



# CARBON TRACKER METHODOLOGIES

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Upstream Oil and Gas



## About Carbon Tracker

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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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## About Carbon Tracker Methodologies

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Overview of methodologies and metrics for the alignment assessments which complement Indicator 6 of the Disclosure Framework within the Climate Action 100+ Net Zero Company Benchmark.

As a research partner to Climate Action 100+, Carbon Tracker Initiative conducts financial analysis and has developed a set of alignment assessments to help investors identify, quantify, and assess transition risk exposure for select upstream oil & gas companies' investment plans.

Full details of Carbon Tracker Initiative's research and methodologies are available on [www.carbontracker.org](http://www.carbontracker.org). Please direct questions and enquiries to [hello@carbontracker.org](mailto:hello@carbontracker.org)

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# 1 Carbon Tracker – Research and Analysis

Carbon Tracker carries out scenario analysis to examine and understand the impact of the energy transition on future demand for oil and gas products, and thus the impact for companies participating in the oil and gas value chain. This analysis helps the investment community better understand the financial implications of the energy transition required to address climate change.

- 1) Our analytical research identifies the highest cost (and thus most at risk) investments enabling greater scrutiny by investment analysts, asset owners, financial institutions, policy makers and financial regulators.
- 2) Our regulatory research builds the case for reform of the financial regulatory system to improve transparency of climate-related financial risks and articulates the key changes to be made.
- 3) We provide expert insight for those engaging with energy companies around future strategy and capital expenditure (capex).

Our research is grounded in conventional financial analysis and focuses on forward-looking material issues. As a not-for-profit research house, we are free from the constraints that would be imposed by a commercial financial research business model. This allows us to challenge business-as-usual approaches that we consider to be unsustainable in the face of the unprecedented challenge posed by climate change.

## 2 The need to reduce emissions

Emissions of greenhouse gases will need to fall significantly if the world is to avoid catastrophic levels of global warming. Such constraints will have profound effects on the supply of and demand for fossil fuels, which account for the largest human source of greenhouse emissions.

Our Upstream oil and gas analysis is focused on the financially material risks posed to companies by the continued development of new oil and gas production projects. Our research aims to prevent capital being deployed on assets that risk becoming financially stranded – that is those that may not yield expected returns – as demand falls away through the energy transition. Our focus is therefore on advancing the energy transition through the stewardship of capital, with the intention of preventing capital being wasted on assets with a high risk of becoming economically stranded.

Our research publications are freely available on our website [www.carbontracker.org](http://www.carbontracker.org) as well as on research platforms such as Bloomberg, FactSet, Refinitiv and S&P Capital IQ.

### 3 Carbon Tracker's least cost framework for oil and gas

In a series of reports since 2011, Carbon Tracker has explored the financial implications for the oil & gas sector of the shift to a lower carbon economy in line with international climate ambitions.

Carbon Tracker's lens is that of the market – assessing which potential oil and gas developments do not make economic sense and might erode significant value in the energy transition, at the same time as taking the planet into a progressively more dangerous climate.

Underlying this analysis is the logic that in a world of limited demand, the lowest cost supply options will be most competitive and the higher cost options may fail to deliver economic returns – in other words, becoming economically “stranded”.

Our focus is on the risks posed to fossil fuel companies if they continue to invest in projects that are not needed as the world transitions towards a cleaner energy system, and thus the risk of value loss that investors in these companies – in both the primary and secondary markets - are exposed to.

By using classic supply and demand curves, we can illustrate what proportion of potential investment is in low-cost projects that are potentially financially-viable under different transition scenarios towards a low-carbon world, and what proportion is on higher-cost projects that are unlikely to be viable. Investment in the latter runs a greater risk of eroding shareholder value.

## 4 Alignment Assessments for Upstream oil and gas

Carbon Tracker has developed **two assessments for upstream oil & gas** for the Climate Action 100+ Net Zero Company Benchmark, focused on investment and capital allocation plans for select companies with upstream oil & gas exploration and production operations. The purpose of these assessments is to help investors identify, quantify, and assess the degree of climate alignment and thus transition risk exposure for Climate Action 100+ focus companies.

These independent alignment assessments complement Indicator 6 of the Disclosure Framework within the Climate Action 100+ Net-Zero Company Benchmark to help investors assess oil & gas companies' announced upstream capital expenditure plans, as well as considering future production plans. The assessments are based on Carbon Tracker's least cost methodology for modelling global oil and gas supply and demand. A summary of the approach is included alongside each indicator below, with a more detailed description of the methodology later in this document.

This modelling underpins the assessments using supply (production) data from Rystad Energy, alongside the following demand scenarios from the International Energy Agency (IEA) to quantify different levels of climate alignment and transition risk exposure.

### International Energy Agency (IEA) demand scenarios used by Carbon Tracker

Stated Policies Scenario (STEPS): Our business-as-usual proxy. STEPS is consistent with c.2.4°C warming outcome and describes a projection of the future energy system whereby already enacted, and already announced yet to be enacted, legislation on climate change is assumed to continue, but not be developed further. *Source: IEA, World Energy Outlook 2024.*

Announced Pledges Scenario (APS). The APS assumes that in addition to following through with their policies, governments will also deliver on the promises that have yet to be passed into law. In other words, it looks into what stakeholders are saying they will do. This scenario is included as we recognize that some investors seek to understand alignment against a looser "well below 2 degree" interpretation of the Paris Agreement goals. It also enables investors to have an indication of the extent to which companies are not aligned with 1.5°C. *Source: IEA, World Energy Outlook 2024*

Net Zero Emissions By 2050 Scenario (NZE): A normative pathway aiming for net-zero CO<sub>2</sub> emissions by 2050, aligning with the Paris Agreement 1.5°C goal. As the name suggests, net zero is reached by 2050. *Source: IEA, World Energy Outlook 2024*

## Oil &amp; Gas indicators:

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                      |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>INDICATOR 1: RECENT INVESTMENTS – Compatibility of the company's <u>recent</u> upstream oil and gas investment with a Paris-aligned pathway</b></p> <p>In the most recent full year (2025), all of the upstream oil and gas investments sanctioned by the company were assessed not to be incompatible with the IEA's Net Zero Emissions by 2050 Scenario (NZE, 1.5°C).</p> <p>*Failing that, companies will be assessed against the IEA's Announced Pledges Scenario (APS, 1.7°C).</p>                                                                                                                                                                                                                                               | <p>Score:</p> <p>Green: Recent upstream capex is not incompatible with NZE (1.5°C)</p> <p>Green: No recent investment identified</p> <p>Amber Recent upstream capex is not incompatible with APS (1.7°C)</p> <p>Red: Recent upstream capex is incompatible with both NZE (1.5°C) and APS (1.7°C)</p> |
| <p><b>Additional data points: Recent capex committed to projects assessed not to be compatible with the NZE (a 1.5°C pathway)</b></p> <ul style="list-style-type: none"> <li>Proportion of the company's overall upstream oil and gas capex allocated in the most recent year to projects that are assessed not to be compatible with the NZE.</li> <li>Absolute dollar value of capex allocated in the most recent year to projects assessed not to be compatible with the NZE.</li> </ul>                                                                                                                                                                                                                                                 | <p>Data points:</p> <p>% of upstream O&amp;G capex</p> <p>\$ value</p>                                                                                                                                                                                                                               |
| <p><b>Additional data points: Recent capex committed to projects assessed not to be compatible with the APS (a 1.7°C pathway)</b></p> <ul style="list-style-type: none"> <li>Proportion of the company's overall upstream oil and gas capex allocated in the most recent year to projects assessed not to be compatible with the APS.</li> <li>Absolute dollar value of capex allocated in the most recent year to projects assessed not to be compatible with the APS.</li> </ul>                                                                                                                                                                                                                                                          | <p>Data points:</p> <p>% of upstream O&amp;G capex</p> <p>\$ value</p>                                                                                                                                                                                                                               |
| <p><b>Details on assessment methodology:</b></p> <p>Assets which are assessed to be incompatible (i.e. not economically competitive under) with ambitious Paris-aligned scenarios, are more likely to become financially stranded. Accordingly, those companies which sanctioned such assets are more exposed to associated transition risk.</p> <p>This assessment gives an indicator of the above risk for recent investments, and uses the results of Carbon Tracker's least cost methodology to determine if recently-sanctioned upstream oil and gas investments were compatible (on a cost basis) with either the NZE (1.5°C) and/or APS (1.7°C) scenario. This provides an indication of the company's transition risk exposure.</p> |                                                                                                                                                                                                                                                                                                      |

*The more that the company has committed to projects which are incompatible with a given scenario, the greater the stranded asset risk.*

The threshold for whether a project is compatible - or not - with a given scenario is derived from Carbon Tracker's least cost modelling: it is the marginal breakeven price of the last project needed to satisfy demand under a given scenario.

- A green 'yes' score indicates that the company's investment approach is not incompatible with the NZE (1.5°C) scenario, as only projects with a breakeven price lower than the NZE threshold price were sanctioned. Companies can also score a green if no new investments were identified.
- An amber 'yes' score indicates that the company's investment approach is not incompatible with the APS (1.7°C) scenario, as only projects with a breakeven price lower than the APS threshold price were sanctioned.
- A red 'no' score indicates that the company's investment approach is incompatible with both the NZE (1.5°C) and the APS (1.7°C) scenario, as projects with a breakeven price higher than the APS were sanctioned. The percentage of a company's upstream capex on projects incompatible with APS scenario is included next to a 'no' score.

Supplementary data is only applicable where a company receives a red traffic light assessment. The additional datapoint provides further granularity to the traffic light scores, showing both the proportion, and the absolute value, of upstream capex on new projects assessed not to be compatible with the APS scenario. N.b. this is the capital committed to in the year via the sanction (final investment decision); the investment itself may be spread over a period of several years.

#### INDICATOR 2: FUTURE INVESTMENTS –

##### **Compatibility of the company's potential future investment on new upstream oil and gas projects with a Paris-aligned pathway**

The company's potential future capex in new upstream oil and gas projects are assessed not to be incompatible with the IEA's Net Zero Emissions by 2050 Scenario (NZE, 1.5°C).

\*Failing that, companies will be assessed against the IEA's Announced Pledges Scenario (APS, 1.7°C).

**Green:** Future upstream capex is not incompatible with the NZE (1.5°C)

**Amber:** <50% of future capex is incompatible with the APS (1.7°C)

**Red:** 50-100% future capex is incompatible with the APS (1.7°C)

##### **Additional Data Point: Proportion of potential future investment (capex) on unsanctioned upstream oil and gas projects assessed to be incompatible with the APS (a 1.7°C pathway)**

- Proportion of the company's potential future unsanctioned oil and gas capex assessed to be incompatible with the APS (1.7°C).

Data point:

% of capex incompatible with APS (1.7°C)

#### **Methodology for assessment:**

Potential upstream investments that are assessed to be incompatible with (i.e. not economically competitive under) ambitious Paris-aligned scenarios, are more likely to become financially

stranded. Accordingly, those companies which are considering investing in such assets are more likely to be exposed to transition risk.

This assessment gives an indicator of that risk for potential future investments, and uses the results of Carbon Tracker's least cost methodology to determine if the extent to which a companies' portfolio of potential upstream oil and gas investments is compatible (on a cost basis) with either the NZE (1.5°C) and/or APS (1.7°C) scenario, to give an indication of transition risk exposure.

*The higher the percentage of incompatible opportunities in capex terms, the less climate-aligned the investment plan, and the more exposed the company is to the risk of stranded upstream assets.*

This assessment uses the IEA's Stated Policies Scenario (STEPS) as a proxy for potential "business as usual" investment in new projects; individual projects are then assessed for compatibility with either the NZE (1.5°C) or the APS (1.7°C), based on relative breakeven price (cost-competitiveness). This analysis excludes consideration of projects so costly they are also incompatible with even STEPS.

The assessment of the compatibility of a company with a given scenario is based on the compatibility of the individual upstream projects within its portfolio, and thus the companies' potential investment approach on new upstream oil and gas projects. Where individual projects are assessed to be incompatible with the APS, then the potential capex associated with those projects is aggregated and expressed as a percentage of the company's total business-as-usual capex.

- A green 'yes' score indicates that the company's investment approach (in terms of potential future upstream capex) is assessed to be not incompatible with the NZE (1.5°C).
- An amber 'yes' score indicates that the company's investment approach (in terms of potential future upstream capex) is assessed to be no more than 50% incompatible with the APS (1.7°C).
- A red 'no' score indicates that the company's investment approach (in terms of potential future upstream capex) is assessed to be 50-100% incompatible with the APS (1.7°C).

The additional datapoint provides further granularity to the traffic light scores, showing the proportion of potential upstream capex on new projects assessed not to be compatible with the APS. N.b. as for indicator 1, this is the capital committed to in the year via the sanction (final investment decision) of projects that may be invested over a period of a number of years, rather than the total capital spent within the year.

See the description of the least cost methodology in Section 3 for further detail.

## 5 Carbon Tracker's oil & gas least-cost analysis

Carbon Tracker's least cost methodology has been developed across a series of reports over the past decade, exploring the financial implications for the oil and gas sector of the transition to a lower carbon economy. The most recent report which describes the modelling alongside associated

company-commentary is *Paris Maligned 3* <sup>1</sup>(April 2025). The modelling is also described in more detail in *Oil and Gas Least-Cost Methodology* <sup>2</sup> (September 2024).

The modelling is used to assess whether individual projects are compatible with a given climate/energy transition scenario, and this forms the basis of Indicators 1, 2 and 3 for Upstream oil and gas

## Identification of individual project compatibility

A summary of the methodology is described here, and is illustrated in the Figure 1, showing an example cost curve with the cumulative *potential* oil supply (2026-2040) from unsanctioned oil fields using Rystad Energy's base case supply curve, showing APS and STEPS supply gaps.

Future oil and gas demand under a given scenario (e.g. from the International Energy Agency, IEA) is compared to the future production from existing oil and gas fields (using supply data from Rystad Energy), to give a supply gap for both oil and gas. Oil is considered a global market; gas is modelled in four regional markets and then rest of the world, plus global LNG trade.

To understand how this supply gap could be filled, a cost-curve is created from all potential projects within a given market by ordering them by project breakeven price (Figure 1).

Starting with the lowest cost project, and moving up the curve, projects are identified as being compatible, or "inside", a scenario until the supply gap (shown on the x-axis for each scenario) is filled.

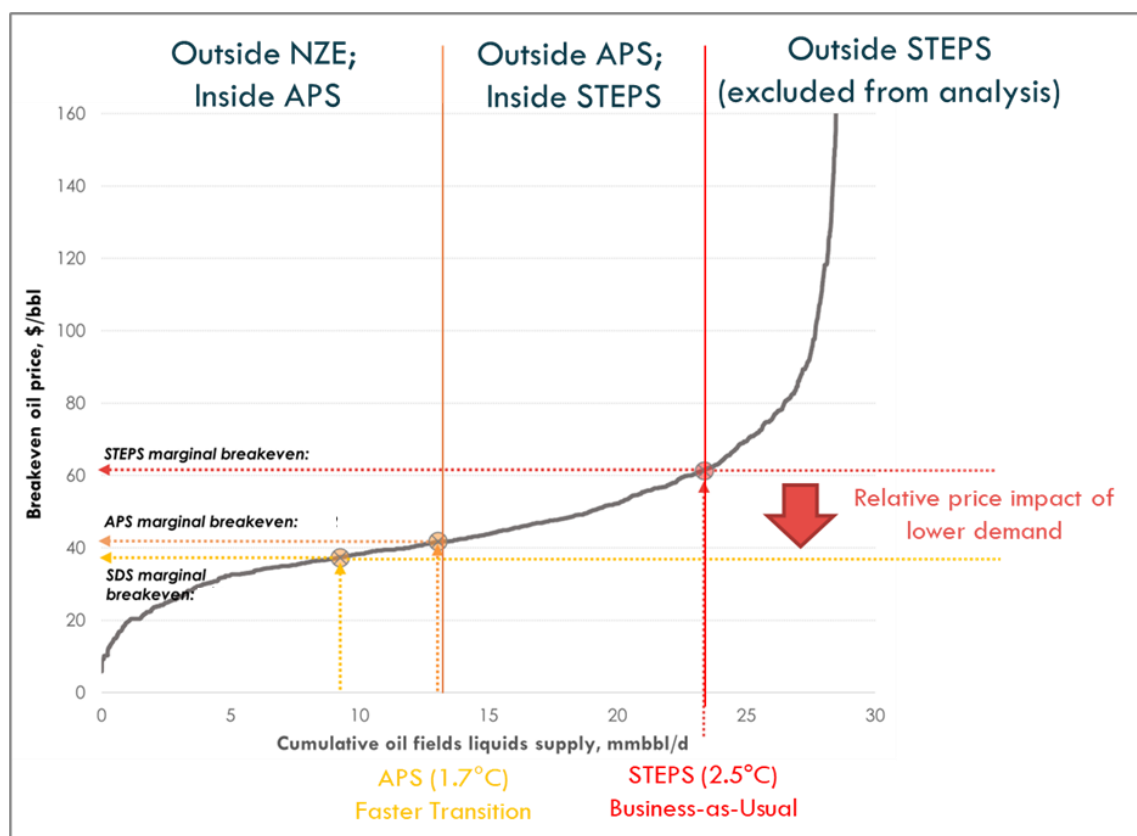
In the example shown in Figure 1, the aggregate supply gap under APS is 13mmbbl/day for the period 2022-2040. The resultant marginal breakeven price of the last project needed to satisfy demand is shown on the y-axis. In the example shown in Figure 1, the marginal breakeven price for APS is \$42/bbl, using a 15% IRR.

Those higher-cost projects that are not identified as being inside the scenario – i.e. those that have a breakeven price higher than the marginal breakeven price are considered as incompatible, or "outside", that scenario.

This modelling forms the basis of three of the four indicators within the benchmark. Further details is given below, which complements the details shown within the indicator table.

<sup>1</sup> <https://carbontracker.org/reports/paris-maligned-iii/>

<sup>2</sup> <https://carbontracker.org/reports/oil-and-gas-least-cost-analysis/>

**FIGURE 1. ILLUSTRATIVE COST CURVE FOR GLOBAL OIL PROJECTS**

Source: Adapted from Paris Mismatched, Carbon Tracker

Notes: Cost curve is illustrative, and should not be used to read volume or breakeven price information for individual scenarios.

## INDICATOR 1: RECENT INVESTMENTS – Compatibility of the company's recent upstream oil and gas investment with a Paris-aligned pathway

To assess the compatibility of recent upstream investments with a given scenario, the breakeven price of the marginal project required to satisfy demand under that scenario is used as a threshold price to assess the previous year's investments – in the example shown in Figure 1 that price is \$42/bbl. As per the details in the indicator table, the capex associated with projects that are assessed as incompatible with a given scenario is aggregated by company, expressed both in absolute terms, and as a proportion of overall capex.

## INDICATOR 2: FUTURE INVESTMENTS – Compatibility of the company’s potential future investment on new upstream oil and gas projects with a Paris-aligned pathway

To assess the degree of alignment of a specific company’s potential investment plans, the proportion of capital associated with project options assessed as incompatible with a given scenario is expressed as a percentage of capital associated with all projects which would go ahead under a business-as-usual scenario (STEPS). In the example shown in Figure 1, those projects with a breakeven price of \$42/bbl or lower are assessed as not incompatible with APS, and those with a breakeven price greater than \$42/bbl are assessed as incompatible with APS.

To derive an overall figure for the % of a company’s potential portfolio that is incompatible with a given scenario, the capex associated with projects that are assessed as incompatible is aggregated and compared to the potential business-as-usual projects:

$$\% \text{ of capex incompatible with APS} = \frac{\text{capex associated with projects that are incompatible with APS}}{\text{total capex with projects that are compatible with STEPS (the business-as-usual scenario)}}$$

A company with 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, as a greater proportion of assets potentially at risk of stranding if developed. The higher the number, the less aligned the company’s potential projects with the scenario, and the greater the stranded asset risk.

### Additional notes to the least cost methodology

**A note on NZE and its changing definition:** Projects with a breakeven price of greater than that of the breakeven price of the marginal project needed to satisfy STEPS demand (c.\$60/bbl in the example) are excluded. Over the past decade oil & gas companies have refocused on value rather than growth, and some projects are now seen as less likely than they might have been previously. High-cost projects have therefore been excluded by reference to STEPS, the IEA’s central scenario that assumes no further climate policy developments beyond those already enacted or announced and is consistent with a global temperature rise of 2.4°C.

Any high-cost projects above the level required in this scenario have been assumed not to go ahead and therefore excluded from this analysis. This approach in effect assumes that companies are already aligned with the STEPS scenario and our modelling therefore focuses on the “surprise” or “misread” of demand levels under the APS or the NZE. This shows the capital at risk if companies collectively (but not necessarily consciously) invest to deliver STEPS demand but are caught out by a lower level of demand.

**Focus on relative project positioning rather than the implicit absolute level of the oil or gas price:** We stress that for climate constrained scenario analyses the relative positioning of projects (and relative differences between companies) are more important than the absolute level of the marginal oil or gas price. 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.

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 winners; by using a third party, global database, enable projects to be compared on a similar basis, and hence derive relative company transition risk.

**Market segmentation:** Oil is reasonably approximated as a global market. Gas demand markets are highly regionalized with transport primarily happening by pipeline with LNG capacity more limited – we match supply and demand separately within five markets (Europe, North America, Russia, Australia, and the rest of the world) instead. LNG markets are assumed to be global; for these projects, we match supply against the IEA’s LNG trade demand figures.

**Supply curve data:** Our least cost modelling is based on the global supply cost curve with underlying asset and project level data from Rystad Energy Group’s UCube database<sup>3</sup> that covers more than 85,000 oil & gas assets owned by 3,000+ companies globally. We can provide results for a range of upstream companies, and our focus is on those included in S&P Global Energy Index (sub-categories – Integrated and Exploration & Production) plus select Climate Action 100+ companies, along with extended discussion and commentary of industry and company results.

**15% hurdle rate:** Each company’s results are derived from a full market supply curve showing the amount of potential production (including uncommercial assets) at each level of production cost. The measure of cost we use here is the breakeven price – the oil or gas price needed for each individual project’s future cash flows to yield a NPV = 0 with a given discount rate of 15%. Alternatively, these could be seen as the oil or gas prices that give each project an internal rate of return (IRR) of 15%, an approximation of a minimum return required to justify sanction given risks such as cost overruns and delays, and the need to provide a minimum return to investors.

For further discussion about Carbon Tracker’s methodology, please see [www.carbontracker.org](http://www.carbontracker.org) and our most recent publications and methodology documents.

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<sup>3</sup> See more information on <https://www.rystadenergy.com/energy-themes/oil-gas/upstream/u-cube/>

## Disclaimer

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