Annex F – The Least Cost Methodology for setting science-based targets for Oil, Gas and Integrated energy companies

Least-cost methodology for the setting of science-based targets for Oil, Gas and Integrated energy companies

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Introduction

This document outlines the Carbon Tracker Initiative's approach to target-setting for upstream oil and gas production, which constitute the bulk of global emissions across the value chain which, if addressed, would have knock on effects for extractives business models. Carbon Tracker utilizes a "least cost methodology" (LCM). Our methodology approximates the impact of a shift to a low carbon demand trajectory, while remaining neutral on the measures that cause that shift. Accordingly, we assume that companies will approve future projects based on their economics rather than their emissions, due to the generally greater importance of financial metrics – i.e. profitability – in investment decisions. This leads to our proposition that in a low-carbon world with ever-shrinking fossil fuel demand, the corresponding supply will come from the lowest-cost projects, reflecting the way that the market can be observed to react in times of low demand/pricing.

The LCM approach approximates an economically rational world behaving under market-based conditions without any top-down allocation of emissions budgets. In other words, it reflects the financial variables used today to inform investment decisions, without a global agreement apportioning supply. Approaches which assume an equal rate of decarbonisation across all companies, meanwhile, remain unimplemented.

The LCM approach has two further benefits in this context. Firstly, it reflects investment risk as well as the imperative for decarbonisation – a high cost producer following a fair share pathway may suffer losses (and perhaps not be able to sustain production along the pathway) as overall oil demand/prices weaken. Secondly, it delivers society with energy at the lowest possible cost (hence delivers the highest consumer surplus). Requiring production from oil sands and low-cost Middle Eastern fields to fall at the same rate would not achieve either of these, as well as not currently having a mechanism to make it happen.

Scenario choice - the SBTi context

The Science Based Targets initiative (SBTi) is considering use of "Lower 2°C" scenarios, or scenarios with at least a 66% probability of NOT exceeding 2°C and with carbon budget smaller than 1000 Gt CO_2 over the 2020-2100 period. Examples of scenarios within this range would comprise the IEA World Energy Outlook (WEO) Sustainable Development Scenario (IEA WEO SDS 2019).

The Carbon Tracker Initiative (CTI) can apply its "least cost methodology" (LCM) to any scenario which provides sufficiently granularity on the translation of a carbon budget into a regional allocation of fossil fuel use over time. CTI has applied the LCM to the following scenarios: IEA WEO SDS 2019; IEA Energy Technology Perspectives (ETP) Beyond 2 Degrees Scenario (B2DS 2017); and as a reference baseline case the IEA WEO Stated Energy Policies Scenario (IEA WEO STEPS 2019, previously known as the New Policies Scenario).

The LCM could also be applied to scenarios of even lower assumed warming, for example the P1 and P2 scenario archetypes (IPCC 2018) in order to provide a high-ambition benchmark that is conservative on future technological development. The P1 scenario assumes no fossil fuel CCS or BECCS, and the P2 pathway assumes limited BECCS use. CTI has covered these two scenarios in its publications but in general terms only to date, as the very limited demand for additional oil and gas development implied renders detailed analysis less instructive.

In the SBTi context, choosing scenarios for Oil & Gas SBT setting purposes should consider the amounts of CCS/CCUS (carbon capture and storage/ carbon capture utilization and storage) and carbon dioxide removal (CDR) technologies at "moderate" levels, within physical limits of the planet. These questions are not discussed in this document, the reader is invited to see the document "Scenario choices in setting Science-based target for the Oil & Gas sector" for a separate discussion.

Insofar as this methodology uses scenarios which incorporate CCS/CCUS and CDR, these assumptions are reflected in greater demand for fossil fuels for the same atmospheric carbon outcome (all else equal). As above, the methodology is based on the fossil fuel demand profiles that result from a model (most likely constrained by a carbon budget) rather than the simple carbon budget itself, meaning that any changes to underlying assumptions must therefore be translated through to applicable demand numbers for each market. Accordingly, if any adjustments to assumptions relating to CCS/CCUS and CDR are required, such adjustments would have to (a) take place at the scenario selection level and (b) be capable of being allocated regionally and by commodity, over time.

Allocation approach

The LCM is a forward-looking method that allocates potential future production according to an economic rationale of assuming that demand is met by the lowest cost projects available. We propose this methodology to offer a simplified model of how markets might rationally allocate supply in the face of dwindling demand and, similarly, how extractives companies might consider a competing set of potential investments.

The approach is based on the economic logic that in a competitive market, the higher-cost projects will be outcompeted by those that can supply the market at lower cost. The approach therefore matches the aggregate demand level derived from any given low-carbon transition pathway scenario to the lowest cost project set that might supply it.

The LCM assumes that projects which are already producing or under development continue to produce, and therefore anticipated production from these sources is netted off the total required demand level. It then turns, in sequence, to the cheapest available sources of potential future production to supply the residual demand until the given level of demand is satisfied. The basis for comparing projects in the LCM is unit level production costs, with Carbon Tracker using breakeven prices for this purpose.

The method follows these steps:

1. Select a scenario to use with an associated climate outcome;
2. Identify a demand profile in that scenario for each fossil fuel commodity regionally and over time under that scenario;
3. Identify an internally consistent set of supply data with associated supply costs (preferably from an external database) that estimates break-even costs for potential projects and establish a merit order of such projects based on costs (a “cost curve”);
4. Deduct future production from existing projects from the demand profile to establish residual demand to fill with future project options;
5. Fill residual demand with available potential production from future project options on a least-cost basis, yielding a list of projects that are “inside” and “outside” the specified scenario demand;
6. Calculate aggregate carbon emissions for the scenario period for each company based on their project set that fits inside the demand level;
7. Optional: Adjust that budget based on emissions intensity of the company’s portfolio;
8. Define a pathway for future company emissions using the company’s calculated carbon budget, it’s known starting point (today’s production/emissions) and the assumption of a linear trajectory.

Select a scenario

Comparing supply to demand for a given climate outcome requires translating an ultimate associated global warming, defined by a carbon budget, into separate demand pathways/levels for the energy sources under review. These demand levels are then used as the basis of the analysis. A number of different organisations produce modelled demand scenarios for given climate outcomes.

To date the method has already been applied to the IEA WEO SDS 2019; the IEA Energy Technology Perspectives (ETP) Beyond 2 Degrees Scenario (B2DS); scenarios from the IAMC 1.5°C Scenario Explorer database[1] consistent with the P1 and P2 scenario archetypes (used in the IPCC Special Report on Global Warming of 1.5 Degrees); and as a reference baseline case the IEA WEO Stated Energy Policies Scenario (IEA WEO STEPS 2019, previously known as the New Policies Scenario). For more information on scenario selection for SBT setting purposes, please see "Scenario choices in setting Science-based target for the Oil&Gas sector".

Identify a demand profile

Once a scenario has been selected, appropriate levels of demand for the energy source of interest (for example oil, gas and coal) must be determined for the time period covered by the scenario.

Analysis may be performed on a global or regional basis depending on requirements. For example, Carbon Tracker treats oil as a single global market, but looks at gas as regions (interlinked by LNG). If the purpose requires regional analysis, then demand levels must be provided on a regional basis.

Scenario outputs are provided with variation in granularity, regional basis, and units by different providers, and these may further vary from the basis in the supply data with which they will be matched. Accordingly, some conversions, adjustments and estimations may be required in order to determine an appropriate and properly applicable set of demand data.

Once a demand profile has been determined for a particular fuel, this can be considered in aggregate as a global "production budget" for that fuel.

Identify an internally-consistent set of supply cost data

An appropriate source of supply data must be selected to develop a universe of available supply options and compare their relative positioning in terms of production costs. The database should be reputable and reasonably comprehensive for the required purpose.

There are several commercially-available options; the Carbon Tracker Initiative has used Rystad Energy's UCube[2] database for oil and gas analysis.

While other databases could be selected, each database should, at a minimum, include: (1) individual asset definition, with breakeven costs estimates; (2) identification of company ownership of assets; and (3) sufficient regional coverage to evaluate the selected fuel in relevant markets. While several companies maintain such information, we believe there is value in the internal consistency that comes

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[1] https://data.ene.iiasa.ac.at/iamc-1.5c-explorer/#/login?redirect=%2Fworkspaces

[2] About Rystad Energy: "Rystad Energy is an independent energy research and business intelligence company providing data, tools, analytics and consultancy services to the global energy industry. Our products and services cover energy fundamentals and the global and regional upstream, oilfield services and renewable energy industries, tailored to analysts, managers and executives alike."
Rystad Energy can provide all oil & gas data as a custom download, sourced from their UCube database. UCube (Upstream Database) is an online, complete and integrated field-by-field database, including reserves, production profiles, financial figures, ownership and other key parameters for all oil and gas fields, discoveries and exploration licenses globally. UCube includes 65,000 oil and gas fields and licenses, portfolios of 3,200 companies, and it covers the time span from 1900 to 2100."

from using a single database and the ability to verify the data used, to the extent that third parties can acquire the data. Using a third-party database will also address company concerns about the commercially sensitivity of their project costs.

Any dataset that seeks to anticipate projects costs will have to rely on forecasting and modelling, as future costs themselves cannot be validated. However, it is important that the modelling assumptions be understood, applied consistently and, where not, that any departures be justified. This further supports the importance of utilizing datasets which can be scrutinized and evaluated by third parties.

While the LCM does rely heavily on future estimates, we note that the principal use of this information is not to identify a precise cost estimate for the future, but to separate future projects into two broad categories—those that fit within a given budget and those that do not. Consequently, what matters most is that the database accurately reflects the relative (as opposed to absolute) economic position of the projects, compared to each other.

Deduct future production from existing projects from the demand profile

In Carbon Tracker's methodology, assets that are already producing and under development are all assumed to continue producing for their base case lives, and hence are netted off the total demand level to leave a residual level of demand that will be filled by currently unsanctioned projects.

This reflects the reality that once a project has been sanctioned and capex sunk, it will likely continue to produce unless and until the lifting costs are higher than prevailing prices (and often beyond this point). Accordingly, it is unusual for a project to be permanently shut in once sanctioned even if it never creates value overall; hence production from such assets is assumed to be "locked in".

Conversely, the decision to sanction a new projects would factor in all future costs (i.e. capex, opex, capital costs, retirements costs, etc), meaning that breakeven costs are likely to be higher in any case than for sanctioned assets on a point-forward basis.

The database incorporates the potential timing of assets (e.g. if an asset is not likely to be able to start producing until 10 years in the future, its production will only be considered available from that point) and the production profile of those assets. For example, if only performing the analysis for a 20 year period, it will only incorporate production from an asset that is anticipated in that period, including natural decline, rather than full available reserves/resources.

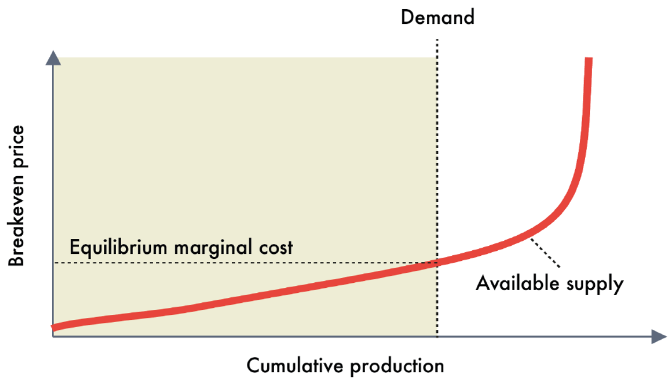
This appears to be approximately consistent with the way that the oil & gas industry views the future, given frequent charts which show a "supply gap" based on the difference between production from existing assets and carbon constrained demand. In practice, production from existing assets may underperform or outperform initial base case expectations due to, for example, less or more infill drilling, or changing understanding of geological conditions. Actual production will be contingent upon investments made (or not made) to slow natural decline.

Fill residual demand with available potential production from future project options on a least-cost basis

Now working with a quantum of residual demand and a set of potential future projects that might supply that demand, the LCM seeks to match the lowest cost supply to the demand profile in the aggregate over the time period specified.

In Carbon Tracker's methodology, projects are compared on the basis of their "breakeven price", defined as the oil or gas price required to generate a net present value of 0 for that asset at a given discount rate. Carbon Tracker uses a 15% discount rate to reflect cost of capital, a contingency and a minimum return, meaning that it is intended to be a proxy for a minimum price that companies might require for sanction rather than a true breakeven which might only cover cost of capital and not generate additional value. However, companies could choose other discount rates, provided they were explained and applied consistently.

The residual level of demand is then assumed to be satisfied by the lowest cost available project, starting with the lowest cost and sequentially incorporating gradually higher cost projects until the level of demand is met. This process then generates a list of projects which are needed to supply demand for oil and gas in the specified scenario over a particular time period, i.e. those which "fit within" that level of demand, and the remainder of projects that do not fit within. This is illustrated in the below example cost curve.



Source: CTI

The breakeven price of the highest cost project that fits within the demand level is referred to as the marginal cost; projects that have cost levels above this point are assumed not to go ahead. We typically don't focus on the absolute value of this marginal cost, as its actual value is not important to the analysis – the key factors are the fundamentals of supply and demand, and the marginal cost is just an output derived from these. Accordingly, it is not viewed as a forecast of future oil or gas price.

As assets frequently produce both gas and oil, there is an interdependency of the different fuels. If an asset is required for its oil to satisfy oil demand, any associated marketable gas should also be considered for gas market demand and vice versa. Carbon Tracker uses an iterative model to establish the set of projects which satisfies both gas and oil demand in equilibrium.

Calculate aggregate carbon emissions for the scenario period for each company

At this stage in the process, the methodology yields a list of potential projects which are assumed to go ahead within a given scenario, along with various detail on those projects including their associated production levels. The carbon emissions associated with those projects can also be estimated. In its most recent work, Carbon Tracker has used asset level estimates of carbon emissions related to consumption (and operations)[3] produced by Rystad Energy consistent with the underlying data. Other methods could be used, for example using average emissions factors by project type.

The production and associated carbon for these projects can then be aggregated at different levels as required. As the database contains detail of company ownership interests, the amount of future carbon can be aggregated at the level of each company based on its current portfolio. In other words, each company's carbon budget is therefore calculated on a bottom-up basis using the competitive positioning of its available project set. The aggregate level of carbon associated with a company's projects that fit within a given demand level is its "company level carbon budget" for that scenario.

This bottom up approach is therefore highly flexible, and the analysis can be re-run periodically to take account of, for example, M&A activity – if a company buys a low-cost, "inside-budget" project, its own carbon budget will expand and the selling company's will shrink commensurately (if a high-cost, "outside-budget" project is sold, there will be no impact on either company's carbon budget as it is assumed that the project does not go ahead in any case). Further, by developing company budgets that are differentiated based on costs, it approximates an outcome which is both reflective of the competitive nature of commodity markets and socially beneficial (in that society's energy needs are met at the lowest possible cost). Perhaps most importantly, it results in analysis where the "micro adds up to the macro" – if each company's carbon budget under this approach was added together, the result would be equivalent to the global carbon budget for the starting scenario temperature outcome.

This approach therefore focuses on the ultimate amount of emissions that result from the extraction of fossil fuels, including from consumption, and links those emissions to upstream production levels.

This *approach is only applicable to upstream operations of an integrated oil and gas company. If a company wishes to set targets based on volumes measured in other parts of it's the oil and gas value chain – e.g. downstream or sales – this method will need to be supplemented*.

Optional: Adjust "budgets" based on emissions intensity of the company's portfolio

The aggregate carbon emissions by company defined above are based on project-level emissions estimates as measured in the present day. Accordingly, while they encourage production and investment restraint, they do not factor in other desirable actions that companies should take to further contribute towards climate change mitigation, for example improving energy efficiency, using renewable sources of electricity rather than fossil, or prioritising developments with lighter hydrocarbons or less reservoir CO_2.

Therefore, for these numbers to be translated into more holistic "budgets" that encompass other aspects of corporate behaviour, we expect that investors (and management) will also want to incorporate aspects of emissions intensity in order to incentivise producers appropriately. While there

[3] These emissions will be approximated to Scope 1 (Direct) emissions from methane from operations and Scope 3, Use of sold products of the oil extracted from the ground.

are a number of potential ways to set these, we believe there is significant value in keeping budgets calculations as transparent as possible.

Those companies with relatively high carbon intensity project portfolios arguably have more space to decarbonise at a greater rate compared to lower-carbon peers. We therefore suggest a simple approach where for such companies, their aggregate emissions are adjusted for their carbon intensity when calculating “company carbon budgets”. To define a company carbon budget on an intensity-adjusted basis, we take the same set of projects that fit within a particular scenario for each company and apply an industry-average emissions intensity. Company carbon budgets are therefore aligned with each company’s share of global production under that scenario. Worse than average companies are therefore assumed to improve their intensity towards industry average.

For those companies that have projects with better-than-average emissions intensities, rather than setting a less stringent budget, we set company carbon budgets to be the same as their aggregate emissions as defined above. However, we highlight that this does not mean such companies do not have scope to lower their intensity further, and indeed should consider how they might adjust targets to create the incentives to do so. While we believe that every company has some space to further decarbonise, this methodology recognises the steps some have already taken in this regard. We feel this is a reasonable approach, as the oil and gas demand projections under climate scenarios typically assume future emissions efficiency improvements overall.

We also expect that companies should make efforts to reduce their emissions of non-CO_2 greenhouse gases, such as methane – these are outside the scope of this methodology.

Define a pathway for future company emissions

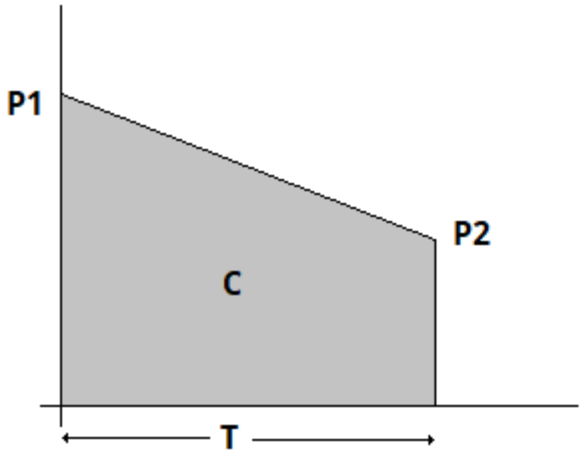
While the aggregate company carbon budgets provide a clear link to the global carbon budget, an aggregate figure over two decades is likely to be of limited use for target-setting purposes.

To turn these budgets into an enforceable plan, investors and management teams will need to consider how to translate them into annual targets. It may be that different approaches are applicable to different companies, although we caution against the danger that methodologies are “cherrypicked”, with each company adopting the approach that gives the most favourable outcome for themselves and the industry aggregate exceeding the global carbon budget.

For example, we assume a linear projection as the simplest and most intuitive way of turning aggregate budgets into trajectories to inform annual metrics, to allow comparison between companies, and place the budgets in the context of current annual production.

Companies may consider other trajectories to use when defining their target pathway. However, as well as being the simplest, a linear approach – starting now – will generally be the somewhat conservative in terms of committing emissions and requires only gradual changes to company business models. Much like the concept of a carbon budget at a global level, assuming a trajectory where absolute emissions continue to increase in the near term simply uses up the budget quickly to begin with and makes steeper, and more challenging, reductions necessary later on. Companies that follow this route may find that the greater implied scale of change is unachievable in practice and hence fail in their targets.

With a known starting point (the company's current emissions/production, say P1) and a carbon budget calculated as above (C), the assumption of a linear trajectory therefore defines the target pathway of a company's emissions over time (T), as well as the level of reduction to achieve (P2).



This is, given that

$$C = \frac{(P1+P2)}{2} * T \,,$$

you can obtain P2 as

$$P2 = \frac{2C}{T} * P1$$

The magnitude of a company's carbon budget relative to its current emissions will dictate the steepness of the target pathway – if a company's project options are mostly high cost, meaning that it has a small carbon budget compared to its current emissions level, emissions will need to fall more sharply in order that the carbon budget is not breached.

Target expression

Targets calculated using this methodology can be represented in a variety of different ways, for example:

- As a total, absolute carbon budget for emissions over a period (with the definition of emissions provided);
- A pathway based on the total carbon budget, the company's starting point and the assumption of a trajectory to achieve that carbon budget as suggested above. This pathway may be represented with interim emissions levels and an end-point.

Further, the targets may be represented in ways other than tonnes of CO_2, for example in terms of production volumes that are anticipated to result in the budget level of CO_2 emissions.

References

CTI (2019a) “Breaking the Habit – Methodology”

CTI (2019b) “Balancing the Budget – Methodology”