Improving Oil and Gas Sector Climate Disclosures

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Abstract

Currently, disclosures of carbon dioxide and methane emissions by oil and gas companies are insufficient to make meaningful comparisons between companies, or to monitor companies’ progress toward commitments to reduce emissions across their supply chains. This information is material because these emissions are large, highly variable, and with proper incentives can be significantly reduced. Emissions from extracting oil and refining it into transportation fuels and other products used in the United States exceed emissions from using diesel fuel.

Extensive peer-reviewed literature on emissions from oil and gas production at a field and country level demonstrates that comparing emissions from different types of oil is feasible and illuminating. There is an important opportunity to match these assets and their associated emissions with companies on an equity and/or operational basis. We propose a new set of metrics that would allow meaningful quantitative analysis of oil and gas companies’ climate-related performance and plans.

Reducing emissions from the supply chains of fossil fuels is a necessary first step, but not ultimately sufficient to meet long-term climate goals. However, while many industries must cooperatively develop a low carbon transportation system, reducing oil and gas company supply chain emissions is firmly under the control of the companies themselves. By focusing on evaluating the various steps in oil extraction, processing, refining, and distribution, the metrics we propose can help motivate companies to chart a course consistent with keeping global temperature increase well below two degrees Celsius (2°C).
Existing Data and Models on Emissions from Oil and Gas Production

Recent peer reviewed analysis demonstrates that the emissions from oil and gas production are large; vary dramatically between different sources of oil and gas and different technology and practices for extraction, refining, and transport; and can be dramatically reduced at low cost.

Academic researchers, national labs, and regulators have analyzed the supply chain emissions of the oil and gas sector around the world. Supply chain emissions include those from oil and gas extraction, processing, refining, and distribution. Meaningful analysis of emissions from the oil and gas sector requires not just direct emissions data, but also life-cycle emissions models that incorporate emissions data from oil extraction and processing to provide a realistic picture of the sector’s emissions.

A recent comprehensive analysis of the global oil industry’s carbon intensity, measured in tons of carbon dioxide equivalent (CO$_2$e) emissions per barrel of oil, analyzed emissions from 8,966 oil fields in 90 countries that represent 98 percent of global crude oil production (Masnadi et al., 2018b). The authors estimate that at least 18 metric gigatons of CO$_2$e emissions could be saved over the next century through wise resource choices and improved gas management practices, which is more than 2% of the remaining carbon budget for a >66 percent chance to keep global average temperature increases below 2°C (Le Quéré et al., 2016).

That study used similar analytical tools and data sources as those used by policymakers including the California Low Carbon Fuel Standard, the European Union Fuel Quality Directive, and the Canadian Clean Fuel Standard. Two key open source models that are widely used are the Oil Production Greenhouse Gas Emissions Estimator (OPGEE)$^1$, which evaluates emissions from oil extraction, and the Petroleum Refinery Life Cycle Inventory Model (PRELIM)$^2$, which
evaluates emissions from oil refining. Publications from numerous research groups have used these and related models to evaluate the emissions associated with the oil used in specific jurisdictions, including the United States (Cooney et al., 2017), California (California Air Resources Board, 2018), and China (Masnadi et al., 2018a). The Oil-Climate Index from the Carnegie Endowment for International Peace has created a global perspective, combining OPGEE and PRELIM with the Oil Products Emissions Module (OPEM), which calculates emissions from the use of different petroleum products, to produce an Oil-Climate Index that compares full life cycle emissions by production stage for 75 types of oil, representing nearly 25 percent of global oil production (Gordon, Brandt, Bergerson, & Koomey, 2015). Total emissions per barrel of oil range from 458 kg of CO$_2$e to 736 kg of CO$_2$e. However, the variation in the full lifecycle masks even larger variability in the emissions under the direct control of companies that extract and refine oil.

Emissions from oil extraction and processing vary by almost a factor of 10, ranging from 21 to 206 kg of CO$_2$e per barrel. Among the sources of oil with the highest extraction and processing emissions are tar sands oils from Canada, heavy crudes from California extracted with extensive use of steam, and oils from Texas and Nigeria that involve extensive venting and flaring of natural gas. Extraction and surface processing emissions are determined both by the properties of the resource and the method used to extract and process it, so oil companies can reduce extraction emissions by prioritizing resources that are inherently less carbon intensive to extract or by adopting extraction and processing techniques that minimize emissions, or both.

Likewise, emissions from refining vary by almost a factor of 10, with emissions per barrel ranging from 10 to 99 kg of CO$_2$e per barrel. Oils with the highest refinery emissions involve extensive use of heat and hydrogen to remove impurities and break down larger
hydrocarbon molecules into molecules suitable for use as transportation fuel and other petroleum products. Oil refiners can reduce emissions by either prioritizing sources of oil that are less carbon intensive to refine, or by adopting refining techniques that minimize emissions, or both.

While the Oil-Climate Index and related models focused initially on liquid petroleum-based fuels, the models are being expanded to provide more detailed treatment of the natural gas lifecycle as well. Natural gas extraction, collection, distribution, and use has similarities and overlaps with oil extraction and refining, but also unique features, including a larger share of emissions associated with leaks in collection and distribution than does oil. Increasingly, the same global companies are participating in both oil and gas markets, so it is important to take a comprehensive view of both types fossil fuels to assess companies’ emissions performance. However, while interconnected and overlapping, oil and gas serve different markets. Oil refined into petroleum serves primarily the transportation fuel market, while natural gas serves primarily as a source of heat and power in stationary applications. Thus, it is important to distinguish between the oil and gas supply chains within a comprehensive assessment.

Emissions from the extraction and transportation of natural gas have also been subject to considerable scrutiny in the peer-reviewed literature, which has revealed that methane emissions from the natural gas supply chain are quite large and can be cost effectively mitigated. Such emissions have been subject to regulations at the federal level in the United States, Canada, Mexico, and elsewhere, as well as in the US states of California, Colorado, Ohio, and Pennsylvania, although some US federal regulations are being stopped or reversed by the current administration.

The models used to estimate emissions from oil and gas extraction, refining, distribution, and use are also being used and expanded upon to evaluate technologies that could reduce those
emissions, such as using solar energy to provide heat and power used in oil extraction with solar steam (Wang, O’Donnell, & Brandt, 2017) and utilizing and sequestering captured anthropogenic carbon dioxide during the oil extraction process (Kolster, Masnadi, Krevor, Mac Dowell, & Brandt, 2017).

Emissions from extraction, surface processing, refining, and distribution of oil and gas are smaller than emissions from the use of petroleum-based transportation fuels and natural gas. Even if operational efficiencies in the oil and gas sector brought these emissions to zero, they would not be sufficient to bring sector-wide emissions from company operations and from the use of oil and gas products to net zero by mid-century, consistent with the Paris climate agreement’s goal of keeping global temperature increase well below 2°C. Thus, mitigation of these emissions is no substitute for a transition away from fossil fuels. However, the aggregated emissions from oil and gas extraction are very large. For example, more than 700 million metric tons of CO₂e were associated with extracting and refining the oil used to produce petroleum products used in the United States in 2014, which exceeded the carbon emissions associated with using diesel fuel that year and was more than triple the emissions from using jet fuel.
Figure 1: Emissions from the extraction, surface processing, and refining of petroleum products used in the United States (in CO₂e units which include methane) compared to the carbon dioxide emissions associated with their combustion (non-CO₂ emissions are a minor source here).

Sources: Cooney et al., 2017; Energy Information Administration, 2017.

Many of the mitigation opportunities in the oil and gas sector are available at very low cost. Some of the most carbon-intensive oils and refining processes are highly energy intensive and not as profitable as many lower-emission sources of oil. Emissions from venting and flaring often represent a lost economic opportunity to capture and use natural gas produced in oil extraction.
Assigning Lifecycle Emissions to Companies is an Opportunity for Accountability

Despite clear evidence that emissions from the extraction, surface processing, refining, and distribution of oil and gas are large, subject to cost-effective mitigation, and can be calculated based on available data, it is perhaps surprising that it is nearly impossible to accurately associate these emissions with the large oil and gas companies responsible for them. The reason this assignment is challenging is not simply that companies are not making information public, although disclosure is certainly incomplete. Rather, the structure of the available information prevents meaningful accountability.

Existing standards for corporate emissions disclosure from the Greenhouse Gas Protocol are organized either by company, value chain or product. Company emissions disclosure often follows the Corporate Standard or the Corporate Value Chain (Scope 3) Standard (World Resources Institute & World Business Council for Sustainable Development [WRI & WBCSD], 2004; WRI & WBCSD, 2011a). Although these standards provide insight into a company’s emissions, Corporate or Corporate Value Chain Standards are not the best way to compare companies’ emissions performance, given the widely varying structure and activities of different oil and gas companies. Instead, carbon intensity metrics are needed. A product-level lifecycle is one such approach, which isolates “the emissions associated with the production and use of a specific product, from cradle to grave, including emissions from raw materials, manufacture, transport, storage, sale, use, and disposal” (WRI & WBCSD, 2011b). For an oil company this could be the lifecycle emissions of gasoline or diesel fuel. It could also be conceived more broadly, such as emissions per unit of energy in all the energy products a company sells, including gasoline, diesel, jet fuel, and perhaps even natural gas. However, aggregating the full lifecycle emissions can mask significant differences in performance and opportunities for
emissions reductions. For example, a recently published global assessment of field-level upstream carbon intensity of oil production concluded that 18 metric gigatons of emissions could be mitigated over a century through “wise resource choices and improved gas management practices” (Masnadi et al., 2018b). This would reduce average emissions from oil extraction by 30 percent, but since emissions from oil extraction constitute just 11 percent of the gasoline lifecycle, the full lifecycle would be reduced by just 3 percent (Cooney et al., 2017).

Appropriate scrutiny of oil and gas company emissions performance requires standardized carbon intensity metrics for each of the major links in the oil and gas supply chain. Masnadi et al. (2018b) provide an illustrative example of what one might expect to learn from such a metric. Measuring emissions intensity per units of energy in CO₂e per mega-joule (MJ), the authors describe a range from 3.3 g CO₂e/MJ to 29.8 g CO₂e/MJ — a variation by a factor of nine — between the highest- and lowest-emitting countries. The same information organized by company on an equity and/or operational basis would provide a valuable metric of how oil companies are aligning their investments with their stated carbon emissions reduction goals — and would give investors and others a way to differentiate between companies on the basis of carbon intensity.

**Oil and Gas Company Emissions Should Be Evaluated by Lifecycle Stage**

The Union of Concerned Scientists recently contracted with experts in oil and gas industry lifecycle analysis at KeyLogic to evaluate options for evaluating oil and gas companies’ emissions. Their analysis concluded that to facilitate meaningful comparisons, emissions should be evaluated separately at each lifecycle stage, as illustrated in the graphic below.
Figure 2. For the petroleum supply chain, crude extraction, refining and product use account for the largest share of production emissions, with transport of crude and finished products accounting for most of the rest. For natural gas, gas production, gathering and boosting, and end use are the largest sources, but methane leaks during transmission and distribution are also significant.

The oil and natural gas industries are closely linked both physically and economically. Oil and gas are sometimes extracted from the same wells, and the supply chains also intersect at oil refineries. Moreover, many of the largest oil companies also have substantial investments in natural gas. Thus, a consistent approach to the major stages of the oil and natural gas supply chains is needed to evaluate the emissions performance of major oil and gas companies.

By breaking emissions into links in the supply chain, an emissions factor can be obtained in relevant units, for example kg of CO$_2$e global warming pollution per barrel of oil or million
standard cubic feet of natural gas. The links for oil are: oil extraction, crude transport, oil refining, product transport, and end use. The links for natural gas are: gas extraction, gathering and boosting, gas processing, transmission and storage, distribution, and end use. Metrics based on these links would allow for comparison between companies based on their performance within each link. Each company would have not one overall carbon intensity metric but several, depending on which stages of production they are active in. This additional detail would in significant measure address the limitations of existing metrics discussed above, without adding a level of complexity that would render the results challenging to interpret by non-experts.

A single company-wide assessment could be compiled by weighting performance in each area by each company’s business structure and exposure in that lifecycle stage. After weighting, this score would not be a carbon intensity metric in emissions per unit of product. Instead, a normalization of each link against industry performance could be used to develop a rating, perhaps on a 5-point scale based on peer comparison. These ratings could then be aggregated to produce a company-wide assessment. Such a metric would also allow for tracking a company’s progress over time and for comparison with peer companies to establish which companies are leading, and which are falling behind. This would allow for a single score facilitating industry-wide comparisons even of firms with dissimilar portfolios. But the results could also be unpacked by examining the lifecycle stages that contributed to that score, and ultimately to the specific factors contributing to their performance, which could motivate pressure for performance improvements. Scores and rankings based on comparable data could thus spur competition and innovation in the oil and gas sector.
Possible Models for Standardizing Meaningful Disclosure

The ideal metric would be transparent, quantifiable, reproducible, comparable, and easy to use. A standardized framework to interpret emissions can be built upon the foundation of models like OPGEE for oil extraction and PRELIM for refineries. These models are open source and are housed in universities.

However, a neutral trusted third party is needed as a clearing house for the relevant disclosed information. Existing disclosure standard-setters such as CDP, the Climate Disclosure Standards Board (CDSB), the Global Reporting Initiative (GRI), and the Sustainability Accounting Standards Board (SASB) are an obvious starting point, since they have established frameworks developed through broad consultations with reporters and users of Environmental, Social, and Governance (ESG) data. Building the metric onto an existing framework would also limit the burden on those within the companies who compile ESG information and prepare ESG reports, pre-empting potential complaints of questionnaire fatigue.

As emissions disclosure is increasingly used to evaluate the financial prospects of oil and gas companies, it will be important that the information can be certified as accurate. To ensure this, the standards for disclosure and the models used to compile data should be integrated into and linked with financial disclosures and could be endorsed or adopted by either financial regulators, or industry standard-setting bodies. For example, the Climate Risk Disclosure Act introduced in September 2018 by US Senator Elizabeth Warren and seven co-sponsors would require the Securities and Exchange Commission (SEC) to issue rules that would include reporting standards for estimating direct and indirect greenhouse gas emissions by publicly listed fossil fuel companies. The proposed metrics would inform such reporting standards.
Implications for the Future

In response to shareholder resolutions and other pressures, oil and gas companies have been publishing plans and making commitments to reduce emissions in line with the Paris climate agreement, but under present disclosure regimes, these commitments are not verifiable, trackable or comparable between companies.

Reducing methane emissions is one of the key short-term emissions reduction opportunities in the oil and gas industry, and many oil and gas companies are involved in voluntary initiatives to reduce fugitive methane emissions, such as EPA Natural Gas Star, Oil and Gas Climate Initiative, Oil and Gas Methane Partnership, ONE Future, and The Environmental Partnership spearheaded by the American Petroleum Institute. The level of ambition and disclosure varies dramatically between these different initiatives, and while the increased disclosure means it is possible to gain insight into specific efforts of some individual companies, it is not possible to compare the performance of different companies to one another across the whole industry. Moreover, it is difficult to assess how significant a company’s methane emissions reduction commitments are to its entire emissions portfolio.

Over the long term, it is important to understand the scale of investment and progress of companies’ stated commitments to low-carbon strategies such as carbon capture and sequestration, hydrogen vehicle refueling, or algae biofuels. Only with quantifiable benchmarks for scale-up and a description of how these strategies will affect companies’ overall product carbon intensity will it be possible to assess whether their commitments or plans for a world in which global warming is held well below 2°C are realistic, to compare them against competitors, and to track their progress against these commitments over time.
**Information Would Be Useful to Many Different Stakeholders**

A metric by lifecycle stage would have multiple potential uses and multiple potential audiences. The business and investment communities are increasingly demanding that fossil fuel companies report their plans for a world in which global warming is held well below 2°C. In 2017, the Task Force on Climate-Related Financial Disclosures (TCFD) recommended that companies across all sectors should disclose what a 2°C-or-lower scenario would mean for their businesses, strategies, and financial planning. Shareholder resolutions calling for such reports have passed by substantial margins at BP, ExxonMobil, Occidental Petroleum, and Royal Dutch Shell. With major fossil fuel companies now issuing so-called “2°C reports”, investors need tools and data to assess companies’ plans for consistency with the Paris climate agreement, compare them, and monitor individual companies’ progress in implementing them.

The TCFD recommendations focus on financial risks to companies from climate change, rather than the risks that these companies’ operations and products pose to our climate. As such, TCFD-compliant disclosures by oil and gas companies should address portfolio resilience to policies designed to meet the Paris climate agreement goals — including exposure to carbon pricing and companies’ competitive position within the sector. Preliminary analysis of oil and gas company reports published in the first year since the TCFD issued its recommendations suggests that developing standardized methodologies and a common level of disclosure would be valuable. Coherence of disclosures could be improved if companies connected their performance, targets, and ambitions with the level of decarbonization required to keep global temperature increase well below 2°C (World Business Council for Sustainable Development, 2018).
The ideal metric would encompass both granular data and simple scores of major oil and
gas producers by lifecycle stage and across a company’s operations. Data should be routinely
updated in order to revise scores and maintain competitive pressure on industry players over the
long run. Investors that apply ESG standards could use granular data in their engagements with
corporate leaders and refer to scores to weight their investments towards better-performing
companies in the industry. Non-governmental organizations (NGOs) and academic researchers
could use the data to evaluate and publish accessible summaries of company and industry
performance and exert pressure for progress. Evaluations and scores could inform and empower
consumers who factor company performance on ESG metrics into their purchasing decisions.
Companies seeking to demonstrate leadership on climate change could use their disclosures,
verified by a neutral trusted third party and scored by independent NGOs or academic analysts,
to validate claims they may make about their progress and relative standing in the industry.

Policymakers could use the information to assess whether existing or proposed climate
policies are appropriately targeted to change company incentives. For example, the metric would
help highlight how much company carbon intensity could be reduced through methane emissions
reductions, carbon capture and sequestration in oil extraction or refineries, or integration of
renewable energy sources into the liquid fuel supply chain. Regulations on the oil and gas
industry, fuel standards policy, or tax policy could be refined or adopted to ensure that US fossil
fuel producers have an incentive to lead. US leadership in low emissions technology would
reduce US emissions directly and ensure that US producers have a competitive advantage in a
global industry that will inevitably be operating under increasingly severe climate policy
constraints.
How to Get from Here to There

In order to ensure that emissions comparisons are comprehensive, it is essential to represent the entire fossil fuel supply lifecycle. Engineering-based models like OPGEE and PRELIM are distinct from emissions inventories in using data like well depth, bore diameter, or distance to market to compute approximate emissions. In the absence of complete disclosure, information like this ensures a consistent comparison, and sensitivity studies suggest the estimates are reasonable. However, over time engineering estimates should be supplemented and ultimately replaced with reported data, provided the reporting is trustworthy, comprehensive, and comparable. As emissions profiles become key performance indicators, companies should be held accountable to report this information, attest to its accuracy, and submit to validation by periodic audits. The metric should be designed to avoid unintended consequences, such as creating perverse incentives for companies to hide behind convoluted corporate structures, spinoffs, and joint ventures, and/or to move assets into entities that are completely opaque.

Conclusion

As the world transitions away from fossil fuels to prevent the worst effects of climate change, the carbon intensity of the fossil fuels we continue to use matters. Reductions in heat-trapping emissions from extraction, surface processing, refining, and use of oil and gas resources are necessary but not sufficient to achieve the goals of the Paris climate agreement. Improved and standardized disclosures of these emissions are necessary but not sufficient to facilitate the necessary reductions in emissions. Voluntary disclosures and/or estimates should become the basis for mandatory disclosures enacted through public policy, as a key component of implementing the Paris climate agreement commitments at the national and subnational level.
References


Endnotes

1 The OPGEE model, documentation and associated publications are available at

https://eao.stanford.edu/research-areas/opgee

2 The PRELIM model, documentation and associated publications are available at

https://www.ucalgary.ca/lcaost/prelim

3 The Oil-Climate Index data and associated documentation are available at

http://oci.carnegieendowment.org