



GLOBAL 250 GREENHOUSE GAS EMITTERS

A NEW BUSINESS LOGIC

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CONTENTS

Executive Summary	2	Looking at Utilities Through the Sustainability Premium Lens	17
Global Greenhouse Gas Emitters	3	Early Indications of Econometric Relevance	19
Leaders of the New Business Logic: Less Makes More	5	The Key Role of Policy Makers and Cities	20
Forces Driving a Post-Carbon Economy	5	The 1 Gigaton Coalition	20
Signals from the Global Marketplace: Is Conventional Wisdom Wrong? Could It Be Upside Down?	6	Global Policy-Making Trend (Interview with the Norwegian Minister for the Climate and Environment, Vidar Helgesen)	23
The Sustainability Premium: A New Business Logic for Growth	8	Conclusion: A Sustainability Premium for the Planet	25
Maturity and Momentum Applied to Climate Impact Management	9	State of the Climate 2017 – Climate Change by the Numbers	25
Case Studies: Looking at Leadership	9	Appendix 1: Performance: The Global 250 and Our Planet	26
–Xcel Energy –Ingersoll Rand –Total Group		Appendix 2: Correlation Between Co ₂ Change Rate and Financial Performance	32
Sector Leadership	15	Appendix 3: Earth Observation Missions	34
A Look at Climate Impact and the Automakers in the G250	16		

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EXECUTIVE SUMMARY

This Global 250 Report addresses the following key questions:

Question: Who are the Global 250 (G250) companies?

Response: The Global 250 (G250) consists of a diverse and interconnected group of publicly traded businesses in the following sectors: oil, gas, utility, automotive, aircraft, manufacturing, steel, mining and cement. They provide essential products and services to the global economy. They also represent approximately one-third of global annual anthropogenic emissions, when including their value chains. Without continual reductions in emissions from this group of companies, effectively mitigating the long-term risks of climate change is not possible.

Question: Among this critical group, how are emissions trending over the past three years?

Response: Overall, emission trends are flat (on average and adjusted for revenues) when they should have been going down by roughly 3% per year to stay under 2 degrees C of global warming. Each year's delay in reduction necessitates a steeper reduction curve in the future, likely increasing the cost and complexity of the required transformations, and decreasing the probability of meeting targets required for limiting disruptive climate events.

Question: Is there new evidence that implementing decarbonization strategies, especially for large carbon-intensive businesses like the G250, creates either a drag on financial performance or a premium?

Response: First, there is no evidence that executing decarbonization strategies results in a financial penalty, including reduction in total shareholder returns, reduction in profitability or employment, or other common measures of value. Second, there is emerging evidence of companies driving business opportunity, competitive differentiation and

value creation through effective execution of climate-impact-management strategies. The report describes new methods for assessing how companies that are transforming their products and processes to meet the demands of a low-carbon economy. Three case examples, Xcel Energy, Ingersoll Rand and Total, all top-150 emitters, are presented along with a new model for gauging the positive impacts of their decarbonization strategies on business outcomes.

Question: Given the long-term transformation challenge confronting these large emitters and the importance to investors, companies and policy makers in understanding company performance, how can we assess a company's progress and define leadership?

Response: Progress can be assessed by looking at whether a specific emitter is reducing aggregate emissions across all scopes in line with the latest scientific guidance, or roughly 3% per year through 2050. The report also describes a new sector-specific analytic method for assessing the "Maturity" level and "Momentum" factor of decarbonization strategies for a sample of the G250 in the automotive and utility sectors. The sector analysis concludes by examining relationships between these ratings and some key financial outcomes.

Question: How are policy-, city- and investor-leadership evolving to support the transition to a post-carbon economy?

Response: Engagement is the main theme. We are seeing increasing and direct engagement with carbon-intensive businesses from investors and policy makers of all stripes. This engagement yields increasing advantages to businesses that are effectively decarbonizing.

This report provides new analytics and insight on these critical issues as business leaders, investors, policy makers and concerned stakeholders navigate the risks and opportunities of climate change.

GLOBAL 250 GREENHOUSE GAS EMITTERS

The 250 companies¹ referenced in this report, together with their value chains, account for approximately one-third of global annual greenhouse gas (GHG) emissions.² For a decade or more, the management teams in these large organizations have recognized the potential future constraints that climate change could pose on their business operations and outlook. While many have deferred making a strategic shift toward a low-carbon future, others have recognized a new business logic: a historic opportunity for innovation that drives durable growth and competitive advantage.

As the early movers see it, carbon-intensive firms – whether they are big energy producers, consumers or makers of energy-intensive products who could ride the coming wave of technological and organizational change – would be positioned to prosper in a carbon-constrained world. Companies and their customers would see increased eco-efficiencies and reduced eco-risks. Firms unwilling or unable to adapt would ultimately fall behind as the new business logic of a post-carbon economy slowly but surely redefines the terms of competition.

The question for most managers, investors and analysts has been one of timing. Not surprisingly, conventional wisdom suggests that it is still too early – shareholders could pay a penalty resulting from the significant investments required to transform core processes and product portfolios for low-carbon markets that have not yet fully materialized or technologies that are still rapidly evolving. While there could be significant consequences for being late, those consequences could be many years away.

However, given the decade or longer time frame required for most major emitters to successfully migrate their operations to embrace this new business logic, it is increasingly difficult to rationalize delay. This is true even though, for many of these emitters change admittedly will require significant disruption in current business models.

Companies such as Total, Ingersoll Rand, Toyota, Iberdrola and Xcel Energy, among a small but increasing group of others, are executing on strategies to diversify and decarbonize their business models in heavily carbon-intensive sectors. Their plans, begun a decade or more ago, have proven business results and provide a pathway to a profitable low-carbon future that stretches to 2050 and beyond. Looking at the G250 as a whole, evidence is accumulating of strategic advantages among companies demonstrating readiness for leadership in the post-carbon economy.

Figure 1: Global 250 Performance

Global 250	Performance
Number of companies with Science-Based Targets	30 (Science Based Targets Initiative)
Number of companies decarbonizing at 3%/year or above	Approximately one-third of the G250 adjusted for revenue level changes and potential production factors
GHG Index/Revenues Index/Decoupling Index/Employment Index (2016-2014)*	GHG Index (96), Revenues Index (90), Decoupling Index (98), Employment Index (101)
Sector rank by Absolute Emissions**	Energy (47%), Utilities (15%), Materials (14%), Transportation (10%), Capital Goods (8%)
Decoupling Index Rank**	Utilities (112), Capital Goods (107), Transportation (103), Materials (96), Energy (77)
Country headquarters rank by Absolute Emissions**	United States of America (27.6%), Japan (11.0%), China (7.5%), Germany (6.6%), India (5.3%)

*Average

**Top 5 sectors/countries only

¹ Thomson Reuters and CDP have collaborated on this report to bring together the latest data from companies that do report, and the latest estimates for those that do not or incompletely report. The finance sector was excluded as there are insufficiently complete estimates on their scope 3.

² This is measured against total anthropogenic emissions, including land use of approximately 52 Gigatons CO₂e. This number includes direct, indirect and value-chain emissions (scopes 1, 2 and 3) adjusted for double counting of 60%.

Companies in the Global 250 include the Top 15 (rank based on total emissions) (Figure 2), which alone account for about 10% of global annual emissions.³

Figure 2: Top 15 of the Global 250 (See Appendix 1 and its footnote for full list of Global 250.^{4,33})

Rank 2015	Company Name	GHG emissions Tons CO ₂ e Scope 1+2+3			GHG Index	Revenues Index	Decoupling Index	Employment Index
		2016	2015	2014				
1	Coal India	2,076,244,220	2,014,314,687	1,869,412,290	111	118	107	93
2	PJSC Gazprom	1,176,925,161	1,247,624,306	1,264,855,340	93	116	124	103
3	Exxon Mobil Corporation	1,098,498,615	1,096,498,615	1,145,083,349	96	55	58	94
4	Thyssenkrupp AG	953,797,000	954,185,140	955,185,140	100	95	95	96
5	China Petroleum & Chemical Corporation	721,411,029	874,153,506	901,550,000	80	68	85	126
6	Rosneft OAO	853,709,607	835,868,134	829,849,040	103	91	88	N/A
7	Cummins Inc.	805,593,388	813,043,062	920,001,660	88	91	104	101
8	PETROCHINA Company Limited	621,336,019	730,924,555	688,790,000	90	71	79	95
9	Royal Dutch Shell	734,160,000	698,868,219	735,119,000	100	55	56	98
10	Rio Tinto	670,621,000	669,751,731	652,023,000	103	71	69	85
11	China Shenhua Energy	664,949,000	643,832,223	733,109,000	91	72	80	98
12	Korea Electric Power Corp	456,346,512	634,243,789	666,588,494	68	105	153	216
13	Total	469,545,000	581,900,000	598,400,000	78	60	77	102
14	Petróleo Brasileiro SA – Petrobras	468,402,442	547,476,491	618,399,435	76	84	111	85
15	United Technologies Corporation	403,968,529	530,627,775	530,803,247	76	99	130	96

³ This is measured against total anthropogenic emissions, including land use of approximately 52 Gigatons CO₂e. This number includes direct, indirect and value-chain emissions (scopes 1, 2 and 3) adjusted for double counting of 60%.

⁴ GHG Index above 100 indicates increasing emissions trend; Revenues Index above 100 indicates increasing revenue trend; Decoupling Index above 100 indicates revenues increasing faster than emissions; Employment Index above 100 indicates increasing employment trend.

LEADERS OF THE NEW BUSINESS LOGIC: LESS MAKES MORE

Becoming a leader on climate impact management requires solving two related challenges:

Challenge 1: What must a leader do?

Borrowing from recent WRI and Thomson Reuters analysis, leaders must develop strategies to run their businesses in line with the latest scientific guidance on climate change. That is, they must envision a future strategy for their firms that meets customer needs and shareholder demands for continued growth and profitability, while at the same time reduces aggregate emissions across all scopes linearly at about 3% per year according to the latest scientific guidance. This first dimension of leadership on climate impact can be called “Science-Based Climate Goals” or SCGs. One example of the kind of leadership is The Science-Based Target Initiative. More than 300 companies are using this coalition’s methods to define and commit to achieving such targets. Other companies have aggressive decarbonization strategies in line with IPCC guidance, although not part of the Coalition. In either case, leadership requires setting in motion the strategy and measuring the progress for deep decarbonization.

Challenge 2: Execution ... How can a leader do it?

Among the G250, leadership requires transforming a large complex business whose carbon-heavy product and operating models have evolved through decades of experience. Successfully implementing SCGs requires developing new capabilities, processes and products, and sustaining positive change across longtime horizons, often across multiple C-suite changes. For companies that sustain their commitment to innovation that results in decarbonization – such as Philips in super-efficient lighting or Boeing in commercial aircraft – valuable innovation and competitive differentiation can result.

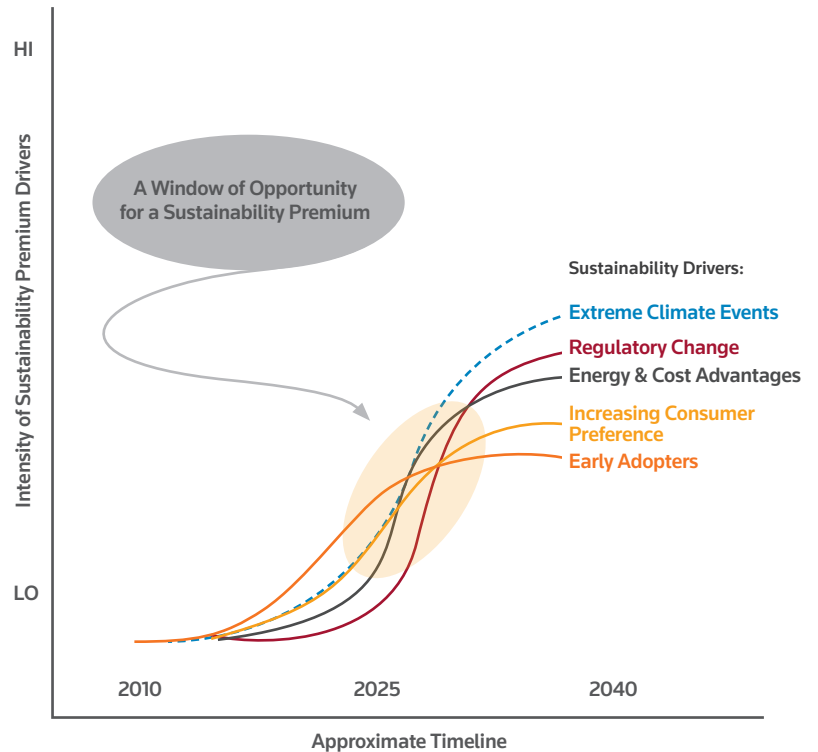
In past decades, many companies saw opportunities for competitive advantage by adopting advances in quality, technology and globalization strategies, to name a few. In many cases, firms translated effective execution of these innovations into market success, as Toyota demonstrated with their world-renowned quality method, the Toyota Way.⁵ Similarly, decarbonization and, more broadly, sustainability strategy have the potential to drive a “Sustainability Premium” (Lubin and Esty, MIT Sloan Review, 2014). As defined by Lubin and Esty, a Sustainability Premium is reflected in a measurable and durable driver of enhanced business value from the successful execution of a company’s integrated business and sustainability strategy.

As was true in the past, disruptive forces on the competitive landscape – like quality, technology and globalization – over time become business requirements. Once relatively unique capabilities become corporate “must haves” they lose much of their power as differentiators.

We are at the knee of a multi-year curve on managing climate impact. As Goldman Sachs states in their recent report,⁶ “Core to our thesis is that the Low Carbon Economy is emerging through a series of rapid technology shifts in select, carbon-intensive industries.” The potential for successful execution of a robust climate impact strategy to drive business value and competitive advantage is likely to be greatest in the next decade, before operating in a new low-carbon business environment becomes a ubiquitous requirement.

In Figure 3, the shaded area represents an increasing growth opportunity over the next decade for any company in the G250 to capture the potential benefits of the Sustainability Premium. It’s really a once-in-a-century opportunity at a time of dramatic technological, regulatory and planetary change.

Figure 3: Forces Driving Post-Carbon Economy



⁵ http://vedpuriswar.org/Book_Review/The%20Toyota%20Way.pdf

⁶ **The Low Carbon Economy, Technology in the Driver’s Seat.** <http://www.goldmansachs.com/our-thinking/pages/new-energy-landscape-folder/report-the-low-carbon-economy/report-2016.pdf>

As analysts and observers of the critical transformation that businesses must undertake, our task is to provide signals to corporate leaders, investors and policy makers about the potential value of decarbonization strategies and the progress companies are making with execution. The place to begin is reviewing the conventional wisdom that suggests a business cost for environmental performance, rather than potential positive synergies.

SIGNALS FROM THE GLOBAL MARKETPLACE: IS CONVENTIONAL WISDOM WRONG? COULD IT BE UPSIDE DOWN?

Increasingly, investors⁷ see the value creation potential from companies that are transparent on their emissions and offer product portfolios designed to compete in the emerging low-carbon economy.⁸ Investors themselves are also coming under increasing regulatory pressure to disclose the carbon footprint of their own portfolios. It's no accident that one of the largest investors in the world is contributing to this report: State Street Global Exchange.⁹

Mark McDivitt, Managing Director, Head of ESG Solutions, State Street Global Exchange, part of a firm with \$28 trillion in assets under custody and administration and \$2.5 trillion in assets under management, offers the following observations from an investor perspective on carbon-intensive business models:

- The Paris Agreement, unlike Copenhagen, Kyoto, and other COP gatherings, drove home the point that the private sector, partnered with individual Country Intended Nationally Determined Contributions (INDCs), will be the impetus needed to start to limit overall global warming.
- There is increasing pressure coming from asset owners, which will require global carbon-intensive businesses to disclose their climate risk management plans. These asset owners, including State Street, are pressing carbon-intensive businesses for transparency on their climate risk plans.
- The global investor community will not be limited to "playing defense" with negative screening and divestiture strategies designed to limit exposure to carbon-intensive assets, particularly those not positioned to decarbonize in line with scientific and policy guidance. Right now, many leading owners, asset managers, endowments, insurance companies and hedge funds are "playing offense," investing in innovative leaders in carbon-intensive business sectors that are delivering sustainable solutions and above-market returns.
- The investor community knows that business operations are responsible for the vast majority of addressable GHG emissions, and it is these same business operators and their owners, among other stakeholders, who will experience results of climate change.
- For global financial players of all stripes, it's time to answer the question "Are you in the game integrating climate impacts into investment strategies or are you still on the bench?"

And returning to Goldman Sachs' recent report on the emerging low-carbon economy, consider this summary of the scale of the impact:

"More than meets the eye: One-fourth of equities could be affected by 2025."

"The technologies that we focus on directly transform only relatively small sectors in our coverage; in terms of GICS industries, primarily autos and electrical equipment (note that some solar companies are also classified as semiconductor firms or utilities). However, extensive supply chains tie these industries to a much broader set of sectors, comprising roughly a quarter of our coverage. We believe investors should be as vigilant about the implications of low-carbon technologies along these supply chains as they are in the markets in which they take share."¹⁰

Adding to this investor view that climate change matters for a significant portion of the global marketplace, and that it presents a transformative opportunity, a growing body of work from global consultancies like KPMG, PwC and Deloitte strongly suggests the underlying business opportunity. Dennis Whalen, leader of KPMG's Board Leadership Center, summarizes: "As we cross the threshold to a lower-carbon world, there is a growing recognition of risks associated with long-term carbon-intensive business models. Early movers that invest now in staying competitive in a low-carbon future can gain significant advantages as they integrate lower-cost, lower-risk and more resilient business models."

And similarly, the conventional wisdom from the global legal community is shifting towards increasing concern around the risks incurred by carbon-intensive business models. David Hackett, partner at the global law firm Baker McKenzie, summarizes that "Greater marketplace and legal scrutiny lies ahead for major emitters of greenhouse gases, and as the 'climate leaders' accelerate their emission-reduction and innovation efforts, the others will find their competitive positions increasingly untenable accompanied by the growing potential for expanded risk and liability. Charged with the responsibility for assessing material risk, corporate boards of directors will find this duty more and more significant in light of the emerging risks associated with climate change."

⁷ BlackRock switch helps pass 'historic' climate measure at Occidental <https://www.reuters.com/article/us-blackrock-occidental-climate/blackrock-switch-helps-pass-historic-climate-measure-at-occidental-idUSKBN1882AA>; Company climate risk disclosure could become mandatory in a few years <http://www.reuters.com/article/us-climatechange-risks-disclosure-idUSKBN18J1QB>

⁸ Cary Krosinsky from the Yale Center for Business and the Environment comments: "Financial performance has been studied for some time as pertains to ESG, but the vast majority of studies fail to take into account the nuances in the field as it is practiced, hence an understandable mantra has emerged where many still assume that one leaves financial returns on the table by accounting for any of ESG. Fortunately, the truth is very different from

that perception. In particular, the value-seeking strand of sustainable investing has outperformed for quite some time. Going back to the end of 2007, a robust analysis of all the world's public-facing socially responsible investment funds, then 850 in number, found that positively focused value-seeking funds outperformed negative screening funds, as well as mainstream benchmarks including the MSCI World over 1-, 3- and 5- years (Krosinsky/Robins, 2008)."

⁹ State Street was founded in 1792 and is the second oldest financial institution in the U.S. It has approximately \$28 trillion in assets under custody and administration and \$2.5 trillion in assets under management.

¹⁰ <http://www.goldmansachs.com/our-thinking/pages/new-energy-landscape-folder/report-the-low-carbon-economy/report-2016.pdf>



And on the specific and crucial question of the role corporate boards must play, we have guidance from Professors Bob Eccles and Tim Youmans¹¹ on the fiduciary duty owed by boards of directors to corporations, which includes considering the material regulatory and legal risks as atmospheric concentrations of CO₂ continue to rise. Indeed, they urge, “Boards of carbon-intensive emitters can provide critical leadership on mitigating emerging regulatory, reputational and operational risks.”¹²

From a global policy perspective, we are seeing increasing engagement, incentives and opportunity. Norwegian Minister of Climate and the Environment Vidar Helgesen remarks in the interview printed in full later in this report that:

“The private sector plays a crucial role in developing zero- and low-emission technologies that we need to reach our climate targets. New and improved technologies for solar and wind electricity generation, electric vehicles and industrial processes are examples of areas where we have already seen the private sector make a huge impact. Changes in the market are happening faster than ever before, and the winners will be those capable of transforming to new, green solutions. Policy makers globally are increasingly engaging with the private sector to encourage and incentivise this transformation, and those firms which hold on to legacy business models will find themselves increasingly at a competitive disadvantage.”

The New Bottom Line

Finally, as explained in detail in Appendix 2, a series of correlational analyses was undertaken to better understand the potential benefits or costs of leadership on GHG emissions. We compared the financial

performance on a number of key indicators between companies in the G250 that show leadership as measured by GHG reduction trends, and those that do not show such evidence. If implementing business processes that result in meaningful GHG reductions does indeed create an earnings drag, declines in job growth or negative effects on shareholder returns, it should be especially evident among the G250.

The results indicate no significant correlation between progress on reducing GHG emissions and the most common measures of business performance, such as total shareholder return, P/E ratio, and employment levels. However, as the scatterplots reveal, there are a sizable number of firms that are successfully integrating positive performance on decarbonization with strong shareholder returns (see the green dots in Appendix 2).

In sum, this review of the conventional wisdom among the G250 suggests the need for further inquiry into what is enabling the success of these global giants as they invest in decarbonizing. Is there a new business logic beginning to take hold even among the world’s largest emitters? Is there a Sustainability Premium to be found among firm’s marrying sector-leading returns with meaningful progress on GHG reductions?¹³ Of course, it goes without saying that shareholders’ returns are the result of many factors internal and external to the firms in question. However, successful decarbonization may be a contributor to overall performance. To answer these questions, we will need new, more nuanced methods for understanding how sustainability strategy contributes to performance. Let’s begin by examining several of the world’s largest GHG emitting firms that have succeeded in creating competitive differentiation with sustainability and better understand how they are creating their Sustainability Premium.

¹¹ For more on the statement, see Eccles’ and Youmans’ survey of the fiduciary duty owed by boards of directors to corporations, to shareholders and to other stakeholders: [Materiality in Corporate Governance: The Statement of Significant Audiences and Materiality](#) – Journal of Applied Corporate Finance. Also: [The Board That Embraced Stakeholders Beyond Shareholders](#) – MIT Sloan Management Review, [Why Boards Must Look Beyond](#) corporations, which includes considering the material regulatory and legal risks as atmospheric concentrations of CO₂ continue to rise. Indeed, they urge, “Boards of carbon-intensive emitters can provide critical leadership on mitigating emerging regulatory, reputational and operational risks.”

¹² <https://blogs.thomsonreuters.com/sustainability/wp-content/uploads/sites/15/2017/06/Global-100-Greenhouse-Gas-Performance-New-Pathways-for-Growth-and-Leadership-2017.pdf>

¹³ Of course, there are also the myriad and growing number of analyses demonstrating the importance of ESG factors to effective risk management and long-term value creation generally, and climate leadership specifically, e.g. Gunnar Friede, Timo Busch & Alexander Bassen (2015) ESG and financial performance: aggregated evidence from more than 2,000 empirical studies, *Journal of Sustainable Finance & Investment*, 5:4, 210-233, DOI: 10.1080/20430795.2015.1118917

THE SUSTAINABILITY PREMIUM: A NEW BUSINESS LOGIC FOR GROWTH

If, as has been argued herein by us and by others, decarbonization strategies are a fast-emerging driver of differentiation and competitive advantage, it should now be possible to identify companies among the G250 who have advanced such strategies and are now harvesting business opportunity from them. These leading firms, across multiple business sectors, have combined a far-reaching strategic vision with a robust capacity to execute, producing the potential for a Sustainability Premium.

The concept of a Sustainability Premium was developed in earlier publications on corporate sustainability by David Lubin and Daniel Esty (*The Sustainability Imperative*, *Harvard Business Review*, May, 2010, and *Bridging the Sustainability Gap*, *MIT Sloan Management Review*, 2014), and by Esty and Winston in their 2006 book, *Green to Gold*. These works describe how firms successfully build capabilities to envision and execute sustainability strategies, and how such strategies simultaneously can create shareholder and stakeholder value.¹⁴

Gauging the potential for delivering a Sustainability Premium requires a different approach to assessment – one that is more dynamic and strategy focused, indexing a growing capacity to execute. This approach is equally useful to, for example, company management and investors, each interested in assessing the firm's progress on turning climate challenges into opportunities for product and process innovation that can drive growth and profitability.

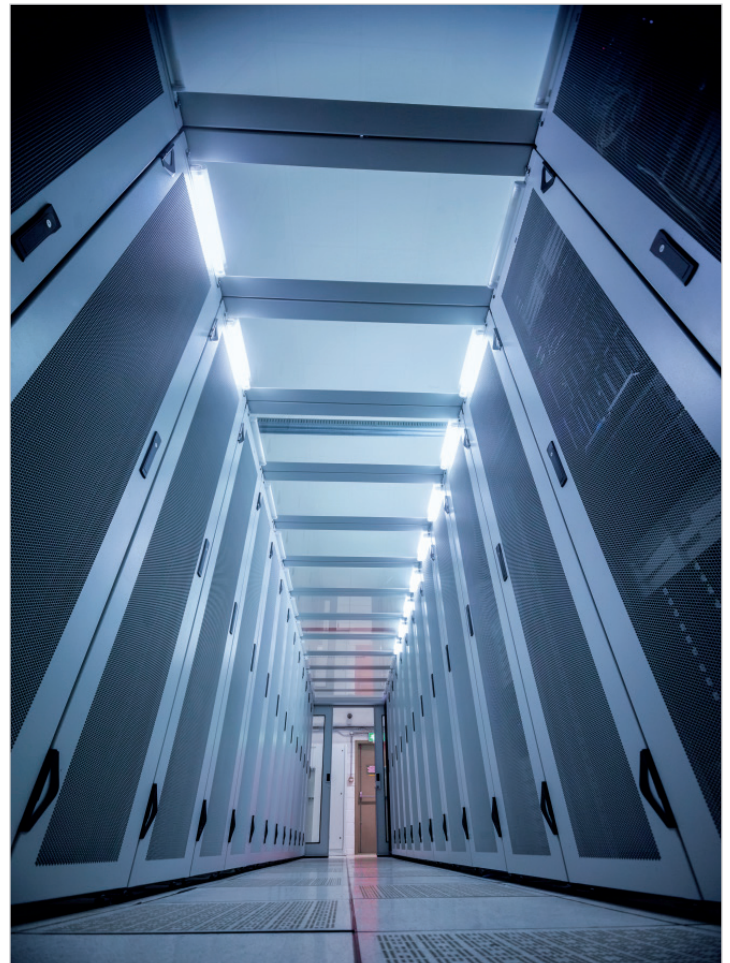
New Metrics for a New Business Logic

The disciplines of business and operations management contain a rich body of work that was first developed in the 1970s and 1980s to assist firms in optimizing business value from their deployment of information technology.¹⁵ This work describes how firms traverse a “maturity curve” as they expand specialized capabilities. Firms that committed to progressing higher up the curve could, if successful, gain significant business advantages. For example, among the airlines in the 1980s, American Airlines stood above its peers on the information technology maturity curve, as exemplified by the power of its Sabre reservation system and its pioneering American Advantage frequent flyer program to drive passenger miles and loyalty. Both showed American Airline's sophistication in using technology to change the terms of competition. Over time, management experts used the maturity curve approach to analyze other emerging sources of value, including human-capital management, supply-chain management and strategy management, to name a few.

Here, we report examples of new work developed by Constellation Research and Technology (CRT), in partnership with Thomson Reuters,¹⁶ applying maturity curve concepts to aspects of sustainability management. In this case, assessing the progress of large,

carbon-intensive businesses as they address the challenges and opportunities of competing in a carbon-constrained future. Climbing the Climate Impact Management Maturity Curve may not be a strategic priority for all firms, especially those whose businesses have minimal climate impacts. But for the G250, climate impact management is nothing less than a business imperative.

Given the value of time and rate of improvement in assessing the performance of firms on sustainability and climate impact, CRT adds the “Momentum” factor to the analysis. For the work described here, Momentum reflects the annualized rate of change (positive or negative) in CO₂e emissions. Taken together, Maturity and Momentum, (the M2 analytics), represent a new means of assessing leadership on climate impact and a firm's potential to develop a durable Sustainability Premium.



¹⁴ It is not surprising that these sorts of innovations are value drivers. [Between 1982 and 2007, the proportion of enterprise value derived from intangible assets among SP500 more than doubled from 3x to 85%.](#) Intangible assets are themselves the product of effective execution of strategies – like sustainability strategies.

¹⁵ https://en.wikipedia.org/wiki/Maturity_model

¹⁶ Developed by Constellation Research and Technology, Inc. principals Professor Daniel Esty, Professor Jay Emerson and Dr. David Lubin, Thomson Reuters ESG innovation partners

M2: Maturity and Momentum Applied to Climate Impact Management (A framework developed by Constellation Research and Technology in partnership with Thomson Reuters)

Maturity level is a measurement of an organization's capacity for innovation and continuous improvement of core business processes and disciplines. Here, increasing maturity reflects the capability to drive long-term deep decarbonization in processes, products and operations across all relevant scopes. The higher the level of maturity on climate impact management, the greater the likelihood of the organization gaining maximum advantage for itself and key stakeholders.

The Climate Impact Management Maturity Curve follows from the more general sustainability maturity model. Companies can be classified as located at a point in time along a curve demarcated by five stages (and additional sub-stages) as summarized here:

- **Stage 0: Pre-engagement** – The firm does not show consistent evidence of engagement on climate impact or recognition of the relevance of climate issues to business operations.
- **Stage 1: Initial Engagement** – The firm engages on the issue of climate change with relevant policy, procedures and/or broad statements of intent.
- **Stage 2: Systematic Management** – The firm undertakes systematic management of the issue of climate change by assessing and reporting facts relevant to its operations and impacts (e.g. GHG reporting, initial goal setting and assessment of its performance relative to peers and/or universal standards). Initial proof-of-concept demonstrations of change pathways provide a business case for advancing up the curve.
- **Stage 3: Transforming the Core** – The firm demonstrates meaningful progress and scalable plans for transforming key processes, products and/or systems needed to optimize on a low-carbon value proposition. Target setting expands in scope and time frame, ultimately consistent with the goal of reducing anthropogenic impacts quickly enough to avoid the most serious effects of climate disruption (e.g., in line with IEA 2-degree emissions guidance or Science Base Goals).
- **Step 4: Competitive Differentiation and Cultural Advantage** – The firm is successfully executing strategies that create competitive differentiation and the potential for competitive advantage through low-carbon innovations in products and/or processes that generate material improvements in cost structure, revenue growth and/or business model strength. The firm has built the capacity for continuous improvement of the low-carbon value proposition over time, including across transitions in management. Corporate culture drives progress.

Momentum is a measure of the rate of change over time in a key performance indicator, normalized or indexed in such a way as to enable comparisons between firms on their likely near-to-intermediate future trajectory. The Momentum analysis on Climate Impact Management relies primarily on appropriately normalized multi-year trajectory of the most relevant GHG emissions data for the company.

CASE STUDIES: LOOKING AT LEADERSHIP THROUGH THE M2 LENS: SEEING EVIDENCE OF A SUSTAINABILITY PREMIUM

The GHG-intensive industry leaders profiled below are among the most significant contributors¹⁷ to global emissions.¹⁸ In the following discussion, we provide a retrospective analysis describing the pathways these firms followed to their leadership positions, and growing evidence of the sustainability premium in their results. They demonstrate that viable pathways exist, even in the most carbon-intensive sectors, for a world under 2 degrees C of warming.

Case Study: Xcel Energy (No. 169 in the Global 250)

Let's begin by mapping Xcel Energy's climb up the maturity curve in the carbon-intensive utility sector.

Stage 1: Initial Engagement – Xcel acknowledges climate change as a strategic issue. In 2004, the company issued its first carbon management plan. Then, in 2005, Richard Kelly was appointed chairman and

CEO, and the company issued its first Triple Bottom Line Report stating that *"comprehensive action is needed to address climate change today, including greatly increasing our use of resources that produce lower or no CO₂ emissions, increasing our energy conservation opportunities for customers, and participating in research and development on carbon sequestration... regardless of regulation our company is implementing voluntary carbon management target ..."*¹⁹

By 2005, Xcel's deployment of renewables accounts for about 9% of their energy mix, and is seen as "a cost-effective hedge against more volatile fuel prices." Xcel Energy has begun to focus on capturing efficiency gains for itself and its customers by rolling out energy-saving programs that have the added benefit of enabling better demand management. The capacity and economics of renewable initiatives are being actively tested.

¹⁷ Of the fossil fuels, Coal is responsible for the most (24.8%) of GHG emissions, followed by Oil (20%) and Natural Gas (18.5%) for a total of 63.3% http://www.ecofys.com/files/files/world-ghg-emission-flow-chart-2012_v9-c-asn-ecofys-2016_Q2.pdf

¹⁸ Carbon dioxide (CO₂) accounts for 76% of GHG emissions (65% from fossil fuels and industrial processes, 11% from forestry and other land use) <https://www.epa.gov/ghgemissions/global-greenhouse-gas-emissions-data>

¹⁹ <https://www.xcelenergy.com/xcel%20energy%20csr%202005/>
<https://www.google.com/search?client=safari&rls=en&q=xcel+energy+2005+CSR+report&ie=UTF-8&oe=UTF-8>

Stage 2: Systematic Management – In 2006, Xcel is systematically reporting GHG emissions and launching innovations that meet customer needs while simultaneously delivering benefits on the climate challenge. Programs such as Xcel’s Solar*Rewards® (to encourage solar usage), and Xcel’s energy efficiency programs such as Home Smart are launched.

Stage 3: Transforming the Core – By 2010, Xcel reported 10% GHG reductions from their 2005 baseline, and confidently set a 20% reduction target by 2020. Energy efficiency savings had grown to 987 GWh of power, and the Solar*Rewards program enrolled more than 7,300 customers.²⁰ Xcel Energy became a founding member of the Solar Technology Acceleration Center to build and share knowledge. Xcel maintains its commitment to clean energy through a leadership transition in 2011 to its new CEO and Chairman, Ben Fowke. As vision becomes reality, the growth rate of the new renewable and efficiency-focused Xcel was replacing the old business model.

Stage 4: New Business Model Creation and Differentiation – By 2015, Xcel Energy is recognized by the EPA as a climate leader.²¹ Emissions have declined 24% from 2005 levels, well ahead of targets, and the company produced 34% of its total energy from renewables

with a goal of 43% by 2020. Xcel introduced Renewable*Connect in Minnesota and Colorado, a new way for consumers to set the dial on purchasing renewable energy for homes or businesses all the way up to 100%.

In 2017, Xcel’s investor presentation²² opened with an assertion that its business strategy enables earnings growth without bill increases to its customers resulting from key factors including reduced fuel and operating and maintenance costs from its renewables-heavy portfolio. Xcel positions its brand with investors, consumers and employees as the leading clean energy provider, with a goal to add another 4,000 MW from wind and solar by 2021, pushing its CO₂ reductions to 45% below 2005 by that year.

Leadership Reflected in Market Outperformance and Lower Cost of Capital

Xcel has climbed the maturity curve and has produced total returns that significantly outperform their peer groups²³ (+106% vs. +47%) over the last five years (Figure 4). This outperformance occurred while producing a GHG Momentum Score for the 2012-2015 period equating to an annualized rate of decline in CO₂e of 4.93% per year.

Figure 4:

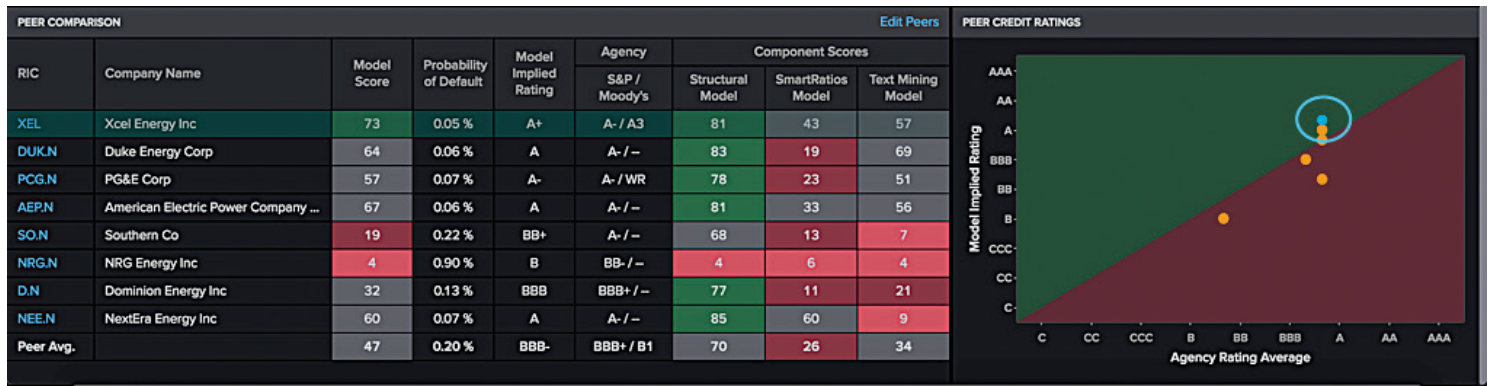


Source: Thomson Reuters Eikon

²⁰ <https://www.xcelenergy.com/staticfiles/xcel/Corporate/CRR2010/index.html#2005>
²¹ <https://www.google.com/search?client=safari&rls=en&q=xcel+energy+corporate+social+responsibility+2016&ie=UTF-8&oe=UTF-8>
²² Xcel Energy Morgan Stanley Investor Presentation Mar. 2, 2017 Xcel Doc No. 1001220683

Xcel also demonstrates best-in-class ranking in terms of its credit-worthiness vs. its peers, providing lower cost access to capital, a crucial advantage in this sector²⁴ (Figure 5).

Figure 5:



Thomson Reuters StarMine® in Eikon

Case Study: Ingersoll Rand (No. 60 in the Global 250)

Ingersoll Rand (NYSE: IR), a leading industrial equipment maker of pumps, compressors, HVAC and refrigeration systems, ranks 60th on our list of major emitters. However, Ingersoll Rand is also a leader on sustainability, accelerating its efforts in recent years through the development of specific goals, targets and strategies surrounding sustainability-advantaged product development and significantly enhanced operational efficiency. Here is an overview of how they progressed up the curve.

Stage 1: Initial Engagement – Ingersoll Rand first generated a carbon inventory in 2006, and issued its first sustainability report in 2007. In 2009, Mike Lamach was named CEO and chairman, and soon after recognized the opportunity to integrate sustainability into the company’s core strategy and operations.

Stage 2: Systematic Management – By 2010, Ingersoll Rand had formed an External Advisory Council (EAC) on Sustainability and expanded the sustainability organization, to drive greater transparency, coordination across the business and target-setting. This included enhanced value propositions regarding climate-related opportunities (e.g., product innovations, life-cycle assessments, end-of-life planning, etc.). By 2011 Ingersoll Rand was organizing and tracking the efforts

of “green teams” across the enterprise, discovering deep employee engagement benefits from participation in the sustainability initiatives. Ingersoll Rand established its first set of company-wide sustainability goals for energy and waste reductions by 2013.

Stage 3: Transforming the Core – In 2014, Ingersoll Rand conducted its first materiality assessment of climate and sustainability factors, integrating the results into their Enterprise Risk Management process in 2015. From this work, an advanced set of sustainability goals was established, running through 2020 to 2030 on expanded criteria surrounding climate and environment, as well as related governance, customer, supply chain, employees and community considerations.

These goals drove a \$500 million investment in product innovation to reduce the greenhouse gas refrigerant footprint of its products by 50%. Operational improvements from office buildings, manufacturing facilities and their fleet would reduce GHG emissions by 35%, all contributing to the avoidance of 20 million metric tons of CO₂ by 2020. The CEO and all senior managers’ compensation would be tied to achieving these goals.

In 2015, Ingersoll Rand became the first industrial company to acknowledge climate risk in the 10-K filing, and confirm further plans to re-engineer products for a climate-constrained world.

²³ Xcel Energy Morgan Stanley Investor Presentation Mar. 2, 2017 Xcel Doc No. 1001220683

²⁴ Predictive Analytics from Thomson Reuters StarMine Combined Credit Risk Model

Consistent with this plan, Ingersoll Rand introduced its EcoWise portfolio in 2015. EcoWise is the Ingersoll Rand label for industry-leading products that meet customer needs while reducing climate and environmental impacts at a significantly greater level than alternatives. The EcoWise portfolio includes products from Trane and Thermo King businesses that use low global warming potential refrigerants and have higher efficiency than comparable legacy products.

In 2016, Ingersoll Rand sought and received validation from the Science Based Targets Board that its programs and initiatives are consistent with Intergovernmental Panel on Climate Change (IPCC) guidance on emission reduction.

Transitioning to Stage 4: Creating Competitive Advantage –

Fast forward to 2017 – while Ingersoll Rand does not break out cross-division sales from its EcoWise portfolio, our analysis suggests that revenue growth from this line has significantly outpaced growth overall, adding a very positive dimension to the future revenue growth outlook.

The company now features their sustainability strategy on their new homepage, with the tag of “A World of Sustainable Progress.” Product innovations have resulted in 6.7 million tons of avoided CO₂e, and the

continued expansion of the EcoWise portfolio put Ingersoll Rand on track for its 2020 goals. A 29% verified reduction in GHG intensity from operations has already been reported.

During the company’s Investor Analyst Day in 2017, sustainability strategy was central to their value proposition, focusing on growth opportunities and enhanced productivity resulting from Ingersoll Rand’s climate commitment and energy efficiency efforts.

Leadership Reflected in Market Outperformance and Lower Cost of Capital

As Ingersoll Rand’s sustainability-driven strategy combines with enhanced operating results, one can begin to see evidence of a Sustainability Premium. The new business logic of lower climate impacts and higher financial returns appears to be taking shape at Ingersoll Rand. The company continues to financially outperform, beating the S&P 500 on total return over the past five years by fully 132% (+170% vs. 73%) (Figure 6).

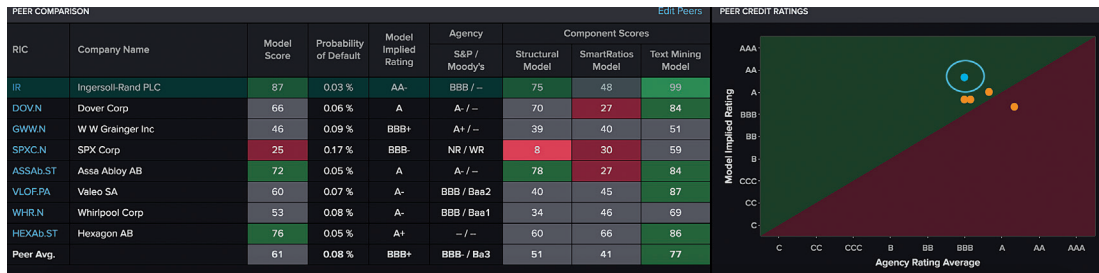
Figure 6:



Source: Thomson Reuters Eikon

It’s also demonstrating best-in-class credit worthiness vs. peers (Figure 7).

Figure 7:



Source: StarMine, Thomson Reuters Eikon



Case Study: Total (No. 13 in the Global 250)

Finally, let's take a closer look at one firm's journey up the curve, operating in a very challenging business sector: fossil-fuel based energy. France's Total S.A. (Total)²⁵ is the fourth largest publicly held oil and gas company in the world and, as such, it is responsible for GHG emissions that place it 13th on our list of major emitters. Today, Total is widely recognized as a leader among fossil fuel majors for its vision of a new clean energy future and its progress on adapting a large, complex business for that future. Indeed, Total's emissions performance over the last three years shows reductions well ahead of IPCC guidance, with an approximately 20% aggregate decline in total GHG emissions across all scopes.²⁶

While it is possible to trace the roots of Total's climate-related efforts back 20 years or more, our 'maturity curve' analysis begins with their initial recognition of the challenges that climate change poses for a major energy company, and the need to address them.

Stage 1: Initial Engagement – In 2006, Total was one of the first major fossil fuel companies to publicly acknowledge the importance of climate change as a global risk. Their initial efforts focused on reducing flaring gas in the production process. Significant efforts began on this important source of scope 1 emissions to prove that cost-effective approaches could be broadly implemented for significant reductions.

Stage 2: Systematic Management – By 2008, Total began issuing systematic reporting on key GHG and climate-related performance metrics, including product use. Their efforts set them ahead of many oil majors, and included initial target setting for improvements in Total's operational footprint, driving the twin objectives of further reducing waste and cost, as well as mitigating climate risk.

Stage 3: Transforming the Core – In 2009, Total launched its EcoSolutions portfolio aimed at offering customers the opportunity to meet their energy needs, but doing so with products and services

engineered to deliver climate-advantaged benefits. Given that approximately 85% of Total's climate impacts come from product use, meaningful change requires redesigning and transforming its product lines and energy mix. The 2011 acquisition of a majority stake in SunPower, along with additional acquisitions in clean energy solutions, including Aquion Energy (storage technology), Saft (battery design), Stem (energy optimization) and BHC Energy (operational energy efficiency) demonstrated Total's commitment to transforming the company's business model from a 20th century fossil fuel giant into a 21st century new energy leader.

Transitioning to Stage 4: Creating Competitive Differentiation –

By 2014, under the leadership of Patrick Pouyanne, Total's new chairman and CEO, the company's strategy to differentiate itself from other oil majors is fully articulated. Going forward, Total would build its future business on three strategic pillars:

1. Reducing the carbon intensity of its fossil fuel product mix
2. Investing judiciously in carbon capture, utilization and storage technologies
3. Expanding their business base in "renewables," which includes production, storage and the distribution of clean energy and biofuels

The first major step was exiting the coal business in 2015. In 2016, Total's strategic direction advanced through the rollout of a new organizational structure creating (among other things) greater focus on renewables and low-carbon energy solutions. A newly formed Strategy & Climate division was formed to ensure that Total's business trajectory is kept tightly aligned with the IPCC's 2-degree C scenario, as well as support meaningful public policy actions such as a price on carbon. As Pouyanne stated in the 2016 announcement, "Our ambition is to create a new business that will help make Total the responsible energy major."

Total's commitment to low-carbon energy is among the most ambitious of oil and gas majors. Like its peer group, Total faces additional strategic decisions that will be critical for their ongoing financial success. Having stated that it will not invest in new high-cost, high-carbon resource development, expert analysis makes it clear that planned capital expenditures for the energy majors, including Total, could breach the 2-degree boundary. Total's recent acquisition of Maersk Oil, though adding to Total's geographic balancing of production and potential for financially beneficial operational synergies, also adds to a footprint that in the long term must be reduced.

If Total is to achieve its full Stage 4 potential, it will need to continue to demonstrate viable decarbonization pathways consistent with the 2-degree boundary, and commensurate actual emissions reduction performance through to 2050.

First, this will require sustained rapid growth of its EcoSolutions portfolio revenues in comparison to the company overall, ultimately making it the engine for Total's future financial success.

Second, investors, analysts and other key stakeholders will be looking for Total's continued leadership among the oil majors as they address the

²⁵ Of the examples of emerging leadership in this report, Total represents an underlying thesis that even the most carbon-intensive firms have the opportunity for transformative business model change, although in cases like Total's the challenges are much more significant than other sectors where underlying asset valuation is not so directly impacted.

²⁶ According to Total completed CDP Climate Change information request submissions

potential challenge of so-called “stranded assets.”

Total is one of the few energy majors entering the top tier of the Maturity Curve and, as such, the firm is well positioned to drive continued growth and financial benefits from their climate impact management strategy.

Leadership Translates into Reduced GHG Impacts

And the data shows leadership. Total has reduced emissions over the last three years well ahead of IPCC guidance, with an approximate 20% aggregate decline (or roughly 130 million tonnes) in total GHG emissions across all scopes.²⁷ And while emissions declined, Total’s carbon intensity

saw a 9.2% average annual rate of decline in GHG/BOE (greenhouse gas emissions/barrel of oil equivalent), between 2013 and 2016, or a cumulative decline of 27.5% from the baseline year of 2013.²⁸ Both aggregate emissions and the GHG intensity of their footprint are falling significantly.

Total Return and Cost of Capital for a Leader

Figures 8 and 9 provide evidence that Total’s strategy, along with its ability to execute it, is already generating value for the firm.

Total significantly outperforms its peers on total return during this period of decarbonization (e.g., 5 year: +48% vs. -15%) (Figure 8).

Figure 8:

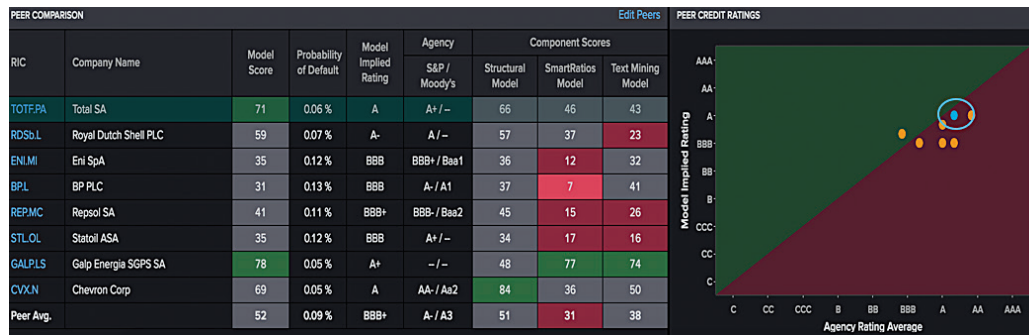


Source: Thomson Reuters Eikon

Thomson Reuters Eikon™ platform displays Total’s peer-leading credit rating, represented by the blue dot in the peer-scatterplot (Figure 9). This is a significant advantage in the capital-intensive energy sector. As Total continues to extend its climate impact leadership with more

renewable and low-carbon solutions, the increasing value of its transformed green product portfolio is likely to significantly outpace the potential declining value of its traditional high-carbon products.

Figure 9:



Source: StarMine, Thomson Reuters Eikon

²⁷ According to Total completed CDP Climate Change information request submissions

²⁸ http://www.annualreports.com/HostedData/AnnualReportArchive/t/NYSE_TOT_2015.pdf

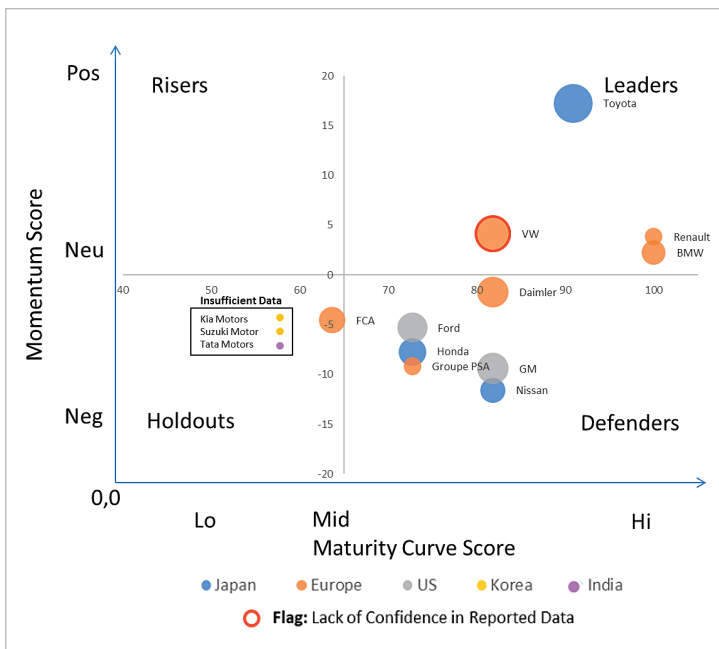
SECTOR LEADERSHIP USING THE M2 LENS

Transitioning now from individual case studies to a sector-level analysis using the CRT’s M2 lens to help analyze performance on climate impact management, we will look at two key sectors for climate: automotive and utilities.

The Auto Majors Seen Through the M2 Lens – A Key Sector for Managing Climate Impact

The major automakers have an important role to play in curbing emissions, especially given current and forecasted growth in vehicle ownership and usage. Today the sector produces approximately 93.5 million cars and other light-duty vehicles annually, responsible for approximately 17% of annual anthropogenic GHG emissions.²⁹ With rising incomes in the emerging economies, the total production is expected to grow significantly for the foreseeable future.

Figure 10: G250 M2 Analysis: Automobile Sector



NOTE: 2016 scope 3 product use data became available as this report went to press. This new data will show movement among the players. Figure 10 will be updated and available online at: www.constellationresearch.com and at sustainability.thomsonreuters.com

In tailoring the M2 Model for an analysis of the automakers global performance, the five general maturity stages described earlier are adapted. Each stage has a number of separate sub-stages or steps that enable more detailed analysis. Each of the automakers in the G250 has been analyzed to determine stage and sub-stage level.

Summary Description of the Auto Sector Maturity Curve

Stage 0: Pre-engagement – The company has not issued consistent policy statements or otherwise recognized the need to address climate impacts from its fossil fuel-based products.

Stage 1: Initial Engagement – The company issues policy statements recognizing the need for climate risk mitigation and enhanced resource efficiency, along with initial reporting of climate impact data.

Stage 2: Systematic Management and Goal Setting – The company expands GHG reporting to include the most relevant scopes, with verifications, with long-term targets for key portions of the most material emissions scope.

Stage 3: Transforming the Core – The company establishes global fleet-level targets for emissions reductions, and demonstrates significant progress on transforming its (and its key suppliers’) manufacturing processes to reduce climate impacts from operations. The company demonstrates significant progress bringing to market a changing product portfolio, including a cross fleet range of high- and ultra-high-efficiency vehicles.

Stage 4: Competitive Differentiation and Cultural Advantage – The company’s aggregate average fleet emissions place it in the top tier on fuel efficiency and emissions reductions in the sector. The company publicly supports policy and regulatory action to reduce emissions, and builds engagement on climate impact with employees, customers and other key stakeholders. The company tests and develops new products and business models that create the potential for breakthrough solutions to reduce climate impacts for automobile use.

Momentum Scores are calculated only for companies with reported and verified or confirmed scope 3 product use data for the relevant time period (2012 to 2015), producing a normalized annual rate of change classification based on data from CDP.

²⁹ <http://news.ihsmarket.com/press-release/global-auto-sales-set-reach-935-million-2017-risk-greater-ever-ihs-market-says>

A LOOK AT CLIMATE IMPACT AND THE AUTOMAKERS IN THE G250

Of the 15 firms in the automotive sector that appear on the G250 list, three firms stand out for both the highest Maturity Curve Scores and positive Momentum ratings based on global production. They are BMW, Renault, and Toyota. The mid-tier performers, including Daimler, GM, Nissan, Ford, Honda and Fiat, all exhibited mid-level or better Maturity Scores but negative Momentum Scores based on the reported trend in emissions from vehicles produced. The lower-tier firms, including Tata, Kia, Suzuki, do not report sufficient evidence to score them, itself a signal of a relatively low level of maturity.

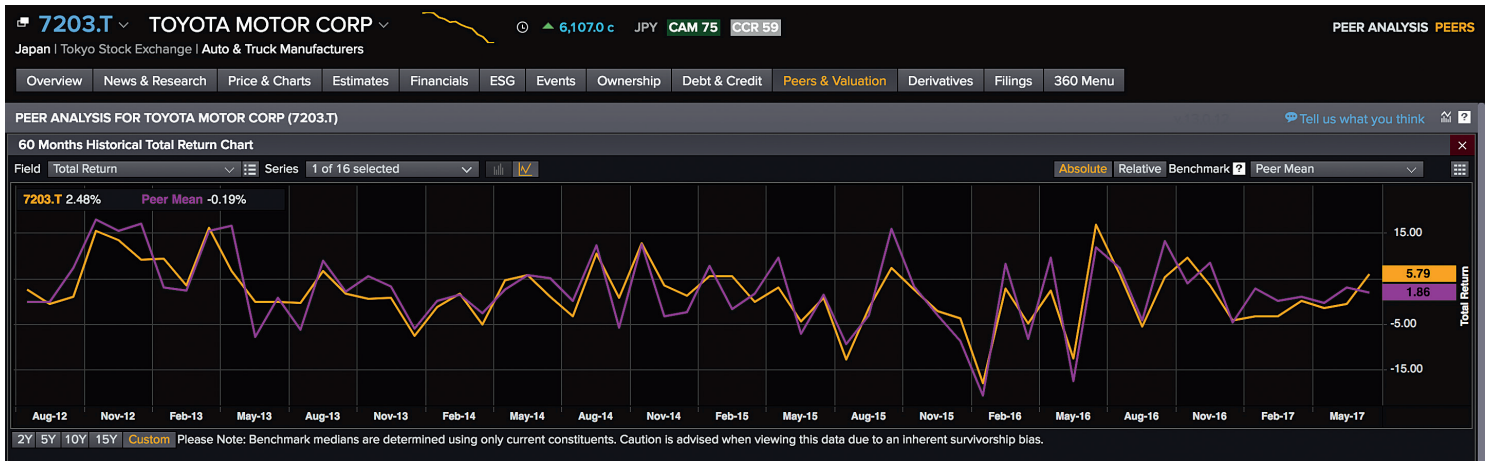
The last 18 months has seen significant change in the direction of many in the industry. As new highly efficient vehicles become more meaningful components of the revenue mix, we expect significant changes in these ratings.

**The Automotive Leader:
Toyota – Evidence for a Sustainability Premium**

The Leaders are gaining ground on meeting the market demand for fuel-efficient and climate-advantaged products across the automotive price/performance spectrum. Toyota, more than any other automaker in the G250, exemplifies a company that is building its brand and culture around sustainability, as it did with quality more than three decades ago. Toyota is monetizing the leadership position it has built over the past decade. Based on recent announcements, Toyota will face increased competition for the high-GHG efficiency segment it helped create.

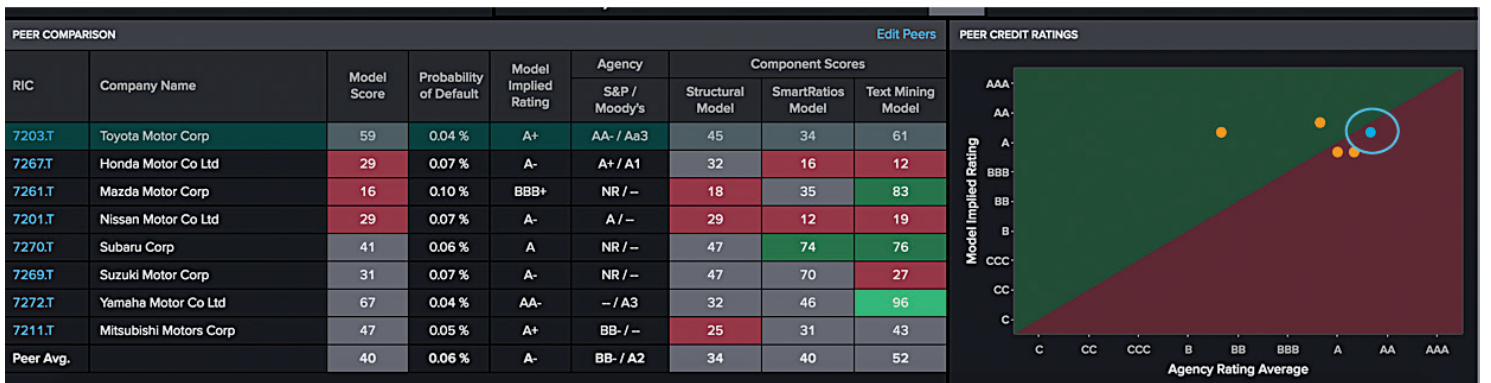
As illustrated in Figures 11 and 12, Toyota’s strategic vision and capacity to execute, as reflected in its M2 score, has enabled it to significantly outperform its industry peer benchmark on total return over the last five years (Figure 11) and lead the peer group on credit ratings (Figure 12).

Figure 11:



Source: Thomson Reuters Eikon

Figure 12:



StarMine, Thomson Reuters Eikon

The Automotive Defenders – Daimler, GM, Nissan, Ford, Honda, Fiat and Peugeot

The Defenders are meeting their compliance requirements and have built the capabilities to design and produce high efficiency/ low impact autos and light-duty vehicles. However, in comparison to Toyota, their year-over-year global scope 3 emissions improvements are less impressive. Many have exhibited a “defensive strategy”, meaning they have invested in capabilities to transform their product, including bringing new innovations to market. But based on the best information available, their overall shift in production toward lower-emissions vehicles will need to improve. GM’s recent announcement of their plan to have 20 electric vehicles in the market by 2023 and ultimately abandon internal combustion engines, and Nissan’s recent success with the Leaf sales are prime examples of a shift from defense to offense on climate impact.³⁰

The Risers

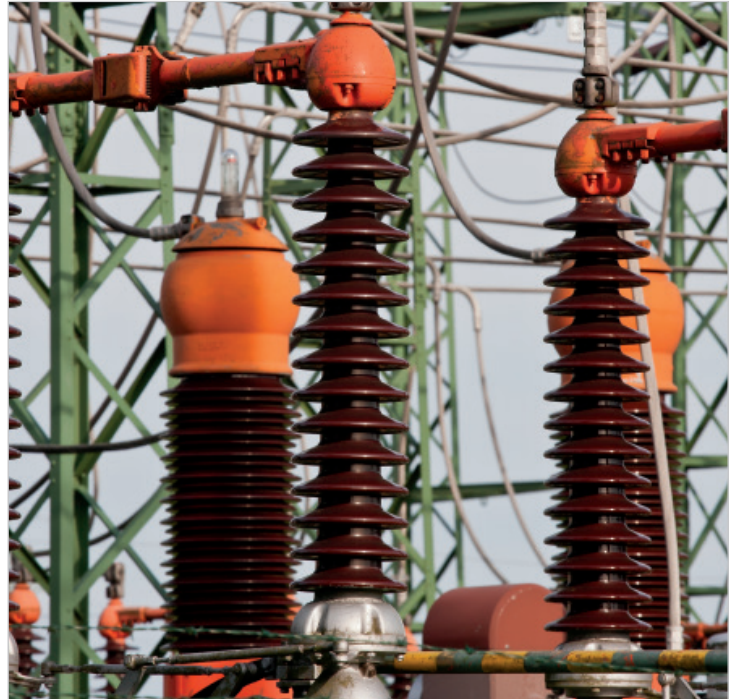
While, for obvious reasons, not on our list of the G250 largest GHG emitters, Tesla would be an excellent example of an automotive sector M2 Riser. Tesla was founded in 2003 to bring to market a bold new concept in electric vehicles – combining ultra-low emissions with high-performance driving. The questions for Tesla will be their capacity to scale up, reduce costs and meet growing demand for next-generation vehicles. The Tesla value proposition and Tesla story have yielded market returns for shareholders that are in line with other breakthrough technology companies. While Tesla must manage very high expectations, the demand for its newest products suggests the buyers are with them.

LOOKING AT THE UTILITY SECTOR THROUGH THE M2 LENS

The 52 companies classified in the utility sector on the G250 include the world’s largest publicly held electricity generators, transmission and distribution companies, as well as the operators of the largest natural gas services to end users. As our developing economies race to provide badly needed utility services to their people, successfully adopting innovative methods for integrating a growing share of low carbon and renewables into the mix is essential. No possibility exists for effective mitigation of climate risk without deep decarbonization from this sector.

Looking at leadership among utility companies through the M2 lens gives us both cause for optimism from the progress being made by a significant number of firms, and concern due to the seeming lack of meaningful engagement from a roughly equal number of utility companies on our G250 list. Leaders are evidencing opportunities to align climate and shareholder objectives.

The M2 Model for Utilities follows the same general five-stage structure described earlier, tailored to the specific challenges and opportunities in the sector.



Summary Description of the Utility Sector Maturity Curve

Stage 0: Pre-Engagement – The company has not issued consistent policy statements or otherwise recognized the need to address climate impacts from its fossil fuel-based energy products or energy production processes.

Stage 1: Initial Engagement – The company publicly recognizes its responsibility for developing strategies to mitigate future impacts, sees climate risks as material to future operations, and provides a plan to more deeply integrate climate impacts into business strategy.

Stage 2: Systematic Management and Initial Target Setting – The company initiates and expands climate impact reporting, including external verifications for primary emissions factors, and begins the process of target setting for future improvements across all relevant scopes.

Stage 3: Transforming the Core – The company initiates and expands renewable production/distribution setting intermediate and long-term targets, as well as targets, to increase customer efficiency (where appropriate). Positive emissions reductions are observed at an annual rate of 2% or greater, with material increases in production from renewables equal to 2% or greater.

Stage 4: Competitive Differentiation and Cultural Advantage – The company is producing and/or delivering a share of renewables as a percent of total energy. Using Tonnes of CO₂e (all scopes) per MW hour, the company performs in the top one-third of G250 Utilities (currently <= 0.41 Tonnes of CO₂e/MWh) or has an average annual decline on this metric greater than or equal to 2%.

³⁰ <https://www.nbcnews.com/business/autos/gm-going-all-electric-will-ditch-gas-diesel-powered-cars-n806806>

Figures 13 and 14 place the companies in the G250 utility sector on the CRT M2 Curve.

Figure 13: G250 M2 Analysis: Utility Sector Transmission and Distribution

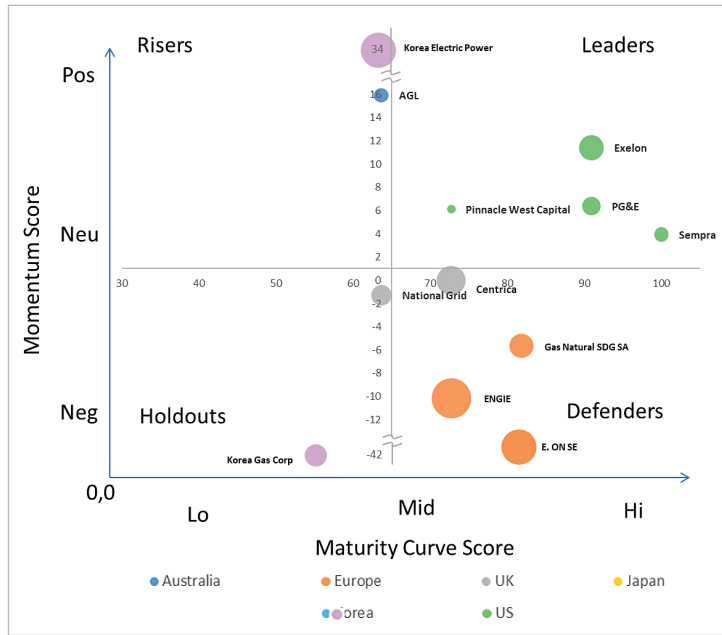
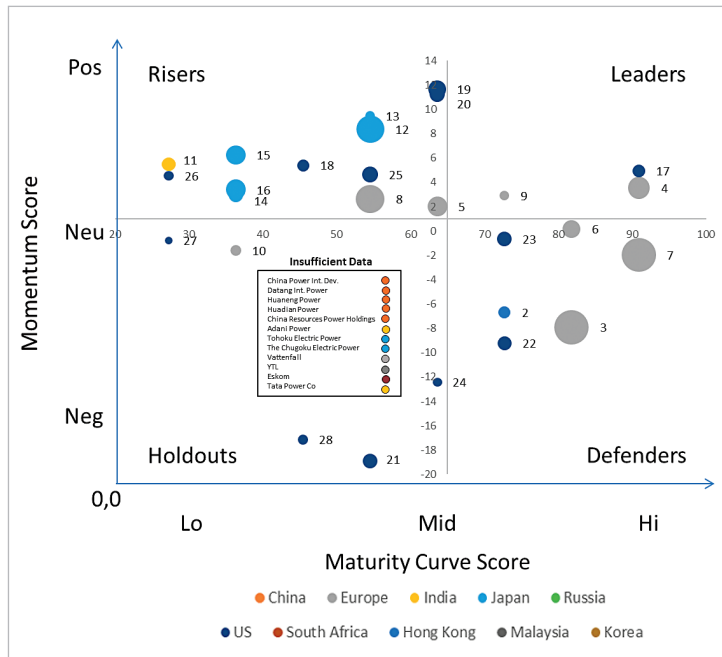


Figure 14: G250 M2 Analysis: Utility Sector Electricity Generators



NOTE: 2016 GHG data on the utility sector became available as this report went to press. Figures 13 and 14 will show movement. Updated utility sector M2 analysis will be available at: www.constellationresearch.com and at sustainability.thomsonreuters.com

The Utility Sector Momentum Score

In addition to the Maturity Curve assessment, a Momentum Score was created comparing 2012 to 2015 data, calculating a simple “rate of change” measure of overall GHG emissions (normalized in the local currency of the reporting Company to remove currency effects). A second specialized Momentum Score was also calculated using the same method but rating only Momentum on Growth of Renewables, above a threshold level.

Some Observations on the Utility Sector

The Leaders

Overall, as the M2 Curve illustrates, approximately one-third of the utility sector firms on the G250 list reach the high end of our Maturity Curve model, engaging in active strategies to mitigate emissions and reduce climate impacts. At the top of our curve are the firms with a significant portfolio of renewables, steep reductions in CO₂ intensive production (often from fuel switching), positive current Momentum, and significant targets that will drive reductions far into the future. Firms such as Iberdrola, Xcel, Exelon and PG&E are demonstrating the potential for transformation in the sector.

The Defenders

As in the auto sector, there are a group of utility firms that are positioned to make more significant progress on CIM, but are not currently performing to capacity, possibly due to one of many factors, including lack of strategic intent, regulatory uncertainties, feasibility of investing in cost-effective renewable production, etc. These firms, including companies such as CLP Holdings, AES Corp, Centrica and others, will need to more aggressively define their CIM game plan, and communicate it to interested stakeholders, as they seek to serve their market position in a changing world of new energy alternatives. It is likely that over the next decade, pressure for clean energy will continue to build as climate impacts become more palpable. Developing significant clean energy capacity can take many years. Now is the time for gearing up renewables and clean energy alternatives.

Legend for numbers in Figure 14

Indicator	Company
2	CLP Holdings Limited
3	EDF
4	Iberdrola SA
5	VEOLIA
6	Endesa
7	ENEL SpA
8	RWE AG
9	Public Power Corporation SA
10	Polska Grupa Energetyczna (PGE) SA
11	NTPC Ltd
12	The Tokyo Electric Power Company Holdings, Inc. (TEPCO)
13	Electric Power Development Co., Ltd (J-POWER)
14	Kyushu Electric Power Co., Inc.

Indicator	Company
15	Chubu Electric Power Co., Inc.
16	The Kansai Electric Power Co., Inc.
17	Xcel Energy Inc.
18	DTE Energy Company
19	Duke Energy Corporation
20	American Electric Power Company, Inc.
21	FirstEnergy Corporation
22	The AES Corporation
23	NRG Energy Inc.
24	WEC Energy Group
25	The Southern Company
26	Calpine Corporation
27	Dynegy Inc.
28	PPL Corporation

The Risers

The Risers in the G250 group are no doubt seeing that potential shift in both demand and business requirements for more sustainable energy solutions. Although, for the most part, they are only midway along the Maturity Curve, they are demonstrating significant positive Momentum on executing their decarbonization strategies. Companies such as Tokyo Electric Power Company, NTPC Ltd, Kyushu Electric Power, Chubu Electric, Calpine and DTE Energy typify the group.

The Holdouts

With few exceptions, it is difficult for an analyst to adequately understand these firms due to lack of transparency and/or public engagement on the climate change. Many companies in this quadrant may well be doing more than we know or have been able to report here. Becoming part of the global dialogue would benefit all parties. Investors, alongside other stakeholders, have an important role to play with these firms. As previously stated in this report, managing climate risk is inherently a “team sport.” For these firms, it is time to get in the game.

EARLY INDICATIONS OF M2 ECONOMETRIC RELEVANCE

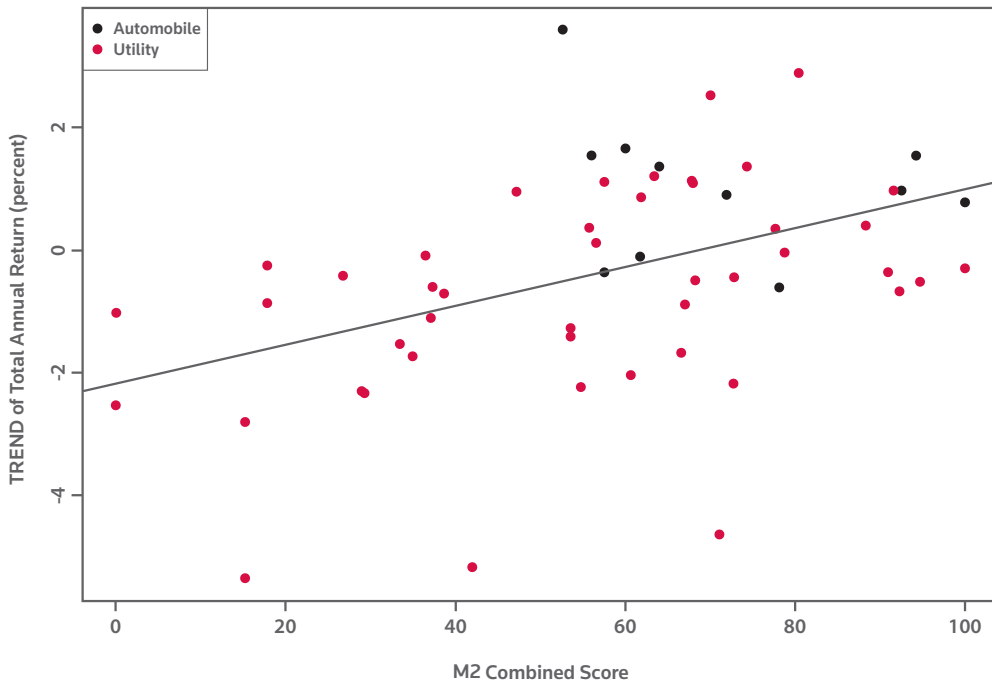
Many investigators have advanced arguments and data to show relationships between environmental performance and business outcomes. All suffer from various data deficits in their analyses and we are no different. Our G250 sample is highly skewed to large businesses and doesn't even fully represent all sector members. The data collected is difficult to verify, and standards are inexact.

With these caveats and others, we can report that the correlation between CRT's combined Maturity and Momentum (M2) Scores and the direction and rate of change in long-term trends on Total Returns (2001-2016) for the companies in the auto and utility sectors described earlier. The Percent Annual Change of Total Returns by company showed a moderate positive correlation with M2 Scores. A linear regression analysis was used in which the y-axis represents the change in the Percent Annual Change of Total Returns, while the x-axis represents M2 Scores (Figure 15). A correlation of 44% was found with a p-value of 0.0007. Total Returns are expressed as a percentage and are defined by the annual change in stock price with the inclusion of relevant dividends. Total Returns are calculated at the end of each calendar year.

What this suggests is that even including some outlier state-owned enterprises that may reduce the magnitude of the correlation, there does appear to be more than anecdotal evidence that superior M2 scores reflect a capacity to improve total shareholder returns as firms mature in their capabilities and climate impact management begins to be a strategic issue.

Better data, more complete sector coverage and the increasing business impacts from climate change will enable us to detect clearer signals of a firm's sustainability premium potential in the future.

**Figure 15: M2 Combined vs TREND of Total Annual Return (percent)
Correlation (p-value) with all companies = 0.44 (0.00074)**



THE KEY ROLE OF POLICY MAKERS AND CITIES

Particularly important in the broader stakeholder group are policy makers at all levels, including at the city level, where the world's population is migrating, and where there is much opportunity for engagement between the private and public sectors. In collaboration with the United Nations 1 Gigaton Report on renewable energy development and efficiency, we are proud to co-publish the following excerpt from their latest report, the full version of which can be found at www.1gigatoncoalition.org/.³¹

These are important examples of public-private innovation at the city level in two key countries: India and China.



Content provided by the United Nations Environment Programme (UNEP)

Lead Authors from 1 Gigaton Coalition: Zitouni Ould-Dada, Rashmi Jawahar Ganesh

Thomson Reuters would like to thank and acknowledge the important contributions of the 1 Gigaton Coalition. Important data and analytics support was provided by Angel Hsu, Carlin Rosengarten, Amy Weinfurter and Yihao Xie (Yale University), and Evan Musolino and Hannah E. Murdock (REN21).

Renewable energy sources and energy efficiency improvements are well recognised as two critical means of reducing greenhouse gas emissions, and bringing development benefits to improve health, education and green economic growth. In 2016, a record 138.5 gigawatts (GW)³² of new capacity of renewable energy was installed, mostly in developing countries and emerging economies. This would help to achieve the climate goal and also deliver co-benefits including human health and security. This is why the 1 Gigaton Coalition, a voluntary international framework initiated by the Government of Norway and coordinated by UN Environment, has been working to quantify emission reductions resulting from the growth in renewable energy capacity and the improvements in energy efficiency.

The 1 Gigaton Coalition has previously published two reports where it reported significant emissions savings from various renewable energy (RE) and energy efficiency (EE) initiatives and bilaterally supported projects. The 2016 report analysed 224 supported renewable energy and energy efficiency projects in developing countries implemented between 2005 and 2015 and found that they would reduce greenhouse gas (GHG) emissions by approximately 0.116 gigatons of carbon dioxide (GtCO₂) annually in 2020. While efforts in developing countries represent promising contributions to global climate mitigation, meeting the Paris Agreement's long-term climate goals

will require more ambitious renewable energy and energy efficiency initiatives. Also, since the energy projects are quite diverse and complex, they require a robust calculation methodology. To address this, various dialogues have been held with international experts, policy makers and researchers to help refine the methodology and ultimately develop a unified one.

The 2017 report of the 1 Gigaton Coalition presents a new methodology for quantifying emission reduction by developing criteria intended to assess a sector's compatibility with global climate goals. This latest report shows how these compatibility conditions can be applied to 273 partner-supported renewable energy and energy efficiency projects in developing countries, which were implemented between 2005 and 2016. These projects were found to reduce GHG emissions by approximately **0.258 gigatons of carbon dioxide (GtCO₂)** annually in 2020. Since the world's cities produce almost half of all greenhouse gas emissions, they are central to tackling climate change. This report highlights some of the increased efforts by non-state actors in a number of cities – such as New Delhi (India), Nanjing (China), Kampala (Uganda), Mexico City (Mexico), Lagos (Nigeria) and Valle del Cauca region (Colombia) – where they work together with the private sector to reduce emissions, and improve the lives of local communities.

³¹ For more information about the 1 Gigaton Coalition, please contact Zitouni Ould-Dada (zitouni.ould-dada@unenvironment.org) or Rashmi Jawahar (rashmi.jawahar.affiliate@unenvironment.org).

³² Renewable Energy Policy Network for the 21st Century (REN21). (2017). Renewables 2017 Global Status Report. Retrieved from: www.ren21.net/gsr

Thomson Reuters, in its recent report *Global 100 Greenhouse Gas Performance: New Pathways for Growth and Leadership* finds that there is a crucial link between sustainability and growth in the Global 100 industries. These companies, including their value chains, are estimated to account nearly for a quarter of global annual emissions. Their report highlights select companies, which have achieved progress by embracing new business models to support decarbonisation. Such companies have not only achieved financial gains but are also growing responsibly in an increasingly fragile and resource-constrained planet. This kind of recognition will help non-state actors to continue to make bold commitments – all of which are crucial not only for delivering the Paris Agreement, but also in closing the emissions gap needed to stay well below 2 degrees Celsius.

Two case studies from the 2017 1 Gigaton report are briefly illustrated below.

New Delhi, India – Transforming Waste into Energy

In New Delhi, India, an estimated 60% of the population experience respiratory problems due to dumping of waste in open spaces. The city is tackling this problem by forming an innovative public-private partnership between the East Delhi Municipal Corporation and the Infrastructure Leasing and Financial Services Environment (IL&FS Environment) to set up an Integrated Municipal Waste Processing Complex at Ghazipur. This plant is reducing emissions and transforming waste into energy. The plant's construction lowers health and safety risks for employees and the nearby community; generates land savings critical to a rapidly growing city; and reduces leachate and toxic emissions from the landfill.

To ensure that local waste-pickers receive support and retraining, IL&FS Environmental employs 70 former waste-pickers in its plant. They partnered with a non-profit organisation to establish Gulmeher, a community center that offers direct employment and artisan training to about 200 local women. The Delhi-based start-up, Aakar Innovations, also supports Gulmeher, training women as suppliers of its products. To further expand financial inclusion, 400 local families received bank accounts and Permanent Account Number cards, and kiosk banking was provided to the local community through the State Bank of India. This plant will save 8.2 million tons of greenhouse gas (GHG) emissions over its 25-year lifespan and help mitigate landfill area and air and water pollution.



New Delhi, India: Energy generating plants powered by risk husk waste.

Nanjing, China – Moving Ahead with Electric Vehicles

Nanjing Municipal Government aspires to restructure Nanjing's economy around less carbon- and energy-intensive industries, including sustainable transportation, in alignment with China's national economic, energy and climate policies. As a result, the city has drastically cut its carbon emissions and use of oil, and generated over US \$71 million in savings from lower energy bills. It has also rolled out a series of policies aimed at promoting the sale, use and production of renewable energy vehicles. The city deployed the fastest rollout of electric vehicles in the world, adding 4,300 electric vehicles to their streets during 2014-2015. This transition to electric vehicles (EV) helped Nanjing reduce CO₂ emissions by 246,000 tons in 2014.

Nanjing Municipal Government receives policy direction and support from the central and provincial government. The private sector also plays a key role in Nanjing's expansion of its EV sector, by providing solutions, products, services and investments. In August 2017, the Nanjing New Energy Automobile Operation Alliance was launched. It consists of 37 companies across the entire EV value chain – including carmakers like BYD, real estate developer China Fortune Land Development and charging station solution provider e-charger. The alliance is also supported by the Nanjing Municipal Government's EV Office and the Nanjing Economic and Technological Development Zone. The city supported this effort by installing battery-swapping and charging stations, offering incentives for the construction of additional charging facilities, introducing purchase-price and electricity-price subsidy schemes, and mandating the use of electric vehicles in the public sector. Platforms like this will enable Nanjing to expand its volume of EVs and develop a transportation sector that runs on clean, pollution-free renewable energy.

The work of the 1 Gigaton Coalition, and more specifically its case studies showing some leading examples of private sector at city level, is complementary to the work of Thomson Reuters. This is particularly important in the current political climate following the announcement of the U.S. to leave the Paris Agreement, and the consequences this would have for achieving the global climate change goals. But the 1 Gigaton Coalition and Thomson Reuters reports show the critical role of private sector and cities in particular in raising ambition to reduce emissions, building knowledge, and supporting implementation of the Paris Agreement in addition to country efforts. The commitments of non-state actors, in particular private sector, shows that making our way towards a low-carbon future is possible, and that the leadership they are showing in taking action should inspire other actors to see the opportunity for more actions towards decarbonisation and climate adaptation.



Nanjing, China: BYD electric bus in Nanjing Xinjiekou bus stop.

About the 1 Gigaton Coalition

The 1 Gigaton Coalition is a voluntary international framework initiated and supported by the Government of Norway, and is coordinated by UN Environment. Its mission is to measure and report reductions of greenhouse gas emissions resulting from renewable energy and energy efficiency initiatives and programmes. It provides a platform for countries to promote their efforts in the energy sector and their contributions to reducing the emissions gap needed to stay below 2 degrees Celsius and achieving the Sustainable Development Goals. There is currently no universally agreed methodology for measuring and reporting emissions savings resulting from renewable energy and energy efficiency activities. The 1 Gigaton Coalition has therefore been working with partners and stakeholders to develop a robust harmonised methodology.

Website: www.1gigatoncoalition.org

GLOBAL POLICY MAKING TREND

Alongside cities, the global policy community – with the recent exception of the United States at the federal level – is increasingly focused on policy initiatives that reward companies that commit to aligning their business and climate strategies, as exemplified in this interview with the Norwegian Minister for the Climate and Environment, **Vidar Helgesen**:

QUESTION:

1. *What is Norway's view of the current role and importance of the Paris climate agreement?*

MINISTER HELGESEN:

The adoption of the Paris Agreement was a turning point, as it is the first legally binding framework committing all countries to put forward their contributions to fight climate change and to strengthen them in the years ahead. I trust that the ambition mechanism will ensure that Parties' contributions will have a higher ambition over time. The Paris Agreement sends important signals to investors and businesses all over the world. The unprecedented support for the Agreement and the speed in which it entered into force, shows that the world now recognises the urgency of action to combat climate change.

QUESTION:

2. *What new steps can leading policy makers take to help accelerate climate change mitigation? What opportunity does Norway have to provide leadership in this regard?*

MINISTER HELGESEN:

- **Price on carbon:** Not at all new, but we know it works and it is definitely an instrument that should be used more globally. Norway has been leading in this respect. Combined, the carbon dioxide (CO₂) tax and EU-ETS cover more than 80 percent of Norwegian GHG emissions. In our climate strategy for 2030 the CO₂ tax is an important tool.
- **Designing a tax system that leads to lower carbon emissions/ encourages technological shifts:** The Norwegian government has set itself a target that all new passenger cars sold in 2025 shall be zero-emission vehicles. The tax system has been designed so that the purchase of zero-emission cars should be more economically favourable than the purchase of conventional cars. Improvements in technological maturity, in a way that zero-emission vehicles will be competitive in relation to conventional vehicles, is a precondition for the 2025 target.

Norway's successes in introducing electric vehicles indicate that if government backing and purposeful policies make them competitive to purchase and use, they can take over a large share of the market from conventional models that run on fossil fuels.

- **Strategy for green growth:** Economic growth, reduced emissions and (full) employment must be addressed simultaneously. The Norwegian government will present a strategy for green

competitiveness in a few weeks. Working together with the different sectors for long-term change to the low-emission society is one important part of the process. Around 15 business sectors have made their own road map to the low-emission society, highlighting both opportunities and challenges for each sector.

- **Research, development and investment:** Supporting technology development and introduction are also key. Norway has strengthened the financial support to research and development in all phases – from pure research to market introduction. These last years we especially have increased the support to green pilot projects, the most costly and risky phase of technology development. The government is also in the process to establish a new investment company that will contribute to climate change mitigation.

The Norwegian government will continue to ensure that the public sector as a customer supports the adoption and development of new environmentally friendly technologies and solutions. For example, environmental requirements in public procurement processes has promoted the development of electric ferries in Norway.

QUESTION:

3. *How important is the private sector as a whole on the climate change issue? What role do you see the private sector increasingly playing in response to climate change?*

MINISTER HELGESEN:

The private sector is crucial. There is no way we can solve climate change without the private sector.

First, the private sector plays a crucial role in developing zero- and low-emission technologies that we need to reach our climate targets. New and improved technologies for solar and wind electricity generation, electric vehicles and industrial processes are examples of areas where we have already seen the private sector make a huge impact. Changes in the market are happening faster than ever before, and the winners will be those capable of transforming to new, green solutions. Policy makers globally are increasingly engaging with the private sector to encourage and incentivise this transformation, and those firms which hold on to legacy business models will find themselves increasingly at a competitive disadvantage.

Second, we need the private sector to help mobilise the capital and necessary finance to solve the remaining challenges. Public funding will not be sufficient to cover the mitigation investments needed. However, public funding can be used to catalyse increased private and commercial investments.

Third, the private sector has begun to utilise their influence to push for climate change policies that make sense. Reaching the Paris Agreement was a result of the fact that governments, companies and NGOs realised that going green makes business sense. I believe we've only seen the beginning of the influence that can be reached through such partnerships.

QUESTION:

4. *Is there an evolving model for public-private sector engagement to address increasingly complex climate change issues?*

MINISTER HELGESEN:

Yes. There is no doubt that the relationship between the public and private sector is continuously evolving to address the common challenges we are facing. Since 2007, Norway has been particularly engaged in supporting global efforts to reduce destruction of tropical forests. NICFI (Norway's International Climate and Forest Initiative) actively engages with and enters partnerships with the private sector with the aim to secure deforestation-free supply chains and encourage a low-carbon development path.

In January of this year, we launched a new risk-sharing fund to kick-start investments in deforestation-free agriculture in countries that are working to reduce their forest and peat degradation. The fund aims to motivate the redirection of financial flows towards intensified land use, combining forest conservation with increased food production and economic growth, thus creating systemic change that will have large-scale, long-lasting impact. By crowding-in co-investors, the andgreen fund maximises the amount of private capital available. This is one recent example of how the public sector and the private sector can work together to reach our shared goals.

QUESTION:

5. *Are there specific regulatory actions you are seeing, either in Norway or globally, that seem particularly significant in responding to climate change?*

MINISTER HELGESEN:

This year the Norwegian Parliament adopted a new climate act; this is a new invention in Norwegian legislation. The main objective of the act is to promote the implementation of Norway's emission reduction targets as a part of the transition to become a low-emission society. It sets binding emission reduction targets for 2030 and 2050 and makes legally binding the long-standing political aim to become a low-emission society by 2050. The act will have an overarching function in addition to existing environmental legislation. It gives a clear direction for the climate policy and provides the necessary flexibility to implement climate measures.

QUESTION:

6. *Does the recent spate of severe weather events suggest more urgency is needed on mitigation and adaptation? How should governments and industry begin to respond accordingly?*

MINISTER HELGESEN:

- In order to reduce vulnerability to climate change, governments must respond with both adaptation and mitigation actions.
- Future vulnerability will depend on the extent to which climate change considerations are incorporated into planning and decision-making processes in all areas and all levels of society.

- All sectors – private and public – are responsible for assessing and addressing the impacts of climate change on their areas of competence.
- Climate change adaptation is still a quite new field of research, and it is important – with a close link between research communities and policy makers – that we can adjust our policies as we learn more and more about the effectiveness of different adaptation measures.

QUESTION:

7. *Are there any technological innovations that you think hold particular promise in addressing climate change, and which should be encouraged by policy makers?*

MINISTER HELGESEN:

- **A green shift** will require technological innovations in different areas, from energy, transport, buildings, industry, food production and infrastructure.
- **Second-generation renewables**, for example, bigger wind turbines and more effective solar panels, will likely transform the energy sector globally within the next decades. Electricity produced with zero emissions and zero marginal cost will likely be key in the global efforts to address climate change.
- **In the transport sector**, it is likely battery technologies will be most important in the decarbonisation process. With the cost curves, we have seen on battery technologies it could be a matter of years before electric vehicles are cost-competitive. However, the scaling up of the production of electric vehicles will be just as important. I believe that technological development and political signals for the phasing out of the combustion engine will be powerful drivers for the decarbonisation of our transport sectors. Since the 1990s, Norway has had in place a range of benefits for zero-emission vehicles, from tax breaks to user benefits such as free toll roads. Today, Norway has the world's highest share of zero-emission vehicles in its passenger car fleet. In the first half of 2017, the battery-electric vehicles had almost a 19% market share of the total new passenger car sales.
- **The world's first electric car ferry** has been in commercial operation since 2015. From January 2018, two more electric car ferries will operate on Norwegian fjords. Around 50 battery electric or hybrid-electric car ferries are either in planning or in construction in Norway. The development is the result of an active public procurement strategy from the Norwegian government. Today, as a rule, the Norwegian government requires zero and low-emission technology for all new public tenders for car ferries.
- It will be extremely difficult to reach the goals in the Paris Agreement without a massive deployment of carbon capture and storage (CCS) globally. Norway strongly supports CCS technologies as one important tool to mitigate climate change, but to succeed we will need broad international cooperation. The Norwegian government also continues to support and plan for the development of a CCS project in Norway.

CONCLUSION: A SUSTAINABILITY PREMIUM FOR THE PLANET

The pathway to the top is not an easy climb. It takes years, and in many cases, a decade or more of hard work. Not all firms have the vision to see the opportunity. For some, it may not exist without radical transformation. Others may start strong but stop along the way as management changes shift priorities. Some CEOs prefer to wait and see whether the new business logic is real in their market.

For such companies, the risks are great. Catching up may be hard or impossible – think of digital photography and Kodak. And even among those that see the opportunity, not all can build the *capacity to execute* fully – remember BP’s initiative to get “*Beyond Petroleum*”?

Many companies at the top of the curve are delivering a *Sustainability Premium* to their shareholders and their planet. Firms not yet there, but maintaining strong momentum as they climb the curve, have a significant sustainability premium potential. Understanding how to spot companies as they are rising is an important insight for investors seeking an opportunity in a changing competitive landscape, and a challenge many analysts are taking up.

The cases and sector views presented demonstrate that making our way toward a low-carbon future is not just possible, but profitable. The data suggest companies, even in carbon-intensive sectors, can have a winning strategy turning leadership into transformative business opportunity.

The world is entering a new chapter in meeting the climate challenge. Three things are true.

1. The planetary timeline for bending the GHG curve is tightening, adding urgency to the need for change.
2. The needed cost curve reductions on new climate-friendly technologies have arrived. This means “crossing the chasm” from early adoption to mainstream demand and accelerated growth is now underway. Many early movers are gaining business advantages.
3. The rewards for leadership are accelerating from investors, consumers and regulators, all of which have increasingly sophisticated tools for detecting and measuring climate leadership. (Please see Appendix 3 on new satellite detection for GHG.)

Climate constraints will continue to grow into powerful market forces effecting business and investors. Policy making that once supported exploitation of the natural world is shifting gears to enable and reward the new carbon logic. We are making progress, and leaders in all domains can serve as role models.

This may be the biggest business opportunity any of us will ever see – changing the energy production and use-patterns of the planet. This is as big as electrification and mass production, and arguably much bigger than synthetics, IT, the Web, and globalization. There is a new bottom line coming into focus that is replacing business as usual.

Which logic do we follow?



STATE OF THE CLIMATE 2017

CLIMATE CHANGE BY THE NUMBERS

The four warmest years on record globally occurring in the past four years. Warmer oceans and increased atmospheric water vapor spawning turbo-charged hurricanes. Live coverage of the latest climate-enhanced extreme weather event. Climate change is making the daily news. The impacts become more real and hit closer to home every year. What is the current state of earth’s climate by the numbers?

16 of 17 warmest years on record globally have occurred since 2000.

1 in 27 million odds that this string of warmest years since 2000 occurred naturally.

1.48C – global average temperature change from early industrial levels most likely for the whole of 2016. www.scientificamerican.com/article/earth-flirts-with-a-1-5-degree-celsius-global-warming-threshold/

4 for 4 – the four warmest years on record globally have occurred in the past four years.

2017 – is likely to finish as the second- or third-warmest year on record globally.

2016 – unprecedented third consecutive “warmest year on record” globally since 1880. www.ncdc.noaa.gov/sotc/global/201613

2015 – second consecutive warmest year on record globally since 1880.

2014 – previous warmest year on record globally since 1880.

410 ppm – atmospheric CO₂ likely to reach unprecedented level in 2017. scripps.ucsd.edu/programs/keelingcurve/wp-content/plugins/sio-bluemoon/graphs/mlo_one_year.png

22 to 44 cm – IPCC projected sea level rise by 2100.

1 trillion tons – cumulative ice loss in Greenland between 2011 and 2014. www.independent.co.uk/environment/climate-change-global-warming-greenland-ice-melting-rate-sea-levels-rise-a7147846.html

\$300 billion – Estimated cost of Hurricanes Harvey, Irma and Maria, and western U.S. wildfire in 2017. insideclimatenews.org/news/28092017/hurricane-maria-irma-harvey-wildfires-damage-cost-estimate-record-climate-change

3.4 million – people in Puerto Rico without power after Hurricane Maria. Thousands of new climate-driven refugees migrating to the U.S. mainland? www.scientificamerican.com/article/puerto-ricans-could-be-newest-u-s-climate-refugees/

Contributed by Minnesota Public Radio Chief Meteorologist Paul Huttner, www.theguardian.com/environment/climate-consensus-97-percent/2014/aug/21/scientist-in-focus-meteorologist-paul-huttner

APPENDIX 1: PERFORMANCE: THE G250³³ AND OUR PLANET

As mentioned earlier, the G250 emitters matter because they represent a large portion of annual GHG emissions, and they can immediately influence their marketplaces and policy makers to drive significant but linear manageable reductions of 3% per year in line with recent scientific guidance. Looking at the performance of this group of companies, we see in Figure 16 the top 250 publicly traded

emitters of the world and their most recent emission figures across all scopes. It is critically important that this data is used to launch a deeper discussion into the latest emissions figures and company plans for decarbonization. The G250 companies themselves may have more up-to-date information than is currently available through public sources or expert estimate, and their input is welcome.

Figure 16: The Global 250

Rank 2015	Company Name	GHG Emissions Tons CO ₂ e Scope 1+2+3			GHG Index	Revenues Index	Decoupling Index	Employment Index
		2016	2015	2014				
								Baseline 2014 = 100
1	Coal India	2,076,244,220	2,014,314,687	1,869,412,290	111	118	107	93
2	PJSC Gazprom	1,176,925,161	1,247,624,306	1,264,855,340	93	116	124	103
3	Exxon Mobil Corporation	1,098,498,615	1,096,498,615	1,145,083,349	96	55	58	94
4	Thyssenkrupp AG	953,797,000	954,185,140	955,185,140	100	95	95	96
5	China Petroleum & Chemical Corporation	721,411,029	874,153,506	901,550,000	80	68	85	126
6	Rosneft OAO	853,709,607	835,868,134	829,849,040	103	91	88	N/A
7	Cummins Inc.	805,593,388	813,043,062	920,001,660	88	91	104	101
8	PETROCHINA Company Limited	621,336,019	730,924,555	688,790,000	90	71	79	95
9	Royal Dutch Shell	734,160,000	698,868,219	735,119,000	100	55	56	98
10	Rio Tinto	670,621,000	669,751,731	652,023,000	103	71	69	85
11	China Shenhua Energy	664,949,000	643,832,223	733,109,000	91	72	80	98
12	Korea Electric Power Corp	456,346,512	634,243,789	666,588,494	68	105	153	216
13	Total	469,545,000	581,900,000	598,400,000	78	60	77	102
14	Petróleo Brasileiro SA - Petrobras	468,402,442	547,476,491	618,399,435	76	84	111	85
15	United Technologies Corporation	403,968,529	530,627,775	530,803,247	76	99	130	96
16	BP	499,780,356	498,532,391	503,912,000	99	52	52	88
17	BHP Billiton	467,795,000	474,376,663	436,331,000	107	83	77	94
18	Chevron Corporation	500,853,000	456,670,481	446,984,124	112	55	49	85
19	Valero Energy Corporation	443,271,000	438,112,727	449,248,000	99	58	59	99
20	Wistron Corp	403,527,472	403,459,693	512,740,724	79	111	142	N/A
21	Peabody Energy Corporation	372,034,991	397,048,383	435,215,170	85	69	81	81
22	Lukoil OAO	338,014,263	394,684,146	387,677,000	87	95	109	N/A
23	Toyota Motor Corporation	251,538,526	377,020,000	383,198,000	66	123	188	102
24	YTL Corp	359,818,025	372,968,912	393,985,600	91	80	87	N/A
25	General Motors Company	328,696,823	354,788,985	380,880,503	86	107	124	104
26	Phillips 66	353,835,500	330,318,261	324,759,000	109	53	48	106

³³ GHG emission data for this report is a result of a collaboration between Thomson Reuters and CDP, to combine and publish the most current and best estimates available on these companies. Generally, if a company reported its emissions, those figures were used unless they are not sufficiently representative of the global footprint of the company. More specifically by source, Thomson Reuters source for data is scopes 1, 2 and 3 public disclosures made by the company, or proprietary estimates in lieu of scopes 1 or 2. CDP sources for data are:

- **Scopes 1 and 2:** CDP-completed information requests, CDP data check of information requests, bottom-up models (physical activity data * emission factors for O&G, coal, cement, electric utilities and iron & steel), intra-company models (using previously reported values to estimate, interpolation, etc.) and multivariable regression model (revenue per activity treated as independent variables; for scope 2, CDP uses reported or estimated steam, heat, electricity & cooling (SHEC) and multiplies that by a geographical revenue-weighted average grid factor based on IEA country grid factors.
- **Scope 3:** CDP-completed information requests, CDP data check of information requests, multivariable regression model. CDP selects a level of the 3-tiered activity classification system CDP developed based on the best p-value per activity – activity is the most granular (e.g., cement) followed by sector (e.g., construction materials) and then industry (e.g., materials). CDP bottom-up estimates for “use of sold products” for fossil fuel companies and auto manufacturers.

Where changes in GHG from 2014 to 2015 for specific scopes (for example scope 3) are known to be due to changes in level of reporting, methodology used or estimation methods (e.g., in cases of cross-sectional regression analysis with differing test data) the change in scope 1 & 2 emissions is used in conjunction with the company’s respective 2015 scope 3 emissions data to determine scope 3 emissions values for 2014 (and for different scopes as the case may be). For 2016, CDP-reported values and preliminary estimates were used (that will be updated in the cases of Alcoa, CVS Health, Essar Oil, Hellenic Petroleum, Kia Motors, Statoil and others) as well as methods described above for changes from 2015 to 2016. For Ingersoll Rand, increasing emissions number in 2016 is a result of a fuller inventory of emissions than in previous years to date; Ingersoll Rand has reduced GHGs from the use of sold products by 6.7 million metric tons CO₂e, according to Ingersoll Rand.

Financial years for GHG emissions and revenues may differ, and may differ with calendar years. In some cases, the values reported are the same from one year to the next as disclosure is private to CDP, insufficient disclosure or only one year’s data was available. The data source is Thomson Reuters for Glencore plc, RWE AG, Bridgestone Corporation, The Tokyo Electric Power Company Holdings, Inc. (TEPCO), Nippon Steel & Sumitomo Metal Corporation, Showa Shell Sekiyu K. K. and Evraz PLC.

GHG Index above 100 indicates increasing emissions trend; Revenues Index above 100 indicates increasing revenue trend; Decoupling Index above 100 indicates revenues increasing faster than emissions; Employment Index above 100 indicates increasing employment trend. Decoupling Index & Revenue Index may be affected by price volatility (e.g., price of oil) and high inflation rates.

Revenues indexes for ArcelorMittal, Eskom, Vattenfall Group, MOL Nyrt., Cosmo Energy Holdings Co., Ltd. Alcoa Corp., Korea East-West Power, and National Grid PLC will be provided in a subsequent update. Employment indexes were not available for all companies in the G250 and will also be provided in a subsequent update.

Rank 2015	Company Name	GHG Emissions Tons CO ₂ e Scope 1+2+3			GHG Index	Revenues Index	Decoupling Index	Employment Index
		2016	2015	2014				
27	Volkswagen AG	340,656,337	328,298,166	337,075,378	101	107	106	106
28	Glencore plc	339,425,188	326,636,000	331,348,000	102	69	68	N/A
29	ENGIE	321,213,893	320,939,381	352,946,103	91	89	98	N/A
30	Statoil ASA	240,563,574	319,983,912	325,540,226	74	47	64	91
31	Eni SpA	287,432,924	297,311,713	338,010,554	85	57	67	96
32	Vale	335,362,681	289,056,616	272,454,946	123	115	93	84
33	Honda Motor Company	304,145,341	284,953,792	279,006,000	109	117	107	105
34	Marathon Petroleum	280,623,000	279,742,953	257,367,900	109	65	59	98
35	Hitachi, Ltd.	123,825,362	272,874,653	266,803,783	46	104	224	105
36	Reliance Industries	263,339,699	268,098,109	253,852,910	104	68	65	101
37	ConocoPhillips	254,345,983	254,391,143	254,407,888	100	46	46	70
38	Huaneng Power International	240,237,500	248,507,205	252,371,200	95	90	95	112
39	RWE AG	241,800,000	247,500,000	248,800,000	97	94	97	98
40	ArcelorMittal	238,082,827	244,894,455	332,358,056	72	N/A	N/A	N/A
41	Anglo American	248,611,091	243,575,598	332,688,759	75	79	106	84
42	CNOOC	196,054,993	235,549,089	212,858,000	92	53	58	73
43	MAN SE	225,213,654	225,234,175	200,231,641	112	95	84	96
44	LafargeHolcim Ltd	198,870,897	221,252,230	134,520,461	148	143	97	135
45	Procter & Gamble Company	222,684,239	221,185,336	221,566,336	101	88	88	93
46	Surgutneftegas OAO	198,159,770	218,715,099	217,298,000	91	115	126	99
47	China Coal Energy	176,286,650	216,367,422	263,829,830	67	86	128	87
48	Eskom	211,294,029	215,682,502	238,941,883	88	N/A	N/A	N/A
49	E.ON SE	84,485,909	210,662,733	234,422,941	36	34	94	73
50	Daikin Industries, Ltd.	198,770,331	199,047,459	161,380,748	123	114	93	178
51	Anhui Conch Cement	209,805,800	197,375,558	188,506,500	111	92	83	108
52	General Electric Company	171,501,000	197,315,071	199,277,438	86	106	123	93
53	PTT	184,456,302	191,310,709	193,296,399	95	66	69	N/A
54	NTPC Ltd	185,642,700	187,636,198	190,303,906	98	93	95	N/A
55	Saic Motor Corporation	267,220,000	185,711,331	200,820,000	133	120	90	92
56	Goodyear Tire & Rubber Company	177,210,349	182,845,651	182,586,890	97	84	86	113
57	China National Building Materials Company Limited	191,952,000	180,915,910	183,555,000	105	83	80	99
58	Boeing Company	170,950,000	178,391,357	178,932,357	96	104	109	85
59	China Resources Power Holdings Company Limited	174,732,400	173,462,593	173,667,000	101	94	93	91
60	Ingersoll Rand Co. Ltd.	217,122,025	165,732,301	192,276,559	113	105	93	79
61	SK Innovation Co Ltd	183,094,580	165,143,892	154,876,000	118	60	51	N/A
62	Centrica	150,217,194	161,816,771	153,807,451	98	92	94	N/A
63	BASF SE	163,823,000	160,155,082	184,435,082	89	77	87	102
64	Gas Natural SDG SA	159,177,837	159,945,294	163,308,856	97	94	96	100
65	Oil & Natural Gas	149,826,262	159,904,592	166,753,000	90	78	87	90
66	JX Holdings, Inc	163,075,771	159,881,528	171,078,672	95	61	64	100
67	Yanzhou Coal Mining	159,341,940	158,447,639	183,840,850	87	55	64	99
68	Novatek OAO	156,080,208	156,080,208	138,008,795	113	150	133	N/A
69	Nissan Motor Co., Ltd.	154,730,523	148,144,914	144,556,655	107	116	109	N/A
70	Repsol	182,879,966	145,826,882	140,950,973	130	73	57	107
71	Ford Motor Company	154,276,861	143,022,720	162,637,714	95	105	111	101
72	South32	156,852,236	142,512,427	119,372,427	131	32	24	818
73	Canadian Natural Resources Limited	142,267,603	142,348,671	122,005,520	117	56	48	737
74	Airbus Group	141,471,321	141,769,289	142,789,000	99	110	111	95
75	The Dow Chemical Company	120,360,000	141,319,296	176,072,000	68	83	121	97
76	Rolls-Royce	133,108,391	133,041,391	130,577,000	102	109	107	106

Rank 2015	Company Name	GHG Emissions Tons CO ₂ e Scope 1+2+3			GHG Index	Revenues Index	Decoupling Index	Employment Index
		2016	2015	2014				
77	Cloud Peak Energy Inc	96,608,000	128,998,371	153,987,400	63	60	96	92
78	EDF	127,475,878	128,871,252	133,668,819	95	97	102	81
79	A.P. Moller - Maersk	125,269,835	128,531,578	87,674,000	143	75	52	105
80	ENEL SpA	114,583,000	128,303,000	123,697,000	93	94	101	98
81	OMV AG	128,041,375	126,832,094	152,954,859	84	54	64	90
82	Bridgestone Corporation	124,831,818	126,375,000	130,375,000	96	91	95	88
83	Michelin	146,764,802	125,146,604	125,146,604	117	107	91	99
84	American Electric Power Company, Inc.	119,007,154	125,013,953	141,089,051	84	100	119	94
85	Tesoro Corporation	137,389,500	124,071,429	125,336,457	110	60	55	N/A
86	Ecopetrol Sa	111,544,774	123,420,224	127,979,342	87	72	83	N/A
87	Exelon Corporation	130,405,040	122,344,562	114,529,647	114	114	100	N/A
88	Duke Energy Corporation	120,852,909	121,082,368	149,303,540	81	101	125	102
89	Nestlé	113,467,241	120,814,398	126,542,982	90	98	109	97
90	Huadian Power International Corporation Limited	116,086,000	119,479,645	135,157,900	86	93	108	115
91	Dongfeng Motor Group	50,181,000	118,101,212	49,409,000	102	147	145	122
92	The Southern Company	80,691,800	117,878,223	130,532,000	62	108	174	121
93	Anadarko Petroleum Corporation	114,759,647	116,022,274	116,336,758	99	52	52	74
94	The Tokyo Electric Power Company Holdings, Inc (TEPCO)	94,583,200	114,111,036	114,111,036	83	114	137	95
95	Royal Philips	104,368,904	113,442,754	140,248,625	74	115	154	100
96	Kumba Iron Ore	120,495,720	112,270,067	118,730,195	101	84	83	102
97	Fiat Chrysler Automobiles NV	114,393,185	111,383,550	91,000,390	126	119	94	101
98	Datang International Power Generation	102,614,300	108,940,287	128,893,000	80	82	103	92
99	POSCO	100,590,000	106,673,000	108,554,000	93	82	88	94
100	Occidental Petroleum Corporation	104,568,240	106,304,717	100,532,000	104	52	50	185
101	PBF Energy Inc	152,337,800	106,230,581	106,602,770	143	80	56	89
102	NRG Energy Inc	71,802,687	105,366,813	126,533,959	57	78	137	N/A
103	Korea Gas Corp	104,199,772	104,308,462	111,262,638	94	57	60	N/A
104	Dynegy Inc.	80,269,600	103,949,720	99,494,800	81	173	214	91
105	Electrolux	103,661,269	103,750,760	103,750,548	100	108	108	87
106	Suncor Energy Inc.	106,182,100	103,402,759	96,999,676	109	67	61	92
107	Sasol Limited	84,528,015	103,194,119	103,924,128	81	109	134	93
108	Formosa Petrochemical	106,864,263	101,714,289	104,305,908	102	60	58	N/A
109	CONSOL Energy Inc.	94,147,791	100,558,256	107,984,581	87	68	78	93
110	Vedanta Ltd	103,123,300	98,611,867	86,833,647	119	103	87	N/A
111	Panasonic Corporation	81,985,371	98,172,826	97,220,519	84	99	117	100
112	Vattenfall Group	88,899,282	98,122,530	98,122,530	91	N/A	N/A	N/A
113	Toray Industries, Inc.	111,345,755	97,007,474	108,146,019	103	115	111	101
114	Alliance Resource Partners L.P.	90,289,050	96,734,791	95,241,510	95	84	89	98
115	Nippon Steel & Sumitomo Metal Corporation	91,000,000	96,000,000	97,600,000	93	89	95	108
116	Tohoku Electric Power Co., Inc.	95,906,821	95,961,690	61,119,310	157	103	66	93
117	Adaro Energy PT	95,720,349	95,718,219	104,535,382	92	76	83	60
118	Westmoreland Coal Company	103,287,100	93,264,470	86,509,820	119	131	109	76
119	Chesapeake Energy Corporation	84,035,630	93,155,409	95,135,000	88	34	39	87
120	Devon Energy Corporation	79,739,062	93,020,764	89,940,179	89	53	59	115
121	Lockheed Martin Corporation	92,273,779	92,398,723	92,121,623	100	118	118	97
122	Essar Oil	45,668,010	91,858,732	90,208,656	51	63	125	102
123	Tonen General Sekiyu K.K.	87,729,800	91,586,235	94,244,300	93	61	65	N/A
124	Siemens AG	93,002,568	88,658,698	108,194,469	86	112	130	N/A
125	S-Oil Corp	88,790,000	87,284,594	82,181,656	108	57	53	N/A
126	LG Electronics	75,951,768	86,815,261	79,712,548	95	94	98	N/A

Rank 2015	Company Name	GHG Emissions Tons CO ₂ e Scope 1+2+3			GHG Index	Revenues Index	Decoupling Index	Employment Index
		2016	2015	2014				
127	SK Holdings	149,429,200	86,786,316	76,844,288	194	148	76	N/A
128	The Kansai Electric Power Co., Inc.	62,224,847	86,360,199	99,387,090	63	98	156	92
129	Caterpillar Inc.	69,082,000	85,595,751	62,008,000	111	70	63	97
130	Teck Resources Limited	86,939,387	84,222,253	98,486,457	88	108	123	N/A
131	PepsiCo, Inc.	68,518,060	83,421,536	89,128,331	77	94	123	N/A
132	YPF SA	73,939,388	81,600,725	78,559,300	94	148	157	N/A
133	Hyundai Heavy Industries Co Ltd	81,745,000	81,383,406	81,383,406	100	75	74	N/A
134	Vedanta Resources PLC	82,267,572	81,201,436	80,765,308	102	83	81	85
135	Tatneft OAO	82,182,065	80,496,743	79,572,800	103	123	120	N/A
136	Alliance Holdings GP LP	68,256,076	80,051,595	79,151,510	86	84	97	105
137	Exxaro Resources Ltd	77,331,555	79,914,829	78,322,102	99	127	129	75
138	Chubu Electric Power Co., Inc.	67,689,757	79,709,388	87,690,114	77	100	130	88
139	Idemitsu Kosan Co., Ltd.	79,866,000	79,535,024	86,283,000	93	71	77	100
140	Apache Corporation	65,440,074	79,161,005	89,039,000	73	42	57	N/A
141	EOG Resources, Inc.	76,107,533	78,802,409	85,004,280	90	42	47	123
142	Bristol-Myers Squibb	78,501,655	78,528,735	78,922,535	99	122	123	N/A
143	Renault	83,902,656	78,241,404	81,435,752	103	125	121	N/A
144	Mitsubishi Chemical Holdings Corporation	75,206,000	77,980,987	89,922,000	84	101	121	N/A
145	Kia Motors Corp	124,910,000	77,334,018	77,093,781	162	112	69	N/A
146	Imperial Oil	77,678,049	76,917,793	79,571,694	98	69	71	78
147	The AES Corporation	77,055,087	76,768,574	80,752,300	95	84	88	N/A
148	Showa Shell Sekiyu K. K.	70,466,000	76,475,000	75,147,000	94	58	61	N/A
149	Cenovus Energy Inc.	67,397,254	76,314,248	78,384,063	86	62	72	73
150	Husky Energy Inc.	74,336,319	75,296,319	72,626,319	102	54	52	107
151	Bashneft	78,369,200	75,168,688	78,048,720	100	93	93	N/A
152	PPL Corporation	64,367,500	72,837,941	74,734,000	86	96	111	120
153	BMW AG	74,900,679	72,724,837	70,746,941	106	117	111	120
154	Wesfarmers	75,716,094	70,792,124	70,824,782	107	108	101	101
155	Inpex Corporation	88,138,187	70,547,209	70,340,640	125	76	60	94
156	Chongqing Changan Automobile Company Limited	69,786,149	69,779,539	63,757,010	109	148	136	107
157	LyondellBasell Industries Cl A	70,713,864	69,767,163	91,505,000	77	64	83	96
158	Inner Mongolia Yitai Coal Company Ltd.	95,816,100	68,460,132	94,329,110	102	90	89	100
159	Hino Motors, Ltd.	76,784,130	68,445,110	68,461,100	112	109	97	103
160	Bharat Petroleum Corporation	70,732,900	67,526,451	65,591,300	108	83	77	N/A
161	HollyFrontier Corp.	67,738,400	67,189,358	67,040,410	101	53	53	135
162	MMC Norilsk Nickel OSJC	85,106,800	67,178,972	54,979,000	155	120	78	N/A
163	MOL Nyrt.	67,884,358	66,689,351	63,637,385	107	N/A	N/A	64
164	HeidelbergCement AG	77,997,572	66,571,346	68,792,881	113	120	106	112
165	Sempra Energy	57,969,699	66,309,288	66,442,429	87	93	106	63
166	Marathon Oil Corporation	60,386,028	64,863,656	60,579,000	100	38	38	101
167	KOÇ HOLDING A.S.	67,625,000	64,346,000	50,939,000	133	103	78	N/A
168	Halliburton Company	42,252,413	64,193,576	69,538,515	61	48	80	N/A
169	Xcel Energy Inc.	58,680,958	64,167,651	66,393,988	88	95	108	98
170	Daimler AG	78,216,000	63,587,900	54,582,100	143	118	82	101
171	AGL Energy	50,500,998	63,022,234	44,612,250	113	110	97	N/A
172	Groupe PSA	93,960,233	62,582,705	71,310,206	132	105	79	N/A
173	Unilever plc	66,114,830	62,134,290	75,407,119	88	109	124	138
174	Weichai Power Co.,Ltd.	31,740,000	61,738,835	36,929,000	86	117	136	N/A
175	Iberdrola SA	55,341,031	61,638,169	60,784,641	91	97	107	91
176	CRRC Corporation Limited	53,219,000	60,891,536	60,440,752	88	103	117	138

Rank 2015	Company Name	GHG Emissions Tons CO ₂ e Scope 1+2+3			GHG Index	Revenues Index	Decoupling Index	Employment Index
		2016	2015	2014				
177	Toshiba Corporation	59,093,100	60,465,796	80,729,400	73	79	109	76
178	CIMIC Group	59,939,859	59,939,859	165,960,000	36	65	179	188
179	The Coca-Cola Company	58,911,126	59,910,997	66,654,343	88	91	103	69
180	CEMEX	59,030,805	59,138,266	58,809,565	100	125	125	105
181	AmerisourceBergen Corp.	63,870,901	59,132,081	73,785,000	87	123	142	94
182	Hess Corporation	50,040,511	59,071,957	59,426,449	84	45	54	92
183	WEC Energy Group	59,352,500	58,654,071	57,420,771	103	150	145	102
184	Tata Power Co	61,227,082	58,324,274	60,323,391	101	82	81	122
185	Delta Air Lines	58,254,720	58,216,428	45,652,801	128	98	77	96
186	Archer Daniels Midland	55,841,000	57,395,825	75,670,616	74	77	104	106
187	Endesa	50,396,715	57,072,951	71,381,673	71	88	125	101
188	CLP Holdings Limited	52,479,400	57,026,780	66,079,190	79	86	108	16
189	Yara International ASA	59,966,500	56,504,508	56,504,508	106	100	94	N/A
190	The Chugoku Electric Power Company	45,057,130	56,488,485	58,556,190	77	98	127	97
191	PG&E Corporation	51,605,908	56,361,352	58,901,262	88	103	118	N/A
192	FirstEnergy Corporation	82,730,593	56,315,591	71,162,393	116	97	83	105
193	HP Inc	41,368,400	55,908,031	70,440,800	59	85	145	102
194	Cosmo Energy Holdings Co., Ltd.	61,261,000	55,763,000	53,650,700	114	N/A	N/A	N/A
195	Colgate Palmolive Company	56,086,087	55,598,576	55,611,165	101	88	87	105
196	PTT Exploration & Production Public Company Limited	53,641,106	55,537,827	55,773,876	96	62	65	N/A
197	United Continental Holdings	54,557,228	55,328,955	44,700,756	122	94	77	100
198	Public Power Corporation SA	48,808,866	55,222,255	70,677,000	69	89	129	70
199	Southwestern Energy	51,387,166	55,130,255	46,258,300	111	60	54	86
200	TÜPRAS-TÜRKIYE PETROL RAFINERILERI A.S.	56,570,500	55,063,700	44,119,016	128	88	68	96
201	Pinnacle West Capital Corporation	58,704,833	54,678,496	59,183,668	99	100	101	N/A
202	Kawasaki Heavy Industries, Ltd.	58,453,241	54,645,279	77,522,358	75	111	148	80
203	Encana Corporation	44,231,710	54,273,170	62,318,039	71	36	51	83
204	DTE Energy Company	52,340,000	54,192,022	54,646,648	96	86	90	110
205	Polska Grupa Energetyczna (PGE) SA	52,922,500	54,071,919	57,915,900	91	100	109	98
206	Hyundai Mobis Co Ltd	55,305,923	53,465,836	53,756,407	103	109	106	N/A
207	Navistar International Corporation	52,689,046	53,373,833	53,209,270	99	75	76	N/A
208	Adani Power Ltd	58,168,100	53,052,324	54,755,629	106	165	155	101
209	Cardinal Health Inc.	56,685,000	52,984,605	58,839,126	96	133	139	99
210	Bayer AG	52,275,147	52,275,147	59,866,000	87	113	130	95
211	Honeywell International Inc.	51,846,620	51,948,934	52,446,788	99	98	99	104
212	Hewlett-Packard	51,744,500	51,744,500	56,340,800	92	91	99	N/A
213	Nucor Corporation	55,178,000	51,715,306	79,571,000	69	77	111	97
214	Electric Power Development Co., Ltd (J-POWER)	59,452,120	51,260,474	49,190,230	121	110	91	100
215	Deere & Company	47,448,952	51,138,182	45,635,153	104	74	71	100
216	Deutsche Post AG	48,490,000	50,798,509	58,410,000	83	101	122	115
217	Origin Energy	20,758,326	50,747,999	50,747,999	41	81	197	103
218	Air Liquide	42,263,000	50,709,585	52,585,000	80	118	147	N/A
219	Hindustan Petroleum Corporation	52,178,600	50,658,953	50,077,800	104	85	81	N/A
220	Kyushu Electric Power Co Inc	37,340,700	50,235,036	63,544,270	59	102	174	91
221	China Power International Development Limited	49,350,300	49,368,137	41,599,000	119	92	78	N/A
222	Tata Motors	50,981,198	49,098,470	46,597,586	109	119	109	83
223	Air Products & Chemicals, Inc.	52,169,177	48,736,882	62,239,081	84	91	109	103
224	Samsung Electronics	63,773,000	48,616,745	48,616,745	131	98	75	N/A
225	Alcoa Corp.	33,352,000	48,288,853	53,286,165	63	N/A	N/A	N/A
226	Linde AG	45,220,000	47,783,987	44,442,400	102	99	98	N/A

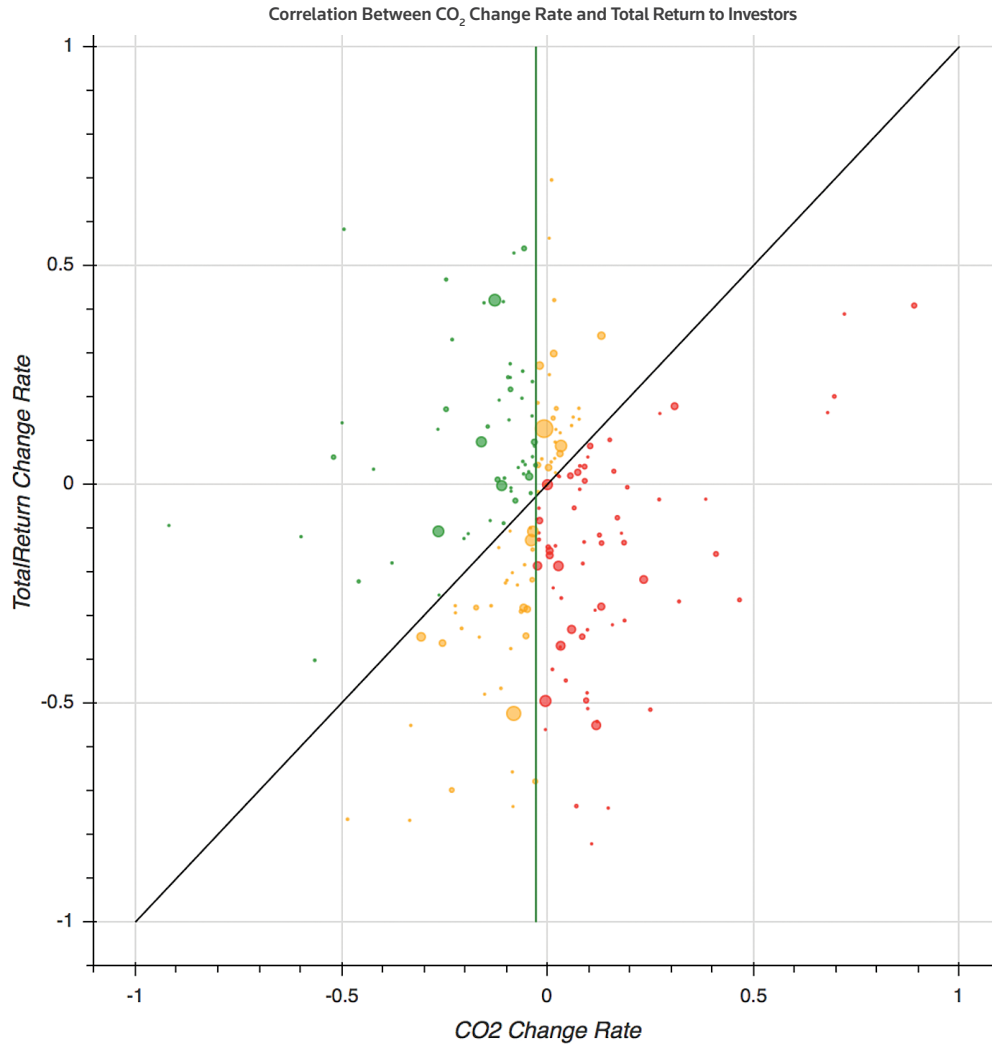
Rank 2015	Company Name	GHG Emissions Tons CO ₂ e Scope 1+2+3			GHG Index	Revenues Index	Decoupling Index	Employment Index
		2016	2015	2014				
227	SK Networks Co. Ltd.	61,326,000	47,281,992	62,352,000	98	82	84	N/A
228	Noble Energy, Inc.	54,833,670	47,176,506	47,314,434	116	68	59	92
229	Neste Oyj	51,698,870	47,097,105	54,786,300	94	78	83	102
230	Taiwan Cement	44,623,500	47,054,819	47,837,700	93	76	81	N/A
231	PolSKI Koncern Naftowy ORLEN	48,094,580	46,910,394	41,667,300	115	74	65	59
232	CVS Health	12,193,361	46,858,189	35,840,600	34	127	374	90
233	Korea East-West Power	39,632,121	46,692,791	47,645,964	83	N/A	N/A	N/A
234	San Miguel Corp	58,270,000	46,441,261	48,162,000	121	89	73	103
235	Toyota Industries Corporation	45,141,764	46,298,388	46,286,715	98	85	87	102
236	Johnson Controls	46,185,853	46,185,853	38,492,171	120	95	79	89
237	VEOLIA	50,480,379	46,032,265	44,934,398	112	102	91	79
238	General Dynamics Corporation	45,461,000	45,649,056	45,702,378	99	102	102	98
239	United States Steel Corporation	43,165,000	45,207,227	75,860,335	57	59	103	92
240	Ashok Leyland	45,125,726	45,149,415	34,846,000	130	194	150	113
241	National Grid PLC	44,260,760	44,971,548	49,720,558	89	N/A	N/A	N/A
242	Hellenic Petroleum	23,605,100	44,870,592	41,623,134	57	70	124	105
243	EDP - Energias de Portugal S.A.	32,030,999	44,556,113	33,895,768	94	90	95	115
244	McDonald's Corporation	41,256,490	43,345,225	47,309,692	87	90	103	79
245	Evraz PLC	47,431,700	43,040,000	47,000,000	101	59	59	98
246	African Rainbow Minerals	43,530,718	42,960,990	42,943,516	101	126	124	98
247	Woodside Petroleum	37,750,700	42,918,965	44,245,611	85	55	64	N/A
248	Costco Wholesale Corporation	43,510,000	42,618,841	56,404,000	77	105	137	104
249	Mitsubishi Electric Corporation	43,415,701	42,491,331	44,426,500	98	108	111	105
250	Deutsche Lufthansa AG	41,687,344	42,375,797	42,375,797	98	105	107	100

APPENDIX 2: CORRELATION BETWEEN CO₂ CHANGE RATE AND FINANCIAL PERFORMANCE

In Figure 17, company trends (positive or negative) on CO₂e emissions is plotted against momentum on Total Return to shareholders for the most recent four-year period available for the G250 across all scopes 1, 2 and 3. The larger the dot, the higher the absolute level of emissions,

typically reflecting both the scale of the enterprise and intensity of emissions. Companies to the left of the vertical green line are decarbonizing in line – often reflecting significant investment in transforming products and operations.

Figure 17:



A Pearson correlation analysis of the top emitters from North America and Europe, after excluding outliers, unsurprisingly shows a positive correlation between change of revenue and CO₂e emission; however, no correlation between either rate of change in Net Income or Total Return and CO₂e emissions was found. In other words, while revenues tend to trend with emissions, financial performance measured by Total Return and Net Income may not.

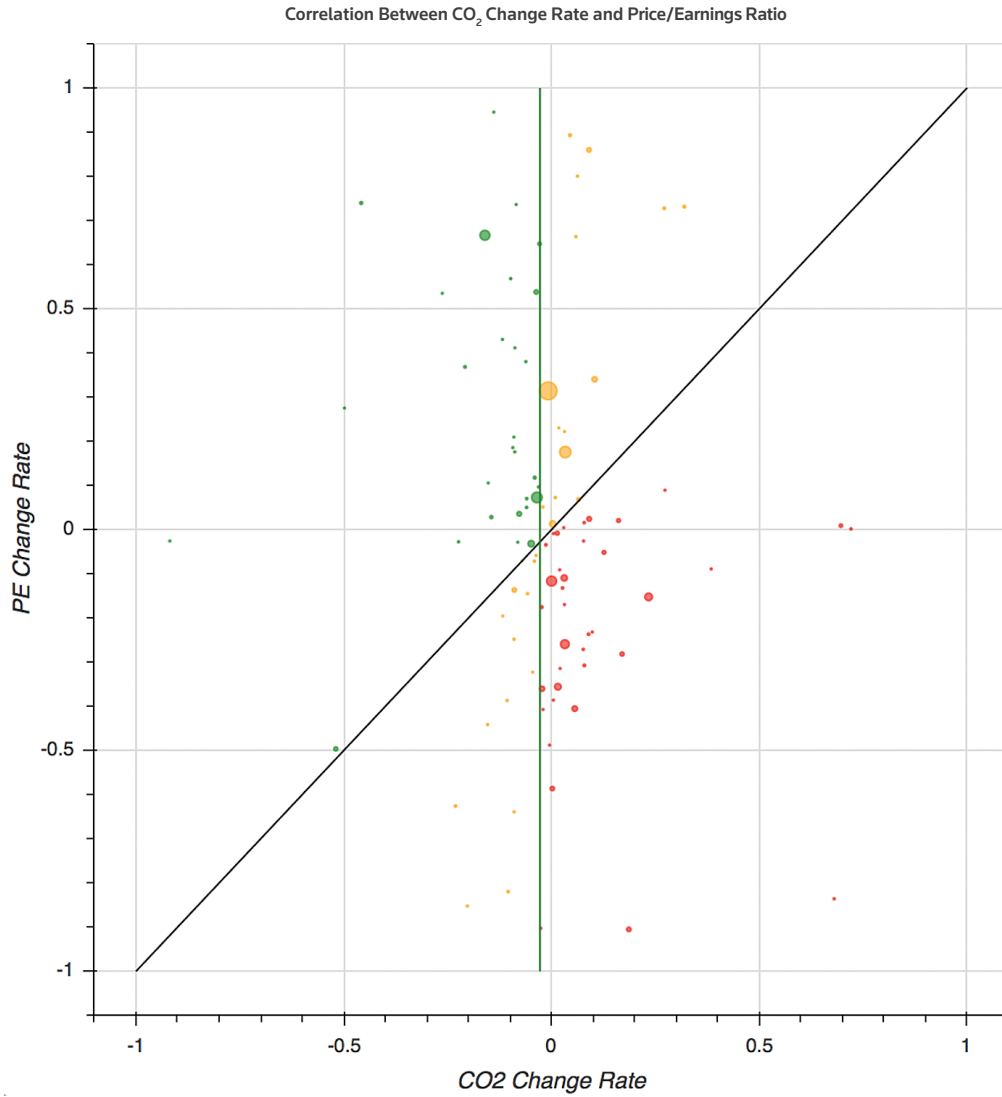
This raises the question of what is driving superior value growth among firms achieving significant emission reductions, often at significant expense to the firms. How can shareholder value not be negatively impacted from significant investment in decarbonization that may have limited short-term benefits?³⁴ Addressing this question requires a better model of the contribution that decarbonization makes to company performance, and better measurement of those sources of value.

³⁴ Of course, shareholder value could be negatively impacted by any business decision, including decarbonization, which does not adequately leverage the rapidly emerging options for lower-cost technical innovation, regulatory incentives and shifting consumer sentiment, among many factors in the Sustainability Premium framework.

The creation of consistent profits independent from the amount of GHG being released, points to a trend away from correlation between increased CO₂e emission leading to more net income (Figure 18). Perhaps more to the point, there is no evidence that emissions reductions initiatives lead to declines in income, shareholder returns

or core financial outcomes. In fact, as we show in the discussion of the Sustainability Premium, some of the largest emitters are demonstrating the potential of decoupling strategies with positive trends in both emissions reduction and earnings growth.

Figure 17:



¹ <https://www.thomsonreuters.com/en/press-releases/2017/may/thomson-reuters-launches-latest-greenhouse-gas-emissions-report.html>

APPENDIX 3: EARTH OBSERVATION MISSIONS

Content Provided by the European Space Agency

In the context of climate change and the related political initiatives to regulate GHG emissions, there is an increased demand for independent information. To support informed decisions and global stock-taking exercises, a dense grid of observations for top-down emission estimates will be necessary. This will support the bottom-up strategy as implemented today in global stock-taking and emission inventories. The two most prominent GHG's that will be addressed that way are carbon dioxide (CO₂) and methane (CH₄).

Past and present Earth observation missions addressing those GHG's (e.g., Scanning Imaging Absorption Spectrometer for Atmospheric CHartography [SCIAMACHY, ESA], the Orbiting Carbon Observatory 2 [OCO-2, NASA] or GOSAT [JAXA]) did not address all aspects needed to fully exploit the potential for scientific and regulatory application. Either the spatial resolution was coarse (SCIAMACHY), the contiguous covered Earth surface is too limited (OCO-2), or it is a sampling concept (GOSAT) not providing contiguous coverage.

A newly envisaged GHG observation mission is aimed to overcome these limitations by employing several satellites, each one providing a few 100 km contiguous coverage of the Earth's surface at a high spatial resolution (about 2 by 2 km). This will allow us, for the first time, to generate "images" of the global CO₂ and CH₄ distribution and their change in time. The envisaged combination of high spatial and temporal resolution with data acquisition over an area allowing imaging capability is unprecedented. Imaging capability will allow us, for the first time, to interpret data in their spatial context. In combination with inverse modeling techniques, it is expected to be able to trace the origin of emissions and estimate respective fluxes.

This data will initially be collected for an approximate period of 10 to 15 years, which can be prolonged at will by replacing decommissioned satellites. The downstream concept will allow for participation of other interested parties by coordinating the launch of additional satellites to optimize the return of data. The system could be implemented in the frame of Copernicus, an Earth observation program led by the European Commission with ESA coordinating the space component. The first system unit could be launched around 2025.

CO₂ and CH₄ measurements could be accompanied by co-located high spatial resolution NO₂ observations to support the CO₂ flux inversions. NO₂ can be used for additionally mapping emission plumes of high temperature combustion processes. High-resolution NO₂ observations represent a value on their own for air quality applications, especially in densely populated areas.

Current systems in implementation (e.g., Sentinel-4, Sentinel-5 and Sentinel-5p, the latter just about to be launched) are not tailored to measure CO₂, but will deliver information concerning the concentration of a wide range of atmospheric constituents (e.g., CH₄, NO₂, O₃, SO₂, HCHO, BrO, CHOCHO), also supporting air quality and climate change research and applications. In essence, an increased number of space-based assets observing GHG's and the related emissions – put into service by a number of agencies and nations (e.g., from Europe, USA, Japan, China) – will be available in the 2020 to 2030 time frame. Private companies are expected to try to enter this field, offering very specialized, small-scale solutions and services, in the next 10 years (first attempts measuring CH₄ are already implemented).



Illustration: Carbon mission

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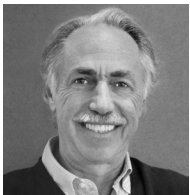
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ABOUT CONSTELLATION RESEARCH & TECHNOLOGY

CRT is a newly launched enterprise founded in 2016 by a team of experts in the fields of business analytics, sustainability strategy and metrics, and data science. Founded by Dr. David Lubin, and Yale University Professors Dan Esty and Jay Emerson, Constellation Research and Technology seeks to both improve the quality and reliability of ESG data, and pioneer new, business strategy centric measures of sustainability performance. CRT brought its Maturity-Momentum (M2) Model to the G250 Report applying 'maturity curve modelling' and dynamic 'momentum' analysis to the climate impact assessment. constellationresearch.com

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David A. Lubin serves as Co-Chairman and Managing Director of

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John Moorhead dedicates his life to fighting climate change as a transparency and

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Tim is a lawyer by training and has spent most of his career working with diverse collaborators to build change-leading initiatives.

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