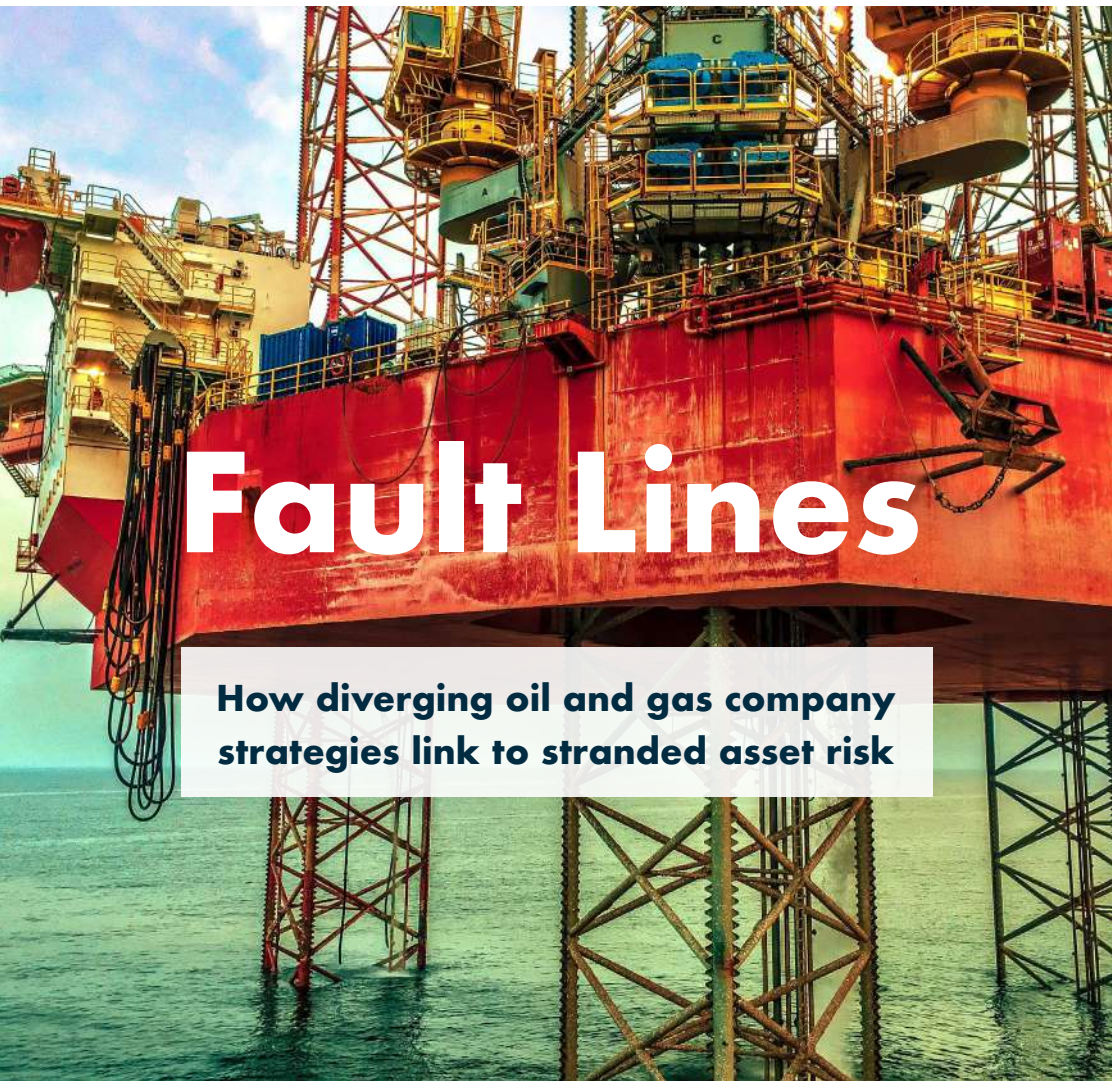




Fault Lines

How diverging oil and gas company strategies link to stranded asset risk

About Carbon Tracker

The Carbon Tracker Initiative is a team of financial specialists making climate risk real in today's capital markets. Our research to date on unburnable carbon and stranded assets has started a new debate on how to align the financial system in the transition to a low carbon economy.

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Key Findings

- **Far from simply an “ESG” issue (environmental, social and governance), for fossil fuel producers the energy transition represents an existential concern that goes right to the heart of strategy.** It therefore requires an integrated approach that touches on different aspects of the business.
- **Oil and gas companies’ emissions ambitions, scale of capex at risk and internal oil price assumptions for impairment tests are all highly correlated.** Companies are increasingly either approaching climate issues holistically or getting left behind on all three. These aspects may be seen as proxies for each other – setting conservative price assumptions or stronger emissions targets appears to link to portfolio management that is more resilient in the transition.
- **European producers clearly outperform their US counterparts** on all three factors in the report. Equinor is a notable laggard.
- **US companies don’t disclose their impairment price assumptions. However, these strong relationships and poor performance on the other factors suggests that their assumptions of long term oil and gas prices are high,** raising the risk of asset write-downs in future and possible continued investment in stranded assets.
- **Companies are taking diverging views of the future** – this further exaggerates the gap between leaders and laggards. We explore using each company’s internal accounting price assumptions as an indicator for how conservative they will be in their future project sanction activity.
- **We highlight \$60bn capex associated with the 15 largest projects sanctioned in 2019 that aren’t competitive on economics under the International Energy Agency’s 1.65-1.8°C Sustainable Development Scenario (SDS).** Most of the majors sanctioned assets that fell into this category. ConocoPhillips is the exception, only sanctioning assets that fall outside the lower-fossil fuel/higher-ambition 1.6 °C Beyond 2 Degrees Scenario.
- **All of the majors have assets available for sanction in 2020-22 that fall outside the SDS.** Timing of approval of these assets is extremely uncertain in the context of Covid-19. However, they may prove a key indicator of company commitment (or lack of) to resilience in the energy transition, or perhaps whether oil company long term demand expectations have been fundamentally shifted down by the crisis.

Executive Summary

In a series of reports since 2011, Carbon Tracker has shown the financial risks to fossil fuel producers related to the shift to a lower carbon economy, in a world where stabilising global temperatures to any level puts a finite limit on the amount of CO₂ that we can emit (“the carbon budget”). In particular, we have looked at the risk of investing in “stranded assets” – projects that fail to deliver adequate returns as conditions change.

In this report we look at potential capital expenditure (“capex”) that might be spent on such stranded assets in the oil and gas industry using an economic framework, and focus on company and project level results. This report updates previous work on this theme, Carbon Tracker’s *2 Degrees of Separation* series, including 2019’s *Breaking the Habit*.

Covid-19 and the wider view

The shock that the Covid-19 crisis has brought to energy markets is hard to overstate. The CEOs of both BP and Shell, along with some forecasters such as DNV GL have suggested that 2019 was the high water mark for global oil demand, therefore that peak oil demand is now in the rear view mirror – scarcely imaginable up until very recently.

A long-standing theme of Carbon Tracker’s work has been the challenge of navigating an uncertain path towards a future energy system, and the risk of fossil fuel producers making poor investments that destroy value as they misread future demand. The current crisis has shone a bright light on such

unpredictability, and comes on top of already heightened stakeholder concerns about climate change and fossil fuel producers’ abilities to navigate the energy transition.

In this report we focus on project portfolio management at oil and gas companies and the extent to which project options do or do not fit into a low carbon scenario on grounds of relative cost-competitiveness. This gives a measure of potential financial risk in the transition. However, we also look at other key aspects of emerging climate-related company strategy, and show how they all fit together as different symptoms of the same underlying issue.

What’s new in this year’s report

- **Impairment prices, emissions plans and capex exposure** – these three metrics are compared side by side and tested for statistical relationships;
- **Impairment prices as a proxy for expected BAU** – we illustratively explore the impact on results of using individual company impairment prices as a proxy for differing expectations of future demand levels, rather than our normal approach of assuming that all expect a future along the lines of the International Energy Agency’s central Stated Policies Scenario (STEPS); and,
- **Sensitivity analysis** – levels of company capex outside a low carbon scenario are tested under conditions of varying demand to see which

companies' outcomes are the most volatile.

“Paris alignment” – just portfolio economics, or other aspects of strategy too?

We have argued that a fossil fuel producer could not be considered aligned with the goals of Paris if it continued to sanction projects that would take the world past its climate limits under Paris, which we calculated based on the economic competitiveness of those projects. The logic is simple – a company that develops high cost projects outside such limits firstly fails the financial risk test of investing in assets which would become stranded as the world decarbonises. Second, it can hardly be called aligned if its business is based on exceeding those climate limits.

So a company might fail the Paris alignment test if it is prepared to sanction projects which lie outside the cost limits implied by the Paris agreement. We know the cost curves of the projects needed to fit a Paris demand profile so, by definition, any project with costs above that curve is non-compliant. But is it enough for a positive claim of Paris alignment to simply have a low cost portfolio, no other strings attached?

We think this is a wider question, and note that many investor initiatives have asked that go beyond simply portfolio economics and look to ensure consistency with climate throughout the business. For example, these may relate to lobbying practices or other efforts to lower greenhouse gas emissions.

Accordingly, while we focus on project economics, it follows that a low-cost portfolio of assets that fit within a Paris-consistent scenario alone is *necessary*, but *not sufficient*, to qualify a producer as aligned with the goals of Paris.

A 2-speed track: oil and gas producers fall into two camps. Some are increasingly incorporating transition risk to an extent into different parts of their business. Others are ignoring it all together.

Far from simply an “ESG” issue, for fossil fuel producers the energy transition is an existential challenge that goes right to the heart of business strategy and hence requires a joined-up approach.

Three of the key indicators of the transition that Carbon Tracker has looked at are shown to be highly correlated with each other. Companies that tend to exhibit some of the key characteristics tend to exhibit them all:

- 1. relative portfolio financial resilience** – a low proportion of their potential capex outside a low carbon scenario on an economic basis compared to peers;
- 2. a more conservative oil price outlook** – disclosing lower internal price assumptions for impairment (and likely planning purposes); and
- 3. emissions ambitions with structures closest to reflecting the finite carbon budget** – including coverage of emissions from use and an absolute basis¹.

¹ For more discussion, see Carbon Tracker, “Absolute Impact: Why oil majors’ climate ambitions fall short of Paris limits”, June 2020. Available at <https://carbontracker.org/reports/absolute-impact/>

These three measures can be viewed either as different components of an integrated transition plan, or as separate proxies for the company's portfolio management. Setting conservative price assumptions or stronger emissions ambitions appears to be related to holding a base of project options that is more resilient in the transition.

Conversely, US companies show portfolios that are vulnerable to stranding in the energy transition, have emissions ambitions that fail to link the full impact of their activities on the atmosphere, and don't even disclose the price assumptions that underpin their financial statements. Transition risks appear to be increasingly concentrated in US hands.

The split in oil and gas companies is clear – European majors are increasingly taking a more consistent approach to resilience in the transition, although there is still a long way to go and Equinor in particular is a notable laggard.

TABLE 1. COMPANY POSITIONING BASED ON PORTFOLIO ECONOMICS, EMISSIONS AMBITION AND IMPAIRMENT PRICE ASSUMPTION

Company	Portfolio economics - unsanctioned assets		Emissions ambition	Impairment price assumption		Overall
	% of STEPS capex outside B2DS budget (% band)	Rank based on B2DS	Rank based on CTI framework	Maximum price over 2020-2050 (Brent oil, real 2020 \$)	Rank based on maximum 2020-2050 price	Average of rankings
Eni	40% - 50%	1	2	60	1	1.3
BP	50% - 60%	3	1	60	1	1.7
Repsol	40% - 50%	2	3	68	4	3.0
Shell	60% - 70%	5	4	60	1	3.3
Total	50% - 60%	4	5	73	5	4.7
Chevron	60% - 70%	6	7	not disclosed	7	6.7
Equinor	80% - 90%	8	6	82	6	6.7
ConocoPhillips	70% - 80%	7	8	not disclosed	7	7.3
ExxonMobil	80% - 90%	9	9	not disclosed	7	8.3

Source: Rystad Energy, IEA, company disclosures, CTI analysis

Note: Emissions rankings differs slightly from that published in Absolute Impact; BP has been moved up in rank from 3 to 1 following its announcements subsequent to publication of that document.

"STEPS capex" is the level of capex modelled as going ahead under the IEA's central Stated Policies Scenario, associated with mean warming of 2.7 °C. B2DS is the IEA's Beyond 2 Degrees Scenario; we estimate that our interpretation is consistent with a 50% chance of limiting warming to c. 1.6°C.

The above being said, we highlight that these are conclusions relative to peers. Even the European leaders still have a significant proportion of potential development portfolios falling outside low carbon scenarios, and assume a future of oil prices above the levels that would give confidence in alignment with a world of continuously falling fossil fuel demand. Even the highest ranking companies will therefore need to assert and demonstrate that they will not sanction assets that fall outside Paris before they might make a claim of alignment.

Close relationship implies that US companies assume high future prices

The close relationship between these three factors implies that they are reasonable predictors of each other, which might be used to imply a rough indication of trends in any missing data and hence back-fill gaps in disclosure.

Although the US companies don't disclose their impairment assumptions, their relatively high cost portfolios and growth-oriented emissions targets indicate high oil price assumptions compared to European peers and the prospect of future write downs if reality doesn't live up to expectations.

While not exactly reflecting the separate price assumptions used for sanction decisions, as impairment prices represent management's best estimates, high assumptions may suggest possible continuing investment in marginal assets that become stranded.

Company price assumptions might be used as a proxy for BAU expectations

Our normal methodology assumes that all oil and gas companies have similar expectations for future demand growth (along the lines of the International Energy Agency's central Stated Policies Scenario). With producers starting to express a wider range of views on future fossil fuel demand, we also indicatively explore using companies' internal price assumptions as proxies for their expectations of the future, where disclosed.

As those companies with lower price assumptions are generally those that have more advantaged portfolios measured against a common proxy (STEPS), then using company-specific proxies based on impairment prices just widens the gap. The relative order of company positioning broadly holds.

Capex analysis continues to highlight the problem

The general conclusions of our analysis are broadly consistent with last year's analysis, namely:

- **The sums of potential capex that may be wasted are measured in the \$trillions:** over a third of BAU level capex doesn't fit in a 1.6°C scenario². For unsanctioned projects the risk is even higher. Around two-thirds of BAU potential capex on unsanctioned oil and gas and around 90% on oil, is likely to destroy value in a 1.6 °C world. For gas, its debatable green credentials and slower demand decline in many scenarios means that only one-sixth of BAU investment in undeveloped assets doesn't fit. But the huge quantum

2 We use the International Energy Agency's (IEA) Beyond 2 Degrees Scenario (B2DS) which in our interpretation is consistent with a temperature outcome of approximately 1.6°C with 50% probability. As a proxy for BAU we use the IEA's Stated Policies Scenario, associated with mean warming of 2.7 °C.

of potential development leaves risks of overinvestment and oversupply – we exclude supply options equivalent to around 60% of new BAU capex entirely, with the relative overhang greatest in LNG.

- **Oil and gas producers exhibit a wide range of exposures:** the most resilient have a large majority of project options that still work in a low carbon world, whereas for some, almost their entire portfolio may fail to live up to hopes.

Specialised companies can be very sensitive to changes in demand and costs

Some projects have breakeven prices very close to the marginal cost levels implied by the low carbon scenarios used here. A small change in demand (and hence marginal cost) can therefore be sufficient to push previously economic projects into the red, or vice versa.

If a company is focused on a particular oil and gas play or development type (and hence has a relatively homogenous portfolio) near these price levels, the change in overall company positioning can be dramatic.

We introduce a measure showing how companies' positioning would change for a +/- 5% change to demand levels. Shale specialists, and in particular Pioneer Natural Resources, have portfolios with economics that position them very close to key demand levels on the cost curve, hence show very high sensitivity.

Diversified players or companies with costs that are largely very low or very high tend to be much more predictable.

Individual project approvals illustrate the slow pace of change, but much will depend on the impact of Covid-19³ in the near term

We highlight the 15 largest projects that were sanctioned in 2019 and don't fit in the International Energy Agency's 1.65-1.8°C Sustainable Development Scenario (SDS) on the basis of production costs, even assuming a margin of error. Together these projects account for \$60bn in associated capex over the next decade in total.

Most of the majors sanctioned assets outside the SDS in 2019. ConocoPhillips is the exception; while it did sanction assets outside of the tougher 1.6 °C Beyond 2 Degrees Scenario (B2DS), the majority of this was in one asset, the Malikai 2 oil field in Malaysia. The company therefore deserves credit for focusing on the low end of the cost curve; statements or commitments that it will not sanction assets that don't fit in a low carbon world may add to stakeholder confidence that this will continue, particularly as it does have plenty of higher cost potential options in its portfolio.

For much of 2020, project sanction activity has been strongly affected by volatility in the oil price, with many approvals being deferred. All the majors have projects available to them over the 2020-22 period that fall well outside the SDS on cost grounds. While the timing of these decisions will likely be dependent on further price movement, whether these projects are sanctioned or not may give an indication of the company commitment (or lack of) to navigating the transition, and whether Covid-19 has impacted expectations about peaking demand.

³ The demand scenarios (November 2019) and supply data (March 2020) were sourced either prior to the Covid-19 crisis or before its impact was properly understood. We consider the results to remain valid, in particular due to the relative nature of the analysis which considers companies' positioning compared to peers, and use of multi-decade scale scenarios where the impact on longer-term fossil fuel demand remains unclear. Further discussion on this point is provided in the document.

Introduction

The Oil and Gas Industry Transition Plans and Stranded Assets

Covid-19 presses the fast forward button...

We have long argued that the energy transition, far from something that can be dismissed as “ESG”, is an existential issue that goes right to the heart of fossil fuel producer business models. For these companies to navigate the energy transition will therefore require a joined-up response that touches on every part of their business. As if that were not enough, with markets always looking to the future, producers were finding it increasingly hard to convince stakeholders they were worthy of support even before fossil fuel demand went into reverse.

Responding to these pressures, some companies have sought to differentiate themselves on their climate change credentials. But, pulled in one direction by an uncertain future and by another by long embedded habits, progress has been slow and inconsistent. Companies would set emissions targets, but tout fossil fuel output growth above even BAU global demand. Executives would be paid simultaneously to cut carbon and produce more.

The Covid-19 crisis has highlighted that the time for dawdling is over. Whether or not BP’s suggestion that 2019 may have been peak oil demand turns out to be right or not⁴, sharp volatility in the oil price and a big hit to demand expectations have reminded everyone of the urgency of mitigating exposure to fossil fuels.

... highlighting the need for comprehensive transition plans

Much like the situation we see today, the energy transition will be characterised by excess fossil fuel supply fighting for a slice of lower demand. This can only result in lower fossil fuel prices and hence deteriorating project economics. This report is the latest in a series looking at oil and gas producer portfolios, and comparing them on the basis of their economics and ability to compete on the basis of costs within a finite carbon budget.

As well as measuring portfolio fit with a low demand future, we look at other key indicators of the energy transition, representing two of the areas in which companies were starting to make progress – their ambitions on emissions and the extent to which these reflect the planet’s absolute constraints, and the internal commodity prices which they use for their accounting. Both of these might reasonably be seen as different elements of an integrated transition plan or proxies for investment activity, and thus give a window on future financial performance; here we examine the link.

⁴ See BP, “Energy Outlook 2020”, September 2020. Available at <https://www.bp.com/en/global/corporate/energy-economics/energy-outlook.html>

The “Paris Alignment” debate

Since the Paris Agreement in 2015, climate change and transition risk have been one of, if not the, hottest topic of discussion in investment circles. In particular, there is the question of “what does it mean to be ‘Paris-aligned’”? Investors have good reasons to ask this question, including from an angle of financial risk for the purposes of investment appraisal (a company with a business model that is aligned with the goals of Paris is likely to have less trouble adapting as the world shifts onto a decarbonisation pathway) and from angles related to their duties to clients, who may prefer that their capital is stewarded in keeping with the long term good of the planet. However, what “Paris-alignment” means in practice is a harder thing to define.

In *Breaking the Habit*⁵, we argued that a fossil fuel producer could not be considered aligned with the goals of Paris if it continued to sanction projects that would take the world past its climate limits under Paris, which we calculated based on the economic competitiveness of those projects. The logic is simple – a company that develops high cost projects outside such limits firstly fails the financial risk test of investing in assets which would become stranded as the world decarbonises, and secondly can hardly be called aligned if its business is based on exceeding those climate limits. (By “stranded” assets, we mean projects that will destroy value for shareholders – i.e. reserves that would have been better off left in the ground.)

So a company might fail the Paris alignment test if it is prepared to sanction projects outside projects limits defined on cost grounds – but is it enough for a positive claim of Paris alignment to simply have a low cost portfolio, no other strings attached?

We think this is a wider question, and note that many investor initiatives have asks that go beyond simply portfolio economics. For example, one might reasonably expect a company to not lobby against or otherwise seek to undermine legislation that would further the goals of the Paris Agreement, before calling that company Paris-aligned. It is hard to say that a low-cost company that attempted to undo or undermine the agreement would be in alignment with that agreement. Similarly, as well as having a portfolio of fossil fuel production that fits within a pathway of net zero emissions by 2050, the company might be expected to set targets for emissions from its own operations to reach net zero by 2050 (the target generally linked with a 1.5 degree outcome).

Accordingly, it follows that a low-cost portfolio of assets that fit within a Paris-consistent scenario alone is **necessary**, but **not sufficient** in itself, to qualify a producer as aligned with the goals of Paris.

⁵ Carbon Tracker, “*Breaking the Habit – Why none of the large oil companies are “Paris-aligned”, and what they need to do to get there*”, September 2019. Available at <https://carbontracker.org/reports/breaking-the-habit/>

A Note on the Covid-19 Backdrop

Since Q1 this year, energy (and in particular oil) markets have been rocked by the sharp falls in demand related to the Covid-19 crisis and lockdowns around the globe. This has had knock on effects to commodity prices – with oil even briefly turning negative in certain markets – and accordingly to company development plans, with projects being deferred or production even shut in temporarily.

We note here that both the supply and demand data used in this report is drawn from times either prior to the Covid-19 crisis or during the crisis but before the implications were better known.

- **Supply data:** Rystad Energy UCube database as at March 2020
- **Demand data:** International Energy Agency (IEA) World Energy Outlook published November 2019 and Energy Technology Perspectives published June 2017

The data therefore does not include the full effects of Covid-19. However, we continue to consider the results valid, for reasons including the following:

- The main focus of our analysis is on company positionings relative to each other, which are more likely to hold in times of turmoil than absolute conclusions particularly when all companies are impacted by the same factor.

- The intent of the analysis is to understand the macro picture over decades, during which time there will no doubt be plenty of unforeseen events and cyclical market changes. This uncertainty is considered in our approach. Further, the extent of the longer-term impact of Covid-19 remains an unknown and subject to much debate.
- Relatedly, our analysis is based on aggregate demand over a 20 year period. Accordingly, short-medium term demand impacts may have a limited effect on the aggregate, even if they accelerate the single point timing of peak oil demand.
- While oil price moves have been extreme, we do not seek to make oil price predictions, and certainly not on an annual timescale. The marginal costs derived from our analysis are not forecasts. They are the theoretical prices needed for sufficient projects to be developed to meet a given demand scenario.
- Companies may sanction economically challenged projects in the expectation that prices may recover rapidly. This therefore makes a cost focus all the more important.

See Section 4 for a fuller discussion on some of these topics in the context of the use of the 2019 IEA Stated Policies Scenario as a proxy for a “business-as-usual” development pathway.

The Carbon Tracker Framework

Carbon Tracker's Least Cost Approach

This report builds on Carbon Tracker's *Two Degrees of Separation* series of reports to determine potential transition risk exposure by company, and uses the same least cost methodology as the previous iteration, *Breaking the Habit*⁶ (published September 2019).

A brief summary of our approach is as follows:

- We use an economic model to link asset-level potential supply of oil and gas to demand pathways under different carbon-constrained scenarios.
- The difference between the future production from already existing oil and gas projects and demand under any given scenario gives the additional production from new (as yet unsanctioned) projects that fits within that scenario.
- Using estimates of individual project economics, we then rank these potential new supply options by breakeven cost, and determine whether each project falls either inside or outside a given scenario on the basis of its relative economic competitiveness. Those inside are economic, those outside will destroy value.
- The capex associated with the projects that fit within a given scenario can be aggregated by company, and compared to potential project capex under a business-as-usual scenario. This can be expressed as the % of business-as-usual capex that either "fits" within or falls outside a given scenario.
- A company which has a higher % of business-as-usual capex associated with projects that fall outside a given scenario is relatively more exposed to transition risk than its peers, with a greater proportion of assets potentially at risk of becoming stranded if developed or a greater required shift in business model if not.

Demand Scenarios

In this report, we match potential oil and gas supply to demand using two low-carbon scenarios published by the International Energy Agency⁷ (IEA):

⁶ Report available at <https://carbontracker.org/reports/breaking-the-habit/>. Methodology available at <https://carbontransfer.wpengine.com/wp-content/uploads/2019/09/Breaking-the-Habit-Methodology-Final-1.pdf>

⁷ The B2DS was published in Energy Technology Perspectives 2017, and the SDS in the World Energy Outlook 2019. Carbon Tracker makes minor adjustments to the scenarios where required, for example assuming linear interpolation between datapoints provided at multi-year intervals and converting units to equivalency with the supply data used.

Beyond 2 Degrees Scenario (B2DS)

We estimate that this scenario is consistent with a 50% chance of approximately 1.6°C warming by 2100.

Sustainable Development Scenario (SDS)

The IEA models the SDS emissions trajectory to 2050, and notes that if this trajectory is extrapolated beyond this point it would result in net zero emissions in 2070. If emissions are assumed to stay at zero thereafter, the IEA concludes this would result in a 66% chance of limiting warming to 1.8°C or a 50% chance of 1.65°C.

To enable assessment of transition risk under these low-carbon scenarios, and as in *Breaking the Habit*, we use the IEA's Stated Policies Scenario (STEPS)⁸ – consistent with c.2.7 degrees of warming (50% chance) – as a business-as-usual baseline. STEPS describes a projection of the future energy system whereby already enacted and already announced but yet to be enacted legislation on climate change is assumed to continue, but not developed further.

The oil demand pathways under each of these three IEA scenarios are shown in the appendix.

It is important to note that these are scenarios and not forecasts (the IEA is explicit on this). However, they provide users with a view of potential pathways linking the global carbon budget (and hence temperature outcome for the planet) to different levels of fossil fuel usage, which can then be used to understand the implications for industry.

The place of 2019 STEPS as a “business-as-usual” baseline post Covid-19

As we are trying to understand the financial risks associated with fossil fuel companies investing in assets that may look attractive under their base case view of demand but turn out to be stranded as actual demand undershoots, there is little point in us looking at projects that are highly unlikely to be developed in the first place. As in previous iterations of this analysis, we therefore use the IEA's central scenario (now STEPS) as a proxy for company behaviour under “business-as-usual”. We use this to estimate which projects the companies might be contemplating being developed under their base case view of the future, and exclude any projects that aren't modelled as going ahead in this scenario.

Since the publication of the IEA's World Energy Outlook in November 2019, the Covid-19 crisis has led to previous demand assumptions being revisited, and a high degree of uncertainty being evident. Some oil companies have suggested oil demand may already have peaked⁹; conversely the US Energy Information Administration (EIA) projects oil consumption as largely returning to pre-crisis levels by the end of 2021¹⁰.

⁸ Formerly known as the New Policies Scenario (NPS)

⁹ See for example BP, “Energy Outlook 2020”, September 2020. Available at <https://www.bp.com/en/global/corporate/energy-economics/energy-outlook.html>

¹⁰ EIA, “Short-Term Energy Outlook”, September 2020. Available at <https://www.eia.gov/outlooks/steo/>

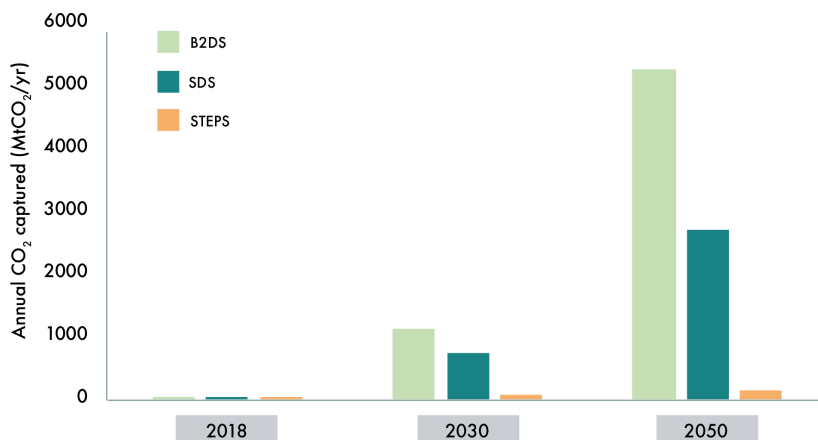
This raises the question as to whether a pre-Covid benchmark of STEPS is a fair proxy for business as usual. Given the high degree of uncertainty in the market at the moment and that the IEA will presumably update STEPS in the next iteration of the World Energy Outlook, we continue to use STEPS on this basis. Further, we highlight that a) as our analysis is based on aggregate supply/demand over the next two decades, if the impact of Covid-19 on demand is relatively short term, this will only have a minor effect on the long term aggregate¹¹; and b) the same proxy baseline is applied to all companies, hence continues to have use for a relative positioning exercise such as this one.

Of further long term interest is that oil companies do appear to be showing divergence in their long term views of fossil fuel market conditions, as illustrated in their disclosed impairment assumptions¹². We explore the possible implications of this for company positionings later in this paper.

CCUS already captured in low carbon scenarios

We should also highlight that both the B2DS and SDS include varying levels of carbon capture, utilisation, and storage (CCUS); the development of these technologies along these lines is therefore incorporated in our analysis. As the levels of CCUS in these scenarios represents a sharp acceleration from today's trends, we treat with caution any suggestion that even greater levels of CCUS might justify the sanction of projects outside any budget. Indeed, we note that should CCUS fail to live up to these hopes, achieving the same level of carbon emissions will require the use of less fossil fuel; this therefore represents a downside risk to the levels of fossil fuel demand assumed here for the same temperature outcome.

FIGURE 1. CO₂ CAPTURED WITH CCUS UNDER B2DS, SDS AND STEPS



Source: IEA, CTI analysis

¹¹ As a simple illustrative example, if a 20-year demand series is flat at 100 per year, then the first two years are adjusted to be 90 and 95 respectively, the aggregate period demand will equal 99.25 on average rather than 100, i.e. a reduction of just 0.75%.

¹² See Carbon Tracker, "The Impair State: The Paris Agreement starts to impact oil & gas accounting", June 2020. Available at <https://carbontracker.org/reports/the-impair-state/>

1.5 degree scenarios imply existing production busts the budget without CCUS

In *Breaking the Habit* we also considered the P1 and P2 scenarios published by the Intergovernmental Panel on Climate Change (IPCC) in its Special Report on Global Warming of 1.5 °C¹³. As noted, future oil and gas demand under the P1 scenario (which assumes no development of bioenergy, carbon capture and storage or BECCS) is already met by future production from already-sanctioned projects, implying that generally no new oil and gas projects fit within this pathway. Accordingly, company differentiation in terms of future portfolios is extremely limited.

The scenarios used here illustrate differences in company positioning when new assets do fit into a given outcome, but at the cost of assuming a higher warming outcome and a reliance on widespread future deployment of CCUS technologies.



Image Credit: Arni Saeberg, CarbFix

Capex Alignment at the Company Level

After each oil/gas supply project is determined as in or outside a given level of demand on the basis of its asset-level portfolio costs as above, these can then be rolled up to the company level to give a view of relative risk under a low carbon pathway, or alternatively the degree to which a company's activities fit with the Paris Agreement on economics.

In this report we focus on capex associated with upstream activities only. Our company universe includes both E&P (exploration and production) and integrated companies, some of which will therefore clearly carry further potential for stranded asset creation along the rest of the value chain beyond that covered here. For example, an integrated company's refineries will be impacted by an overall fall in oil consumption¹⁴.

Alignment, risk and the eye of the beholder

Different stakeholders have different expectations of oil and gas companies in the context of the transition. Investors have different time horizons, mandates, client pressures and so on.

Our research is structured so as to attempt to be useful to a wide range of potential readers, whether their focus is on financial risk or alignment.

Our focus on project economics and capex that doesn't go ahead in low carbon outcomes shows that both financial and non-financial imperatives pull together in this case. The metrics we use give a relative benchmark of the opportunity for companies to destroy financial value assuming normal market logic¹⁵, but can also be seen as a measure of the degree to which their portfolios appear not to be aligned with the goals of Paris without a change of course from the company.

Giving grounding to the "Paris alignment" concept

As observed above, a low-cost portfolio is necessary but not sufficient alone to claim Paris alignment – for example, lobbying practices may put a low-cost company at odds with the agreement.

Companies may also suggest that individual sanction decisions should not be considered in isolation, and that a portfolio should be considered Paris-aligned on average even if it contains projects that are not aligned¹⁶.

¹⁴ For an exploration of transition risk for the oil refining industry, see: Carbon Tracker, "Margin call: Refining Capacity in a 2°C world", November 2017. Available at <https://carbontracker.org/reports/margin-call-refining-capacity-2-degree-world/>

¹⁵ Although not a direct amount of value that may be destroyed, given that companies may take a different course and not sanction projects that don't fit in a low carbon world, among other moving parts.

¹⁶ See for example Carbon Tracker, "Testing testing: BP's Paris goals consistency analysis raises more questions", April 2020. Available at <https://carbontracker.org/testing-testing-bps-paris-goals-consistency-analysis-raises-more-questions/>

This fails to satisfy based on simple maths: if an average were used, every oil company could sanction a mixture of Paris-consistent and inconsistent projects, being consistent with Paris on average, but with the planet failing the Paris goals in total.

Further, as corporate marketing departments increasingly take heed of investor concerns and shift messaging, for example in the form of very long term emissions goals, we believe that examining recent actions is a useful sense check. We term this “verification”. Accordingly, in this report we look at company sanction decisions in the recent past, as well as looking to the future.

Paris Alignment in Capex Terms - Forward-Looking Basis

Short Term

The volatility in oil prices due to the Covid-19 crisis has made it much harder to predict which projects may or may not go ahead, and when.

Their final investment decisions will likely depend on the pathway of oil prices from now on; however it is clear that companies still have plenty of projects available for near term sanction which fall outside Paris limits.

Table 2 shows the twenty largest projects (by capex) outside SDS by a margin of error¹⁷ that were expected to be sanctioned over the next three years (2020-2022) at the time our data was collected (March 2020). While several projects across industry have been deferred or cancelled since then in the face of high commodity price volatility, we have identified only one project on this list that has been suspended indefinitely (Sea Lion in the Falkland Islands).

All of the majors have projects available to them that fall outside SDS. While Eni are not represented on the below list, they are however partners in smaller projects outside the top twenty.

TABLE 2. 20 LARGEST (BY 2020-2030 CAPEX) PROJECTS DUE FOR SANCTION IN THE PERIOD 2020-2022 THAT FALL OUTSIDE SDS BUDGET

Project - Asset(s)	Country	Resource Theme	2020-2030 Capex (BUSD)	Partners (* denotes operator)
Greater Liza (Paya) - Prosperity	Guyana	Conventional - Ultra deepwater (1500+ meter)	5.6	CNOOC, ExxonMobil* , Hess
NW Shelf LNG - Torosa (Browse)	Australia	Conventional - Shelf (to 125 meter)	5.6	BHP, BP , Chevron , CNOOC, Mitsubishi Corp, Mitsui, Shell , Woodside*
Freeport LNG - T4	United States	Conventional - Land	4.8	Freeport LNG*, Zachry Hastings, Osaka Gas, Dow Chemical Company
Yamburgskoye - Achimov Oil	Russia	Conventional - Land	4.6	Gazprom Neft (Public traded part)*, Gazprom

¹⁷ SDS marginal costs are calculated, and projects only shown which have breakeven prices which exceed these levels by at least \$10/bbl for oil and \$1.50/kcf for gas

Absheron - Phase 1	Azerbaijan	Conventional - Deep water (125-1500 meter)	4.0	Total* , Socar, Engie E&P
Mero (Libra NW) - Mero 4	Brazil	Conventional - Ultra deepwater (1500+ meter)	3.7	Petrobras*, Shell, Total , CNOOC, CNPC (parent)
Neptun - Domino & Pelican South	Romania	Conventional - Deep water (125-1500 meter)	2.8	ExxonMobil* , OMV, Petrom (Romania)
Prelude (FLNG) - Crux	Australia	Conventional - Shelf (to 125 meter)	2.6	Oxaka Gas, Seven Group Holdings, Shell*
Balder/Ringhorne - Balder X	Norway	Conventional - Deep water (125-1500 meter)	2.4	MimePetroleum, Vaar Energi*
^ Sea Lion - Phase 1A	Falkland Islands	Conventional - Deep water (125-1500 meter)	2.1	Premier Oil*, Rockhopper Petroleum
BS-4 - Atlanta FDS	Brazil	Extra heavy oil - Ultra deepwater (1500+ meter)	1.9	Enauta*, Barra Energy
Peon	Norway	Conventional - Deep water (125-1500 meter)	1.8	Equinor*, Idemitsu Norway, Petero
Tommeliten - Alpha	Norway	Conventional - Shelf (to 125 meter)	1.3	ConocoPhillips , PGNiC, Total , Vaar Energi
PAJ - Palas	Angola	Conventional - Ultra deepwater (1500+ meter)	1.2	BP* , Sonangol, Equinor, Sinopec Group, Dayuan International Dev., New Bright International Dev.
Jackdaw (30/2a-6)	United Kingdom	Conventional - Shelf (to 125 meter)	1.1	ONE-Dyas, Shell*
WA-01-R - Scarborough	Australia	Conventional - Deep water (125-1500 meter)	1.1	BHP, Woodside*
Browse - Torosa	Australia	Conventional - Shelf (to 125 meter)	1.1	Woodside*, Shell, BP , PetroChina, Mitsubishi Corp, Mitsui
Akacias - Phase 2	Colombia	Extra heavy oil - Land	0.9	Ecopetrol*, Repsol
Snovhit - Future 2	Norway	Arctic - Deep water (125-1500 meter)	0.9	Equinor*, Petoro, Total , Neptune Energy, Wintershall Dea
Orn	Norway	Conventional - Deep water (125-1500 meter)	0.8	Equinor*, Aker BP, Wellesey Petroleum

Source: Rystad Energy, CTI analysis

Note: Onshore tight/shale excluded. \$10/boe margin of error allowed above SDS marginal breakeven for oil fields, \$1.5/kcf for gas. Equity interests held by the majors (ExxonMobil, Chevron, ConocoPhillips, Eni, Total, BP and Shell) have been highlighted.

These projects may be seen as key focuses of attention when trying to understand whether companies are sanctioning assets that don't make economic sense in a low carbon world. It may be that low prevailing prices mean that the sanction of some of these projects is deferred in the short term, although of course this wouldn't necessarily mean that a company wouldn't press ahead when presented with a price that enabled them to do so.

Longer Term Capex Alignment (2020-2030)

Overall, we find that relative company rankings are broadly similar to our 2019 analysis.

Inevitably, some companies have changed positioning in our analysis due to events over the last year, for example changes to project costs or development status, new discoveries/disappointing exploration, and portfolio management including M&A. The main reasons behind changes for the larger companies that have moved significantly are covered in greater detail in the appendix, along with further discussion and results for the full universe.

Certain interesting findings with regard to this years' findings are worth highlighting in brief:

- **For the majors, company positioning approximately mirrors both ambition of any emissions targets and conservativeness of impairment prices**, where disclosed.

- **Some companies are highly leveraged to demand outcomes**, which can be seen in the year on year changes in positioning. Pioneer Natural Resources is a particular example – from a small minority of capex being within SDS last year, this year a large majority is. As discussed last year, this is driven by certain companies having a large proportion of capex at a narrow production cost level close to the marginal cut offs, meaning that a minor change in assumptions can have an outside effect.
- **Some companies with high-cost portfolios may have appeared artificially high in last year's rankings, but have a lower ranking this year.** A clear example is oil sands producer CNRL. The high cost of much of its potential portfolio means that many of its project options are excluded as being above even the business-as-usual baseline; this led to a counterintuitive positioning in 2019 on the (perhaps conservative) basis that we assumed most of its assets weren't on the table for development. The increase in marginal price for STEPS now brings some of these excluded assets into the business-as-usual baseline.

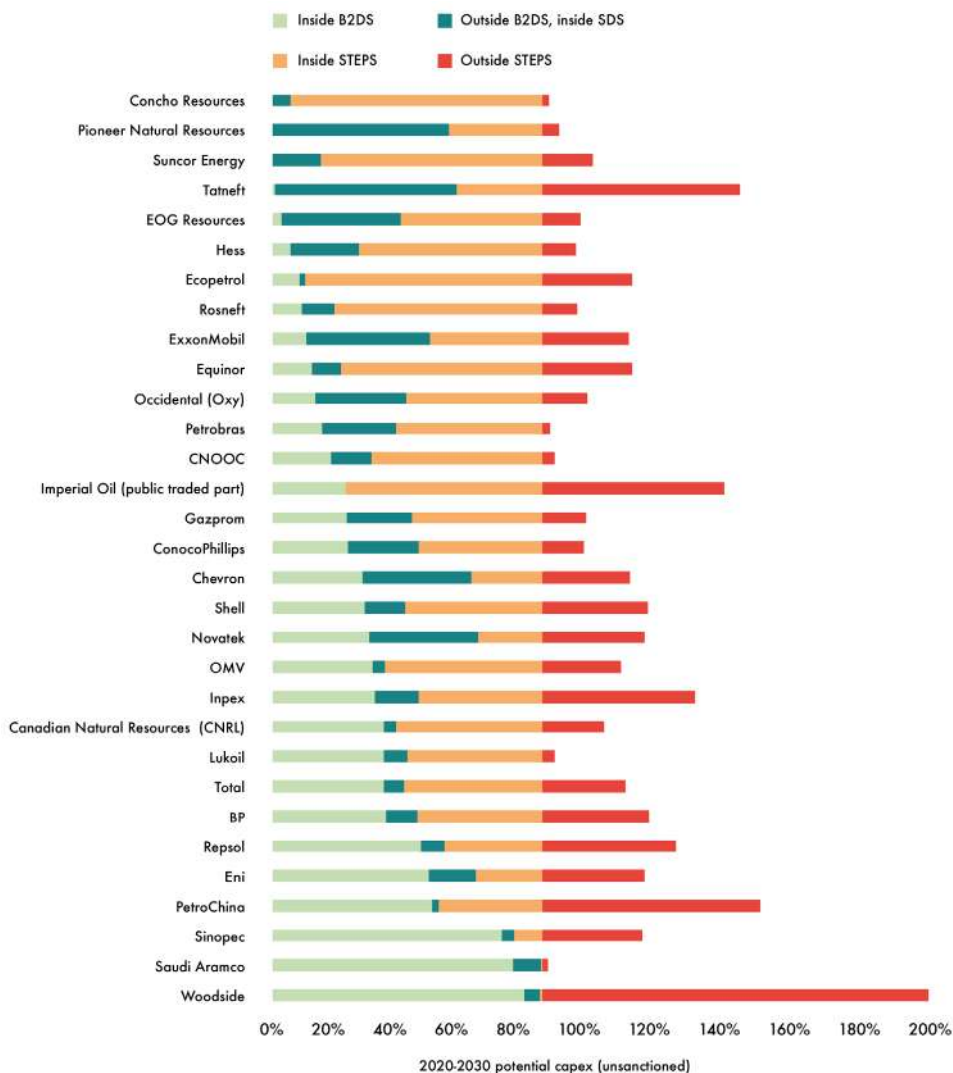
Key conclusions will be discussed in the remainder of this report.

Consistent with previous reports, we use a company universe of the E&P and integrated components of the S&P Global Oil Index¹⁸, plus selected others (65 companies in total - see appendix for full results). Results for the 30 largest companies from our universe by market cap¹⁹ plus Saudi Aramco are shown in Figure 2.

¹⁸ Compared to last year's analysis in *Breaking the Habit*, the following components have been removed from the index: Anadarko (acquired by Occidental Petroleum), Centennial Resource Development, Chesapeake Energy, Oasis Petroleum, QEP Resources, Southwestern Energy, Tullow Oil and Whiting Petroleum. The following components have been added: Beach Energy Ltd, CNX Resources Corp, and Parex Resources. Encana has changed name to Ovintiv.

¹⁹ Bloomberg, 07/09/20.

FIGURE 2. 2020-2030 POTENTIAL STEPS CAPEX OUTSIDE GIVEN SCENARIOS, SELECTED COMPANIES - NEW PROJECTS ONLY (UNSANCTIONED)



Source: IEA, Rystad Energy, CTI analysis

Different indicators whistle the same tune

Multiple strands of evidence now combining on company positioning

Whereas climate change and transition risk issues are often pigeonholed as “ESG” issues (environmental, social and governance), for fossil fuel producers they represent a fundamental and existential threat that goes right to the heart of their strategy.

Accordingly, to successfully navigate the transition and attempt to demonstrate to stakeholders that they “get it”, fossil fuel companies will need to face the challenge in a way that is holistic and touches on every part of their business – whether portfolio management, governance, financial reporting, or any number of other different aspects. Given the industry’s long history and embedded culture, this is taking a while to filter through; however, some companies are increasingly incorporating the transition in different areas.

In particular, over the last 12 months we have seen European oil and gas producers make a slew of related announcements relating to increasingly ambitious emissions targets (which are now finally starting to feed into production targets, in the case of BP²⁰) and updated long-term commodity price assumptions used for accounting purposes.

We have previously looked at company positioning in the context of the transition for each of these topics:

- **Emissions targets** – covered in *Absolute Impact*²¹ (June 2020)
- **Impairment price assumptions** – covered in *Impair State*²² (June 2020)

Here we look at how the pieces all fit together in a mutually reinforcing way, to illustrate the increasingly divergent paths that fossil fuel producers are on. The impression is increasingly of a 2 speed race, with the European companies to varying degrees showing less exposed portfolios, more meaningful emissions targets based on scope 3 and increasingly bringing in absolute emissions characteristics, and more conservative impairment price assumptions underpinning their financial statements. Conversely, the US majors exhibit higher cost portfolios, either absent or limited emissions targets, and don’t even disclose impairment price assumptions.

In the following sections we review BP, Chevron, ConocoPhillips, Eni, Equinor, ExxonMobil, Repsol, Shell and Total under these different dimensions. The results highlight the extent to which views on broad company positioning in the transition are becoming more robust as more data points come out²³.

20 See BP, “BP’s New Strategy To Deliver Net Zero Ambition”, August 2020. Available at https://otp.investis.com/clients/uk/bp_plc/rns/regulatory-story.aspx?cid=233&newsid=1405972

21 Carbon Tracker, “Absolute Impact: Why oil majors’ climate ambitions fall short of Paris limits”, June 2020. Available at <https://carbontracker.org/reports/absolute-impact/>

22 Carbon Tracker, “The Impair State: The Paris Agreement starts to impact oil & gas accounting”, June 2020. Available at <https://carbontracker.org/reports/the-impair-state/>

23 Clearly 9 companies is not a huge sample – we look forward to seeing if the relationships hold as more companies announce emissions ambitions.

Climate “ambitions” that link to carbon budget reality as proxy for stranded asset risk

In *Absolute Impact*, we reviewed the emissions ambition/target announcements for the above 9 companies, with a particular focus on the extent to which their structures linked to the concept of a finite global carbon budget. The companies were ranked based on whether their ambitions had features including an absolute basis, coverage of scope 3 emissions, coverage of full equity share production, and whether they had interim targets to motivate near term action or were solely long term in nature.

We argued that emissions ambitions formulated in a way that recognise the planet’s finite limits would not only show an understanding of climate concerns, but that this would likely feed through to project portfolio management and sanction activity. In other words, companies with weak emissions targets would be more likely to develop the high cost projects that have a greater risk of being stranded and destroying value.

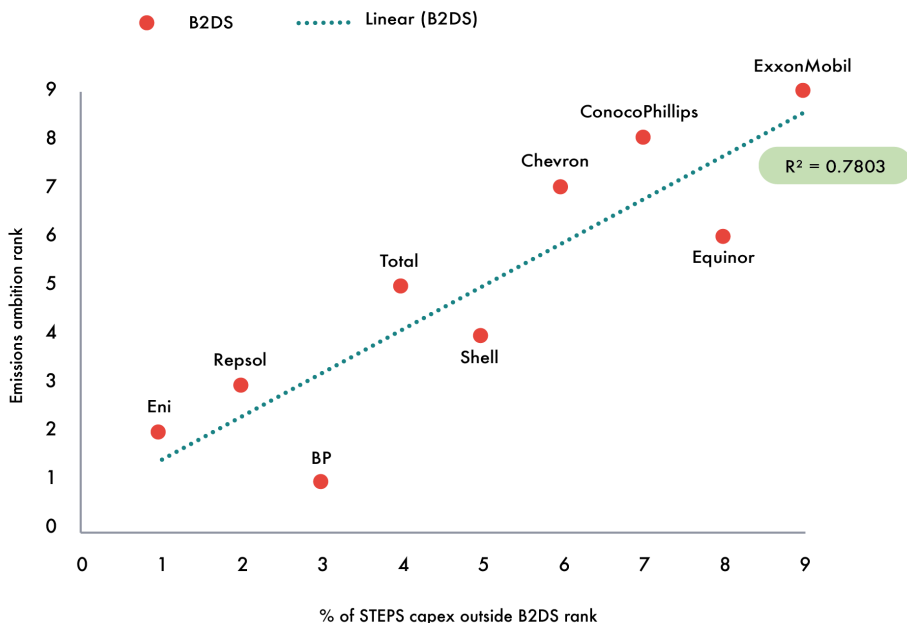
Looking at the correlation between our emissions target ranking and capex positioning relative to B2DS for unsanctioned assets, we find support for this view. Table 3 shows the capex rank for these nine selected companies, used as the x axis in Figure 2 and Figure 3.

TABLE 3. %STEPS CAPEX OUTSIDE B2DS BUDGET AND RANK FOR SELECTED COMPANIES

Company	% of STEPS capex outside B2DS budget (% band)	Rank based on B2DS
Eni	40% - 50%	1
Repsol	40% - 50%	2
BP	50% - 60%	3
Total	50% - 60%	4
Shell	60% - 70%	5
Chevron	60% - 70%	6
ConocoPhillips	70% - 80%	7
Equinor	80% - 90%	8
ExxonMobil	80% - 90%	9

Source: Rystad Energy, IEA, CTI analysis

FIGURE 3. 2020-2030 POTENTIAL STEPS CAPEX OUTSIDE B2DS RANK COMPARED TO CTI EMISSIONS AMBITION RANK (SELECTED COMPANIES, UNSANCTIONED PROJECTS ONLY)



Source: Rystad Energy, IEA, company disclosures, CTI analysis

Note: emissions rankings differs slightly from that published in *Absolute Impact*; BP has been moved up in rank from 3 to 1 following its announcements subsequent to publication of that document.

% of STEPS capex outside B2DS shows a high degree of correlation with CTI's emissions ambition ranking: 88%, and that correlation is found to be highly statistically significant i.e. unlikely to be a result of pure chance (99.8% significance). Setting emissions targets that have a better link to the climate appears to also match up with management of portfolios of projects likely to be more resilient in the transition.

Impairment prices also give a window on future project sanction conservativeness

In *Impair State*, we observed that the energy transition was starting to become visible in the assumptions underpinning companies' financial statements, with the long term price assumptions used for impairment testing

of balance sheet asset values increasingly being revised down with mentions of the energy transition as a rationale (clearly there are shorter term reasons for reductions in price assumptions as well).

Similarly to emissions ambition, we expected that impairment prices would link to company portfolio management – while impairment price assumptions do not necessarily exactly reflect the prices used in the sanction process, they are supposed to reflect management's best estimates of the future. Accordingly, a company with high impairment prices may be assumed to be basing its business on a view of high demand/high prices for fossil fuels, implying that they do not expect success under Paris, and therefore are more likely to invest in high-cost, potentially stranded assets.

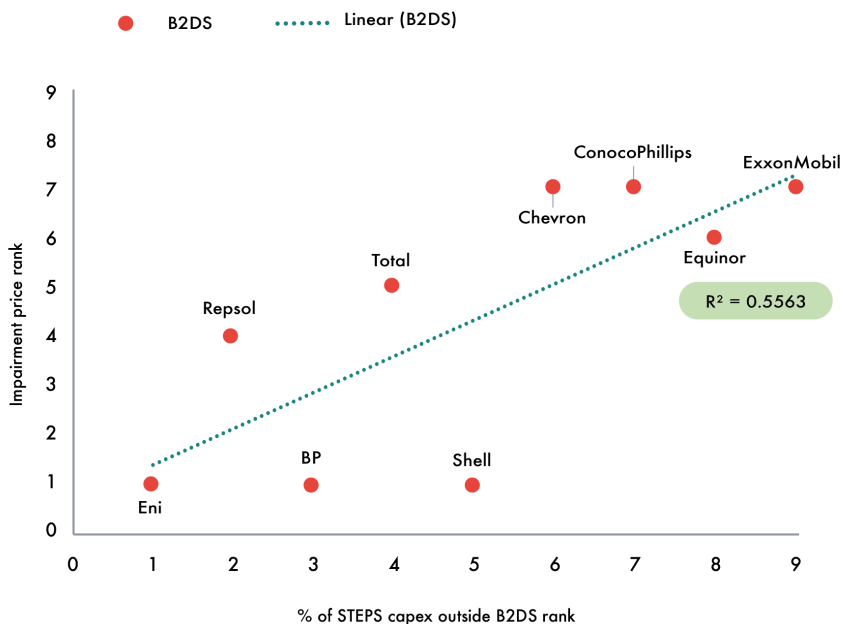
Again, we find support for this view based on our capex analysis. To compare impairment prices, we rank the above 9 companies based on the highest point that their impairment price reaches in future. Where companies did not disclose their impairment prices, we ranked them in joint last place.

B2DS capex positioning shows a correlation with impairment price: 75%, and again with good statistical significance (98% significance). Companies with more conservative price assumptions, and disclosure of those price assumptions, manage their portfolios to be more resilient to the transition.

Rounding off the discussion, it will not be a surprise to hear that ratings under the CTI emissions ambition framework and impairment prices are also closely linked, with a 90% correlation of high statistical significance (99.9% significance). Companies with more progressive management teams tend to have both more conservative impairment prices and more meaningful emissions targets.

Further, the strength of the statistical connection between capex outside B2DS, emissions ambition and impairment price suggests that each factor is a decent predictor of the others.

FIGURE 4. 2020-2030 POTENTIAL STEPS CAPEX OUTSIDE B2DS (SELECTED COMPANIES, UNSANCTIONED PROJECTS ONLY) COMPARED TO RELATIVE RANKING ON MAXIMUM IMPAIRMENT PRICE



Source: Rystad Energy, IEA, company disclosures, CTI analysis

Note: impairment price rankings were ranked based on the highest point reached by the company's future oil price pathway, using Brent oil assumption in real terms in 2020 dollars. Companies that did not disclose their impairment price were ranked joint last.

While the US companies do not disclose their impairment prices, their poor positioning in terms of capex and emissions ambitions implies that their lack of disclosure is not hiding conservative impairment prices, and their financial statements are underpinned by higher price assumptions than their European peers (with the possible exception of Equinor, which stands out a long way from other European companies with its long term price assumption of \$82/bbl in real 2020 dollars).

Putting it all together – company strategies showing some consistency, one way or the other

In conclusion, we find that there are strong links between company positionings based on potential capex that fits within B2DS²⁴, impairment price assumptions and structure of emissions ambition.

TABLE 4. COMPANY POSITIONING BASED ON PORTFOLIO ECONOMICS, EMISSIONS AMBITION AND IMPAIRMENT PRICE ASSUMPTION

Company	Portfolio economics - unsanctioned assets		Emissions ambition	Impairment price assumption		Overall
	% of STEPS capex outside B2DS budget (% band)	Rank based on B2DS	Rank based on CTI framework	Maximum price over 2020-2050 (Brent oil, real 2020 \$)	Rank based on maximum 2020-2050 price	Average of rankings
Eni	40% - 50%	1	2	60	1	1.3
BP	50% - 60%	3	1	60	1	1.7
Repsol	40% - 50%	2	3	68	4	3.0
Shell	60% - 70%	5	4	60	1	3.3
Total	50% - 60%	4	5	73	5	4.7
Chevron	60% - 70%	6	7	not disclosed	7	6.7
Equinor	80% - 90%	8	6	82	6	6.7
ConocoPhillips	70% - 80%	7	8	not disclosed	7	7.3
ExxonMobil	80% - 90%	9	9	not disclosed	7	8.3

Source: Rystad Energy, IEA, company disclosures, CTI analysis

Note: Emissions rankings differs slightly from that published in *Absolute Impact*; BP has been moved up in rank from 3 to 1 following its announcements subsequent to publication of that document.

“STEPS capex” is the level of capex modelled as going ahead under the IEA’s central Stated Policies Scenario, associated with mean warming of 2.7 °C. B2DS is the IEA’s Beyond 2 Degrees Scenario; we estimate that our interpretation is consistent with a 50% chance of limiting warming to c. 1.6°C.

²⁴ Interestingly, SDS capex positionings shows a much weaker correlation with other factors than B2DS. This is because of the in/out binary nature of our methodology and the high degree of sensitivity for shale assets, due to the large quantum of capex in these assets at cost levels very near the SDS marginal price level. Accordingly, the more shale-exposed US companies improve their positioning under SDS compared to B2DS to a greater degree than the European companies. While marginal assets may score as 100% in a budget based on our methodology, in practice they would have little value compared to assets that have lower costs and higher margins. Accordingly, we suspect that if a metric like net present value was used, rather than in/out of the budget, the correlations would hold up better in these cases. With a small sample size, correlations are very sensitive to individual datapoints.

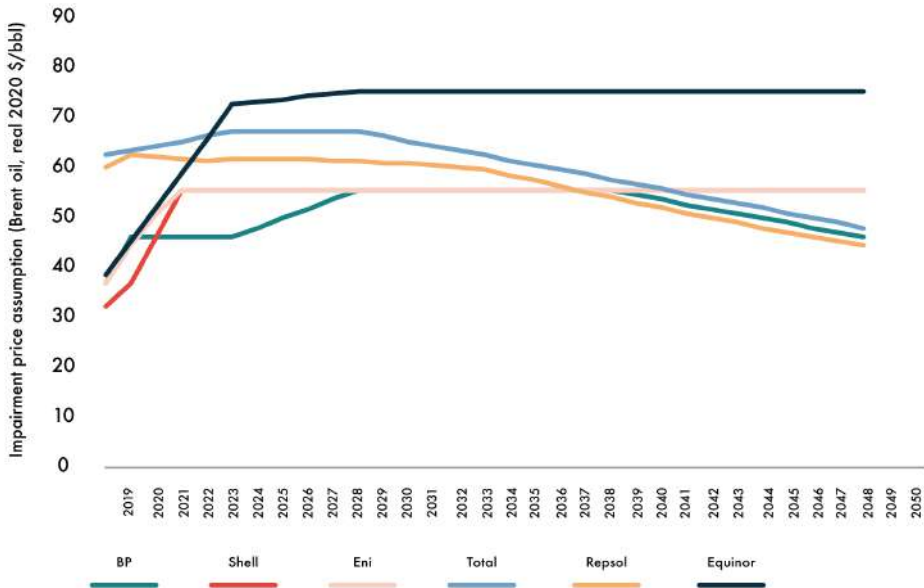
Companies are increasingly either showing well on all of these things, implying that management teams are getting the message that transition plans need to extend throughout the business, or none of them, setting themselves up for poor performance on both financial and environmental aspects. Given that ultimately all of these features speak to the potential for investing in stranded assets, it seems that transition risks may be increasingly concentrated.

Putting all of the companies on a simple comparison table shows a clear trend – European companies show up better than US companies across the board, with Equinor a notable exception.

Impairment prices as a proxy for differing company views of future demand

As discussed above, we express our portfolio results in terms of capex that fits in a low carbon environment relative to capex that goes ahead under STEPS, used as a proxy for business-as-usual behaviour. However, different companies appear to be taking divergent views of the future, raising the question of whether they should be judged against different baselines.

FIGURE 5. OIL AND GAS COMPANY IMPAIRMENT PRICES



Source: company disclosures, CTI analysis

Note: Chevron, ConocoPhillips and ExxonMobil do not disclose impairment prices used.

Looking into the minds of management to get a quantitative view on what they may or may not sanction in future is not straightforward. However, one indication is given by the future price assumption that companies use in their impairment testing for the purposes of their financial reporting.

Given a number of companies have lowered their long term impairment testing prices, often referring to the transition as at least part of their rationale, here we explore using company disclosed prices as an alternative proxy for future behaviour that varies from company to company. Using this framework, the normal business-as-usual marginal price (STEPS by default) is replaced by each company's respective impairment price assumption. A company with a more conservative impairment price is effectively assumed to not be likely to progress higher cost projects in future, and thus be less likely to invest in assets that become stranded.

As usual, we stress that the marginal prices derived from our analysis should not be thought of as forecasts of the prevailing price over that period for a number of reasons²⁵. Accordingly, comparing company impairment prices, which are price forecasts, to the marginal cost levels is far from an exact science. The benefit is not the exact level of the impairment price assumption in the context of the capex analysis, but the relativity between the companies. Companies with lower impairment prices would appear to have a more conservative outlook than peers, and hence the baseline level of future capex assumed for them might be lower.

The below table shows the adjusted business-as-usual proxy for the aforementioned 9 companies (the majors plus Equinor and Repsol). As discussed elsewhere in this document, the measure of impairment price used is the highest point reached by the company's future oil price case. Where companies have not disclosed their impairment prices, we assume the normal STEPS benchmark as a business-as-usual proxy.

TABLE 5. MARGINAL PRICES USED AS ALTERNATE BUSINESS-AS-USUAL PROXY FOR 2020-2040, BASED ON COMPANY DISCLOSURES

Company	Alternate BAU Proxy (\$/bbl)
Eni	60
BP	60
Shell	60
Repsol	68
Total	73
Equinor	82
Chevron	STEPS marginal price
ConocoPhillips	STEPS marginal price
ExxonMobil	STEPS marginal price

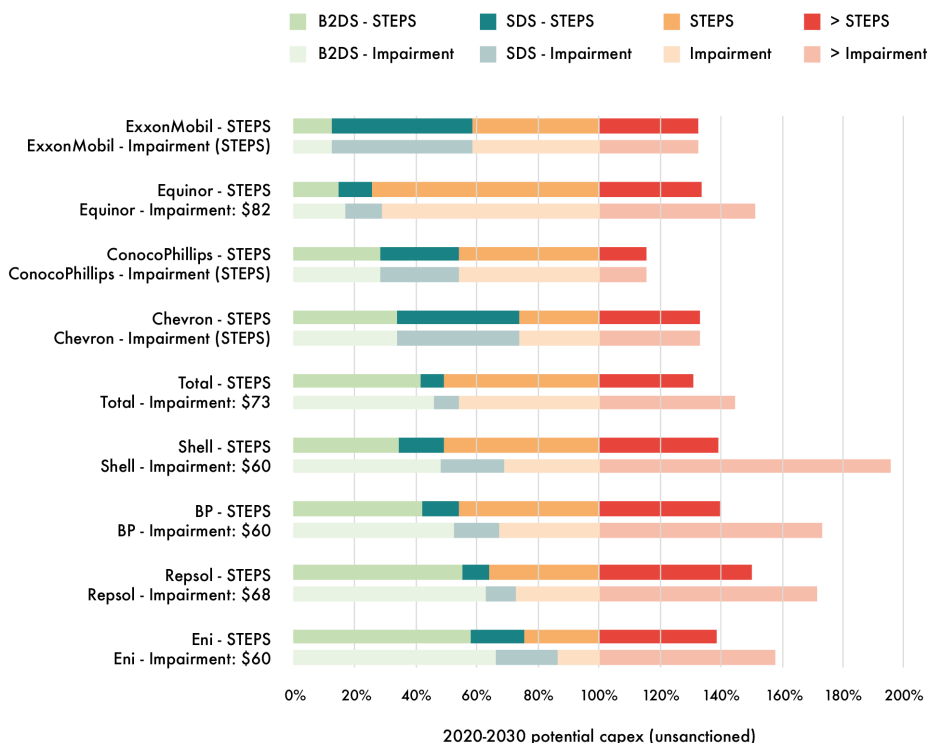
Source: company disclosures.

Note: impairment prices are based on the highest point reached by the company's future oil price pathway, using Brent oil assumption in real terms in 2020 dollars. Companies that did not disclose their impairment price are assumed to have STEPS as a business as usual proxy.

The results of using the above prices as an alternative BAU proxy are shown in Figure 6.

²⁵ For example – the marginal price for an aggregate period reflects the highest cost project that goes ahead in that period but not when; the supply curve may move up and down reflecting cyclical conditions; and our assumption that a project requires a 15% internal rate of return to be sanctioned may not be reflected in the market.

FIGURE 6. CAPEX ALIGNMENT FOR SELECTED COMPANIES USING DISCLOSED IMPAIRMENT PRICES AS AN ALTERNATE PROXY FOR BUSINESS BEHAVIOUR VS USING STEPS – UNSANCTIONED PROJECTS ONLY



Source: IEA, Rystad Energy, CTI analysis, company disclosures.

Notes: For each company, then upper bar represents that capex alignment by scenario as a percentage of STEPS capex, and is the same as shown in Figure 2. The lower bar uses disclosed impairment prices as marginal breakeven prices as a business-as-usual proxy instead of the STEPS marginal breakeven price. N.b. where no disclosure price is available, the marginal breakeven price is set to STEPS.

The companies that disclose their impairment prices therefore improve their positionings in terms of capex outside B2DS/SDS relative to STEPS, with those that have the most conservative assumptions improving most. As discussed above, companies that have more conservative impairment price assumptions already appear to have portfolios that are

more resilient in the transition. The effect of this change is therefore generally to exaggerate the trends we already see, rather than dramatically change the order – the European companies pull further away from their US counterparts.

Sensitivity Analysis – Company Leverage to Demand/Costs

Some companies remain highly leveraged to demand outcomes

As we have discussed previously²⁶, the binary nature of our approach to determining project alignment with a given scenario – assets are either in or out – can lead to high sensitivity of outcomes for certain companies. Where companies have a large proportion of capex on projects that are near to the marginal price cut off levels for a given scenario, a small change in assumptions can lead to outsized effects meaning that they have very high leverage to the inputs used.

A minor shift in project costs, or demand levels, can lead to substantially all of their potential capex switching to either inside or outside of the budget. These companies are typically those that are specialised in a particular theme, therefore have project costs in a narrow range, whereas companies that have more diversified portfolios with projects at a range of project costs behave in more linear ways.

A good example is Pioneer Natural Resources, a specialist in the Permian shale basin. In *Breaking the Habit* (2019), the significant majority of Pioneer's projects lay outside SDS, whereas here over 60% of Pioneer's projects fit within SDS on a least cost basis without a major change in methodology.

The result of this is that such companies' risk of creating stranded assets is particularly sensitive to exact demand outcomes, and we identify this as an additional facet of overall transition risk. Were we to use a metric that has less binary outcomes, for example net present value (NPV), the shift for companies with projects in the margin could be seen as comparable to a shift from between positive and negative NPV, but with the absolute change being relatively small.

Sensitivity analysis to provide a measure of outcome volatility

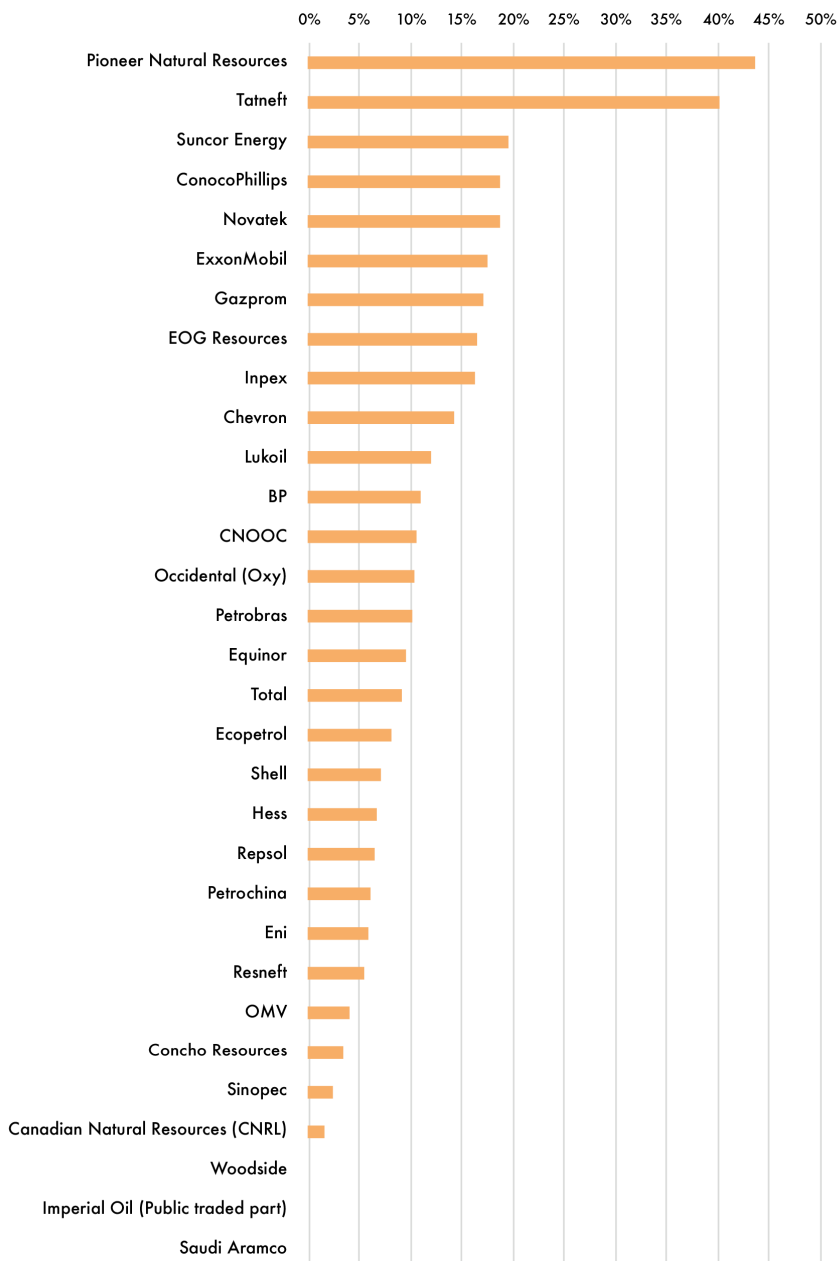
Sensitivity analysis can be used to assess to what extent companies' positionings might change in our analysis for a small change in a given parameter. As an example, we can examine the change in % of company potential capex outside SDS that results from varying SDS oil and gas demand by +/- 5%²⁷. The absolute change in % potential capex outside SDS for the demand shift in both directions is then averaged to give a measure of volatility, analogous to a standard deviation.

The average change in capex alignment by company for this demand shift is then shown in Figure 7. Pioneer, Tatneft and Suncor top this graph, indicating that these companies' portfolios are the most sensitive to small demand fluctuations in terms of falling within a given scenario. Other companies with a high degree of shale liquids exposure feature prominently as among the most sensitive, given the cost profile of much of shale production. Accordingly, those companies with higher average deviation are more likely to move from year to year within our analysis results.

²⁶ See Carbon Tracker, "Breaking the Habit – Why none of the large oil companies are "Paris-aligned", and what they need to do to get there", September 2019. Available at <https://carbontracker.org/reports/breaking-the-habit/>

²⁷ Note that this therefore ceases to replicate the SDS demand levels and temperature outcome, but is presented here for the purposes of sensitivity analysis.

FIGURE 7. SENSITIVITY ANALYSIS BY COMPANY: IMPACT OF A +/- 5% CHANGE IN SDS DEMAND ON COMPANY CAPEX ALIGNMENT (% OF STEPS CAPEX).



Source: IEA, Rystad Energy, CTI analysis.

Conversely, some companies are found to be very insensitive to adjustments to demand, either because their portfolios are generally low cost (Saudi Aramco) or high cost (oil sands producers CNRL and Imperial Oil).

Further discussion on the reasons for any significant shifts in company positioning compared to our 2019 analysis are covered in the appendix.

Paris Alignment in Capex Terms: Verification of Recent Past Actions

2019 calendar year

In *Breaking the Habit*, published in 2019, we found that all 7 majors were participants in the largest projects that were sanctioned in the prior full calendar year (2018) that did not fit within SDS budgets on the basis of production cost-competitiveness.

TABLE 6. THE 15 LARGEST PROJECTS SANCTIONED IN 2019 OUTSIDE SDS BUDGET

Project - Asset(s)	Country	2020-2030 Capex (\$bn)	Resource Theme	Partners (* denotes operator)
Yamal - Kharasaveyskaya (Cen-Apt)	Russia	11.9	Conventional - Land	Gazprom
GGR - Lance Fm (normally pressured)	United States	11.2	Tight gas - Land	Jonah Energy
Golden Pass LNG - T1-T3	United States	10.0	Conventional - Land	ExxonMobil & Qatar Petroleum
Anchor - GC807	United States	6.3	Conventional - Ultra deep-water (1500+ meter)	Chevron, Total
Calcasieu Pass - T1-18	United States	5.2	Conventional - Land	Venture Global LNG
Mero (Libra NW) - Sepetiba	Brazil	3.9	Conventional - Ultra deep-water (1500+ meter)	CNOOC; CNPC; Petrobras; Shell; Total
ACG - Azeri Central East	Azerbaijan	3.3	Conventional - Deep water (125-1500 meter)	BP, Equinor, ExxonMobil, Inpex, ITOCHU, MOL, ONGC (India), Socar, TPAO
Sabine Pass LNG - T6	United States	3.1	Conventional - Land	Cheniere Energy
Severo-Konso-molskoye - PK1 layer (Phase 1)	Russia	1.8	Conventional - Land	BP, Equinor, Rosneft

Kaliningrad-morneft - Kravtsovskoye (D-33)	Russia	0.8	Conventional - Land	Lukoil
Verkhnechonskneftegaz - Danilovskoye	Russia	0.8	Conventional - Land	BP, Rosneft
Goturdepe North - Phase 1	Turkmenistan	0.7	Conventional - Land	Turkmennebit
Mumbai High - South (Phase IV)	India	0.6	Conventional - Shelf (to 125 meter)	ONGC (India)
Midia Gas Development - Doina & Ana	Romania	0.4	Conventional - Shelf (to 125 meter)	Gas Plus, Petro Venture, The Carlyle Group
Ruche Phase 1 & 2 - Dussafu Ruche/Ruche NE Marin	Gabon	0.4	Conventional - Shelf (to 125 meter)	BW Energy, Panoro Energy, Society National Petroliere Gabonaise State of Gabon, Tullow Oil

Source: IEA, Rystad Energy, CTI analysis

Note: Onshore tight/shale excluded. \$10/boe margin of error allowed above SDS marginal breakeven for oil fields, \$1.5/kcf for gas.

Table 6 shows a similar analysis for 2019, including a substantial margin of error applied to the breakeven price²⁸. Total estimated 2020-30 capex associated with these projects is \$60bn. BP, Chevron, ExxonMobil, Shell and Total all feature.

Of the majors, only Eni and ConocoPhillips are not partners in the above projects. While Eni did sanction assets that fail the test of having breakeven costs above the SDS, they were not more than \$10/bbl or \$1.5/kcf above the SDS level which is the margin used in the above table.

ConocoPhillips is the only major not to have sanctioned an asset that falls outside SDS in 2019. While it did sanction assets that fell outside the B2DS, the majority is accounted for by a single project which has a marginal cost only a few dollars above the B2DS cut off, the Malikai Phase 2 oil project in Malaysia (total 2020-2030 capex \$0.4bn, of which ConocoPhillips's share is c.\$140m). The company therefore deserves credit for keeping its sanction activity to assets at the lower end of the cost curve, and we will be interested to see if it maintains this discipline.

As our longer term analysis demonstrates, the company still has plenty of higher-cost opportunities in its portfolio – but it will have flexibility on whether to progress these or not, and stakeholders may appreciate statements of its commitment to continue to only sanction assets that fit in a low carbon world.

Appendix I

Supplementary Company Results

Here we show the full results for our universe of companies, which comprises the E&P and integrated components of the S&P Global Oil Index²⁹, plus selected others (e.g. BHP and Saudi Aramco).

TABLE 7. 2020-2030 POTENTIAL CAPEX OUTSIDE GIVEN SCENARIOS - UNSANCTIONED PROJECTS ONLY

Quartile (based on % of STEPS capex outside B2DS)	Company	% of STEPS capex outside B2DS budget (% band)	% of STEPS capex outside SDS budget (% band)	Upstream capex outside STEPS budget (% of STEPS)
4	Aker BP	90% - 100%	60% - 70%	10% - 20%
4	Apache	90% - 100%	60% - 70%	30% - 40%
4	Concho Resources	100%	90% - 100%	0% - 10%
4	Continental Resources	90% - 100%	40% - 50%	20% - 30%
4	Crescent Point Energy	100%	100%	10% - 20%
4	Diamondback Energy	100%	70% - 80%	0% - 10%
4	Ecopetrol	80% - 90%	80% - 90%	30% - 40%
4	EOG Resources	90% - 100%	50% - 60%	10% - 20%
4	Hess	90% - 100%	60% - 70%	10% - 20%
4	Matador Resources	100%	90% - 100%	10% - 20%
4	Origin Energy	90% - 100%	90% - 100%	60% - 70%
4	Parex Resources	100%	90% - 100%	> 100%
4	PDC Energy	100%	70% - 80%	0% - 10%
4	Pioneer Natural Resources	100%	30% - 40%	0% - 10%
4	Suncor Energy	90% - 100%	80% - 90%	10% - 20%
4	Tatneft	90% - 100%	30% - 40%	70% - 80%
4	WPX Energy	100%	70% - 80%	0% - 10%

²⁹ Compared to last year's analysis in *Breaking the Habit*, the following components have been removed from the index: Anadarko (acquired by Occidental Petroleum), Centennial Resource Development, Chesapeake Energy, Oasis Petroleum, QEP Resources, Southwestern Energy, Tullow Oil and Whiting Petroleum. The following components have been added: Beach Energy Ltd, CNX Resources Corp, and Parex Resources. Encana has changed name to Ovintiv.

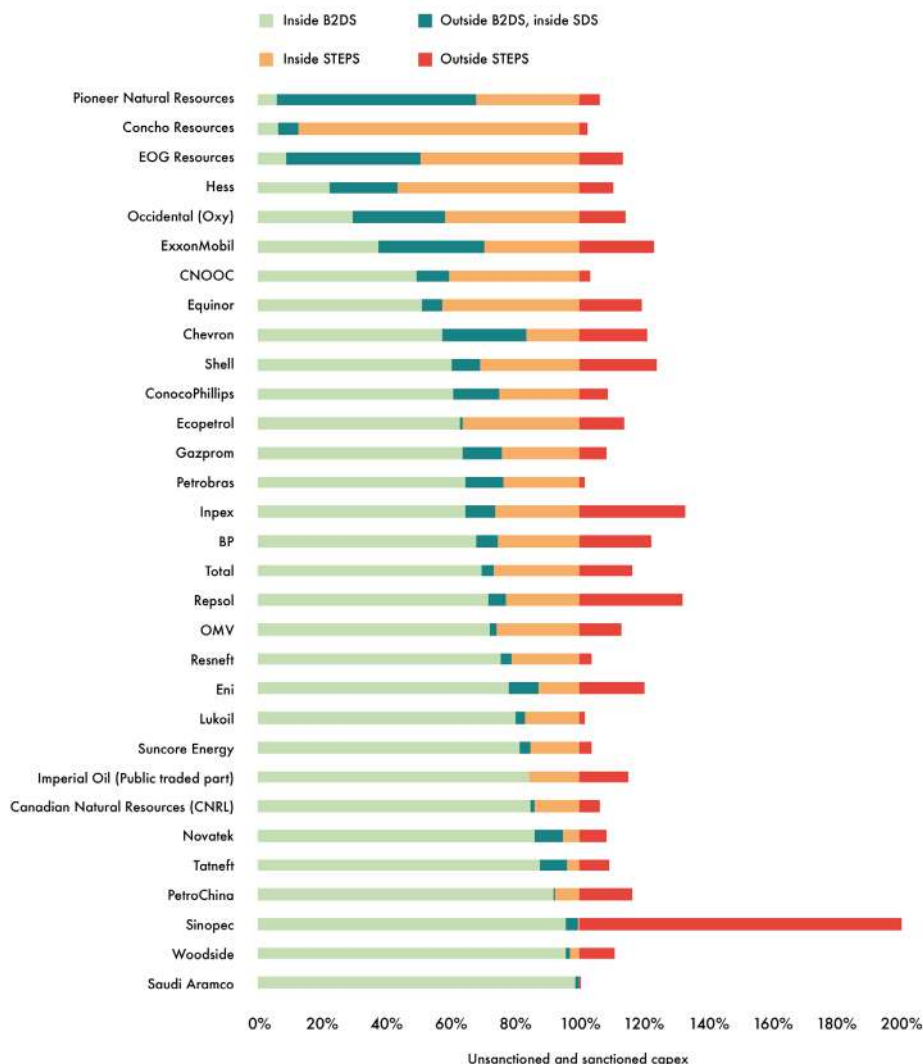
3	Cenovus Energy	70% - 80%	50% - 60%	80% - 90%
3	CNOOC	70% - 80%	60% - 70%	0% - 10%
3	ConocoPhillips	70% - 80%	40% - 50%	10% - 20%
3	Devon Energy	70% - 80%	40% - 50%	20% - 30%
3	Equinor	80% - 90%	70% - 80%	30% - 40%
3	ExxonMobil	80% - 90%	40% - 50%	30% - 40%
3	Gazprom	70% - 80%	40% - 50%	10% - 20%
3	Husky Energy	70% - 80%	70% - 80%	10% - 20%
3	Imperial Oil (Public traded part)	70% - 80%	70% - 80%	60% - 70%
3	Lundin Petroleum	80% - 90%	80% - 90%	10% - 20%
3	Marathon Oil	70% - 80%	40% - 50%	0% - 10%
3	Noble Energy	70% - 80%	40% - 50%	20% - 30%
3	Oxy	80% - 90%	50% - 60%	10% - 20%
3	Parsley Energy	80% - 90%	60% - 70%	0% - 10%
3	Petrobras	80% - 90%	50% - 60%	0% - 10%
3	Rosneft	80% - 90%	70% - 80%	10% - 20%
2	BHP	50% - 60%	40% - 50%	50% - 60%
2	BP	50% - 60%	40% - 50%	30% - 40%
2	Canadian Natural Resources (CNRL)	50% - 60%	50% - 60%	20% - 30%
2	Chevron	60% - 70%	20% - 30%	30% - 40%
2	Cimarex Energy	40% - 50%	0% - 10%	0% - 10%
2	Galp Energia SA	50% - 60%	20% - 30%	40% - 50%
2	Inpex	60% - 70%	40% - 50%	50% - 60%
2	Lukoil	50% - 60%	40% - 50%	0% - 10%
2	Murphy Oil	60% - 70%	50% - 60%	10% - 20%
2	Novatek	60% - 70%	20% - 30%	30% - 40%
2	Oil Search	50% - 60%	20% - 30%	50% - 60%
2	OMV	60% - 70%	50% - 60%	20% - 30%
2	Santos	40% - 50%	10% - 20%	> 100%
2	Shell	60% - 70%	50% - 60%	30% - 40%
2	Total	50% - 60%	50% - 60%	30% - 40%
2	Vermilion Energy	60% - 70%	40% - 50%	70% - 80%
1	Antero Resources	0% - 10%	0% - 10%	0% - 10%
1	Arc Resources	40% - 50%	20% - 30%	0% - 10%
1	Beach Energy Limited	10% - 20%	10% - 20%	> 100%
1	Cabot Oil and Gas	0% - 10%	0% - 10%	0% - 10%
1	CNX Resources Corporation	0% - 10%	0% - 10%	> 100%

1	Eni	40% - 50%	20% - 30%	30% - 40%
1	EQT Corporation	0% - 10%	0% - 10%	>100%
1	PetroChina	40% - 50%	30% - 40%	80% - 90%
1	Range Resources	0% - 10%	0% - 10%	50% - 60%
1	Repsol	40% - 50%	30% - 40%	40% - 50%
1	Sasol	0% - 10%	0% - 10%	20% - 30%
1	Saudi Aramco	10% - 20%	0% - 10%	0% - 10%
1	Seven Generations Energy	0% - 10%	0% - 10%	0% - 10%
1	Sinopec	10% - 20%	10% - 20%	30% - 40%
1	Tourmaline Oil	0% - 10%	0% - 10%	0% - 10%
1	Woodside	0% - 10%	0% - 10%	>100%

Source: Rystad Energy, CTI analysis
Note: GTL and CTL are excluded from the analysis, and therefore are not included in Sasol’s potential portfolio.



FIGURE 8. 2020-2030 POTENTIAL CAPEX OUTSIDE GIVEN SCENARIOS, SELECTED COMPANIES - ALL PROJECTS (SANCTIONED AND UNSANCTIONED)



Source: IEA, Rystad Energy, CTI analysis

TABLE 8. 2020-2030 POTENTIAL CAPEX OUTSIDE GIVEN SCENARIOS - ALL PROJECTS (SANCTIONED AND UNSANCTIONED)

Quartile (based on % of STEPS capex outside B2DS)	Company	% of STEPS capex outside B2DS budget (% band)	% of STEPS capex outside SDS budget (% band)	Upstream capex outside STEPS budget (% of STEPS)
4	Aker BP	60% - 70%	40% - 50%	0% - 10%
4	Apache	60% - 70%	40% - 50%	20% - 30%
4	Concho Resources	90% - 100%	80% - 90%	0% - 10%
4	Continental Resources	80% - 90%	40% - 50%	20% - 30%
4	Crescent Point Energy	90% - 100%	90% - 100%	10% - 20%
4	Devon Energy	60% - 70%	40% - 50%	20% - 30%
4	Diamondback Energy	90% - 100%	70% - 80%	0% - 10%
4	EOG Resources	90% - 100%	40% - 50%	10% - 20%
4	Hess	70% - 80%	50% - 60%	10% - 20%
4	Marathon Oil	60% - 70%	40% - 50%	0% - 10%
4	Matador Resources	90% - 100%	90% - 100%	10% - 20%
4	Noble Energy	60% - 70%	40% - 50%	20% - 30%
4	Oxy	70% - 80%	40% - 50%	10% - 20%
4	Parsley Energy	80% - 90%	60% - 70%	0% - 10%
4	PDC Energy	80% - 90%	60% - 70%	0% - 10%
4	Pioneer Natural Resources	90% - 100%	30% - 40%	0% - 10%
4	WPX Energy	90% - 100%	60% - 70%	0% - 10%
3	Arc Resources	40% - 50%	10% - 20%	0% - 10%
3	Chevron	40% - 50%	10% - 20%	20% - 30%
3	Cimarex Energy	40% - 50%	0% - 10%	0% - 10%
3	CNOOC	50% - 60%	40% - 50%	0% - 10%
3	ConocoPhillips	30% - 40%	20% - 30%	0% - 10%
3	Ecopetrol	30% - 40%	30% - 40%	10% - 20%
3	Equinor	40% - 50%	40% - 50%	10% - 20%
3	ExxonMobil	60% - 70%	20% - 30%	20% - 30%
3	Husky Energy	30% - 40%	30% - 40%	0% - 10%
3	Lundin Petroleum	40% - 50%	40% - 50%	0% - 10%
3	Murphy Oil	50% - 60%	40% - 50%	0% - 10%
3	Oil Search	40% - 50%	10% - 20%	40% - 50%
3	Origin Energy	40% - 50%	40% - 50%	30% - 40%
3	Parex Resources	40% - 50%	40% - 50%	50% - 60%
3	Shell	30% - 40%	30% - 40%	20% - 30%
3	Vermilion Energy	40% - 50%	20% - 30%	40% - 50%

2	BHP	30% - 40%	30% - 40%	30% - 40%
2	BP	30% - 40%	20% - 30%	20% - 30%
2	Cenovus Energy	20% - 30%	20% - 30%	20% - 30%
2	Eni	20% - 30%	10% - 20%	20% - 30%
2	Galp Energia SA	30% - 40%	10% - 20%	30% - 40%
2	Gazprom	30% - 40%	20% - 30%	0% - 10%
2	Imperial Oil (Public traded part)	10% - 20%	10% - 20%	10% - 20%
2	Inpex	30% - 40%	20% - 30%	30% - 40%
2	Lukoil	20% - 30%	10% - 20%	0% - 10%
2	OMV	20% - 30%	20% - 30%	10% - 20%
2	Petrobras	30% - 40%	20% - 30%	0% - 10%
2	Repsol	20% - 30%	20% - 30%	30% - 40%
2	Rosneft	20% - 30%	20% - 30%	0% - 10%
2	Santos	20% - 30%	10% - 20%	>100%
2	Suncor Energy	10% - 20%	10% - 20%	0% - 10%
2	Total	30% - 40%	20% - 30%	10% - 20%
1	Antero Resources	0% - 10%	0% - 10%	0% - 10%
1	Beach Energy Limited	0% - 10%	0% - 10%	>100%
1	Cabot Oil and Gas	0% - 10%	0% - 10%	0% - 10%
1	Canadian Natural Resources (CNRL)	10% - 20%	10% - 20%	0% - 10%
1	CNX Resources Corporation	0% - 10%	0% - 10%	>100%
1	EQT Corporation	0% - 10%	0% - 10%	80% - 90%
1	Novatek	10% - 20%	0% - 10%	0% - 10%
1	PetroChina	0% - 10%	0% - 10%	10% - 20%
1	Range Resources	0% - 10%	0% - 10%	40% - 50%
1	Sasol	0% - 10%	0% - 10%	0% - 10%
1	Saudi Aramco	0% - 10%	0% - 10%	0% - 10%
1	Seven Generations Energy	0% - 10%	0% - 10%	0% - 10%
1	Sinopec	0% - 10%	0% - 10%	10% - 20%
1	Tatneft	10% - 20%	0% - 10%	0% - 10%
1	Tourmaline Oil	0% - 10%	0% - 10%	0% - 10%
1	Woodside	0% - 10%	0% - 10%	>100%

Source: IEA, Rystad Energy, CTI analysis

Notes: GTL and CTL are excluded from the analysis, and therefore are not included within Sasol's potential portfolios

Appendix II: Relative Changes in Company Positioning

As our 2020 analysis incorporates few methodological changes to significantly affect our results, company results are broadly consistent with last year's analysis.

Nonetheless, the year that has passed since our last data update has brought material changes to some companies' relative positioning in our capex rankings. These differences reflect a variety of factors including M&A as well as attempts to reduce costs, and generally fall into one or more of the following categories:

Category	Relative exposure improvement	Relative exposure worsening
Corporate activity	Asset divestment, particularly of non-core positions	Acquisition of new projects outside budget
Data update	Reduction in individual project breakeven costs, sometimes related to improved resource estimates and/or project rationalisation, resulting in project moving inside the budget Deferral of capex on high-cost projects beyond 2030 timeframe Reduction in capex for projects outside budget	Reduction in marginal industry breakeven cost (demarcating in/out of budget) resulting in projects that were inside the budget now being outside Upwards revision to breakeven cost estimates Increased capex outside B2DS but within STEPS, either having previously been excluded as above STEPS or through new acquisitions

In the interest of brevity and given the size of our company universe, below we list a few companies with the largest relative movements in our rankings and the main reasons behind these moves. We mainly focus on companies' rankings with regards to unsanctioned B2DS capex as a share of STEPS capex. Note that these examples are drawn from the 30 largest companies (plus Saudi Aramco) in our 65-strong universe; smaller companies may also have seen their exposures shift but are not detailed here.

Improved relative positioning:

- **Lukoil** – Reduced cost estimates in the Khvalynskoye and Yamalneftegaz gas-condensate projects;
- **Occidental Petroleum (“Oxy”)** – Considerably larger portfolio overall after acquisition of Anadarko, but limited impact on relative positioning. Slight improvement in % of capex outside B2DS and slight worsening in % of capex outside SDS;
- **Saudi Aramco** – Increased capex estimates for the Jafurah and Al-Jalamid shale gas projects, both of which are within B2DS;
- **ConocoPhillips** – Reduced cost estimates and increased capex estimates for Greater Mooses Tooth oil. Discovered Narwhal and acquired Nuna oil projects, both added to B2DS portfolio;
- **Imperial Oil** – Marginal amounts of capex brought into B2DS alignment from nil in 2019, mainly through reduced cost estimates for Montney and increased resource estimates for Duvernay gas;
- **Pioneer Natural Resources** – Reduced cost estimates in Upper Wolfcamp (Permian) have moved a material amount of capex from just outside SDS to just inside;
- **Woodside** – increased reserves estimates and reduced cost estimates for Scarborough, part of Pluto LNG Train 2.

Worsened relative positioning:

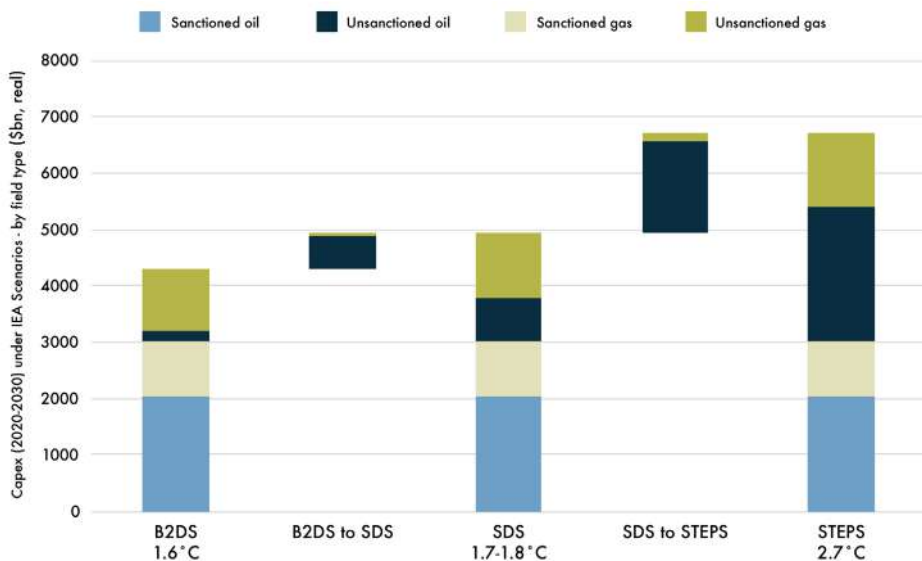
- **Ecopetrol** – Formed joint venture with Oxy in Upper Wolfcamp (Permian) shale which is outside B2DS and SDS;
- **Inpex** – Ichthys Phase 2 received FID, reducing remaining amount of unsanctioned B2DS capex
- **OMV** – B2DS ratio stable, but significantly less SDS capex due to increased cost estimates for Wisting (Norway);
- **Canadian Natural Resources** – Greater amounts of capex now fall within STEPS, reducing the relative share of B2DS capex, mainly through reduced cost and increased capex estimates for parts of Horizon Oil Sands.

Appendix III: Macro Level Capex Implications

Global Capex alignment

Figure 9 shows a bridge plot for the capex (2020-2030) associated with oil and gas projects that go ahead under each scenario.

FIGURE 9. POTENTIAL 2020-2030 CAPEX FOR OIL AND GAS PROJECTS THAT FIT WITHIN DIFFERENT IEA SCENARIOS



Source: IEA, Rystad Energy, CTI analysis

Under SDS, two-thirds of potential capex on new oil fields is at risk of becoming stranded

The chart shows that over a third of total BAU potential capex doesn't fit in a B2DS world. However, over the next decade, \$3 trillion of capex is associated with fields that have already been sanctioned, whether on the initial construction of recently approved projects or further capex during field life (e.g. in-fill wells to assist in recovery).

This is the same under any scenario, given that existing fields are assumed to be “locked in”. This means that the risks are amplified for new projects – B2DS potential capex on new fields is two-thirds lower than under STEPS, illustrating the huge shift needed in growth business models.

Figure 9, on previous page, shows that under SDS, just one third of potential capex (\$0.8 trillion) on new oil fields goes ahead compared to the business-as-usual STEPS. Conversely, oil projects associated with \$1.6 trillion of potential capex over the period are at risk of becoming stranded if they are sanctioned and the world does follow a trajectory that bends towards the goals of the Paris Agreement.

Under B2DS, more than 90% of new oil project potential capex is at heightened risk of being stranded.

Even for gas, there are opportunities to create \$200bn of stranded assets under B2DS

There is a lower degree of variation in capex required for new gas fields between the scenarios than for oil projects. This largely reflects that gas demand peaks later, and falls more gradually, than oil demand in the IEA low carbon scenarios used here.

However, given the large quantum of available supply from potential gas projects and that under these scenarios gas demand remains lower than under “BAU”, there is still plenty of opportunity to destroy value – gas fields associated with \$200bn of capex fail to fit into the B2DS compared to STEPS, or one-sixth of BAU investment.

The volume of potential gas overinvestment is also illustrated by the quantum of potential supply available beyond that which we model as going ahead under the STEPS – we exclude potential capex equivalent to c.60% of the business-as-usual benchmark for unsanctioned assets, compared to c.20% for oil.

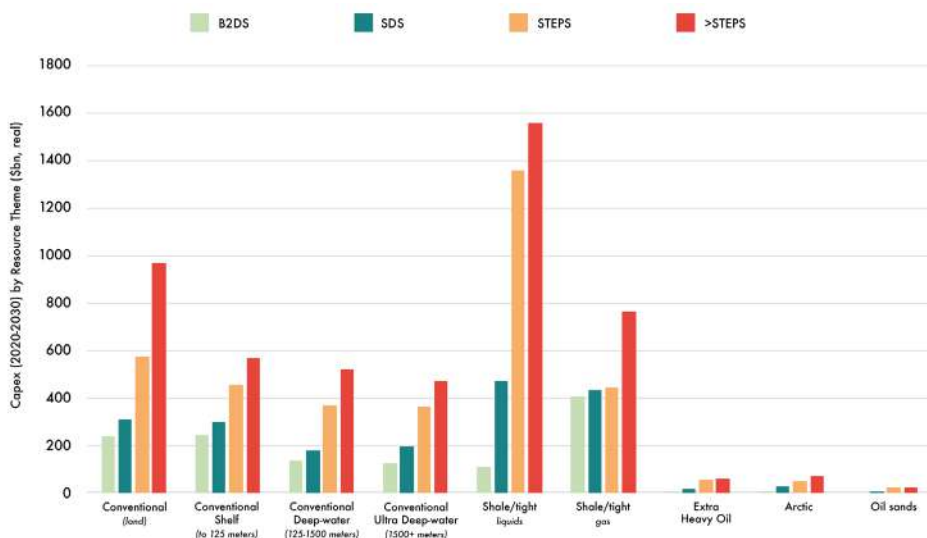
A new “dash for gas” therefore raises the risk of companies destroying value by overinvesting in gas projects, ironically while they try to prove their low carbon credentials and emboldened by the modelled increases in gas use under low carbon scenarios (even though gas demand remains lower under low carbon scenarios than under business-as-usual).

Capex Alignment by Resource Theme

Looking at the analysis results by resource theme (hydrocarbon type, and development environment) yields similar results to our 2019 analysis (Figure 10):

- In general, deep water projects are more likely than onshore / shelf projects to fall outside a lower-demand scenario. These themes all contain projects with costs that range from low to high, illustrating the importance of looking at the issue on a project-by-project basis.
- For shale/tight developments, liquids are significantly more at risk of becoming stranded than gas; liquids projects are also highly leveraged to demand outcomes (B2DS capex is less than 10% of STEPS; SDS is 67%). For shale/tight companies with liquids-focused portfolios this creates a potential issue. We would highlight that this apparent resilience in shale gas is strongly influenced by relatively resilient demand for gas in North America under the scenarios we use; we note large write downs related to US shale gas acreage in recent history.
- While gas demand may be less varied between the different scenarios, there is significant capex associated with shale gas projects that do not fit even within STEPS.
- There remains very limited space for both extra-heavy oil and arctic projects under B2DS and SDS.

FIGURE 10. POTENTIAL 2020-2030 CAPEX FOR OIL AND GAS PROJECTS THAT FIT WITHIN DIFFERENT IEA SCENARIOS BY RESOURCE THEME



Source: IEA, Rystad Energy, CTI analysis

Appendix IV: Methodology and further comments

Introduction to methodology

The methodology underlying this report is provided in the paper accompanying *Breaking the Habit*³⁰. However, in this appendix we provide some further commentary including aspects that are specific to this year's analysis.

Oil and Gas Supply

Having defined the separate demand levels for oil and gas under different IEA scenarios, we turn to modelling which supply projects may be the ones that satisfy this demand. To do this, we first take the production from those projects that are already sanctioned, then use a cost-curve approach to identify those as-yet-unsanctioned projects that fit within a given scenario. We use the UCube database published by Rystad Energy, an industry-standard data supplier, to provide project/asset-level information on production profiles and costs. In using a single data supplier we are able to compare projects on a consistent basis, with the focus on identifying the relative differences between project economics and quantifying associated capex.

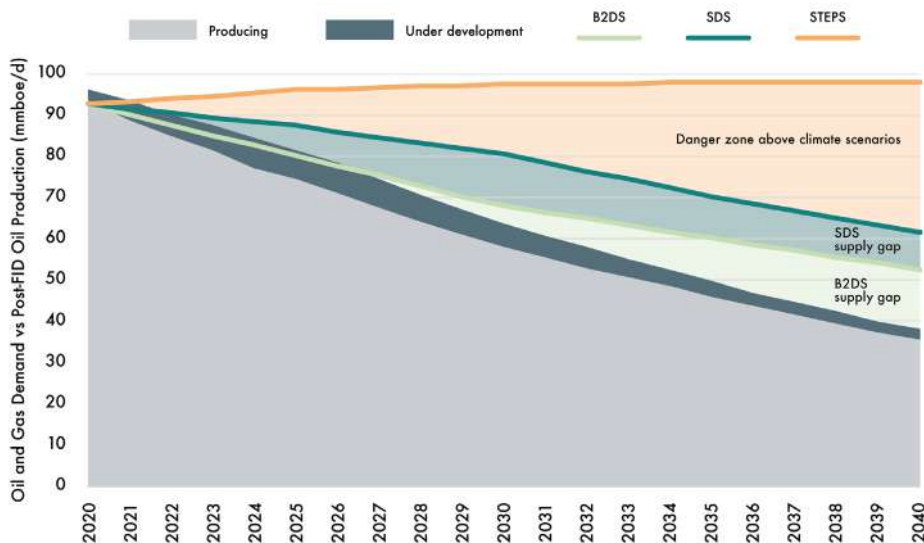
First, we consider the production from already sanctioned projects – those classified as either producing or under development – over the period from 2020-2040. Figure 11 shows this production alongside the IEA demand profiles, and the gap between supply and demand that results.

For existing projects, initial capex will largely have been sunk, and the project will continue to produce while its revenues cover its ongoing operating costs. Accordingly, once a project has been sanctioned, it is modelled as continuing until the end of its base-case life. While such projects may never make a profit on a full life-cycle basis, the carbon emissions associated with its production are to a large extent “locked in” and take up a part of the remaining carbon budget, limiting the space for new projects.

As mentioned previously, a 1.5 degree scenario with no CCUS implies no more space for new oil and gas production; however, the low carbon scenarios used here, which assume a higher temperature outcome and some use of CCUS, imply some new development. Critically however, the gap between existing supply and future demand under these scenarios is far lower than under BAU, raising the risk of the fossil fuel industry misreading demand and overinvesting.

30 Report available at <https://carbontracker.org/reports/breaking-the-habit/>. Methodology available at <https://carbontransfer.wpengine.com/wp-content/uploads/2019/09/Breaking-the-Habit-Methodology-Final-1.pdf>

FIGURE 11. COMPARISON OF OIL DEMAND PATHWAYS UNDER DIFFERENT IEA SCENARIOS AND FUTURE OIL PRODUCTION FROM POST-FID (SANCTIONED) FIELDS



Source: IEA, Rystad Energy, CTI analysis

Focus is on identifying unsanctioned projects that are not needed under lower demand

To understand which new projects go ahead based on the demand pathways in Figure 11, we use a cost curve approach and assume that the projects that go ahead are those that are most competitive in breakeven costs. As well as reflecting a typical view of how commodity markets function in practice, this enables users to understand which projects are more likely to be outcompeted and hence fail to deliver attractive financial returns in a decarbonising world, in other words becoming “stranded”.

As a relative metric of company-level financial risk associated with these projects, we calculate the potential capex on new (unsanctioned) projects that falls outside a low-carbon scenario as a proportion of total potential capex on new projects under a business-as-usual scenario. While not intended to read directly through to proportionate valuation implications, this metric gives an illustration of the opportunity to destroy value in a company’s current portfolio, or the extent to which it will have to change business model if it does not progress those projects.

Our focus on projects that have not yet been sanctioned allows investors to assess differential transition risks and engage companies to take action and try to avoid the value destruction before it happens, in terms of both near-term sanctioning decisions but also longer-term portfolio composition.

While our modelling is based on separate demand profiles for oil (global) and gas (four regional markets plus global LNG trade) under each scenario, we incorporate the extent to which they are linked by projects that produce both oil and gas. So for example if a low cost oil project also produces associated gas, then that gas will be assumed to feed into its respective market, reducing demand for other sources of gas supply; the same is true for gas projects that also produce liquids. We therefore use an iterative modelling approach to find an equilibrium that satisfies demand in each of the different markets.

A note on carbon pricing and project merit order

Our approach to modelling which projects go ahead in a given scenario is therefore based exclusively on each project's costs, giving a financially rational outcome given current knowledge. However, we also recognise that there are merits to future demand being satisfied by the projects that have low carbon emissions, not just low costs. In practice there is something of a correlation between these factors (high cost projects are more likely to also be high carbon) but it is far from perfect.

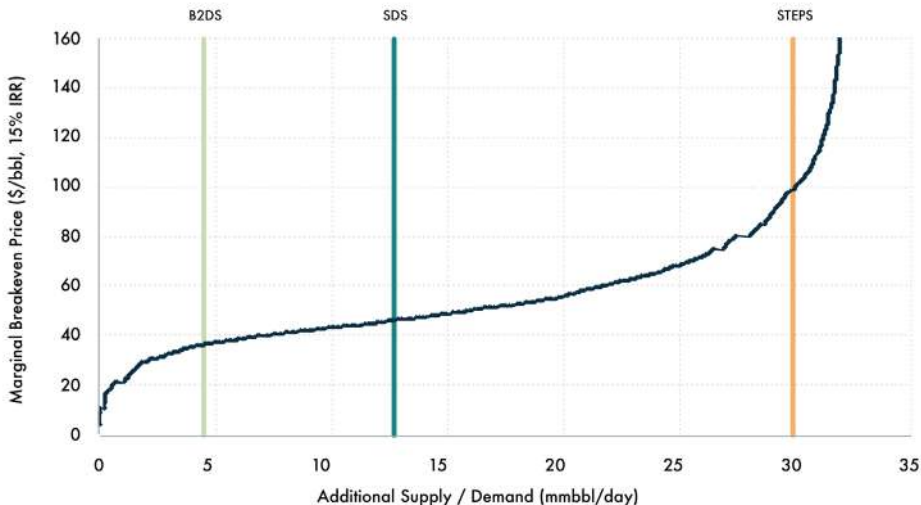
Our approach is to try to understand the financial risks in a relatively robust way, which is relevant today and not too reliant on subjective judgement. While the scenarios we use incorporate various assumptions, for these purposes the main utility is the fossil fuel demand pathway rather than the specific inputs that lead to that pathway (as there are different combinations of assumptions that might lead to a similar outcome). There are a number of ways in which a lower carbon energy system might be promoted, of which a common suggestion is via a carbon price. Our estimates of project costs include actual costs as understood today, but do not incorporate any views of how they might change in future – users may factor in their own views on carbon policy. High carbon projects therefore carry an additional risk factor to the extent to which carbon prices are enacted and increased over time, increasing their costs further and perhaps pushing them out of the budget.

We consider the general principle that project economics are the primary determinant of transition risk to be sound. While in future these may be affected by additional costs related to carbon pricing, we expect the extent to which this affects our analysis to be limited. By way of illustration, a \$40/t carbon price translates into an additional upstream cost of c.\$1.50-2/bbl for the average oil project. Given the wider range of project costs (and the context of relative volatility of oil prices), the impacts are therefore likely to be minor and affect those projects already close to the margin.

Understanding the results

The cost curve in Figure 12 shows the aggregate supply available over the period 2020-2040 from all potential unsanctioned oil fields, ordered by project breakeven price. The vertical lines in Figure 12 show aggregate oil demand in excess of production from already sanctioned projects, i.e. the call on new oil.

FIGURE 12. SUPPLY CURVE FOR UNSANCTIONED OIL FIELDS, 2020-2040



Source: IEA, Rystad Energy, CTI analysis

These potential projects modelled as going ahead depends on the low-carbon scenario chosen. For example, under SDS, an additional 12 million barrels of oil a day (on average) are needed to 2040; consequently, 12 million barrels of the lowest-cost portion of the supply curve are assumed to fulfil this.

Relative project positioning matters; thinking in price terms can be misleading.

The intersection of the demand line and the cost curve defines a marginal project breakeven price; that is the price needed to incentivise the sanction of the last project needed to satisfy demand.

However, we stress that the important thing for the purposes of this exercise is not the absolute level of the marginal price, but the relative positioning of projects (and relative differences between companies). As we have seen in recent years, the supply curve can move up and down, which would affect the marginal price, but not necessarily the order of whether projects are relatively high cost or low cost compared to each other. Further, the breakeven prices

shown are based on delivering an internal rate of return of 15% whereas the assumption of a lower discount rate would imply a lower marginal price.

Similarly, while companies may contend that their projects are lower cost than the estimates in our data, the key is not the absolute cost level of those projects (even assuming an “apples-with-apples” basis of cost estimates for comparison) but where they stand relative to competitors. Not all companies can be the winners; by using a third party, global, database, this enables projects to be compared on a similar basis, and hence derive relative company transition risk.

Under both B2DS and SDS, demand for new projects is similar to our 2019 analysis

Overall demand has fallen slightly under both low-carbon scenarios; there has however been a commensurate fall in forecast production from already-sanctioned fields as future oil/gas price assumptions have been lowered by our data provider. The net effect is that demand for new production is similar in this analysis compared to that in *Breaking the Habit*.

At the lower end, the cost curve is similar to 2019, and so the resulting marginal breakeven prices are also broadly unchanged. Of course, this does not mean that exactly the same set of projects fit within these scenarios; individual projects may have changed relative positioning due to factors such as local conditions, changes in reserve/resource estimates etc. Accordingly, company results may be changed from 2019, with potentially greater impacts for those companies with less diversified portfolios (see Section 5). Companies may also have managed their portfolios via M&A, further influencing relative positioning over time.

Under STEPS, the resultant BAU marginal breakeven price is higher than last year....

In contrast to B2DS and SDS demand, aggregate STEPS oil demand has increased slightly compared to the 2019 analysis. Combined with the slight reduction in future production from already-sanctioned fields, this increases the required supply from new projects compared to the 2019 analysis (which was based on the IEA’s New Policies Scenario, the predecessor to STEPS).

While the lower portion of the cost curve in Figure 12 is similar to that in our 2019 analysis, less available production means that the upper portion has shifted to the left to a point at which the marginal cost increases rapidly with increased supply; i.e. above c.15bbl/day, the marginal price needed to supply any given demand level has increased. This leftwards movement, combined with the additional increased demand effects, results in a higher marginal cost for oil compared to our 2019 analysis.

...however this should not be interpreted as a licence to drill...

As the marginal prices remain stable under both B2DS and SDS, this increase in marginal price under the business-as-usual proxy case should not, however, be interpreted in itself as a reduction of transition risk or long term higher prices compared to this time last year.

As previously, the B2DS and SDS marginal prices are significantly lower than the “business-as-usual” marginal price, illustrating the continued risk of stranding.

The marginal price should also be treated with extreme caution when it comes from the higher end of the curve; a) the steepness of the slope at this point means that small changes at other points in the curve can have an outsize impact on the marginal price, which will change quickly for small changes in volumes; and b) at this point, the projects that set the marginal price are likely to be early stage or subject to less intense development, implying a higher degree of uncertainty in cost estimates.

What this does illustrate is the dynamic interplay between the industry cost curve and prevailing market conditions, and again why it is important to focus on relative project positioning rather than absolute levels of marginal cost.

To the extent that oil and gas demand do not follow the lower carbon pathways, and given that the oil price has tended to be characterised by cyclicity and volatility, there remains the possibility of short term spikes in price. However, to the extent that such spikes occur, they create the greatest opportunity to invest in stranded assets – it only took a few years of prices above \$100/bbl in the last cycle for companies to think the good times would last forever before the winds changed, with plenty of value destruction along the way.

...and may reflect that some companies are starting to recognise transition risks

Looking for signs of progress, as well as reflecting the immediate impact of low oil prices it is possible that the reduction in potential supply available at the top end of the curve may also indicate that some companies are starting to recognise lower long term prices due to the energy transition, and hence be less likely to develop high cost projects. As Carbon Tracker has explored previously³¹, some companies are starting to reference the energy transition in their financial disclosures, and we may therefore be seeing signs of some divergence in company expectations for long term oil and gas demand trends.

Accordingly, STEPS may be less appropriate as a proxy for business-as-usual behaviour for certain companies. While these companies may hold assets that have breakevens below the business-as-usual level, they may delay or cancel them, or sell them to other companies. However, imputing different levels of what “business-as-usual” might mean in the minds of management teams at different companies is fraught with difficulty.

To enable comparison with the results from Breaking the Habit, in this report we continue to present capex results on a similar basis with STEPS assumed to be the business-as-usual proxy for all companies. However, in Section 5 we explore an alternative proxy for business-as-usual company plans and how it would affect company results.

31 See Carbon Tracker, “The Impair State: The Paris Agreement starts to impact oil & gas accounting”, June 2020. Available at <https://carbontracker.org/reports/the-impair-state/>

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