

**INGRID S. DYOTT**Portfolio Manager
The SRI Team**SAJJAD LADIWALA, CFA**Associate Portfolio Manager
The SRI Team

FEBRUARY 2017

CARBON FOOTPRINT ANALYSIS

Assessing carbon impact from a broad perspective can provide valuable investment insights.

Corporate managers and investors alike have shown increased interest in carbon footprint analysis, which provides a snapshot of how a given company may be contributing to the carbon intensity of the economy. From a company perspective, bringing greater transparency to carbon intensity can help better manage emissions, and analyze business risk and potential opportunity. The old adage that “what gets measured gets managed” holds true for emissions. Emissions are directly related to energy costs, such that this tracking can have tangible relevance to the profitability of the company. For example, a company that has a solid grasp of its carbon footprint can wring out inefficiencies from both its suppliers and distribution channels. From an investment perspective, carbon footprint analysis can help gauge the absolute and relative efficiency of a company; it can serve as a tool to engage managements and assess where the company is moving directionally. In our view, managing emissions efficiently is indicative of the quality and rigor of operations, and has the potential to result in greater competitive advantage. At a minimum it serves as a tool to better understand the company’s business.

The Neuberger Berman SRI team, as part of our integrated research process, looks at a range of environmental, social and governance (ESG) issues from workplace practices, human rights and community relations to product integrity and supply chain sustainability. With regard to the environment, we seek companies that are implementing best practices that help minimize their environmental footprint and enhance their social license to operate within their communities. Many environmental issues are linked to social and public health concerns, such as climate change, pollution control and water usage. We look for companies that are proactively addressing a range of environmental issues relevant to their own business, their supply chains and across the products and services they offer. Within this comprehensive approach to addressing environmental issues, and with regard to climate change in particular, we consider greenhouse gas (GHG) emissions at both the company and portfolio levels.

In the pages that follow, we take a close look at carbon footprint analysis—what it is, why it’s important and how it fits into our overall investment approach.

Global Consensus on Curbing Emissions

The global scientific community has reached a consensus goal of stabilizing the earth’s climate to stay within a two-degree (2 °C) global average temperature increase above preindustrial levels by 2050. Most scientists agree that to increase the probability of achieving that goal, the concentration of CO₂ in our atmosphere must be limited to 450 parts per million (ppm).¹ Without additional mitigation efforts beyond those already in place today, warming will lead to high to very high risk of severe, widespread and irreversible impacts globally by the end of the 21st century, according to the IPCC. Substantial cuts in GHG emissions over the next few decades could substantially reduce the risks of climate change by limiting warming in the second half of the 21st century and beyond.² The global business community appears to be on board: More than 80% of the world’s 500 largest companies established emission reduction or energy-specific targets in the 2014–15 financial year, according to CDP.

Determining Carbon Footprint

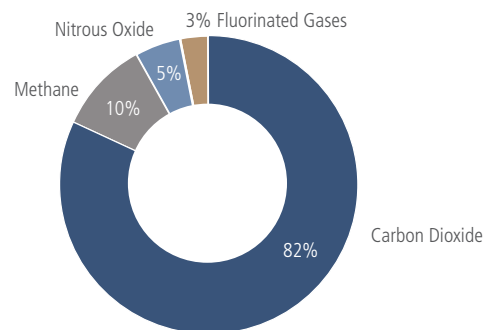
Carbon footprint measures both direct and indirect greenhouse gas (GHG) emissions’ intensity. Absolute total emissions are translated into an “intensity” number by expressing it in relation to revenues, employees or some other basic characteristics of a company. Intensity, therefore, can be used to evaluate a company as it grows over time, whether organically and/or via acquisitions. Intensity also facilitates the comparison of companies of different sizes and companies in different businesses.³ Carbon intensity is one aspect or metric of environmental analysis that can indicate where a company or a portfolio of companies is most exposed to emission levels that may be higher/lower than peers or a relevant benchmark.

The relevance and interest in this analytical exercise has increased more broadly within the context of thinking about capital markets’ contribution and exposure to climate change.

Ideally, a carbon footprint analysis should account for the six main GHG emissions as defined by the Kyoto Protocol across all four categories listed below, and both direct and indirect sources should be reported on a CO₂e (carbon dioxide equivalent) basis.⁴ However, due to currently limited data and gaps in reporting, it remains a challenge to capture all types of GHG emissions when conducting a carbon footprint analysis.

FIGURE 1: U.S. GHG EMISSIONS BY TYPE FOR 2013

TOTAL EMISSIONS = 6,673 MILLION METRIC TONS OF CO₂ EQUIVALENT



Source: EPA, 2013

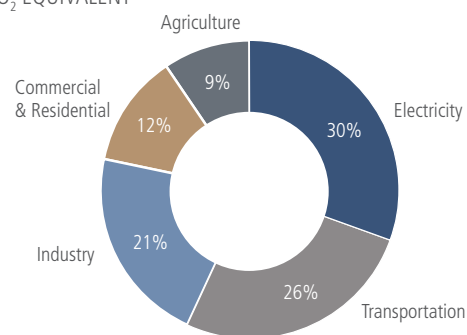
Carbon dioxide (CO₂) emissions are typically caused by burning fossil fuels, solid waste, trees and wood products, and also as a result of certain chemical reactions such as manufacturing cement.

Methane (CH₄) emissions are emitted during the production and transport of coal, natural gas and oil, and can also result from livestock, agricultural practices and landfill decay.

Nitrous oxide (N₂O) emissions result from agricultural and industrial activities, as well as combustion of fossil fuels and solid waste.

FIGURE 2: U.S. GREENHOUSE GAS EMISSIONS BY ECONOMIC SECTOR FOR 2014

TOTAL EMISSIONS = 6,673 MILLION METRIC TONS OF CO₂ EQUIVALENT



Source: EPA, 2014.

Capturing Direct and Indirect Emissions

Typically a carbon footprint analysis aims to include all scope 1 (direct) and scope 2 (indirect) carbon and methane emissions, at a minimum. Scope 3 emissions (from other emissions generating activities including supply chain) are not typically included given the challenges to obtaining comparable and quantifiable data. As companies enhance their disclosure, investors should be able to conduct more robust analysis, inclusive of all main GHG emissions. At this time, conducting a carbon footprint analysis cannot provide a complete picture of the overall environmental impacts of a given company or an overall investment portfolio. In our view, therefore, it is essential to look further, toward the broader benefits associated with those businesses to gain an understanding of their broader portfolio and economy-wide impact.

Key Definitions

The GHG Protocol, the global organization that sets measuring standards, defines direct and indirect emissions as follows: "Direct GHG emissions are emissions from sources that are owned or controlled by the reporting entity. Indirect GHG emissions are emissions that are a consequence of the activities of the reporting entity, but occur at sources owned or controlled by another entity." They further categorize these direct and indirect emissions as shown into three broad scopes:

- Scope 1: All direct GHG emissions
- Scope 2: Indirect GHG emissions from consumption of purchased electricity, heat or steam
- Scope 3: Other indirect emissions, such as the extraction and production of purchased materials and fuels, transport-related

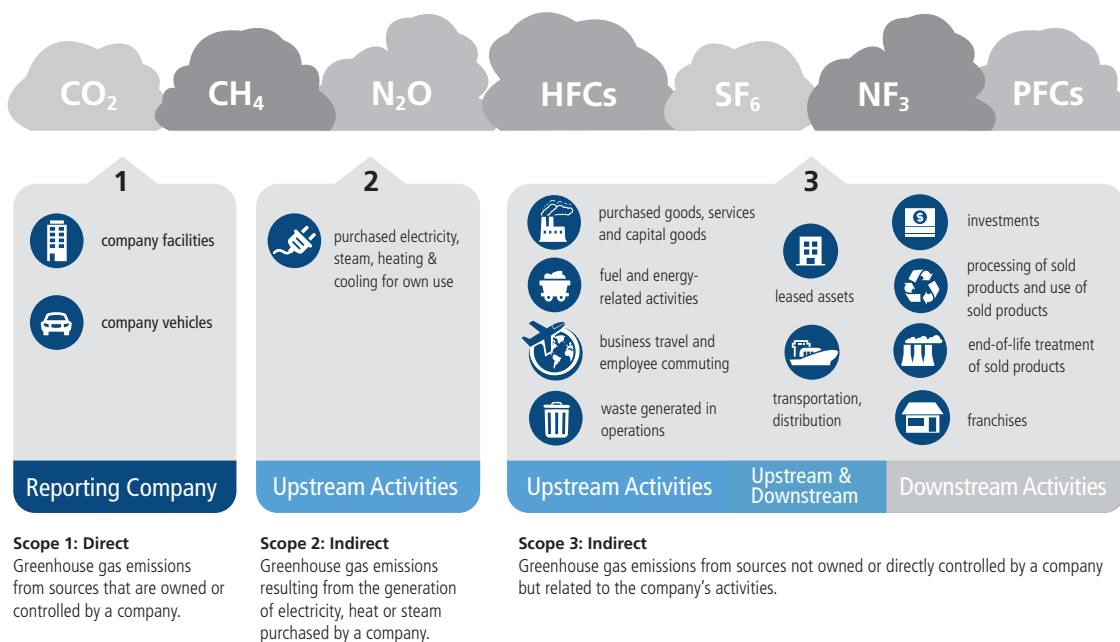
activities in vehicles not owned or controlled by the reporting entity, electricity-related activities (e.g., transportation and distribution losses) not covered in Scope 2, outsourced activities, waste disposal, etc.

Limitations of Carbon Footprint Analysis

Despite the utility of extracting an intensity metric from a carbon footprint analysis of an investment portfolio, we recognize its limitations and do not rely on carbon intensity as a standalone, be-all, end-all metric. Challenges include the following:

- **Gaps in data:** Not all companies disclose their scope 1 (direct) and scope 2 (energy use) emissions. Methodologies that estimate emissions where data is lacking are not always accurate or verifiable.
- **No business model assessment:** Emissions intensity does not take into account or compare one company's business model relative to another. For example, a company may appear to have a low carbon footprint, which may be due to outsourcing rather than innovation or an advantaged model. In other words, scope 3 emissions (suppliers) are often not tracked or included into analysis.
- **Lack of full-cycle view:** The analysis does not take the full business cycle into consideration or, in other words, implications of its customers' usage. Emissions alone may not reflect the fact that a company's products and services may enable customers to be more energy efficient. A simple carbon footprint analysis would not take these additional net benefits into consideration.

FIGURE 3: OVERVIEW OF GHG PROTOCOL SCOPES AND EMISSIONS ACROSS THE VALUE CHAIN



Source: GHG Protocol, 2011.

- **Limited environmental context:** Carbon intensity analysis does not address broader environmental issues. For example, nuclear power may not emit any CO₂, but its overall environmental impact is high due to unresolved waste-related issues.

ESG Integration and Carbon Footprint Analysis: Benefits and Impact

Given that using a carbon footprint alone will not provide a comprehensive approach to evaluating net benefits and impacts of portfolio companies, the Neuberger Berman SRI process includes an analysis of the portfolio's overall carbon footprint in combination with an assessment of the product lifecycle of the businesses within the portfolio. In general, the team uses available emissions data within a larger context of industry and peer business models. For example, a company may appear to have a low carbon footprint, which may be due to outsourcing rather than innovation or an advantaged model. In order to develop a deeper understanding of our portfolio companies' business models, inclusive of understanding how our companies are contributing positively or negatively to the overall footprint, we take additional factors into consideration. To supplement direct and first-tier impact data, we further seek to identify downstream impacts of each company's product portfolio. We look for companies that are developing products and services that provide a net environmental benefit to end users. Finally, we directly engage companies on a range of ESG practices and advocate for further disclosure on environmental data.

FIGURE 4: OUR KEY ESG QUESTIONS IN EVALUATING A BUSINESS

- What is getting measured? Are there reduction targets? Can progress be measured?
- How does the company integrate environmental factors into its business strategy?
- Is there board-level oversight of climate change-related issues?
- How are ESG metrics linked to incentive compensation?
- Is the company policy on political contributions aligned with its climate change strategy?
- What are the possible explanations for why a company has a higher emissions profile than industry peers?
- What's the percentage of revenue derived from product offerings that help facilitate energy efficiency for customers?
- Do energy-efficient product offerings provide additional value by offsetting emissions and enabling a net benefit overall?
- What life cycle analysis (LCA) programs are in place to reduce environmental impact of existing products?
- How does the company engage its supply chain to help minimize product impact?

Our Portfolio and Carbon Footprint Analysis

As an extension of our overall environmental due diligence, we monitor the portfolio's carbon footprint using a variety of tools, company data and third party research when available. To better understand how it compares to the benchmark index and other low carbon offerings, we worked with Trucost to conduct a carbon footprint analysis which measures GHG emissions embedded within the portfolio relative to the S&P 500 Index (as of September 30, 2016). For each holding, the analysis captured both actual and estimated direct (scope 1), indirect (scope 2) as well as within the first-tier indirect impacts (first tier of the supply chain) by identifying companies that are focusing on efficiently managing their own manufacturing and operations (direct impacts) as well as efficiently managing their procurement and supply chains (first-tier indirect impacts).⁵ Each holding's contribution to the carbon footprint of the portfolio is calculated on an equity ownership basis. The carbon footprint of the fund is the sum of these contributions, normalized by revenue owned.

Key Findings of Carbon Portfolio Analysis Include the Following⁶:

- The portfolio's carbon footprint is 124 (tCO₂e/\$mn) compared to the S&P 500 benchmark, which is 280 (tCO₂e/\$mn)
- The portfolio is 56% less carbon-intensive than the S&P 500 benchmark
- The portfolio's efficiency is largely driven by stock selection effects, not sector avoidance, meaning the companies selected had on average lower carbon footprints than their benchmarked peers by industrial sector

The Trucost findings are largely consistent with our own internal carbon footprint analysis findings. We believe that our strength lies within our stock selection efforts, where we continue to seek "best-in-class" companies with leadership ESG practices positioned for advantaged growth across industry sectors. Our work does not end here, however. Next steps include incorporating emissions data into our fundamental and integrated ESG investment process.

Year	2016	2015	2014
NB SRI Portfolio (Total footprint tCO ₂ e/\$mn)	124	139	155
S&P 500 benchmark (Total footprint tCO ₂ e/\$mn)	280	299	301
NB SRI Portfolio % less than S&P 500 benchmark	56%	54%	49%

2014 holdings as of 9/30/2014.
2015 holdings as of 6/30/2015.
2016 holdings as of 9/30/2016.

Evaluating Associated Net Benefits of a Business

In our view, taking scope 3 or downstream impacts into consideration for both suppliers and consumers helps in understanding total environmental impact. It can also assist companies in assessing where there may be opportunities to identify and engage suppliers that are leaders/laggards in this area. On the consumer end, companies looking at scope 3 emissions can improve on product recycling and disposal. Overall, tackling scope 3 emissions can help companies to identify and promote energy efficiency opportunities beyond their own operations, involving their products/services after they have been sold. Likewise focusing on downstream impacts can also help investors identify investment opportunities. We provide a few examples below to illustrate how companies and investors can achieve a broader, favorable impact:

Materials: A fully integrated industrial gas company is one of the two largest carbon contributors in the sector. However, as a facilitator of efficiency and reduction of environmental footprint to a range of industries, its industrial gas applications enable a net GHG benefit for their customers. This means that, despite a higher emissions profile, the company has helped to avoid two times the GHG emissions that it has emitted. In our view, the net benefit of the company's eco-innovation product applications, which comprise a substantial and growing percentage of revenue, have positioned the company to be an industry leader in addressing climate change.

Automobile Components: The transportation industry is the second-largest contributor to emissions in the U.S. Automobile manufacturers are working with their suppliers to meet more stringent regulations on vehicle emissions and fuel efficiency standards. However, in the usage of automobiles by customers, a consequence of including automobile components such as turbochargers is: enhanced fuel efficiency and vehicle performance while reducing emissions, thermal systems which help reduce fuel consumption and emissions, and emissions systems with exhaust gas recirculation (EGR), enhanced engine performance, fuel economy and reduced emissions.

Airlines: The two biggest impacts on efficiency in airlines, another area of transportation, are retiring/upgrading the airline fleet and seat configuration. One company has the youngest fleet in the industry. Relative to peers, this enables the airline to have the lowest carbon emissions per passenger mile, making it the most carbon- (and energy cost-) efficient airline overall.

Semiconductors: This industry plays a critical role in enabling energy savings throughout the global economy. The manufacture of semiconductors themselves is energy-intensive. However, the demand from industry and consumers to reduce power consumption and energy costs has created a large and growing market opportunity. Semiconductor chips and components help to optimize power use across diverse end markets such as variable speed drives for motors, solar and wind inverters, power supply efficiency and power management, with potential customers including electricity providers and appliance manufacturers, among others.

Conclusion

The Neuberger Berman SRI investment team takes an integrated approach to sustainability across our SRI strategy. In our view, carbon footprint analysis is one useful tool among many in helping to identify company emission profiles and associated net benefits and impacts. The current scope of carbon analysis, due to data and methodological challenges, does not incorporate many critical customer and contingent impacts. Our goal is to assess all of these impacts as we seek to invest in companies that have demonstrated a commitment to environmental sustainability by minimizing their environmental footprint and/or producing products and services that have a direct and in many cases broad environmental benefits.

¹IPCC https://www.ipcc.ch/publications_and_data/ar4/wg1/en/spmssp-projections-of.html

²IPCC Climate Change 2014 Synthesis Report Summary for Policymakers http://www.ipcc.ch/pdf/assessment-report/ar5/syr/AR5_SYR_FINAL_SPM.pdf

³Carbon footprints are categorized into Scope 1 (direct greenhouse gas emissions from fuel combustion in vehicles and facilities), Scope 2 (indirect emissions from purchased electricity), and Scope 3 (other indirect greenhouse gas emissions, e.g., waste disposal, outsourced activities, business travel, emissions from leased facilities).

⁴http://unfccc.int/kyoto_protocol/items/3145.php

⁵Direct emissions result from a company's own operations and include GHG emissions from boilers and company owned vehicles, emissions from any manufacturing operations and waste produced.

First tier indirect impacts, also termed supply chain impacts, occur because of the goods or services a company procures. This includes purchased electricity, business travel and logistics.

⁶Trucost has assessed Carbon based on an average annual price of \$36.

The GHG Protocol defines direct and indirect emissions as follows: Direct GHG emissions are emissions from sources that are owned or controlled by the reporting entity. Indirect GHG emissions are emissions that are a consequence of the activities of the reporting entity, but occur at sources owned or controlled by another entity.

The GHG Protocol further categorizes these direct and indirect emissions into three broad scopes:

Scope 1: All direct GHG emissions.

Scope 2: Indirect GHG emissions from consumption of purchased electricity, heat or steam.

Scope 3: Other indirect emissions, such as the extraction and production of purchased materials and fuels, transport-related activities in vehicles not owned or controlled by the reporting entity, electricity-related activities (e.g. T&D losses) not covered in Scope 2, outsourced activities, waste disposal, etc.

This material is provided for informational purposes only and nothing herein constitutes investment, legal, accounting or tax advice, or a recommendation to buy, sell or hold a security. This material is not intended as a formal research report and should not be relied upon as a basis for making an investment decision. The firm, its employees and advisory clients may hold positions of companies within sectors discussed. Specific securities identified and described do not represent all of the securities purchased, sold or recommended for advisory clients. It should not be assumed that any investments in securities identified and described were or will be profitable. Any views or opinions expressed may not reflect those of the firm as a whole. Information presented may include estimates, outlooks, projections and other "forward looking statements." Due to a variety of factors, actual events may differ significantly from those presented. Neuberger Berman products and services may not be available in all jurisdictions or to all client types. Investing entails risks, including possible loss of principal. Investments in hedge funds and private equity are speculative and involve a higher degree of risk than more traditional investments. Investments in hedge funds and private equity are intended for sophisticated investors only. Unless otherwise indicated returns shown reflect reinvestment of dividends and distributions. Indexes are unmanaged and are not available for direct investment. **Past performance is no guarantee of future results.**

The "Neuberger Berman" name and logo are registered service marks of Neuberger Berman Group LLC.

©2017 Neuberger Berman Group LLC. All rights reserved.



Neuberger Berman
1290 Avenue of the Americas
New York, NY 10104-0001