TRANSITION PATHWAY INITIATIVE

CARBON PERFORMANCE OIL AND GAS DISCUSSION PAPER

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Simon Dietz, Carlota Garcia-Manas, William Irwin, Adam Matthews, Rory Sullivan, Faith Ward

@tp_initiative

transitionpathwayinitiative.org

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EXECUTIVE SUMMARY

This report

This discussion paper makes a proposal for how TPI might assess the carbon performance of oil and gas producers. Its central premise is that oil and gas producers are engaged in primary energy supply and therefore, that the appropriate measure of activity for the sector is energy production and that the appropriate measure of carbon performance is the lifecycle carbon intensity of primary energy supply. Using recent disclosures from Shell, Total and Petrobras, this report tests the proposed measure of carbon performance and identifies the key technical and other issues to be considered in the application of this measure.

It demonstrates that:

- It is possible to define low-carbon transition pathways for primary energy production that are consistent with the Paris Agreement NDCs or pledges, and limiting warming of the planet to 2 Degrees;
- An appropriate low-carbon transition pathway for oil and gas producers is measured in terms of companies' lifecycle carbon emissions per unit of energy supplied; and
- It is possible to assess companies against these transition pathways, using data on their current lifecycle greenhouse gas emissions and on their future ambitions, objectives and targets.

Results

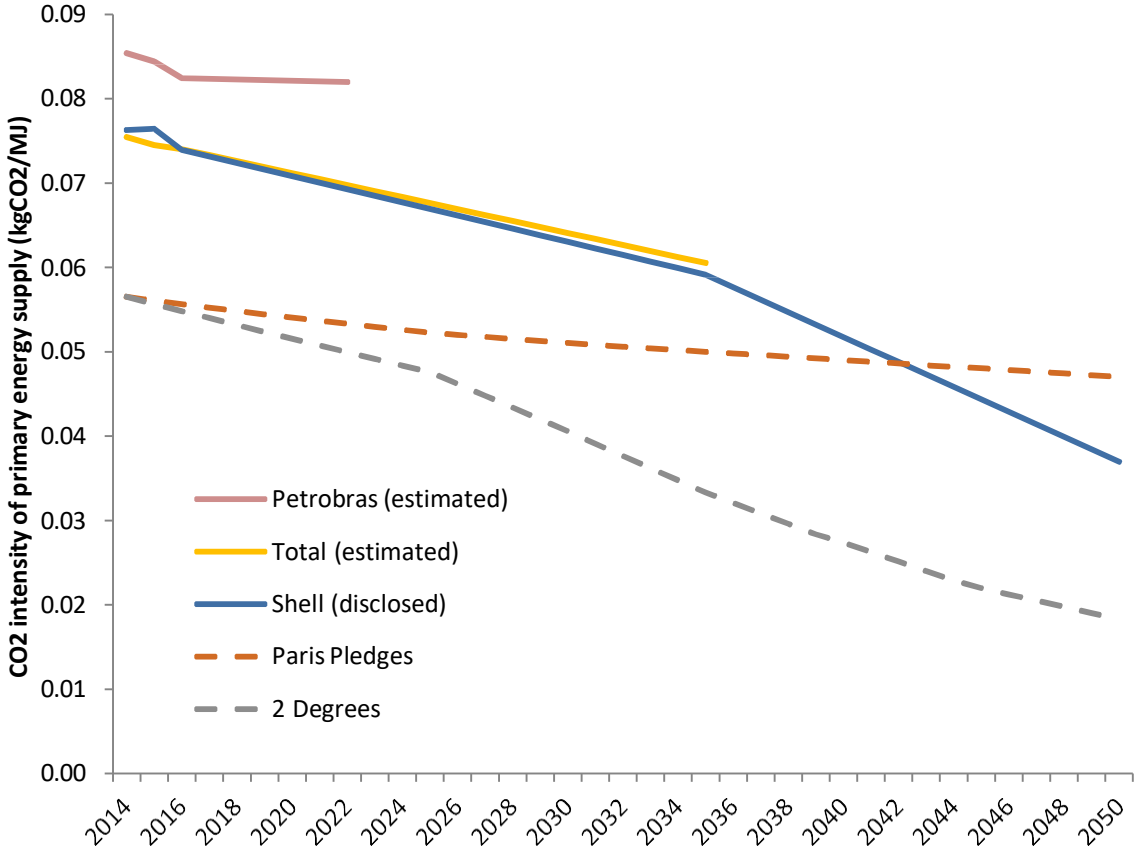
The results of the assessment of Shell, Total and Petrobras against the Paris Agreement NDCs or pledges and against a 2 Degrees scenario are presented in the Figure below. They show that all three are above benchmarks at present but, given their ambitions to diversify and reduce their carbon intensity of energy supply, Shell and Total in particular could achieve alignment with one or both of the benchmarks at some point in the future.

Implications for disclosure, and investor engagement and decision-making

Most oil and gas companies are yet to provide the disclosures necessary to enable investors to assess how they are performing against the Paris Pledges or a 2 Degrees scenario. In turn, this means that investors cannot assess the quality of the strategies being adopted by these companies to manage the risks and opportunities associated with the transition to a low-carbon economy. In the box below, we set out the minimum disclosures that we think should be provided by all oil and gas companies.

Disclosure is only the starting point. Once companies have stated their ambitions or targets, investors will be able to assess their current and future performance and engage with those companies needing to reduce their emissions. Furthermore, with the development of this methodology for primary energy production, investors now have a basis for adopting portfolio-wide approaches to carbon management. It allows investors to deal with the reality that the rate at which individual companies can transition will be shaped by a company's business models, capacities, existing asset base and technological development. It means that investors can also shift capital between companies to enable their portfolios to align with the goals of the transition to a low-carbon economy.

Figure ES1 Carbon intensity pathways for Shell, Total and Petrobras, versus low-carbon benchmarks



Box ES1 Minimum disclosure expectations for oil and gas producers

All oil and gas producers should disclose the following information, updated on an annual basis:

- Current:
  - Total primary energy production (in MJ) for the current/most recent reporting year.
  - Total primary energy production (in MJ) by fuel type for the current/most recent reporting year.
  - Lifecycle carbon footprint (in carbon dioxide equivalent) for the current/most recent reporting year. This should include the direct and indirect (Scope 1 and 2) emissions associated with a company's operations, the emissions associated with combusting the various fuels that it produces (Scope 3 emissions from use of sold products), and the conversion factors that are being used to calculate these emissions. It should also include other indirect or Scope 3 emissions. If the company is offsetting any of its emissions, these offsets should be reported separately.
- Future, ideally to at least 2030 or 2035:
  - Expected total primary energy production (in MJ) for future years.
  - Expected total primary energy production (in MJ) by fuel type for future years.
  - Ambitions or objectives to reduce the company's total carbon footprint (in carbon dioxide equivalent) in future years (where these years are clearly specified). These ambitions should include the direct and indirect (Scope 1 and 2) emissions associated with a company's operations, the emissions associated

with combusting the various fuels that it produces (Scope 3 emissions from use of sold products), and the conversion factors that are being used to calculate these emissions. It should also include other indirect or Scope 3 emissions. If the company is offsetting any of its emissions, these offsets should be reported separately.

- The key assumptions that underpin the company's analysis, e.g. on the level of supply or demand, on carbon policy, on carbon pricing, on emissions per unit of energy produced, etc.

1. INTRODUCTION

1.1. The Transition Pathway Initiative

The Transition Pathway Initiative (TPI) is a global, asset owner-led initiative, supported by asset owners and managers with over £5 trillion (US$6.9 trillion) of assets under management. TPI aims to evaluate what the transition to a low-carbon economy looks like for companies in sectors with a high impact on climate change, such as coal mining, electricity, oil and gas, and steel. It also aims to assess how well-prepared companies in these sectors are for the low-carbon transition. Companies are analysed in two ways:

1. *Management Quality*: TPI evaluates and tracks the quality of companies' governance/management of their greenhouse gas emissions and of risks and opportunities related to the low-carbon transition.
2. *Carbon Performance*: TPI also evaluates how companies' recent and future carbon performance might compare to the international targets and national pledges made as part of the UN Paris Agreement. It does this by comparing companies within each high-impact sector against each other and against sector-specific benchmarks, which establish the performance of an average company that is aligned with international emissions targets.

TPI publishes the results of its analysis through an open online tool hosted by the Grantham Research Institute on Climate Change and the Environment at the London School of Economics (LSE): http://www.transitionpathwayinitiative.org. FTSE Russell is a partner of the initiative and supplies ESG ratings data for the assessment of management quality.

TPI encourages investors to use the data, indicators and online tool to inform their investment research, decision-making, engagement with companies, proxy voting and dialogue with fund managers and policy makers, bearing in mind the Disclaimer that can be found in Section 6.

1.2. About this report

This discussion paper makes a proposal for how TPI might assess the carbon performance of oil and gas producers.

- **Section 2**, we explain how TPI has assessed carbon performance in other sectors, including automotive, cement, electricity, paper and steel.
- **Section 3** then shows how recent ambitions to reduce carbon emissions, articulated by some leading international oil and gas producers, suggests a way forward in assessing carbon performance in this sector.
- **Section 4** presents some initial results from applying the proposed methodology, as well as discussing the limitations of the approach.
- **Section 5** provides a discussion of the broader implications for investors of this method of assessment of oil and gas producers' carbon performance.

2. TPI'S CARBON PERFORMANCE ASSESSMENT

TPI's carbon performance assessment is based on the Sectoral Decarbonization Approach (SDA).[1] The SDA translates greenhouse gas emissions targets made at the international level (e.g. under the Paris Agreement to the UN Framework Convention on Climate Change) into appropriate benchmarks, against which the performance of individual companies can be compared.

The SDA is built on the principle of recognising that different sectors of the economy (e.g. oil and gas production, electricity generation and automobile manufacturing) face different challenges arising from the low-carbon transition, including where emissions are concentrated in the value chain, and how costly it is to reduce emissions.

Therefore, the SDA takes a sector-by-sector approach, comparing companies within each sector against each other and against sector-specific benchmarks, which establish the performance of an average company that is aligned with international emissions targets. In taking a sector-by-sector approach, the SDA differs from other approaches to translating international emissions targets into company benchmarks, which have applied the same decarbonisation pathway to all sectors, regardless of the differences between sectors.[2]

Applying the SDA can be broken down into the following steps:

1. A global carbon budget is established, which is consistent with international emissions targets, for example keeping global warming below 2°C. To do this rigorously, some input from a climate model is required.
2. The global carbon budget is allocated across time and to different regions and industrial sectors. This typically requires an energy systems model, and these models usually allocate emissions reductions by region and by sector according to where it is cheapest to reduce emissions and when (i.e. the allocation is cost-effective). Cost-effectiveness is, however, subject to some constraints, such as political and public preferences, and the availability of capital. This step is therefore driven primarily by economic and engineering considerations, but with some awareness of political and social factors.
3. To compare companies of different sizes, sectoral emissions are normalised by a relevant measure of sectoral activity (e.g. physical production, economic activity). This results in a benchmark path for emissions *intensity* in each sector:

$$\text{Emissions intensity} = \frac{\text{Emissions}}{\text{Activity}}$$

   Assumptions about sectoral activity need to be consistent with the emissions modelled and are therefore taken from the same energy systems modelling.
4. Individual companies' historical emissions intensities are calculated, and their future emissions intensities can be estimated based on any emissions targets they have set (i.e. this assumes companies exactly meet their targets), or on other ways they have articulated their emissions strategy. Together these establish emissions intensity pathways for companies.
5. These companies' emissions intensity paths are then compared with each other and with the relevant sectoral benchmark paths.

In each sector, TPI evaluates companies against two benchmark pathways:

1. A ***2 Degrees scenario***, which is consistent with the overall aim of the Paris Agreement to hold "the increase in the global average temperature to well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels".[3]
2. A ***Paris Pledges scenario***, which is consistent with the global aggregate of emissions reductions pledged by countries as part of the Paris Agreement in the form of Nationally Determined Contributions or NDCs. Several studies have documented that this aggregate is currently insufficient to put the world on a path to limit warming to 2°C, even if it will constitute a departure from a business-as-usual trend.[4]–[6]

A company whose emissions intensity is below the benchmarks can be said to be aligned with those benchmarks and therefore with the international commitments underpinning them. A company whose emissions intensity is above the benchmarks is not aligned.

Another initiative that is also using the SDA is the Science Based Targets Initiative (http://sciencebasedtargets.org/), though, unlike this initiative, TPI's carbon performance assessment is used to evaluate all the companies in a sector, whether they have 'opted in' to setting science-based targets or not. There are also some other differences in the detail of how the SDA is applied by the two initiatives. Nonetheless, in principle, a company that has set a science-based target under the Science Based Targets Initiative should be in alignment with the 2 Degrees scenario and therefore with the Paris Pledges scenario.

In most of the sectors that TPI has assessed, the source of data on the benchmark pathways is the International Energy Agency's biennial *Energy Technology Perspectives* report.[7] In line with TPI's philosophy, the source of data on companies' emissions intensity paths is public disclosures (including responses to the annual CDP questionnaire, as well as companies' own reports, e.g. sustainability reports). In particular, only company disclosures are used to estimate recent and current emissions intensity, and company disclosures are also the source of information on future emissions.

3. APPLYING THE METHOD TO THE OIL AND GAS SECTOR

3.1. Benchmarking oil and gas producers against primary energy supply

In applying the SDA to the oil and gas sector, a key consideration is that the vast majority of lifecycle emissions stem from use of companies sold products, i.e. burning oil and gas for energy in buildings, electricity, industry and transport. Therefore, the scope of company emissions should include emissions from use of sold products, as well as the contribution from direct and indirect operational emissions (i.e. Scope 1 and 2), and ideally other indirect or Scope 3 emissions.

In the main, oil and gas producers are engaged in primary energy supply and therefore an appropriate measure of activity in the oil and gas sector is energy production (but see below for comments on production used for plastics, etc.).

When combined, the measure of carbon performance obtained is the **carbon intensity of primary energy supply**.[1]

In fact, two oil and gas producers, Shell and Total, have recently chosen to articulate their "ambitions" to reduce emissions in exactly these terms: they aim to reduce their carbon intensity of energy supply. In defining their ambitions in this way, Shell and Total are asking investors and stakeholders to think of them as companies that supply primary energy, rather than as oil and gas producers more narrowly. As such, they should be benchmarked against the overall carbon intensity of global primary energy supply.

Primary energy supply is the total net calorific energy supply from all energy sources, including hydrocarbons, biomass and waste used for energy generation, nuclear power and renewables. It is equal to total energy demand plus conversion losses. Together with associated CO_2 emissions, primary energy supply is modelled in the IEA's ETP scenarios, allowing us to calculate the carbon intensity of global primary energy supply in both a Paris Pledges and 2 Degrees scenario.[2]

Like other modelling groups, IEA foresees a low-carbon transition involving the extraction of decreasing volumes of oil and gas (and coal) than under a business-as-usual scenario. At the same time, the other, zero-carbon sources of primary energy command a steadily increasing share (Figure 1). Thus, companies can reduce their emissions intensity by, among other things, diversifying away from fossil fuels and producing more energy from other sources (e.g. second-generation biofuels).

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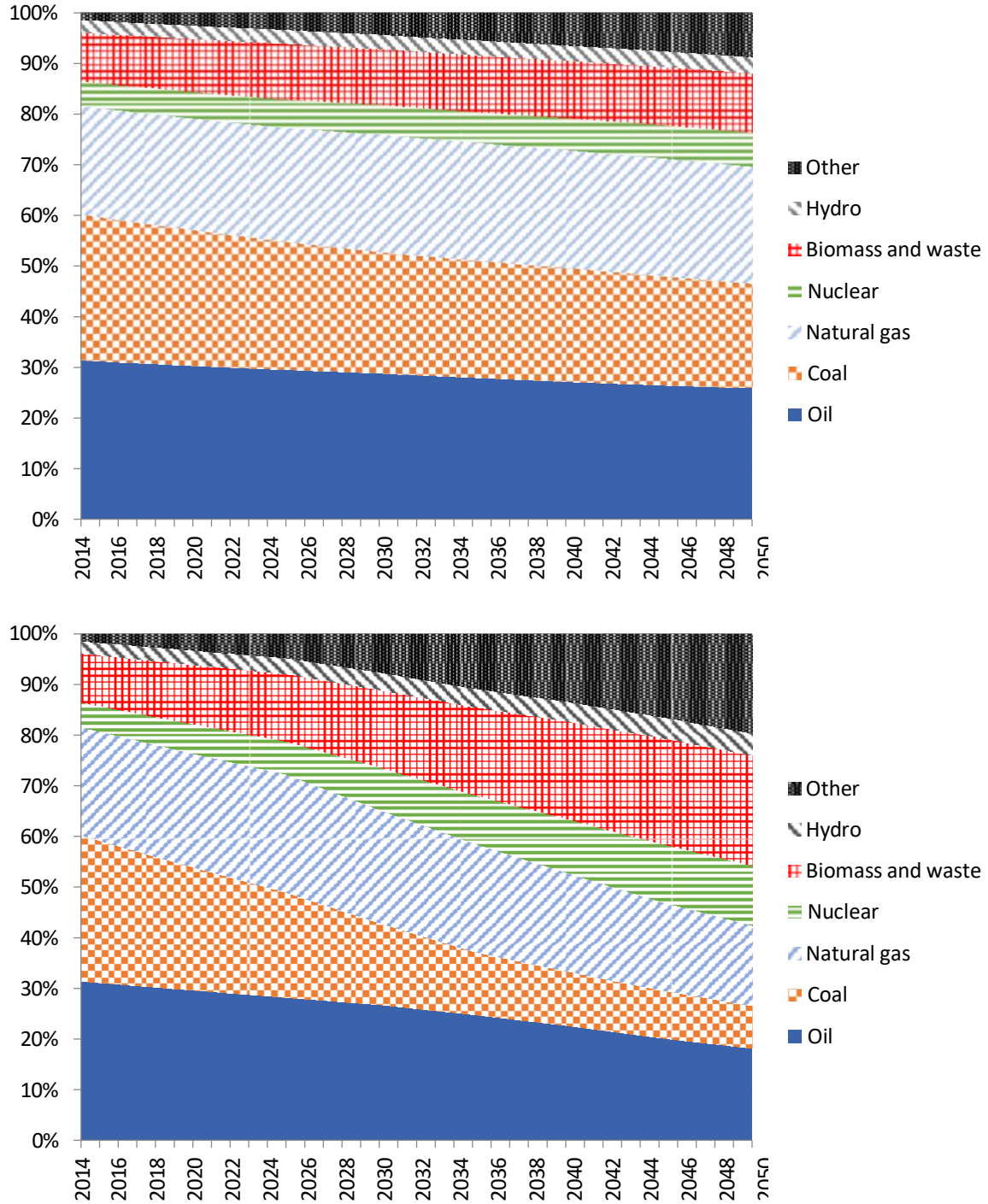
[1] The Science Based Targets Initiative has also indicated that it plans to assess oil and gas producers in this way (https://www.greenbiz.com/article/how-oil-and-gas-companies-can-prepare-low-carbon-world).

[2] IEA's total emissions figures include what are termed 'process emissions': emissions that are "inherently generated in the reactions taking place in an industrial process," including, for example, the calcination of limestone in the cement production process. These are not energy-related emissions. The IEA discloses process emissions for the different industries explicitly included in its model: 6% in the steel industry, 39% in aluminium, 41% in chemicals, and 64% in cement. We have removed these process emissions from the emissions numerator used in our benchmark calculation.

Figure 1 IEA ETP global primary energy mix 2014-2050, Paris Pledges scenario (top) and 2 Degrees scenario (bottom)



Diversification of energy supply is thus one strategy that oil and gas producers can pursue that is compatible with the low-carbon transition. Another strategy is simply not to invest in new production assets, return profits to shareholders and ultimately wind up the business. The benchmarking approach followed in this paper is primarily useful for evaluating the former, diversification strategy.

It is important to point that, since the sources of primary energy are diverse, the set of companies that could be benchmarked against primary energy supply is also potentially very diverse and a discussion is needed on whether the resulting comparisons are meaningful. Producers of biomass or renewable energy are theoretically also primary energy suppliers, for example. They would have very low or zero carbon intensity of

primary energy supply. Therefore the benchmarks will be intrinsically challenging for fossil fuel producers to align with.

3.2. Estimating companies' carbon intensity of primary energy supply

Choice of companies to profile

In this discussion paper, we provide a proof of concept by estimating carbon intensity pathways, per unit of primary energy supply, for three oil and gas companies: Shell, Total and Petrobras.

Shell and Total are included, because they have set ambitions to reduce precisely their carbon intensity of primary energy supply. Shell's target is straightforward in that it provides a base year intensity and proportional reduction target. Total's ambition is expressed in the form of an intended mix of energy products in 2035, from which a target intensity can be calculated.

Petrobras is included because it has indirectly articulated its future emissions plans by setting out its expected oil and gas production volumes up to 2022 (more details below). Therefore, the Petrobras case exemplifies another form of company disclosure that may be used for the purpose of TPI's carbon performance assessment in oil and gas.

We assume that operational and other emissions maintain a constant proportional relationship to product emissions in calculating targets for Total and Petrobras.

We also looked at recent disclosures from BP, Chevron and ExxonMobil, but did not include these companies in the assessment as they do not appear to quantify their future emissions ambitions.

Data availability: disclosures from Shell, Total and Petrobras

In November 2017, Shell announced the ambition of reducing its "net carbon footprint" by 20% below the base year value by 2035, and 50% by 2050.[3] The company's net carbon footprint comprises the lifecycle emissions of energy supplied, which is therefore directly comparable with the IEA's ETP carbon intensity of primary energy supply. Since Shell publishes the base-year value, the pathway is estimated by applying the company's ambitions, in terms of a percentage cut, to this.

Unlike Shell, Total and Petrobras do not currently publish their net carbon footprint. Indeed most oil and gas companies do not. Therefore, we have had to take a different approach, making bottom-up estimates of the carbon intensity of energy supply from various figures disclosed by these companies. These estimates for Total and Petrobras comprise:

1. Emissions from use of sold products;
2. Scope 1 and 2 operational emissions;
3. An adjustment to reflect Scope 3 emissions other than those in the use of product category.

Emissions from product use are from oil and gas combustion. We have estimated this on the basis of disclosed upstream production, which is separated by most companies into liquids (containing oil and natural gas liquids or NGL volumes), and natural gas. Total CO_2 emissions are calculated by multiplying the output of each fossil-fuel product by the carbon intensity of its combustion (see below for further details). We have estimated the split

[3] Shell Management Day Presentation, 23rd-25th November 2017. See http://go.shell.com/2nSSAk5

between crude oil and NGL in liquids, where this is not disclosed, based on natural gas production volumes[4].

Most oil and gas companies also report Scope 1 and 2 emissions in both CO_2 and CO_2e terms. To ensure comparability with the IEA benchmarks, which only include emissions of CO_2, we exclude operational methane and nitrous oxide emissions for now. These appear to be trivial, at 0.0004 $kgCO_2e/MJ$ for Shell.

Unfortunately, few oil and gas companies currently provide a comprehensive disclosure of their Scope 3 emissions, disaggregated by category. Shell publishes a full Scope 3 breakdown, but Total and Petrobras do not. Therefore, in order to ensure some comparability between the estimates for the three companies, we have made a rough adjustment to the emissions intensities of Total and Petrobras. This adjustment is based on the difference between Shell's combined use-of-product and operational emissions intensity, and its full lifecycle emissions intensity, as published by the company itself. We calculate Shell's combined use-of-product and operational emissions intensity to be 0.074 $kgCO_2/MJ$, compared with its lifecycle emissions intensity of 0.085 $kgCO_2/MJ$: a difference of 15%. Therefore, we apply an uplift of 15% to the emissions of Total and Petrobras.

None of the three companies reports production data for electricity from renewables, or biofuels production. We have therefore been unable to include these products in our estimates. Though companies have stated their intention to increase energy production from these sources, we believe that current production is too low to materially affect average intensity.

Estimating emissions from use of sold products

The emissions and energy content of fossil fuels varies depending on the nature of the resource being extracted and the efficiency of combustion. Our analysis uses product CO_2 emissions factors from the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.[8]

Unit conversions are required, most importantly for natural gas production volumes, where they are reported in millions of cubic feet. We convert these to barrels of oil equivalent so that we can compare them with the production volumes of other fossil fuel products. The exact energy content of natural gas differs depending on its hydrocarbon make-up; we have used a standard conversion rate of 5,800 cubic feet per barrel of oil equivalent. This figure is widely used, including in Shell's Annual Reports.

None of the companies included in this analysis reports NGL volumes separately, instead including them with crude oil in a 'liquids' category. In these cases we have estimated volumes, as NGL's combustion carbon intensity is lower than crude oil's; 0.0642 versus 0.0733 kgCO2/MJ respectively according to the IPCC. We have applied a ratio of global NGL to natural gas production of 23.3% to all companies.[9] This is a fairly crude assumption, because the 'liquids ratio' varies a lot by location, from below 10% (the average for gas production in Russia, for example) to above 100% (in Saudi Arabia and other parts of the Middle East). The same approach is taken to NGL volumes in calculating the carbon intensity of oil and gas in the IEA's ETP scenarios.

Our company analysis also ignores the fact that some upstream production is used in plastics and other chemicals, and thus not in supplying energy. We assume these volumes

[4] Natural gas liquids are a mixture of hydrocarbons, mostly butane, propane and ethane, which are produced in natural gas refinement.

'exiting' the energy system have a negligible impact on companies' carbon intensities. Taking account of them would involve subtracting them from product volumes (and therefore emissions, the numerator in our intensity calculation) and from energy production (the denominator). So we in effect assume that the hydrocarbons mix used for downstream plastics and chemicals production is reflective enough of companies' overall production that it does not have a major effect on companies overall carbon intensity of energy supply.

In the case of Total's ambitions, the company publishes a breakdown of the energy products it is aiming to produce in 2035 and it offers a range rather than a point estimate: 45-50% natural gas, 30-35% natural gas and 15-20% renewables. We calculated a specific company trajectory by taking the mid-points of these ranges and apportioning the extra 2.5% proportionally between the three energy products.

3.3. Representative estimates of the carbon intensity of coal, oil and gas supply

To put the results in context in the following section, we have also estimated the average lifecycle emissions intensity of energy for each of coal, oil and natural gas. To do so we have followed the same approach as we took for the companies, described above. For oil and gas, we use the same carbon intensity of combustion figures as we used for the company estimates; we then apply the average Scope 1 & 2 operational emissions per MJ figure from the companies that we have analysed, plus the same 15% uplift that we applied to Total and Petrobras to account for Scope 3 emissions beyond use of sold products.

Our estimate for coal required additional steps. Firstly, we calculated a global, weighted-average carbon intensity of coal-burning, based on the carbon intensity of combustion of the different types of coal (bituminous, sub-bituminous, lignite and anthracite), weighted by their shares in global proved reserves. The assumed carbon intensity of combustion reflects current technologies predominantly in use and therefore assumes no carbon capture and storage (CCS).[5] Secondly, we estimated the operational emissions involved in coal extraction, based on BHP Billiton's coal-segment emissions and production volume data. Thirdly, we applied a 10% uplift to account for Scope 3 emissions beyond use of sold products. This uplift would benefit from a firmer evidential basis.

[5] It is important to note, however, that the IEA scenarios presented above do assume significant deployment of CCS, particularly after 2030.

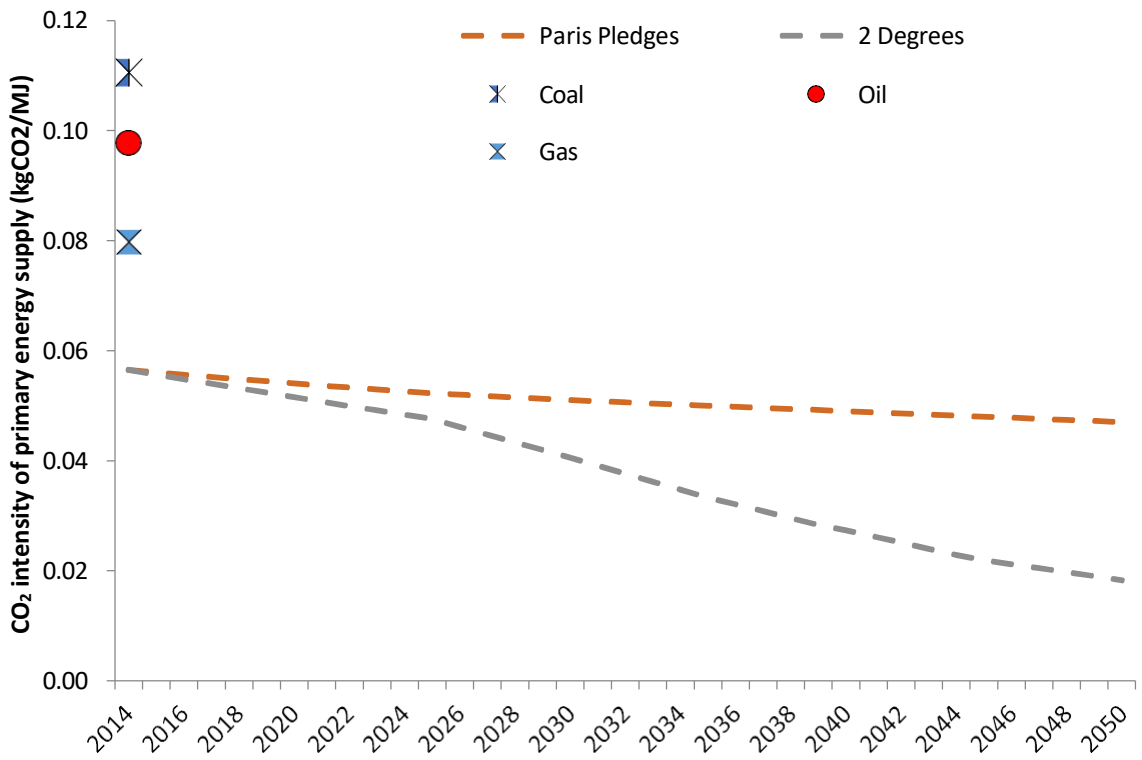
4. RESULTS

4.1. Alignment with the benchmarks

Companies' carbon intensity of energy supply largely reflects the proportion of different energy products in their product mix (for example shares of oil and gas). Operational emissions and other indirect emissions are also relevant, but they are generally a small share of lifecycle emissions. As Figure 2 shows, all hydrocarbon energy sources find themselves above the average carbon intensity of primary energy supply today, which is what the Paris Pledges and 2 Degrees benchmarks quantify.

Coal has the highest carbon intensity per unit of energy, followed by oil, with gas having the lowest of the three. That the average carbon intensity of primary energy is so much lower than the carbon intensity of hydrocarbons, even gas, reflects just how low the carbon content of the other primary energy sources is.

Figure 2 Representative carbon intensity of energy supply for coal, oil and gas, versus the benchmarks



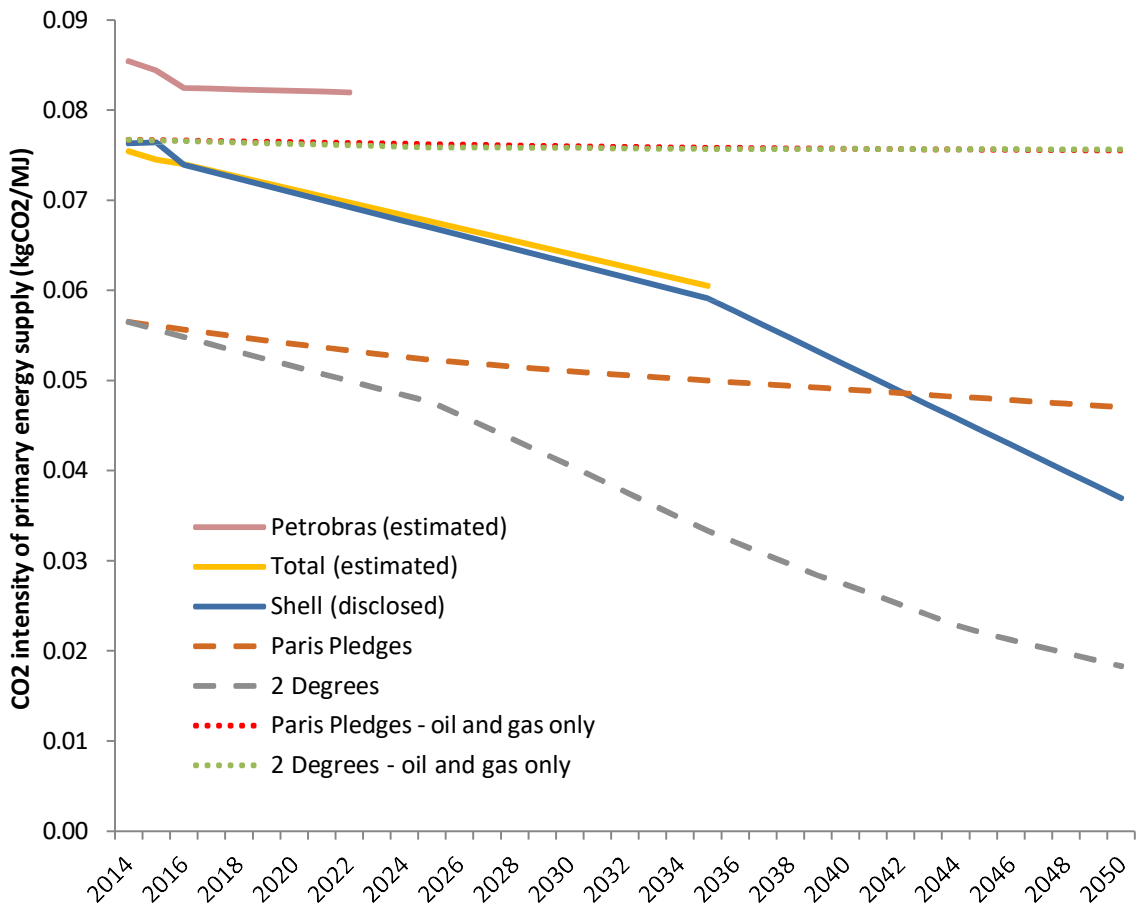
Given the oil/gas product mix of Shell, Total and Petrobras, they are accordingly positioned above the benchmarks today (Figure 3). But by meeting their ambitions to diversify and reduce their carbon intensity of energy supply, Shell and Total in particular could achieve alignment with one or both of the benchmarks at some point in the future.

Figure 3 assesses this by also comparing companies' future pathways with the benchmarks. It shows that Shell becomes aligned with the Paris Pledges benchmark in the early 2040s, and may be on a path to alignment with 2 Degrees in the second half of the century. Total's ambitions only run to 2035 so far. At that time, it is still not in alignment with the Paris Pledges benchmark, but its carbon intensity is closely tracking that of Shell. If it were to increase its ambitions post-2035, like Shell, it would also be aligned with the Paris Pledges benchmark by 2050, but, like Shell, 2 Degrees remains quite far off. Petrobras has not articulated ambitions to reduce emissions so much as declare its projected oil and gas production up to 2022. On this basis its carbon intensity would remain broadly unchanged.

Petrobras has a higher carbon intensity of energy today than Shell or Total, because it produces a higher proportion of oil relative to natural gas and natural gas liquids.

For reference, Figure 3 also plots a pathway for the average carbon intensity of energy supplied by oil and gas only. These pathways are relatively flat, reflecting the intrinsically high carbon content of these fuels and the fact that, in the IEA scenarios, the balance of crude oil and natural gas use globally remains broadly unchanged. This also provides some indication of how far producers must diverge from a conventional hydrocarbon product mix in order to reach the benchmarks.

Figure 3 Carbon intensity pathways for Shell, Total and Petrobras, versus the benchmarks



4.2. Limitations

As discussed above, measuring the carbon intensity of primary energy supply is not the only way to assess oil and gas companies' alignment with the low-carbon transition. Companies could choose to reduce investment in future oil and gas production, but without diversifying into energy from low-carbon sources, instead returning profits to shareholders and winding down activities.

This strategy could also be consistent with required reductions in hydrocarbon production to meet international climate goals. But if companies pursued this latter strategy, then their carbon intensity of energy supply would remain stubbornly above the benchmarks. The trouble is then that the methodology proposed in this paper would not be able to distinguish between companies responding to the climate challenge in this way, and companies ignoring the climate challenge and pursuing a business-as-usual production strategy.

The other main limitation is that, in the absence of comprehensive and reliable information on lifecycle carbon emissions per unit of energy that is provided by the companies themselves (as in the case of Shell), a degree of estimation is involved, which may introduce inaccuracies, including that:

- Most companies do not disclose comprehensive and disaggregated Scope 3 emissions data and at present we have applied a very rough adjustment factor in order to achieve broad equivalence.
- Companies do not appear to disclose information on the carbon and energy content of the specific hydrocarbons that they extract. The energy and carbon content of oil and gas differs by extraction location. An estimate of use-of-product carbon intensity based on more detailed data like these would be more accurate.
- Companies do not appear to disclose the proportion of hydrocarbons that are not used in energy production but are instead used in producing chemicals such as plastics and lubricants. We currently cannot account for this part of oil and gas companies' production.

Overall, therefore, improved company reporting is vital to future efforts to assess the sector.

5. DISCUSSION

This report demonstrates that:

1. It is possible to define a transition pathway for primary energy production, both against the Paris Agreement NDCs or pledges, and against a 2 Degrees scenario.
2. It is possible to assess primary energy producers, particularly oil and gas producers, against these transition pathways, using data on their current production and on their future ambitions, objectives and targets.
3. It is possible to differentiate between companies on the basis of their current and future emissions, although some care is required when looking to differentiate between companies with similar emissions intensities, as the data reported may not be sufficiently granular to establish whether small differences between companies' performance are genuine, or are within the margin for error in estimation.

This report also raises three important conclusions for investors seeking to analyse the future carbon performance of the oil and gas sector.

I. First, most oil and gas companies are not yet providing the disclosures necessary to enable investors to assess how they are performing against the Paris Pledges or a 2 Degrees scenario. In turn, this means that investors cannot assess the quality of the strategies being adopted by these companies to manage the risks and opportunities associated with the transition to a low-carbon economy. The disclosure expectations set out in Box 1 should be a basic expectation of all companies in the sector. The disclosure of this information will enable investors to focus on the key risk for the sector, i.e. the greenhouse gas emissions associated with product use and the sector's exposure to changes in climate- and energy-related policy and regulation.

   Of course, disclosure is only the starting point. Once companies have stated their ambitions or targets, investors will assess their current and future performance, and engage with those companies needing to reduce their emissions. We have noted that different companies will consider adopting different strategies for change; some may diversify their energy mix (e.g. increasing the proportion of renewables), whereas others may choose to exit certain activities altogether, and to return cash to shareholders. All strategies could be viable based on an understanding of companies' ambitions/targets against Paris/2 Degrees. In these discussions, TPI's carbon performance assessment may need to be supplemented with more site-, asset- or project-specific analysis from organisations such as Carbon Tracker, which is particularly suited to establishing the economics of continued oil and gas production.[10]

II. The second is that, with the development of this methodology for primary energy production, investors now have a basis for adopting portfolio-wide approaches to carbon management. With TPI having developed carbon performance methodologies for most high-impact sectors, investors can form a better understanding of the alignment of their portfolios against international climate goals like 2 Degrees. For example, in primary energy, they can consider balancing their investments in the oil and gas sector with investments in, for example, renewables or other low-carbon forms of primary energy. This allows them to deal with the reality that the rate at which individual companies can transition will be limited by the company's business models, capacities, existing asset base and

technological development. Engagement with existing portfolio companies will help, but investors can also shift capital between companies to enable their portfolios to align with the goals of the transition to a low-carbon economy and, over time, to decarbonise their portfolios. This shifting of capital can reinforce the signals sent through engagement, as it provides a further incentive for companies to respond to investors' calls to reduce their emissions.

III. The third is that TPI now provides a sector-by-sector framework for prioritising engagement and for enabling stakeholders and investors to assess the effectiveness of engagement programmes such as Climate Action 100+.

Box 1 Minimum disclosure expectations for oil and gas producers

All oil and gas producers should disclose the following information, updated on an annual basis:

- Current:
  - Total primary energy production (in MJ) for the current/most recent reporting year.
  - Total primary energy production (in MJ) by fuel type for the current/most recent reporting year.
  - Lifecycle carbon footprint (in carbon dioxide equivalent) for the current/most recent reporting year. This should include the direct and indirect (Scope 1 and 2) emissions associated with a company's operations, the emissions associated with combusting the various fuels that it produces (Scope 3 emissions from use of sold products), and the conversion factors that are being used to calculate these emissions. It should also include other indirect or Scope 3 emissions. If the company is offsetting any of its emissions, these offsets should be reported separately.
- Future, ideally to at least 2030 or 2035:
  - Expected total primary energy production (in MJ) for future years.
  - Expected total primary energy production (in MJ) by fuel type for future years.
  - Ambitions or objectives to reduce the company's total carbon footprint (in carbon dioxide equivalent) in future years (where these years are clearly specified). These ambitions should include the direct and indirect (Scope 1 and 2) emissions associated with a company's operations, the emissions associated with combusting the various fuels that it produces (Scope 3 emissions from use of sold products), and the conversion factors that are being used to calculate these emissions. It should also include other indirect or Scope 3 emissions. If the company is offsetting any of its emissions, these offsets should be reported separately.
- The key assumptions that underpin the company's analysis, e.g. on the level of supply or demand, on carbon policy, on carbon pricing, on emissions per unit of energy produced, etc.

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BIBLIOGRAPHY

[1] O. Krabbe *et al.*, "Aligning corporate greenhouse-gas emissions targets with climate goals," *Nat. Clim. Chang.*, vol. 5, pp. 1057–1060, 2015.

[2] J. Randers, "Greenhouse gas emissions per unit of value added ('GEVA'): a corporate guide to voluntary climate action," *Energy Policy*, vol. 48, pp. 46–55, 2012.

[3] UNFCCC, "Paris Agreement," 2015.

[4] United Nations, "Adoption of the Paris Agreement," 2015.

[5] UNEP, "The Emissions Gap Report 2015: A UNEP Synthesis Report," Nairobi, 2015.

[6] R. Boyd, J. Cranston Turner, and B. Ward, "Intended nationally determined contributions: what are the implications for greenhouse gas emissions in 2030?," London, 2015.

[7] International Energy Agency, *Energy Technology Perspectives 2016*. Paris: International Energy Agency, 2016.

[8] IPCC, "2006 IPCC Guidelines for National Greenhouse Gas Inventories," 2006.

[9] IEA, "Natural Gas Liquids Supply Outlook 2008-2015," Paris, 2010.

[10] Carbon Tracker Initiative and PRI, "2 Degrees of Separation: Transition Risk for Oil and Gas in a Low Carbon World," 2017.