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Katie Panella
George Serafeim
Katie Trinh

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Impact-Weighted Accounts Project Research Report

Abstract

We apply the product impact measurement framework of the Impact-Weighted Accounts Initiative (IWAI) in two competitor companies within the oil and gas industry. We design a monetization methodology that allows us to calculate monetary product impact estimates of natural gas provision to emerging markets, energy provided, and emissions created. Our results indicate differences in the impact that competitors have through their products. These differences demonstrate how impact reflects corporate strategy and informs decision-making on industry-specific areas.

*George Serafeim is the Charles M. Williams Professor of Business Administration at Harvard Business School and the faculty lead of the Impact Weighted Accounts Project. Katie Panella and Katie Trinh are research associates at the Impact-Weighted Accounts Project at Harvard Business School. The Impact-Weighted Accounts Initiative is a joint initiative between the Global Steering Group for Impact Investment and the Impact Management Project incubated as a project at Harvard Business School. We are grateful to the Division of Faculty Research and Development of the Harvard Business School for financial support. We thank Natalie Uhr for her invaluable contributions to the construction of the oil and gas product impact dataset. George Serafeim is a co-founder and has an equity stake in Richmond Global Sciences, a technology firm providing software solutions on product impact. Contact email: ktrinh@hbs.edu

1. Introduction

Although significant progress has been made in the environmental and social metrics disclosed by companies and prescribed by reporting standards, these mostly pertain to a company's operations and are still not embedded in financial statements. In contrast to employment or environmental impacts from operations, product impacts, which refer to the impacts that occur from usage of a product once a company has transferred control of the good or service, tend to be highly idiosyncratic limiting the ability to generalize and scale such measurements. As such, for companies that do measure product impact, impact evaluation is highly specific, limiting comparability and scalability. Moreover, the number of companies that have managed to measure product impact in monetary terms is even more limited.

We have put forth a framework in which product impacts can be measured and monetized in a systematic and repeatable methodology across industries and have provided a sample application to the automobile manufacturing industry to address these issues.[1] Within any industry, the framework can be applied using a set of standard principles, industry assumptions and public data to estimate product impacts across the following seven dimensions.

FIGURE 1

Product Impact Framework Dimensions

Reach		Dimensions of Customer Usage			Env Use	End-of-life
Quantity	Duration	Access	Quality	Optionality	Pollutants & efficiency	Recyclability
The magnitude of individuals reached	Length of time the product can be used, particularly for durables	Accessibility of product through pricing and efforts to provide for the underserved	Quality of product through health, safety, effectiveness, and inherent need or goodness	Ability to choose an alternative product with full information and free will	All pollutants and efficiencies enabled through customer usage	Projected product volume recycled at end of product life

[1] George Serafeim and Katie Trinh. "A Framework for Product Impact-Weighted Accounts", Harvard Business School. Accessed July 6, 2020.

In this paper we apply the framework to two competitor companies in the oil and gas industry. We then discuss potential data points and data sources for monetization and detail the decisions behind our assumptions. Finally, we provide examples of insights specific to the oil and gas industry that can be derived from impact-weighted financial accounts and their analysis. The application of the product impact framework to this industry demonstrates feasibility and actionability, while also providing an example of the nuances and decision-making used when applying the framework to other similar industries. The impacts derived demonstrate the potential for product impact measurement to inform strategic decision-making. These results are a first step, rather than a definitive answer, towards more systematic measurement of product impact in monetary terms that can then be reflected in financial statements with the purpose of creating impact-weighed financial accounts.

2. Application of the product impact framework

We apply the product impact framework of the Impact-Weighted Accounts Initiative within the oil and gas industry to ensure the framework is feasible, scalable, and comparable. Through a deep-dive of two competitor companies, we provide a cohesive example that examines the impacts of oil and gas companies on consumers across the seven product impact dimensions of the framework to uncover nuances of the framework application in estimating monetary values. The companies will be referred to as Companies A and B given the purpose of this exercise is to examine feasibility and not to assess the performance of individual companies. We do note that the data is from two of the largest oil and gas firms globally.

2.1 Data collection process

This application is based on publicly available data from company disclosures and industry-wide assumptions informed by regulatory bodies and established research firms. These examples reference user effects as identified in academic literature and make use of existing data and metrics with the goal of incorporating publicly available data.

Self-disclosed company data points reflect information found in the company's disclosures from 2018 such as the Form 10-K or annual sustainability reports, which often disclose Sustainability Accounting Standards Board (SASB) and Global Reporting Initiative (GRI) metrics. Industry-wide assumptions on energy conversions, energy consumption, power outage costs, and

emissions from oil and gas come from various economic, academic, industry and government studies. Given the methodology determines monetary impacts, the industry wide assumptions inevitably rely on some market-determined price and valuations.

3. Oil and gas application of the product impact framework

3.1 Overall impacts estimated

TABLE 1

Product Impacts of Company A and B

							Dimensions of Customer Usage								
						Reach	Access		Quality			Optionality	Env Use	End of Life	
Company	Revenue	Relevant Impact Revenue	Positive Product Impact	Negative Product Impact		Quantity	Affordability	Underserved	Health & Safety	Effectiveness	Need	Monopoly	Emissions	Recyclability	
A	$290bn	$279bn	$24bn	-$128bn	Motor gasoline (barrels)	809m									
					Other petroleum (barrels)	1,203m	-	$1,393m	-	-	$22,124m	-	-$128,407m	-	
					Natural gas (mcf)	4,027m									
B	$388bn	$340bn	$32bn	-$152bn	Motor gasoline (barrels)	797m									
					Other petroleum (barrels)	1,679m	-	$5,689m	-	-	$25,830m	-	-$152,084m	-	
					Natural gas (mcf)	3,944m									

Table 1 summarizes the monetary product impact estimates of two oil and gas companies as estimated by oil and gas sales. The underserved dimension examines the impact of electricity enabled by gas provision to emerging markets. The health and safety dimension examines the impact of fuel recalls. The need dimension examines the impact of energy enabled by oil and gas provision. Within environmental usage, we examine the emissions created from use of oil and gas sold. The following sections dive into the details, assumptions, and decisions behind these estimated impacts.

3.2 Reach

3.2.A Volume sold by oil and gas companies

TABLE 2

Oil and Gas Sales Volume of Company A and B

Data			
		A	B
10K	Motor gasoline sold (barrels annually)	809,205,000	797,160,000
10K	Other petroleum sold (barrels annually)	1,202,675,000	1,678,635,000
10K	Natural gas sold (mcf annually)	4,026,680,000	3,944,051,000

The goal of the reach dimension is to identify the number of individuals served by the company. For oil and gas companies, consumption is nearly impossible to measure in real-time given the large number of end-users.[2] Thus, for oil and gas companies, we examine sales volume as reported in financial disclosure data as an indirect estimate for individuals reached. Company A and B both report petroleum product sales in thousands of barrels daily. Since both companies report gasoline sales within their petroleum product categories, we examine gasoline separately from other petroleum sales. For other petroleum sales, we sum sales from all categories aside from gasoline. For natural gas sales, Company A reports natural gas sales in millions of cubic feet per day. Since Company B does not report natural gas sales, we refer to Company B's volume of natural gas available for sale. Lastly, we multiply these figures by 365 to convert daily sales to an estimate of annual sales volume.

We note that while oil and gas companies have other products outside of petroleum and natural gas, we limit this example to the product impact of downstream petroleum and natural gas product lines. We choose to exclude other product lines, such as petrochemicals and other energy sources since the downstream petroleum and natural gas product lines make up over 85% of Company A and B's revenue. A company with significant revenue from other energy sources can estimate their own product impact and reach as described in this paper. For petrochemicals, a company could estimate the product impact of specific petrochemicals by applying the general product framework to the relevant or predominant petrochemical.

[2] John Kemp. "Is U.S. gasoline consumption overstated and if so by how much?" *Reuters.* Published April 2016. Accessed May 2021 at <https://www.reuters.com/article/us-usa-gasoline-kemp-idUSKCN0X827N>.

3.3 Access – Affordability

3.3.A Oil and gas affordability

The goal of the affordability dimension is to identify the positive impact of more affordable product or service provision. Unlike other industries in which firms exhibit price control and price differentiation is observed, oil and gas companies provide a commodity and price is effectively determined by four industry inputs: cost of crude oil, refining costs, distribution costs, and taxes.[3] Thus, as with the application of the IWAI product impact framework to water utilities[4], firms within the oil and gas industry do not have an affordability impact.

3.4 Access – Underserved

TABLE 3

Underserved Impact of Company A and B

Data				Estimation		
Company datapoints		**A**	**B**		**A**	**B**
10-K	% natural gas sales by market			% natural gas sales in Africa	0.12%	10.45%
	Africa	0.12%	10.45%		x	
	Asia	28.83%	31.55%	% natural gas for electric power	80.50%	
	South America	0.00%	6.01%		x	
				Natural gas sold (mcf annually)	4,027m	3,944m
					=	
				Natural gas for electric in Africa	3.8m	331.9m
Industry assumptions					x	
IGT	% natural gas for electric power			kWh in mcf of natural gas	303.55	
	Africa	80.50%			=	
	Asia	38.50%		kWh enabled in Africa	1,159m	100,745m
	South America	47.50%			÷	
EIA	kWh in mcf of natural gas	303.55		Annual per capita kWh consumed	485.72	
	Annual per capita kWh consumed				=	
World Bank	Africa	486		Individuals reached in Africa	2.4m	207.4m
	Asia	1,877			x	
	South America	1,695		Averted outage loss	$18.65	
	Per capita loss from outage	$18.65			x	
				Underserved impact in Africa	**$45m**	**$3,868m**
				Overall underserved impact	**$1,393m**	**$5,689m**

[3] "Gasoline explained: Factors affecting gasoline prices". *US Energy Information Administration.* Updated March 2021. Accessed May 2021 at < https://www.eia.gov/energyexplained/gasoline/factors-affecting-gasoline-prices.php>.
[4] George Serafeim and Katie Trinh. "Accounting for Product Impact in the Water Utilities Industry", Harvard Business School. Accessed May 2021.

3.4.A Sales to the underserved

The goal of the underserved dimension is to identify the impact associated with provision of products or services to underserved customers. For a product or service to enable underserved access, two criteria need to be met as outlined in the initial framework and discussed in subsequent applications to pharmaceuticals[5], airlines[6], and others. First, the product or service must be accessed by an underserved population. Second, the product or service must enable sustainable development, as outlined by the UN Sustainable Development Goals (UN SDG).

Thus, we estimate the underserved impact in the oil and gas space by examining natural gas sales used for electricity in emerging markets. Per the first criteria, we examine sales to emerging markets as a proxy for estimating access to an underserved population. Per the second criteria, we determine that natural gas sales used for electricity meets SDG 7 which focuses on ensuring access to affordable, reliable, sustainable, and modern energy for all.[7] We note that natural gas sales for other purposes and petroleum sales do not meet the criteria outlined in the indicators of SDG 7 which include access to electricity and reliance on clean fuels. While petroleum (specifically kerosene) is used in many households as the primary cooking fuel, we do not examine petroleum sales for cooking in the underserved dimension given the identified adverse health effects from pollution associated with household kerosene combustion.[8]

3.4.B Natural gas sales data

To identify emerging market natural gas sales, we use company self-reported data on the percent of natural gas sales by region. Given public data availability, we include all sales within the following markets: Africa, Asia, and South America. A company estimating their own underserved impact could identify relevant markets for inclusion with more granularity.

For industry-wide assumptions, we refer to the Institute of Gas Technology and World Bank estimates on the percent of natural gas used for electric power in these geographies and the

[5] Amanda Rischbieth, George Serafeim and Katie Trinh. "Accounting for Product Impact in the Pharmaceuticals Industry", Harvard Business School. Accessed May 2021.
[6] George Serafeim and Katie Trinh. "Accounting for Product Impact in the Airlines Industry", Harvard Business School. Accessed April 2021.
[7] "Sustainable Development Goals 7". *United Nations Department of Economic and Social Affairs.* Accessed May 2021 at <https://sdgs.un.org/goals/goal7>.
[8] Michael N Bates and Nigel Bruce. "WHO Indoor Air Quality Guidelines: Household Fuel Combustion. *World Health Organization.* Published 2012. Accessed May 2021.

per capita electric consumption in these geographies.[9] [10] We refer to the US Energy Information Administration for conversion rate for natural gas to energy in kilowatt-hours.[11]

We estimate per capita averted loss associated with lack of power in emerging markets from World Bank data on the average annual output loss from power shortages for representative emerging markets[12] divided by the relevant population.

3.4.C The impact estimate

We multiply Company A and B's total natural gas sales by the percent of natural gas sales in the relevant emerging market geography and the percent of natural gas sales used for electric power in the same geography to estimate Company A and B's emerging market natural gas sales for electricity. We then multiply the emerging market natural gas sales for electricity by the conversion rate for kilowatt-hours and divide by the average per capita energy consumed within that geography to estimate the number of individuals reached within that geography. We multiply the number of individuals reached by the per capita estimated averted loss associated with lack of power to estimate the underserved impact within the relevant emerging market geography. Table 3 provides an example of this calculation for Company A and B's sales in Africa. We repeat this calculation for the other emerging markets in which Company A and B sell natural gas to estimate the overall underserved impact.

3.5 Quality – Health and Safety

3.5.A Oil and gas health and safety

The health and safety dimension aims to capture instances where a customer's health, safety, or privacy has been breached. We note that this dimension examines unexpected health and safety issues outside of expected product performance. For an oil and gas company, this dimension is where we examine oil and gas recalls due to faulty fuel. Both Company A and B did not have any oil and gas recalls or faulty fuel related issues in 2018. Thus, both Company A and B do not have a health and safety impact for this year.

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[9] Donald L. Klass, Riaz A. Khan and Salahuddin Khwaja. "The Domestic Natural Gas Industry in Developing Countries". Published May 1992. Accessed May 2021.
[10] The World Bank Data. "Electric power consumption (kWh per capita)". *IEA Statistics © OECD/IEA.* Accessed May 2021.
[11] "What are Ccf, Mcf, Btu, and therms? How do I convert natural gas prices in dollars per Ccf or Mcf to dollars per Btu or therm?" *US Energy Information Administration.* Updated June 2020. Accessed May 2021 at < https://www.eia.gov/tools/faqs/faq.php?id=45&t=8>.
[12] Fan Zhang. "In the Dark". *World Bank Group.* Published 2019. Accessed May 2021.

3.5.B Impact estimate methodology

To demonstrate how a company could estimate their own health and safety impact if they did have a recall or issues with faulty fuel, we include an example for another firm that experienced a gasoline recall in 2012 in Table 4. We divide the gasoline recall volume by the assumed fuel tank capacity to estimate the number of fuel tanks affected by the gasoline recall. We then multiply this figure by the cost associated with cleaning a fuel tank system to estimate the total health and safety impact.

TABLE 4

Health and Safety Impact Example

Data			Estimation	
Company datapoints		**Sample**		**Sample**
10-K	Gasoline recall volume	2,100,000	Gasoline recall volume	2,100,000
				÷
Industry assumptions			Gallons in a full fuel tank	14.00
Estimated	Gallons in a full tank	14.00		=
Chi. Tribune	Fuel tank system cleaning cost	$1,200	Individual fuel tanks affected by recall	150,000
				x
			Fuel tank system cleaning cost	$1,200
				=
			Health and safety impact	**-$180m**

3.6 Quality – Effectiveness

3.6.A Oil and gas effectiveness

In the effectiveness dimension, we aim to capture whether the product or service is effective at meeting customer expectations. In industries where efficacy can be directly measured, including airlines and pharmaceuticals, we estimate the effectiveness impact by examining differences in performance. In industries where efficacy cannot be directly measured, including autos[13] and consumer finance[14], we have estimated the effectiveness impact by examining differences in customer satisfaction.

For the oil and gas industry, we do not estimate an effectiveness impact for Company A and B given the lack of differentiation in a commodity product. While oil and gas companies qualitatively discuss performance differences driven by octane level, additives present, and efficiency, their financial disclosures provide aggregate figures without granularity by octane

[13] George Serafeim and Katie Trinh. "A Framework for Product Impact-Weighted Accounts", Harvard Business School. Accessed April 2021.
[14] George Serafeim and Katie Trinh. "Accounting for Product Impact in the Consumer Finance Industry", Harvard Business School. Accessed April 2021.

level, additives, or efficiency. Thus, current reporting not only suggests a lack of differentiation in performance, but also prevents any measurement of differences in performance where they to exist. The oil and gas industry also does not exhibit differences in customer satisfaction, as the American Customer Satisfaction Index aggregates customer satisfaction at the industry level rather than providing firm level estimates.[15]

While we do not currently estimate an effectiveness impact for oil and gas firms, we note that as performance differences in oil and gas are realized through research, development and innovation, an effectiveness impact for oil and gas firms may be estimated, either as enabled by public data availability or by companies estimating their own effectiveness impact.

3.7 Quality – Basic Need

TABLE 5

Basic Need Impact of Company A and B

Data			Estimation		
Industry assumptions				**A**	**B**
EIA	Energy in 1 mcf natural gas (MMBtu)	1.04	(Natural gas sold (mcf)	4,027m	3,944m
	Energy in 1 barrel gasoline (MMBtu)	5.22		x	
	Energy in 1 barrel kerosene (MMBtu)	5.67	Energy in 1 mcf natural gas)	1.04	
	Global annual per capita MMBtu use	68.80		=	
Energy & Econ	Global per capita power outage cost	$100.00	*Energy from natural gas sold*	*4,176m*	*4,090m*
				+	
			(Gasoline sold (barrels)	809m	797m
				x	
			Energy in 1 barrel gasoline)	5.22	
				=	
			Energy from gasoline sold	*4,226m*	*4,163m*
				+	
			(Other petroleum sold (barrels)	1,203m	1,679m
				x	
			Energy in 1 barrel other petroleum)	5.67	
				=	
			Energy from other petroleum sold	*6,819m*	*9,518m*
				=	
			Total energy supplied (MMBtu)	15,221m	17,771m
				÷	
			Global per capita MMBtu use	68.80	
				=	
			Individuals reached by energy supply	221m	258m
				x	
			Averted outage cost	$100.00	
				=	
			Basic need impact	**$22,124m**	**$25,830m**

[15] "Benchmarks by Company Gasoline Stations". *American Customer Satisfaction Index.* Updated 2020. Accessed May 2021 at <https://www.theacsi.org/industries/retail/gas-station>.

3.7.A Basic needs met by oil and gas

The basic need dimension examines whether the product or service provides some basic need to the population. In the case of oil and gas, provision of oil and natural gas meets a basic need as oil and gas is fundamental for both societal industry and production, and household energy, heating, and transportation. Examining the elasticity of oil and gas demand cements this designation, given, historically, changes in oil and gas price have little influence over oil and gas demand.[16]

3.7.B Data on oil and gas energy produced and used

For oil and gas sales volumes, we refer to Company A and B's financial disclosures as discussed in Section 3.2. For industry-wide assumptions on the amount of energy[17] in natural gas, gasoline, and other petroleum (kerosene), and average per capita global energy use[18] we refer to the US Energy Information Administration. To estimate the global per capita cost associated with lack of power, we multiply the global GDP by the associated cost of lack of power[19] and divide by the global population.

3.7.C The impact estimate

We calculate the total energy supplied by Company A and B by multiplying the volume of natural gas, gasoline, and other petroleum sold by the associated conversion rate to energy in MMBtu and taking the sum. We then divide the total energy enabled by Company A and B by the average annual per capita energy consumption to estimate the number of individuals to which Company A and B provided energy. We multiply the number of individuals that Company A and B provided energy to by the averted global per capita cost associated with lack of power to estimate Company A and B's basic need impact.

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[16] Michael Morris. "Gasoline prices tend to have little effect on demand for car travel". *Today in Energy, US Energy Information Administration.* Published December 2014. Accessed May 2021.
[17] "What are Ccf, Mcf, Btu, and therms? How do I convert natural gas prices in dollars per Ccf or Mcf to dollars per Btu or therm?" *US Energy Information Administration.* Updated June 2020. Accessed May 2021 at < https://www.eia.gov/tools/faqs/faq.php?id=45&t=8>.
[18] Ari Kahan. "EIA projects nearly 50% increase in world energy usage by 2050, led by growth in Asia". *Today in Energy, US Energy Information Administration.* Published September 2019. Accessed May 2021.
[19] *Global Energy Assessment – Toward a Sustainable Future,* Cambridge University Press, Cambridge, UK. Published 2012. Accessed May 2021 at International Institute for Applied Systems Analysis.

3.8 Optionality

3.8.A Optionality in oil and gas

The optionality dimension aims to capture the impact from consumers lacking freedom of choice when making a purchase, which we determine by examining whether the industry is monopolistic, whether the product or service is addictive, and whether there have been any information failures. We do not estimate an optionality impact for oil and gas companies since the industry is not monopolistic, the product is not addictive per medical guidance[20], and no information failures were identified for the consumer.

3.9 Environmental Usage

TABLE 6

Environmental Usage Impact of Company A and B

Data			Estimation		
Industry assumptions				**A**	**B**
	CO2 emitted per MCF of natural gas (tons)	0.06	(Natural gas sold (mcf)	4,027m	3,944m
EIA	CO2 emitted per barrel of gasoline (tons)	0.41		x	
	CO2 emitted per barrel of kerosene (tons)	0.46	CO2 per mcf natural gas)	0.06	
IWAI	Cost per ton of carbon	$114		+	
			(Gasoline sold (barrels)	809m	797m
				x	
			CO2 per barrel gasoline)	0.41	
				+	
			(Other petroleum sold (barrels)	1,203m	1,679m
				x	
			CO2 per barrel kerosene)	0.46	
				=	
			Total CO2 emitted (tons)	1,126m	1,334m
				x	
			Cost per ton of carbon	$114	
				=	
			Environmental usage impact	**-$128,407m**	**-$152,084m**

3.9.A Environmental usage in oil and gas

The environmental usage dimension aims to capture any environmental emissions, pollutants, or efficiencies produced from use of the service or product. For the oil and gas industry, we estimate the impact from the emissions generated from using natural gas, gasoline, and other petroleum sold.

[20] Per the American Society of Addiction Medicine, "Addiction is a treatable, chronic medical disease involving complex interactions among brain circuits, genetics, the environment, and an individual's life experiences. People with addiction use substances or engage in behaviors that become compulsive and often continue despite harmful consequences. Prevention efforts and treatment approaches for addiction are generally as successful as those for other chronic diseases."

3.9.B Environmental usage data

We identify the volume of natural gas, gasoline, and petroleum sold from company financial disclosures as discussed in section 3.2. We refer to the US Energy Information Administration for estimates on the amount of CO2 emitted per unit of natural gas, gasoline, and other petroleum.[21] The cost associated with a metric ton of carbon is estimated in the environmental framework of the Impact-Weighted Accounts.[22]

3.9.C The impact estimate

We estimate the emissions generated from product use by multiplying the volume of natural gas, gasoline, and other petroleum sold by the average volume of CO2 emissions per unit. We then multiply the sum of emissions from usage by the cost of emissions to estimate the environmental usage impact.

3.10 End-of-life Recyclability Impact

The end-of-life dimension aims to measure the averted and created emissions from the end-of-life treatment of the product, as well as the associated volume of product associated with the end-of-life treatment. For the petroleum and natural gas product lines of oil and gas firms, the physical waste from use of the product are emissions and are captured in the environmental usage dimension. We thus do not estimate an end-of-life impact for these firms. This dimension would be especially important when estimating the product impact of petrochemicals.

4. Discussion

This application of the product framework to oil and gas not only indicates feasibility of estimating monetary product impacts within this industry, but also demonstrates the potential value of impact-weighted financial statement analysis.

The product impact dimensions reflect the nature of the oil and gas industry and the potential for significant positive product impact. Oil and gas firms do not have affordability and effectiveness impacts given the product is a commodity. There are also no optionality and end-of-

[21] "How much carbon dioxide is produced when different fuels are burned?" *US Energy Information Administration.* Updated June 2020. Accessed May 2021 at < https://www.eia.gov/tools/faqs/faq.php?id=73&t=11>.
[22] David Freiberg, DG Park, George Serafeim, and T. Robert Zochowski. "Corporate Environmental Impact: Measurement, Data and Information". Harvard Business School Working Paper, No. 20-098. Published March 2020.

life impacts. The basic need dimension reflects the value of providing a fundamental basic need and demonstrates the potential for the industry to be highly positive if issues of environmental usage can be mitigated through adoption of other renewable and sustainable energy sources. The underserved dimension reflects the value of enabling sustainable development in emerging markets through provision of natural gas. The minimal health and safety impact reflects the lack of recall and faulty fuel issues in the industry.

Another potential analysis could compare the product impacts of different companies. Within a single industry, one can identify differences in how the two companies approach different product attributes. For example, our analysis suggests that Company B reaches more underserved consumers than Company A. Company A and B have similar basic need and environmental usage impact, with slight differences stemming from the proportion of sales from gasoline, other petroleum, and natural gas. Analyzing each dimension allows for a deeper understanding of the product impact performance of each company relative to competitors and the broader industry.

Finally, the impact-weighted financial statement analysis indicates which dimensions are most significant for product impact creation. In the oil and gas industry, negative impact is driven mostly by the environmental usage dimension. Oil and gas also has significant positive impacts from providing a fundamental basic need.

4.1 Application of impact-weighted financial statement analysis

To provide an example of the information enabled by impact-weighted financial statement analysis, we generate product impact estimates for other companies within the oil and gas industry. These estimates allow us to identify competitive dimensions of product impact within the industry, as well as compare product impact performance over time.

The dataset consists of product impact estimates across four years, 2015 to 2018, for nine global publicly traded oil and gas companies that are listed or cross-listed in the US with over $2 billion in revenue to ensure data availability and comparability. We note that for the firm-years within the dataset, natural gas and petroleum accounts for a majority of firm revenue. We thus make the simplifying assumption to estimate product impact of only the pure oil and gas segments, petroleum and natural gas, and exclude petrochemicals and renewable energy segments. We expect that for subsequent and future years, renewable energy segments could be included for these firms as these segments become a larger proportion of oil and gas firm revenue.

Given that industry assumptions used for monetizing product impact are constant throughout the industry, the product estimates are calculated by applying the industry-wide assumptions to the respective company-specific data points as demonstrated with Companies A and B. For comparability, we examine the product estimates scaled by EBITDA and revenue.

Table 7

Product Impact of Oil and Gas Companies

	Impact Scaled by EBITDA			Impact Scaled by Revenue		
Impact	N	Average	SD	N	Average	SD
Underserved Impact	36	19.97%	0.30	36	2.55%	0.04
Health and Safety Impact	36	0.00%	0.00	36	0.00%	0.00
Basic Need Impact	36	74.04%	0.93	36	9.03%	0.05
Environmental Use Impact	36	-423.03%	5.50	36	-51.05%	0.26
Overall Product Impact	36	-329.02%	4.51	36	-39.48%	0.23

Table 7 shows the summary statistics for all the impact variables. Examining the average impact scaled by EBITDA and revenue indicates that environmental use and basic need are significant drivers of the overall product impact. The average underserved impact when scaled by EBITDA and revenue also indicates that the dimension can influence overall product impact.

Figure 2

Distribution of Overall Product Impact Estimates Scaled by EBITDA

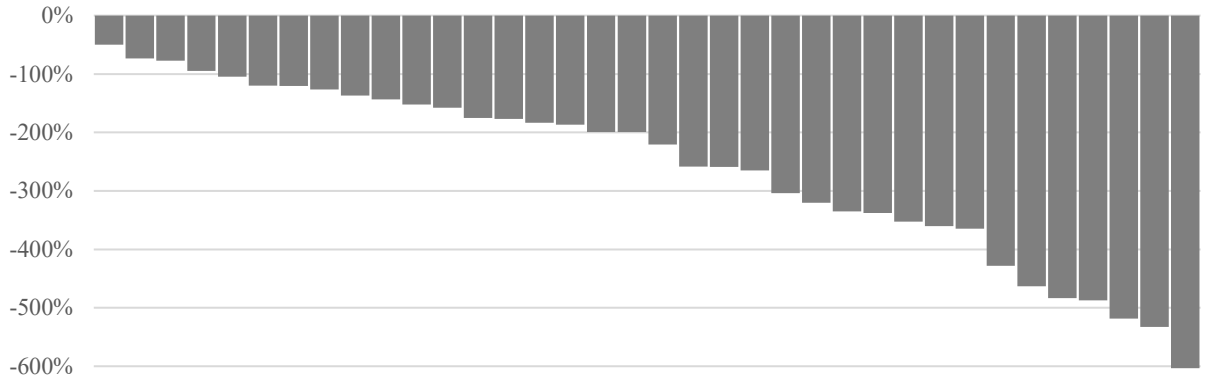


Figure 2 shows the distribution of total product impact in the sample showing significant variation. For all firm-years, we observe negative product impact given the environmental use dimension outweighs the positive impact from the basic need and underserved dimensions.

Hypotheses explaining product impact estimates

There are four hypotheses that can explain the product impact we are observing within the oil and gas industry. The first hypothesis is the *baseline case* in which the product impact estimated is consistent with and captures the impact of the industry. The second hypothesis is the *scope bias case* in which some impacts created by the oil and gas industry have not yet been estimated and included in the total product impact. The third hypothesis is the *measurement bias case* in which the benefits or costs are rightly scoped but incorrectly estimated. Finally, the fourth hypothesis is *sample selection bias* in which the companies selected in our sample are unrepresentative of the full industry.

We minimize issues of *scope bias* by estimating the impact of identified product impact issues raised in the financial and sustainability disclosures by oil and gas firms. However, we note there may exist impacts which are not yet estimated for the industry in the years observed, but will be included in subsequent years, such as impacts from renewable energy and petrochemicals. To minimize *measurement bias,* we use commonly accepted industry research and guidance to estimate benefits and costs. Finally, we minimize *sample selection bias* by including firms across different geographies that serve regions with differing infrastructure levels.

4.2 Discussion of insights enabled by impact-weighted financial statement analysis

Figure 3

2015 Overall Product Impact Estimates

(Scaled by EBITDA)

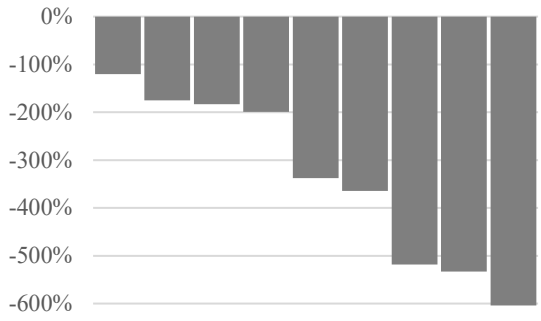
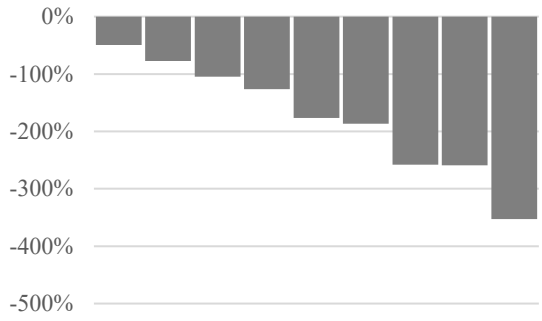


Figure 4

2018 Overall Product Impact Estimates

(Scaled by EBITDA)



Comparing the distribution of overall product impact estimates in 2015 and 2018 indicates a reduction in the magnitude of negative product impact performance. While five firms display negative product impact in excess of -300% of EBITDA in 2015, only one firm displays negative

product impact in excess of -300% in 2018. We note however that this change is not driven by a change in product impact performance, but by growth in EBITDA due to increasing oil and gas prices.

Figure 5

Underserved Impact Estimates

(Across All Years, Scaled by EBITDA)

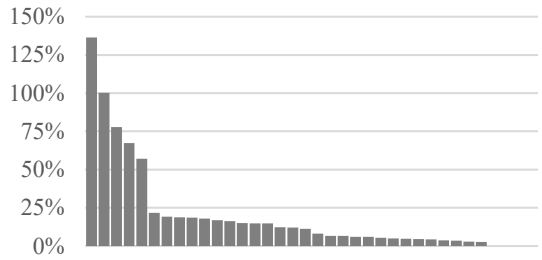


Figure 6

Basic Need Impact Estimates

(Across All Years, Scaled by EBITDA)

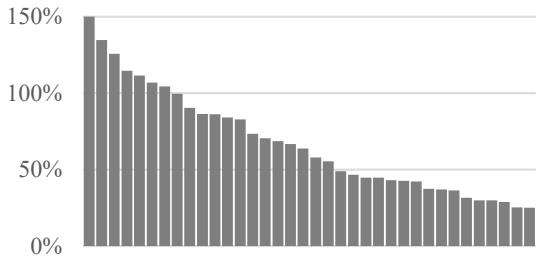
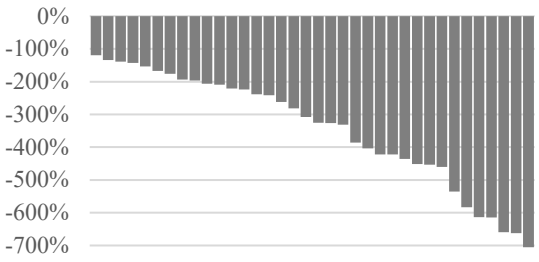


Figure 7

Environmental Use Impact Estimates

(Across All Years, Scaled by EBITDA)



The magnitude and distribution of the underserved dimension suggests that this dimension is a driver of product impact for firms with meaningful efforts to provide oil and gas to underserved customers. Eni and BP are consistent leaders on the underserved dimension given Eni's market presence in Africa and BP's market presence in South America.

The lack of health and safety impact across all firm-years suggests that the oil and gas firms observed in this dataset rarely have recalls and thus breaches to consumer health and safety.

The magnitude and distribution of the basic need dimension suggests that the basic need impact is a key driver of product impact across all firms in the dataset. The observed variation in

basic need is a function of the differing proportion of natural gas, gasoline and other petroleum sales. In general, firms with a greater proportion of sales from gasoline and other petroleum slightly outperform on the basic need dimension, but there is not a consistent leader.

Finally, the magnitude and distribution of the environmental usage dimension suggests that environmental usage is the main driver of product impact across all firms in the data set. Eni and BP also lead the environmental usage dimension given their proportion of natural gas sales versus gasoline sales is slightly higher than other firms in the dataset which is better for emissions.

Ultimately, examining the relationship between product impact performance across different dimensions, we identify trade-offs in different operating and strategic decisions. All firms in the dataset deliver positive basic need impact that is outweighed by their negative environmental usage impact. Thus, firms that deliver less negative product impact than their peers in this dataset are differentiating themselves by delivering more positive underserved impact. As firms have begun to make investments in renewable energy, we expect that in subsequent years, firms with a greater proportion of renewable energy in their portfolio will lead on product impact in this industry as they will deliver positive basic need impact with less negative environmental usage impact.

5. Conclusion

Although interest in ESG measurement continues to grow significantly, product impact has been difficult to systematically measure given the idiosyncratic nature of the impacts and the tendency to view products in broad categorizations of simply good and bad. The creation of a product impact framework allows for a systematic methodology that can be applied to different companies across a wide range of industries. This enables transparency, comparability, and scalability within product impact reporting. The identified standard dimensions on which product impact can be measured are rooted in existing measurement efforts, allowing data that is publicly available to be leveraged.

To ensure applicability, determine feasibility, and identify nuances within each dimension of product impact, we examine company pairs across each GICS sector. In this working paper, we provide a sample application of the product impact framework to the oil and gas industry. We use publicly disclosed data and industry-wide assumptions to derive monetary estimates of a product's reach, accessibility, quality, optionality, environmental use emissions and end of life recyclability.

While publicly disclosed data can provide meaningful insights, use of internal company data can further enable precision and support internal decision-making. This example also highlights the need for ongoing discussion and refinement of industry-accepted assumptions as contemporary literature leads to changing guidance over time.

This paper is one within the series of applications of the framework across each GICS sector, covering oil and gas in the energy sector. Ultimately, the aspiration is to develop and provide a framework that enables more informed decisions which account for the many impacts created by products.