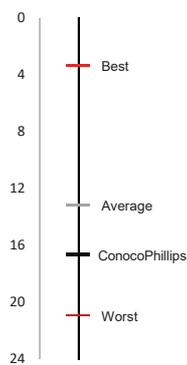
Company strengths

- ConocoPhillips is the highest ranked company from the US. It has a relatively strong performance for climate governance & strategy, ranking seventh. It ranks highly for both climate-related remuneration and board & executive climate management.
- It currently tests its portfolio against four decarbonization scenarios and is looking to publish a standalone climate report in the near future.
- Ranks first in our patent analysis, with high quality patents across a range of technologies.
- Exposure to shorter-cycle US unconventional gives it some capital flexibility and we estimate its discretionary CAPEX over 2018-2022 to be relatively high at 54%.

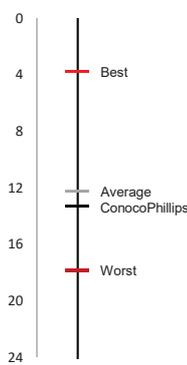
Company Weaknesses

- It still has some exposure to oil sands. However, this was significantly reduced with asset sales in March 2017, reducing exposure to 5% of proved reserves for year end 2017 (share in 2016 was 20%).
- It is forecast by Wood Mackenzie to have the fifth worst NPV/tonne over the remaining life of post-FID assets (US\$124 / t CO₂).
- Its upstream emissions intensity has not reduced since 2013 and its current intensity ranks in the lower half of the company sample (33 kgCO₂e / boe). However, it does have the third lowest flaring intensity (1.7 kgCO₂e / boe).
- Its emissions reduction target is not as ambitious as some companies and it has not officially supported the TCFD.

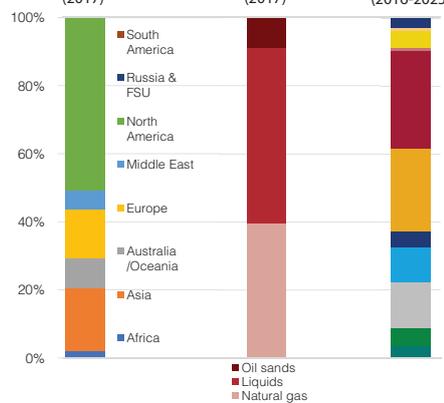
Fossil fuel asset mix weighted rank



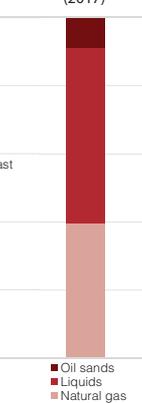
Emissions management weighted rank



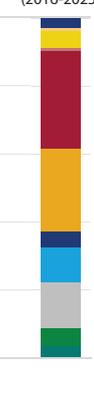
Production split by region (2017)



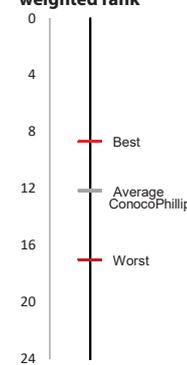
Production split by hydrocarbon (2017)



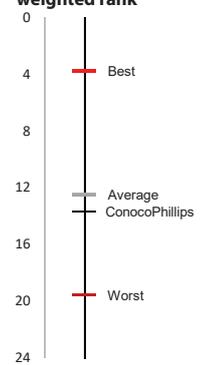
Production split by resource theme (2016-2025)



Capital flexibility & resilience weighted rank



Low-carbon & innovation weighted rank



OMV

Average market cap Q3 2018: US\$ 19 bn
 Upstream production 2017: 0.35 million boe/d
 Scope 1+2 emissions 2017: 11 Mt CO₂

Free-Float: 68.3%

2017 Adjusted EBITDA split by business area (%)

Country: Austria



Ticker	League Table rank	Transition risks rank	Physical risks rank	Transition opportunities rank	Climate governance & strategy rank
OMV AV	9 / 24	7	17	20	12

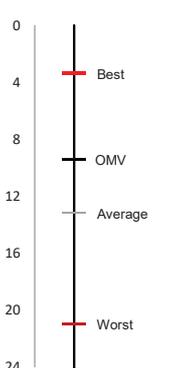
Company strengths

- OMV is aggressively shifting its portfolio towards gas. Current share of production from gas is 48% and we expect this to rise to around 60% by 2022. More than half of its proved reserves are in gas and it has no exposure to oil sands.
- It is forecast by Wood Mackenzie to have the fifth best NPV/tonne over the remaining life of post-FID assets (US\$285 / t CO₂) as well as the fifth lowest upstream emissions intensity over 2016-2025 (19 kgCO₂ / boe).
- Ranks first for water governance & policy. It conducts water stress risk assessments, has a water reduction target and discloses to CDP's water questionnaire (scoring A- for their CDP 2017 water response).

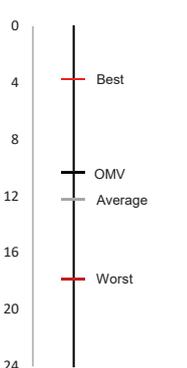
Company Weaknesses

- Performs relatively poorly for low-carbon assets and innovation. Unlike its European peers it is not investing in renewable assets and it has a very limited number of high quality patents across various technologies. However, we note that it recently acquired a 40% share in e-mobility company SMATRICS and is looking to scale its plastics to oil technology.
- It has been the fourth least efficient at adding reserves over the period 2013-2017 with finding and development costs at US\$50 / boe.
- It is forecast by Wood Mackenzie to have the third lowest post-CAPEX cash margin for the period 2018-2030 (US\$8.7 / boe).

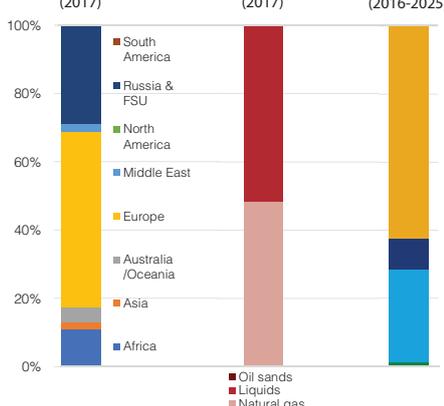
Fossil fuel asset mix weighted rank



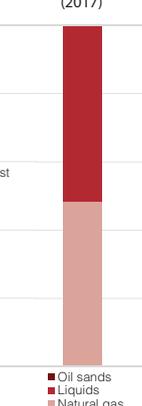
Emissions management weighted rank



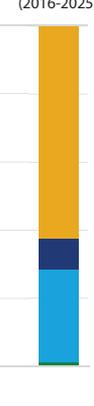
Production split by region (2017)



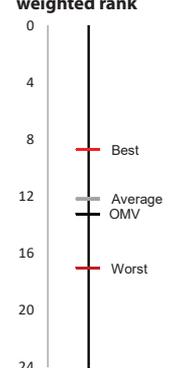
Production split by hydrocarbon (2017)



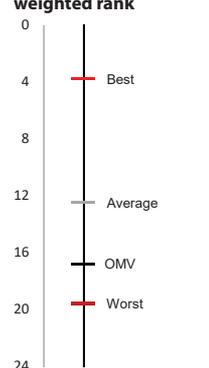
Production split by resource theme (2016-2025)



Capital flexibility & resilience weighted rank



Low-carbon & innovation weighted rank



Gazprom

Country: Russia

Average market cap Q3 2018: US\$ 54 bn

Upstream production 2017: 9.7 million boe/d

Scope 1+2 emissions 2017: 247 Mt CO₂

Free-Float: 49.8%

2017 Adjusted EBITDA split by business area (%)



Ticker	League Table rank	Transition risks rank	Physical risks rank	Transition opportunities rank	Climate governance & strategy rank
GAZP RM	8 / 24	4	3	21	9

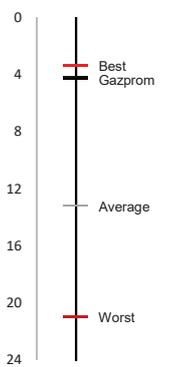
Company strengths

- Gazprom ranks fourth overall for transition risks, with the second best performance for fossil fuel asset mix. Its portfolio is primarily focused on gas (86% of current production and 90% of proved reserves).
- Ranks third for physical risk, with assets primarily located in regions with low water stress. Has strong water governance and policy, including water usage reduction targets.
- Has the lowest production costs (US\$2.9/boe), lowest exploration and development intensity (US\$2.8/boe) and the lowest finding and development costs (US\$2.4 / boe) of all 24 companies.
- Ranks in the top half for climate governance & strategy. Its emission reduction target ranks well relative to peers and it has 2.5% of the executive annual bonus linked to emissions reduction.

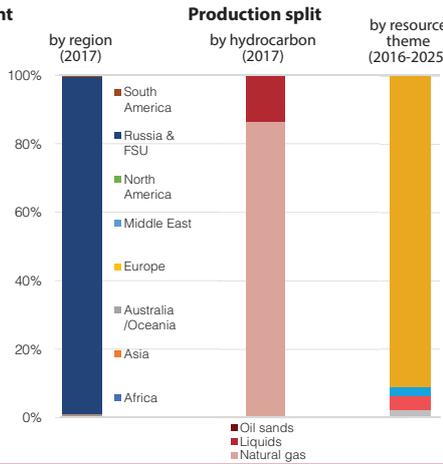
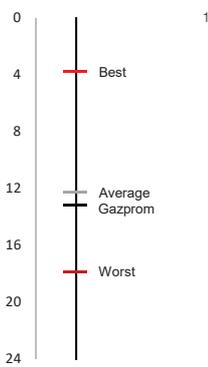
Company Weaknesses

- Ranks in the bottom four for capital flexibility & resilience. We estimate it to have the second lowest discretionary CAPEX over the next 5 years, at only 4.9%. Its proved reserve life of over 40 years highlights its lack of optionality in capital allocation decisions.
- It is forecast by Wood Mackenzie to have the lowest post-CAPEX cash margin for the period 2018-2030 (US\$5.3 / boe).
- It does not disclose any data for Scope 3 emissions.
- It is forecast to have the lowest NPV/tonne over the remaining life of post-FID assets (US\$89 / t CO₂).
- Has not officially supported the TCFD and lacks engagement on other climate initiatives in the industry.

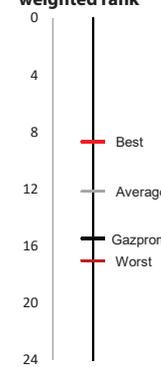
Fossil fuel asset mix weighted rank



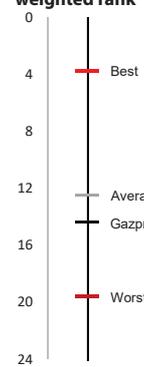
Emissions management weighted rank



Capital flexibility & resilience weighted rank



Low-carbon & innovation weighted rank



BP (i)

Country: UK

Average market cap Q3 2018: US\$ 139 bn

Upstream production 2017: 2.5 million boe/d

Scope 1+2 emissions 2017: 56 Mt CO₂

Free-Float: 100%

2017 Adjusted EBITDA split by business area (%)



Ticker	League Table rank	Transition risks rank	Physical risks rank	Transition opportunities rank	Climate governance & strategy rank
BP/ LN	7 / 24	11	16	6	6

Company strengths

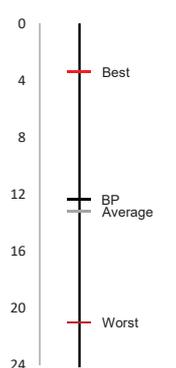
- BP currently has the highest renewable capacity of the companies with over 2GW from its onshore wind and solar portfolio. It is active in biofuels and recently acquired EV charging company Chargemaster. It has a strong digitalization and innovation strategy and the company has committed US\$500 million p.a. to low-carbon activities (around 3% of total CAPEX).
- Is pivoting portfolio towards gas, we expect its share of production from gas to increase from 45% in 2017 to 55% by 2022.
- It reduced its production costs by 16% p.a. since 2014 (third quickest of the company sample). Reduced to a relatively low level of US\$7.2 / boe.
- Ranks sixth for climate governance & strategy. The company conducts scenario analysis through its annual Energy Outlook, having published its 'Even faster transition' scenario in its 2018 edition. It also performs well for climate-related remuneration and board & executive climate management.

Company Weaknesses

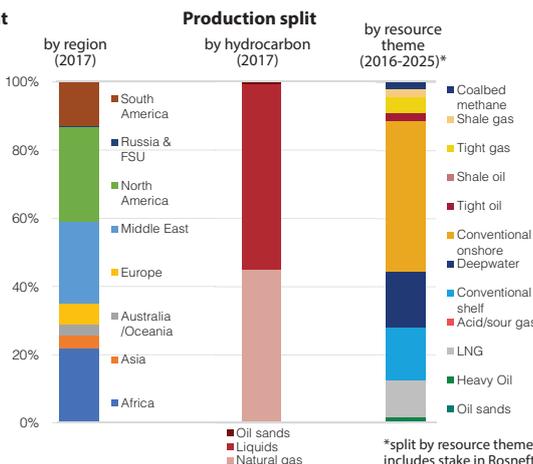
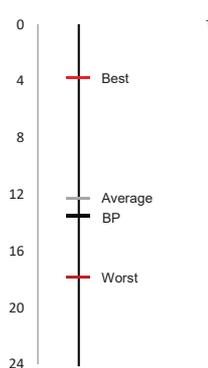
- BP's acquisition of BHP's US unconventional assets has improved its capital flexibility but it still ranks in the lower half of our company sample. We estimate its proportion of discretionary CAPEX for 2018-2022 to be 29%. Its financial gearing is also relatively high at 27% for Q2 2018.
- It is forecast by Wood Mackenzie to have the seventh lowest post-CAPEX cash margin for the period 2018-2030 (US\$11.7 / boe).
- Its emissions reduction target is not as ambitious as some of its peers and it is forecast to have a relatively low NPV/tonne over the remaining life of post-FID assets (US\$126 / t CO₂).
- It is the only European Major not to officially support the TCFD and it did not disclose to CDP in 2018.

(i) Analysis for BP excludes its share in Rosneft

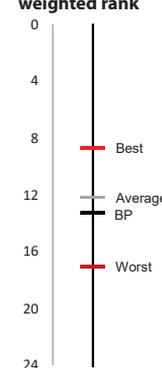
Fossil fuel asset mix weighted rank



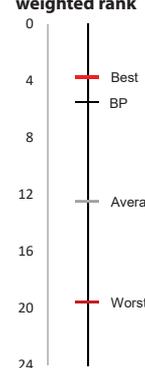
Emissions management weighted rank



Capital flexibility & resilience weighted rank



Low-carbon & innovation weighted rank



Woodside

Country: Australia

Average market cap Q3 2018: US\$ 22 bn

Upstream production 2017: 0.23 million boe/d

Scope 1+2 emissions 2017: 10 Mt CO₂

Free-Float: 99.5%

2017 Adjusted EBITDA split by business area (%)



Ticker	League Table rank	Transition risks rank	Physical risks rank	Transition opportunities rank	Climate governance & strategy rank
WPL AU	6 / 24	2	1	18	11

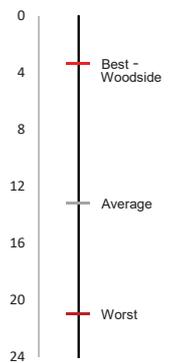
Company strengths

- Woodside Petroleum takes the position of the highest ranked pure-play E&P company. It ranks second overall for transition risks, coming first for its fossil fuel asset mix which is heavily biased towards gas (83% of current production and 86% of proved reserves).
- It has the lowest methane intensity (0.05% of gas production) and flaring intensity is below the group average. Despite having a high upstream emissions intensity, its forecast NPV/tonne is the seventh highest at US\$217 / t CO₂ owing to strong project economics for its LNG portfolio.
- It is forecast to have the highest post-CAPEX cash margin of all the companies for the period 2018-2030 (US\$27.3 / boe).
- Ranks first for physical risk. Has low exposure to water stress related issues due to its offshore portfolio.

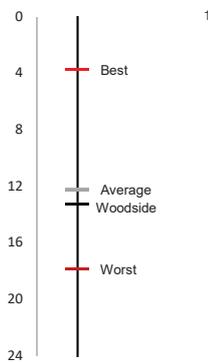
Company Weaknesses

- Ranks last for upstream emissions intensity. Its emissions intensity has increased at 4% p.a. since 2013 and Wood Mackenzie forecast it to have the highest upstream emissions intensity over 2016-2025 at 41 kgCO₂ / boe. We note that this is primarily due to a portfolio biased to LNG which has a relatively high Scope 1+2 intensity. However, LNG is still beneficial from a full life-cycle emissions perspective and credit for this is given in our fossil fuel asset mix section.
- It has been the least efficient at adding reserves over the period 2013-2017 – it has the highest finding and development costs of the 24 companies at US\$96 / boe.
- Lacks exposure to shorter-cycle assets such as US unconventional and is not active in alternative energy or CCUS.

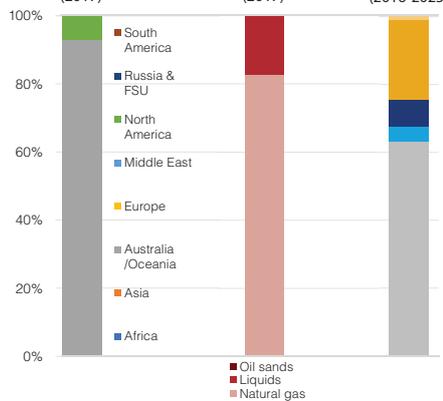
Fossil fuel asset mix weighted rank



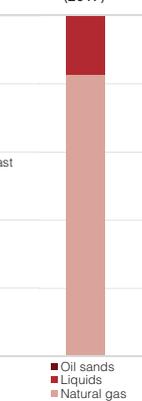
Emissions management weighted rank



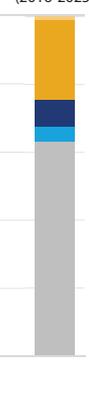
Production split by region (2017)



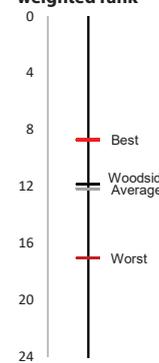
Production split by hydrocarbon (2017)



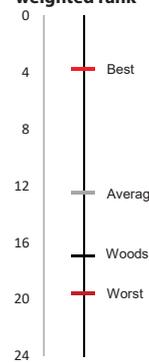
Production split by resource theme (2016-2025)



Capital flexibility & resilience weighted rank



Low-carbon & innovation weighted rank



Repsol

Country: Spain

Average market cap Q3 2018: US\$ 29 bn

Upstream production 2017: 0.70 million boe/d

Scope 1+2 emissions 2017: 23 Mt CO₂

Free-Float: 87.5%

2017 Adjusted EBITDA split by business area (%)



Ticker	League Table rank	Transition risks rank	Physical risks rank	Transition opportunities rank	Climate governance & strategy rank
REP SM	5 / 24	5	12	5	5

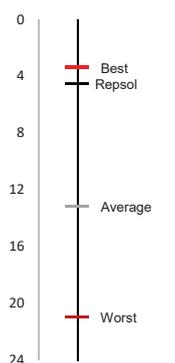
Company strengths

- Repsol aims to deliver value and resilience through its sustainability strategy. It is one of only five companies to officially support the TCFD and is targeting a reduction in its carbon intensity (includes Scope 3 emissions) by 40% by 2040. It is planning to invest around 17% of its 2018-2020 CAPEX in "low-carbon businesses" which consists of both renewables and gas power generation.
- Ranks highly for innovation. It is partnering with companies such as Google to integrate digital solutions into its operations. On a relative basis it has invested the fourth highest amount in low-carbon assets since 2010 (1.8% of total CAPEX), with notable acquisitions in 2018 of both hydro and solar assets.
- It ranks third for fossil fuel asset mix. Its portfolio is heavily tilted towards gas making up 63% of current production and 74% for proved reserves.
- Has the fourth lowest current exploration & development intensity (US\$9.3 / boe) and fourth lowest finding & development costs over 2013-2017 (US\$12.6 / boe).

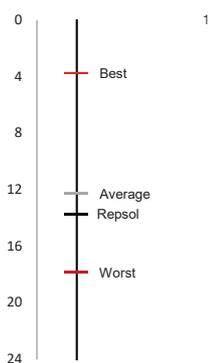
Company Weaknesses

- Has the highest current upstream emissions intensity at 63 kgCO₂e / boe. However, with declining production from a highly emissions intensive asset in Malaysia, this is expected to significantly reduce with Wood Mackenzie forecasting an upstream emissions intensity of 20.3 kgCO₂ / boe over the period 2016-2025.
- Has the highest disclosed methane intensity (1.2 % of gas production).
- Upstream assets have the fourth highest exposure to water stressed regions.
- It is forecast by Wood Mackenzie to have the fourth lowest post-CAPEX cash margin for the period 2018-2030 (US\$9.7 / boe).

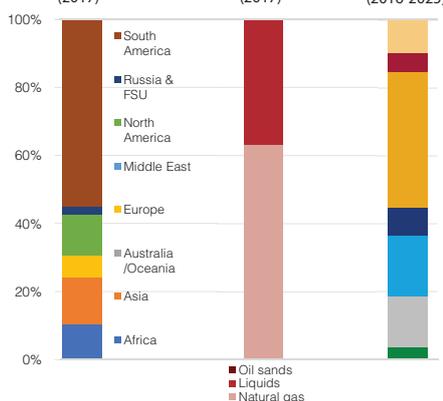
Fossil fuel asset mix weighted rank



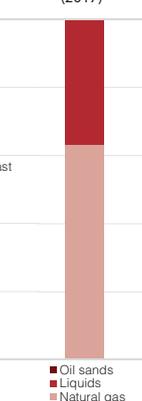
Emissions management weighted rank



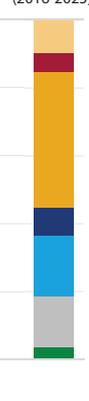
Production split by region (2017)



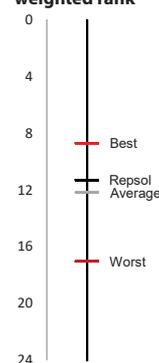
Production split by hydrocarbon (2017)



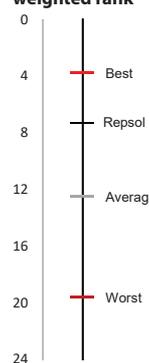
Production split by resource theme (2016-2025)



Capital flexibility & resilience weighted rank



Low-carbon & innovation weighted rank





Ticker	League Table rank	Transition risks rank	Physical risks rank	Transition opportunities rank	Climate governance & strategy rank
ENI IM	4 / 24	6	8	7	3

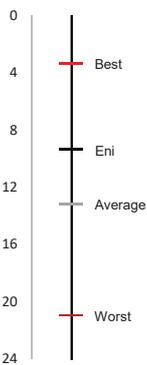
Company strengths

- Eni has communicated its “path to decarbonization” which integrates climate strategy into its business model. Its focus is on pivoting the portfolio to natural gas while developing renewable sources. It has a strong focus on solar projects and is active in biofuels. It plans to spend around 4% of its 2018-2021 CAPEX in new energy solutions.
- Ranks fifth for fossil fuel asset mix. It currently produces more gas than oil and the gas share of its portfolio is set to increase (large gas project Zohr is ramping up and expected to reach plateau in 2019). It has strong focus on conventional resources and no exposure to oil sands.
- Ranks third for climate governance & strategy. It has assessed its portfolio against 2-degree scenarios and has officially supported the TCFD. It ranks well on climate-related remuneration (12.5% of executive annual bonus is tied to emissions reduction) and ranks second for board & executive climate management.

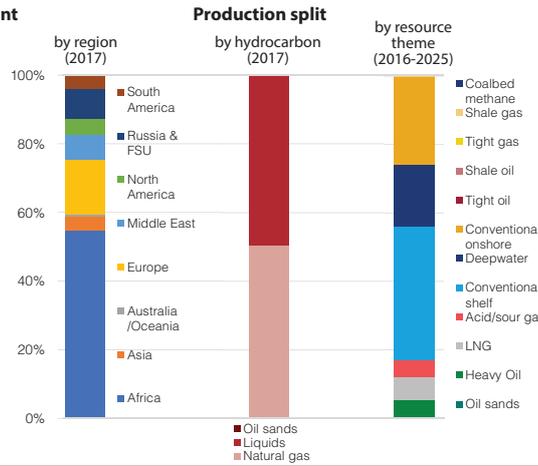
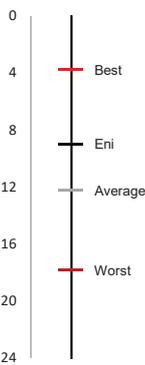
Company Weaknesses

- Although it has a strong Scope 1+2 emissions reduction target, unlike some of its peers it has not set a target / ambition that also includes Scope 3 emissions.
- Lacks exposure to shorter-cycle assets such as US unconventional and is forecast by Wood Mackenzie to have a lower post-CAPEX cash margin for post-FID assets than many companies (US\$13.1 / boe).
- Flaring intensity of 6.7 kgCO₂e / boe is higher than the sample average.
- Some upstream assets have high risk exposure to water stress. However, it has significantly reduced its fresh water withdrawal intensity since 2014 and responded to CDP's 2018 water questionnaire.

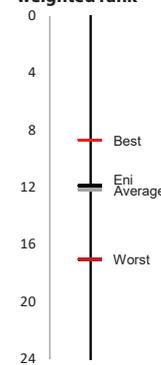
Fossil fuel asset mix weighted rank



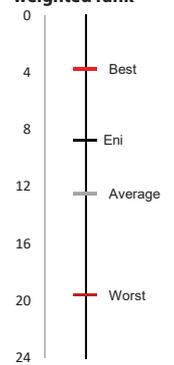
Emissions management weighted rank



Capital flexibility & resilience weighted rank



Low-carbon & innovation weighted rank



Ticker	League Table rank	Transition risks rank	Physical risks rank	Transition opportunities rank	Climate governance & strategy rank
RDSA LN / RDSB LN	3 / 24	9	14	1	2

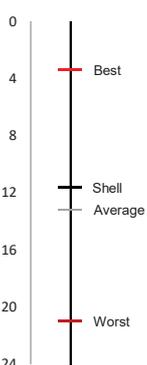
Company strengths

- Shell has taken some bold steps in decarbonization strategy relative to its peers. It has set the ambition to reduce its net carbon footprint of its energy products (includes Scope 1+2+3 emissions) in line with society by 2050, potentially halving its current footprint.
- Ranks first for transition opportunities, coming fourth for capital flexibility & resilience and second for low-carbon assets & innovation. It has a diverse portfolio across its “New Energies” division including solar, wind, biofuels, e-mobility and hydrogen fuel initiatives. It is also active in CCUS (Quest and Gorgon projects) and has a strong digitalization and innovation strategy. The company has committed US\$1-2 billion p.a. (4-7%) of its 2018-2020 CAPEX budget to new energies.
- Ranks second for climate governance & strategy. The company was an early developer of scenario analysis and is one of only five companies to officially support the TCFD.

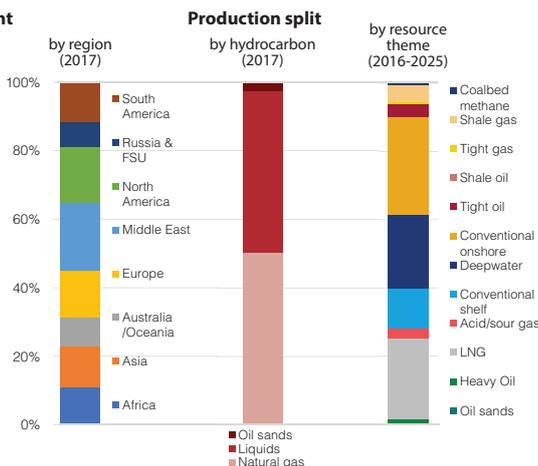
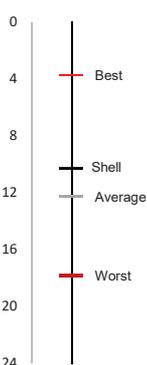
Company Weaknesses

- Upstream emissions intensity has increased at an annual rate of 8.5% p.a. since 2013 and Wood Mackenzie forecast Shell to have an upstream emissions intensity of 26.4 kgCO₂ / boe over 2016-2025, ranking in the lower half of our company sample.
- It has not reduced production costs as much as some of its peers over the period 2014-2017, and its current production cost of \$10.4/boe is higher than the sample average.
- Only average performance for water resilience. Some upstream assets have high risk exposure to water stress and there is no evidence of a company fresh water reduction target. Shell did not respond to CDP's 2018 water questionnaire.

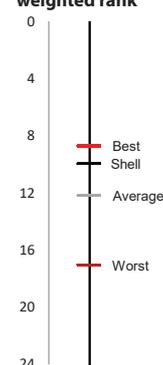
Fossil fuel asset mix weighted rank



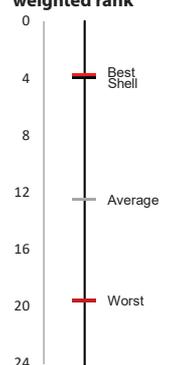
Emissions management weighted rank



Capital flexibility & resilience weighted rank



Low-carbon & innovation weighted rank



Total

Country: France

Average market cap Q3 2018: US\$ 152 bn
 Upstream production 2017: 2.5 million boe/d
 Scope 1+2 emissions 2017: 40 Mt CO₂

Free-Float: 95.5%

2017 Adjusted EBITDA split by business area (%)



Ticker	League Table rank	Transition risks rank	Physical risks rank	Transition opportunities rank	Climate governance & strategy rank
FP FP	2 / 24	10	5	3	1

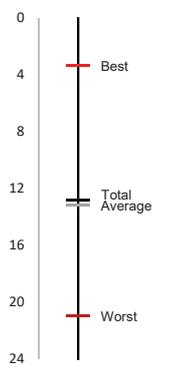
Company strengths

- Total has a clear decarbonization strategy aiming to have "20% low-carbon assets in 20 years" which sees it having a fifth of its portfolio in low-carbon businesses by 2035. It is looking to reduce its carbon intensity (includes Scope 1+2+3 emissions) by between 25-35% by 2040.
- Has invested the most since 2010 on low-carbon assets. Has used M&A to quickly establish market presence across a range of technologies most notably acquiring Direct Energie (utility company), Sunpower (solar) and Saft (batteries).
- Ranks first for climate governance & strategy. It has a strong emissions reduction target, has assessed its portfolio against 2-degree scenarios and is one of only five companies to officially support the TCFD. It ranks second for climate-related remuneration where the executive annual bonus has components focusing on emission reductions, CCUS and other ESG indices.

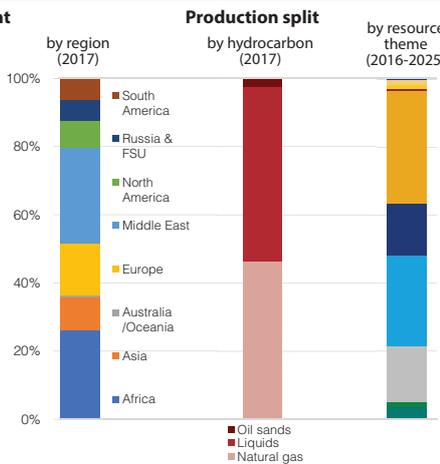
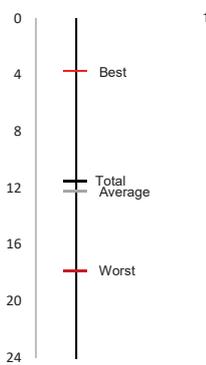
Company Weaknesses

- Despite divesting interests in some oil sands assets it still has some exposure to the higher cost, higher carbon resource (oil sands made up 8.1% of 2017 proved reserves). However, has indicated plans to fully divest remaining assets in the near future.
- Lacks exposure to shorter-cycle assets such as US unconventional and we estimate its discretionary CAPEX over the next five years to be around 30%, in the bottom half of our company sample.
- Ranks 10th for transition risks section. Flaring and methane intensities are higher than some companies and Wood Mackenzie forecast Total to have the fifth highest upstream emissions intensity over 2016-2025 (27.6 kgCO₂ / boe). It also has a relatively low NPV/tonne over the remaining life of post-FID assets (US\$158 / t CO₂).

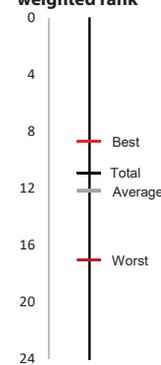
Fossil fuel asset mix weighted rank



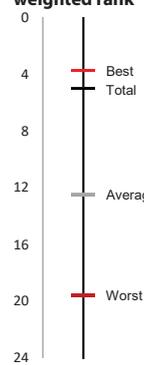
Emissions management weighted rank



Capital flexibility & resilience weighted rank



Low-carbon & innovation weighted rank



Equinor

Country: Norway

Average market cap Q3 2018: US\$ 78 bn
 Upstream production 2017: 1.9 million boe/d
 Scope 1+2 emissions 2017: 16 Mt CO₂

Free-Float: 32.6%

2017 Adjusted EBITDA split by business area (%)



Ticker	League Table rank	Transition risks rank	Physical risks rank	Transition opportunities rank	Climate governance & strategy rank
EQNR NO	1 / 24	3	4	2	4

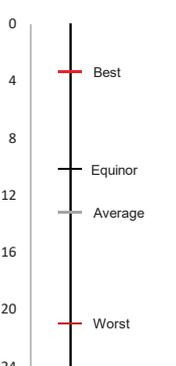
Company strengths

- Equinor convincingly retains first place in our League Table, ranking no lower than fourth across all four main sections. Its recent name change and rebrand to a broad energy company is a bold reinforcement of a shift towards low-carbon assets and the company expects to invest 15-20% of CAPEX in new energy solutions by 2030.
- It has the highest alternative energy capacity currently under development, with a strong focus on offshore wind and is also active in other areas such as CCUS.
- Ranks first for emissions & resource management. It currently has the lowest flaring intensity and lowest upstream emissions intensity (8.8 kgCO₂e/boe). Wood Mackenzie forecast Equinor to have the third best NPV/tonne at US\$356 / t CO₂.
- Has quantitatively assessed the impact of a 2-degree scenario on its portfolio and ranks first for both climate-related remuneration and board & executive climate management.

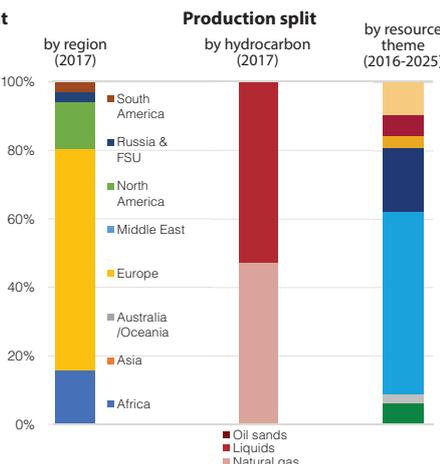
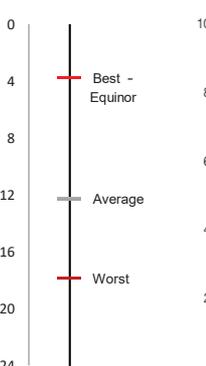
Company Weaknesses

- Equinor is seen to have less capital flexibility than some of its peers. Over 2018-2022 we estimate its proportion of discretionary CAPEX to be 34%, ranking it in the middle of the 24 company sample.
- It is forecast by Wood Mackenzie to have a lower post-CAPEX cash margin (post-FID assets) than some companies (US\$13.5 / boe).
- Has limited downstream operations compared to its integrated peers. It operates just two medium sized refineries and most of its earnings come in the upstream segment. Therefore it has more exposure to oil price volatility than some companies and less incentive to look at potential growth areas such as petrochemicals.
- Unlike Repsol, Shell and Total it has not set an emissions reduction target / ambition that also incorporates Scope 3 emissions.

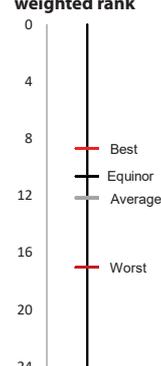
Fossil fuel asset mix weighted rank



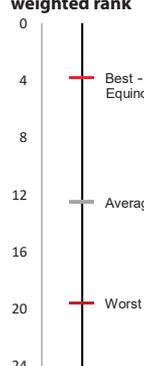
Emissions management weighted rank



Capital flexibility & resilience weighted rank



Low-carbon & innovation weighted rank



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