



INSIGHTS

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CLIMATE CHANGE: ASSESSING IMPACT AT THE PORTFOLIO LEVEL

It is widely acknowledged that climate change will have a broad range of impacts on economies and financial markets over the coming decades. That said, assessing climate change risk within investment portfolios is challenging for a number of reasons. For example, the economic costs of climate change are largely external, meaning that those generating the emissions are not necessarily those bearing the costs. Additionally, inaction on climate change has resulted in part from the timing mismatch between the long-term environmental and societal implications versus the shorter-term focus of investment time horizons. Mark Carney, the governor of the Bank of England, termed this disconnect the “tragedy of the horizon”¹ in that the effects of climate change will be felt beyond the traditional horizons of most actors (businesses, politicians, central banks) and thus they have little incentive to take corrective action. As part of integrating environmental, social and governance (ESG) considerations into the investment process, investors are increasingly aware of the climate change risks in their portfolios—and look to monitor, report and reduce them over the short and long terms.

Over the years, Neuberger Berman Socially Responsive Investing (NB SRI) has engaged and encouraged companies across a range of industries to enhance their transparency and disclosure so that it is complete, comparable and timely. We were early signatories to the CDP² and have benefitted from the growth of climate change-related data—both quantitative and qualitative—available to investors. In working within our impact framework, we have aggregated data across a set of key metrics that can help provide a comprehensive view of our portfolio that goes beyond traditional carbon footprint analysis and instead focuses on a broader set of indicators that highlight the portfolio’s climate change consistency. This analysis exposes the vertical alignment—or lack thereof—of company managements, oversight, operations and supply chain programs; products and services; and transparency and disclosure.

Climate Change Policy Outlook

The world has been waiting to see which U.S. climate and energy policy commitments would remain in place following the change in presidential administrations. Despite some disappointments at the federal level—including the U.S. withdrawal from the Paris Agreement and the rollback of the Clean Power Plan—commitments to more favorable climate change policies have remained in place or in some cases have even been strengthened. Positive momentum from states and cities in the U.S. as well as policymakers globally is further compelling companies to drive innovation and mitigate risk in this area.

¹ [“Breaking the Tragedy of the Horizon—Climate Change and Financial Stability.”](#) speech by Mark Carney given at Lloyd’s of London, published on 29 September 2015.

² CDP, formerly the Carbon Disclosure Project, is a not-for-profit charity organization that solicits and analyzes environmental impact data in connection with a global disclosure system for investors, companies, cities, states and regions to manage their environmental impacts.

Several states and cities have reiterated their commitments to cut emissions and increase their renewable and clean-power generation mix. They have taken the lead to collaborate and tackle climate change issues on local and national levels, while aiming to maintain their contributions to meeting the initial U.S. commitment to the Paris climate agreement to cut carbon dioxide (CO₂) emissions 26% below 2005 levels by 2025. At least 29 states and the District of Columbia now have in place renewable portfolio standards (RPS) that require utilities to sell a specified percentage or amount of renewable electricity. RPS policies, which collectively apply to 55% of total U.S. retail electricity sales,³ not only help to increase renewable energy sources across the country and thus lower emissions, but also create competition and jobs, and make clean energy more affordable.

Business as Usual Is no Longer an Option

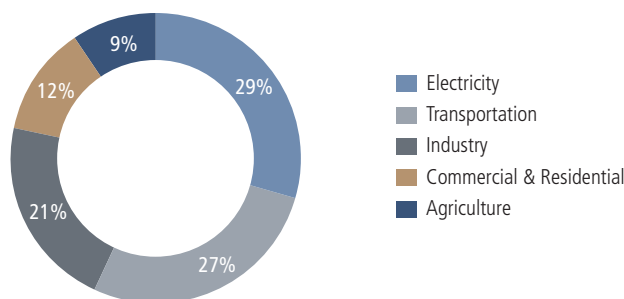
The Paris Agreement aims to limit global greenhouse gas (GHG) emissions to relatively safe levels—thus limiting warming to 2 degrees Celsius, with an aspiration of 1.5 degrees Celsius—with regular reviews to ensure these commitments can be increased as necessary in line with scientific advice. Energy-related carbon dioxide emissions are the majority of global GHG emissions. The challenge of living in a 2-degree world will not be easy, and the business and investor community will need to help lead the transition to a low-carbon economy.

NB SRI Portfolio: As of 9/30/2017, 76% of portfolio holdings by weight are implementing energy-efficiency initiatives, while 36% have product and/or service offerings that enable emission reductions.

The electricity sector is the primary source of CO₂ emissions, followed by transportation, which is poised to overtake electricity generation in the coming years. Corporate actions can drive emissions reductions within these industries. GHG emissions can be reduced on the supply side, for example, by switching electricity generation from fossil fuels to cleaner-burning natural gas and renewables. Emissions can be reduced on the consumption side by investing in companies that are implementing energy-efficiency initiatives and sourcing cleaner power sources. Additionally, companies can drive innovation by offering products and services that enable energy efficiency and reduce emissions across a range of industries and end products.

FIGURE 1. ELECTRICITY, TRANSPORTATION AND INDUSTRY ARE THE PRIMARY SOURCES OF CO₂ EMISSIONS

U.S. Greenhouse Gas Emissions by Economic Sector, 2015



Source: U.S. Environmental Protection Agency.

Note: [Land Use, Land-Use Change and Forestry](#) in the United States is a net sink and offsets approximately 11.8% of these greenhouse gas emissions, not included in total above. All emission estimates from the [Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2015](#).

³ Lawrence Berkeley National Laboratory, April 2016.

Companies Are Taking the Lead on Climate Change

Governance. While for many years companies focused on sustainability, corporate managements more recently have increasingly integrated climate change risk and opportunities into their core business strategy. According to the recommendations of the Task Force on Climate-Related Financial Disclosures (TCFD),⁴ the core elements to reporting on climate risks and opportunities begin with governance followed by strategy, risk management and, finally, metrics and targets.⁵ More companies are now describing key governance characteristics that can help them better manage their businesses in a 2-degree world, such as board oversight of climate-related risks and opportunities, integration of climate change concerns into business strategy, and the incentives that are in place with regard to managing climate change-related issues. In addition, companies should be aware of how their political dollars are spent to ensure policy alignment with their climate-change initiatives.

NB SRI Portfolio: As of 9/30/2017, 68% of company holdings by weight have climate change integrated into their business strategy, and 54% have board-level oversight on climate change issues.

New Initiatives in Energy Efficiency. Given that the electricity grid is the largest contributor of GHG emissions in the U.S., companies are recognizing the economic and environmental benefits of greening their power sources and reducing their reliance on fossil fuels.

The number of companies pursuing renewable sources of energy in the U.S. is rapidly transforming the landscape of corporate power procurement. For some time, corporations have been sourcing renewable energy by utilizing such mechanisms as the purchase of renewable energy certificates (RECs). More recently, companies have begun to enter into power purchase agreements (PPAs) to directly provide their operations with renewable sources of power. Cheaper renewable energy prices combined with greater reliability have made PPAs a more viable option for companies, and they are becoming a key driver for renewable growth in the U.S. As of January 2017, 65 companies have signed on to the Corporate Renewable Energy Buyers' Principles, backed by the World Wildlife Fund and World Resources Institute; these companies represent more than 48 million megawatt hours of annual demand by 2020, equivalent to powering 4.4 million American homes with clean, renewable energy.⁶

Energy efficiency can be viewed as another source of alternative, low-cost power. Substantial investment in energy-efficient technologies enables new and growing markets for companies as well as a customer-value proposition driven by cost avoidance. Deploying energy-efficient technologies reduces demand and exposure to the variable costs of conventional energy sources over the short and long terms. As you can see in Figure 2, efficiency gains since 2000 have limited energy consumption. In fact, without efficiency gains, energy demand in IEA countries would have grown by 1% annually, surpassing the 2007 peak in 2015; instead, energy demand is 1% below 2000 levels.

NB SRI Portfolio: As of 9/30/2017, 67% of portfolio holdings by weight are sourcing and/or have targets in place for purchasing renewable energy.

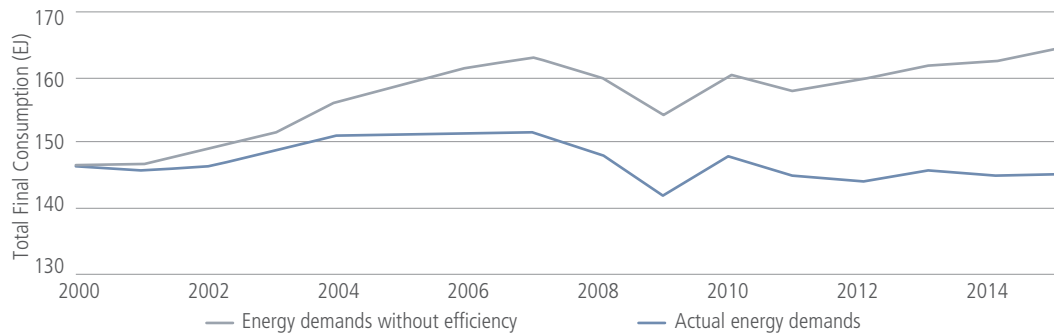
⁴In 2015, Mark Carney, chairman of the Financial Stability Board (FSB) and chair and governor of the Bank of England, formed the Task Force on Climate-related Financial Disclosures (TCFD), the first international initiative to examine climate change in the context of financial stability.

⁵The Task Force on Climate-Related Financial Disclosures (TCFD) has developed consistent climate-related financial risk disclosures for use by companies in providing information to investors, lenders, insurers and other stakeholders. The Task Force will consider the physical, liability and transition risks associated with climate change and what constitutes effective financial disclosures across industries.

⁶More information about Corporate Renewable Energy Buyers' Principles can be found [here](#).

FIGURE 2. ENERGY EFFICIENCY HAS SUPPRESSED OVERALL CONSUMPTION

Efficiency in International Energy Agency Member Countries, as of 2015



Source: International Energy Agency.

Note: IEA member countries include: Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Ireland, Italy, Japan, Korea, Luxembourg, The Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States.

Overall, 48% of the companies in the 2016 *Fortune* 500 have set targets to reduce greenhouse gases, improve energy efficiency and/or increase sources of clean energy.⁷ Companies have a wide range of options when it comes to implementing and facilitating energy-efficiency initiatives. Energy-efficiency programs can span manufacturing, transportation/distribution and supply chains. Opportunities also exist in integrating energy efficiency into product design, thereby increasing the end consumer's awareness of a product's value, overall cost savings and environmental benefits. From an investment perspective, business opportunities, driven by potential energy efficiency gains, can be found across all industries and sectors.

NB SRI Portfolio: As of 9/30/2017, 59% of portfolio holdings by weight have emission-reduction targets in place.

Businesses are reaping bigger and bigger cost savings from their energy-efficiency projects, with 190 companies collectively reporting \$3.7 billion in annual savings.⁸ Among the *Fortune* 100 companies reporting to CDP, 56 reported reliable data on their investments and savings in renewable energy and energy efficiency. Collectively, these companies are saving almost \$2.5 billion annually through more than 60,000 initiatives focused on emission reduction and renewable energy. In 2016 alone, these companies decreased their annual emissions by approximately 54.7 million metric tons of CO₂ equivalent, saving them an average of \$46 per metric ton of carbon dioxide equivalent emissions (mtCO₂e). Reported payback periods typically ranged from one to 10 years.⁹

Product Innovation as a Competitive Advantage. Opportunities driven by potential energy-efficiency gains can be found across virtually all industries and sectors. Taken in aggregate, these types of innovative products and services could have a profound impact on the course of climate change.

In the transportation industry, a significant contributor to GHG emissions, more than three-quarters of all vehicles sold globally today are covered by fuel-economy standards.¹⁰ Automakers are expanding production of electric vehicles to meet a steady and growing consumer demand globally. These existing and emerging technologies will continue to help transform our existing transportation fleet to be cleaner and more efficient. Other companies are conducting lifecycle analysis of the existing products in their portfolios and working with their supply chains to find alternative inputs that are more energy- or water-efficient, that can reduce overall household impacts through sustainable sourcing and product packaging, or that can help customers avoid emissions altogether. There are many avenues companies can take to be part of the solution, and we believe the drive for product innovation will help those companies remain more competitive over the long term.

⁷ "Power Forward 3.0: How the Largest U.S. Companies Are Capturing Business Value While Addressing Climate Change."

⁸ Loc. Cit.

⁹ Loc. Cit.

¹⁰ "International Energy Agency: CO₂ Emissions from Fuel Combustion."

Measuring the Impact of Climate Change: NB SRI Process Overview

In looking for impact, we examine companies across several parameters:

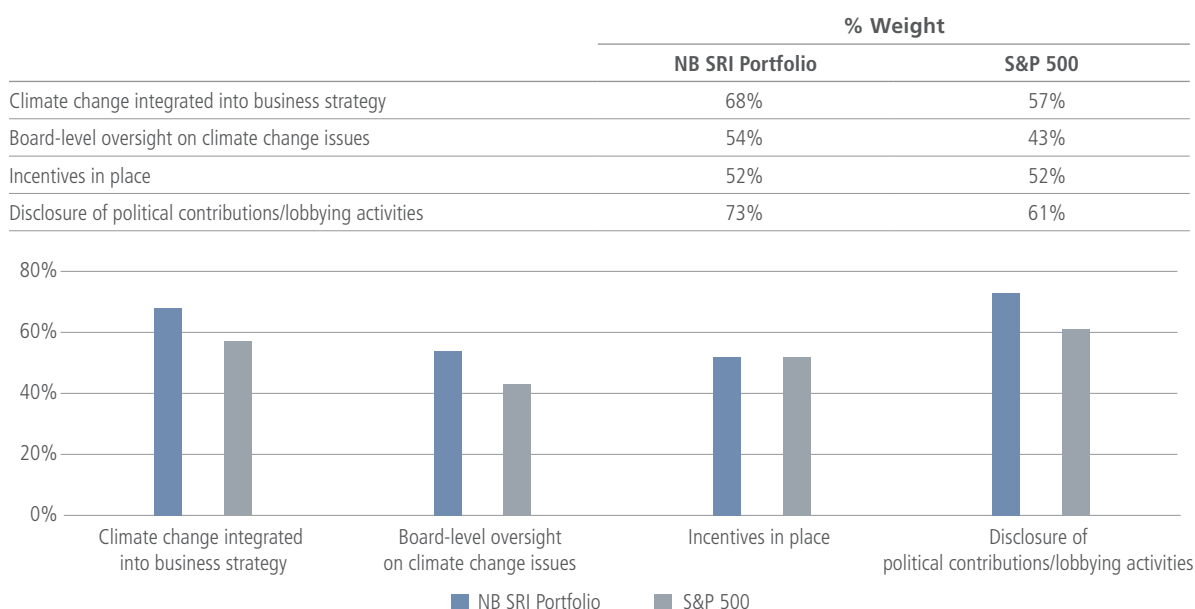
- Management, governance and risk oversight
- Company operations and programs
- Products and services
- Disclosure and reporting

This exercise helps us to better understand their strengths and weaknesses. In some cases, companies may need to enhance their disclosure to better communicate the progress they are making in transitioning to a lower-carbon economy. In other cases, companies may need to consider whether management’s climate change commitments are properly aligned with their political contributions or lobbying activities. Below we take a closer look at each of these factors in the context of climate change and compare the NB SRI portfolio’s weighting in each to that of the benchmark S&P 500.

Management, governance and risk oversight. We look to see how companies are integrating climate change into their business strategy, board oversight, management commitments and incentives, and policies, as well as their consistency across these areas. This includes political contributions and lobbying activities. In our view, the strongest indicator that a company is integrating sustainability into its overall business strategy, culture and DNA is commitment from management and the board.

FIGURE 3. MANAGEMENT, GOVERNANCE AND RISK OVERSIGHT FACTORS: NB SRI VS. S&P 500

As of 9/30/2017



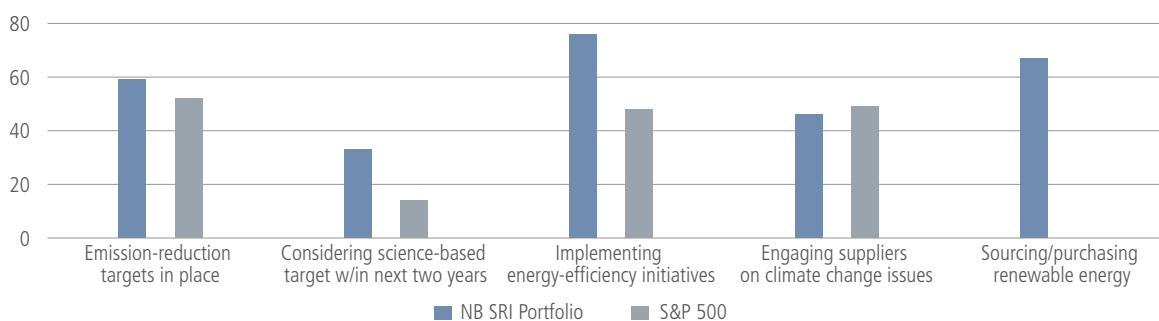
Source: Neuberger Berman, CDP, CPA-Zicklin Index of Corporate Political Disclosure and Accountability.

Company operations and programs. We then look for such things as program implementation to see what emission-reductions targets are in place and what energy-efficiency initiatives the company has implemented to reduce its overall environmental footprint. These efforts can be within the company’s own operations or, to the extent it is relevant and possible, throughout its supply chain. Here we can see where the company has minimized climate change-related risks and, in some cases, has become more efficient and better positioned to avoid more onerous costs in the future.

FIGURE 4. COMPANY OPERATIONS AND PROGRAMS FACTORS: NB SRI VS. S&P 500

As of 9/30/2017

	% Weight	
	NB SRI Portfolio	S&P 500
Emission-reduction targets in place	59%	52%
Considering science-based target w/in next two years	33%	14%*
Implementing energy-efficiency initiatives	76%	48%*
Engaging suppliers on climate change issues	46%	49%
Sourcing/purchasing renewable energy	67%	NA



Source: Neuberger Berman, CDP. *% of Fortune 500 companies.

Products and services. Many investors and companies are reaping the benefits of products and services that can help facilitate energy savings and emissions reductions for their customers. Companies with thoughtful business plans have the ability to implement cost-saving strategies within their organization while also generating additional revenue from new climate change-related market opportunities. Whether they reach consumers directly or enable other businesses to meet their own energy-efficiency targets and goals, these companies are positioned to both implement and facilitate energy-efficiency programs and products. We believe such innovation results in a competitive advantage that ultimately benefits shareholders, employees and communities; we provide some examples in the Appendix.

FIGURE 5. PRODUCTS AND SERVICES FACTORS: NB SRI

As of 9/30/2017



Source: Neuberger Berman.

Disclosure and reporting. Companies that can provide meaningful and comparable disclosure of climate change-related data and/or case studies to investors are more transparent; we believe such companies have an overall advantage in the marketplace, particularly given that investors increasingly are looking for more measurable outcomes. Companies that are open to engagement with their shareholders and take part in ongoing dialogues also stand to benefit as they address potential risks to and opportunities for their business. As discussed earlier, there are several investor initiatives currently underway that seek more comprehensive and material disclosure of climate change-related actions companies are taking.

FIGURE 6. DISCLOSURE AND REPORTING FACTORS: NB SRI VS. S&P 500

As of 9/30/2017



Source: Neuberger Berman, CDP.

Climate Change-Related Sustainable Development Goals

The NB SRI team recognizes and supports the United Nations' Sustainable Development Goals (SDGs). We feel that the NB SRI portfolio has exposure to the following climate change-related SDGs and that our company holdings can further drive beneficial impacts for the environment and communities globally.

 <p>7 AFFORDABLE AND CLEAN ENERGY</p>	Ensure access to affordable, reliable, sustainable and modern energy for all
 <p>11 SUSTAINABLE CITIES AND COMMUNITIES</p>	Make cities and human settlements inclusive, safe, resilient and sustainable
 <p>12 RESPONSIBLE CONSUMPTION AND PRODUCTION</p>	Ensure sustainable consumption and production patterns
 <p>13 CLIMATE ACTION</p>	Take urgent action to combat climate change and its impacts
 <p>15 LIFE ON LAND</p>	Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, halt and reverse land degradation, and halt biodiversity loss

Source: United Nations.

Identifying Climate-Related Risks and Opportunities in the NB SRI Portfolio

As the world transitions to a low-carbon economy, we believe it is important as investors to assess the climate change-related risks and opportunities across our portfolio. Over each of the past several years, we have conducted a carbon footprint analysis of the NB SRI portfolio to find that as of 9/30/2016 we are 56% more carbon-efficient than the S&P 500 benchmark. Our consistently favorable carbon footprint numbers are primarily due to stock selection rather than sector avoidance. We continue to stress, as we have over many years, how climate change risks and opportunities are embedded within our bottom-up analysis of ESG criteria, and we note that the issue of climate change grows more pressing with each passing year. As investors, we have committed to addressing climate change impacts within our portfolio holdings.

Over the past two decades, NB SRI has not invested in coal or oil sands. Currently, our energy holdings have a natural gas bias. In our view, by displacing more carbon-rich fuel sources in power generation, natural gas continues to play an important near-term role in reducing CO₂ emissions. Natural gas can also serve as a bridge to a lower-carbon future as renewables (solar, wind and hydro, as well as nascent alternatives) grow from their current small base and their supply becomes more reliable and widely available. With that said, growing production of natural gas from shale plays across the U.S. presents a new set of ESG issues that need to be analyzed and understood so that they can be integrated into the due diligence process.

Natural gas from low-cost domestic sources now accounts for 26% of energy consumption, versus coal at 20%. The growth of U.S. natural gas production presents both opportunities and challenges for the environment, the economy and ESG investors. On the positive side, relative to other fossil fuels such as coal and petroleum, natural gas combustion emits less carbon dioxide equivalents, negligible sulphur oxides (SO_x), nitrogen oxides (NO_x) and toxic mercury emissions. Natural gas combustion has at least 45% lower emissions intensity at 0.55 kg CO₂ per kWh compared to coal (0.98).¹¹ In addition, natural gas enables on-demand peak generation capacity that is an essential requisite for renewable energy such as wind and solar that today cannot be relied on for base-load supply. We believe these advantages and the growing low-cost availability of domestic gas across the U.S. also explain why natural gas has been capturing share as a supply source for power generation.

We have ongoing dialogue and engagements with our best-in-class exploration and production companies on a range of sustainability issues, particularly on methane fugitive gases and water sourcing, recycling and disposal. We additionally continue to encourage companies to search for renewable sources of energy. Many companies within the NB SRI portfolio are among the largest corporate purchasers of renewables. Company holdings within the technology, industrials, financials, materials, consumer products and energy sectors are currently sourcing renewables and have commitments to add more sources over the next several years, with several having commitments to source 100% renewables over the coming decade.

Forests play a critical role in mitigating climate change because they act as a carbon sink—soaking up carbon dioxide that would otherwise be free in the atmosphere and contribute to ongoing changes in climate patterns. Deforestation undermines this important carbon sink function. It is estimated by the World Wildlife Fund that 15% of all greenhouse gas emissions are the result of deforestation. Over the years, we've had ongoing discussions and engagements to further understand and assess potential deforestation risks within the company supply chains and across our portfolio.

NB SRI Portfolio Supports a 2-Degree Transition

Evaluating the net benefits of a company's products and services can help us better understand how a company is transitioning to operate in a 2-degree world. Below is a discussion of how certain companies may be benefitting from the development of products and services that can help facilitate energy savings and emission reductions—for their customers and for themselves. We believe that seeking portfolio exposure to companies with such innovative products and services will enable NB SRI to benefit from long-term secular opportunities while helping to address climate change-related risks and opportunities.

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. Auto suppliers are driving the technology behind autonomous cars, hybrid vehicles and electric vehicles in addition to active safety components. With a focus on electrical architecture, powertrain and electronics and safety, more than half of the auto suppliers' product portfolio enables fuel economy and emissions reductions.

¹¹ Neuberger Berman estimates, U.S. Energy Information Administration, U.S. Environmental Protection Agency.

Airlines: The two biggest impacts on efficiency in airlines are retiring/upgrading the airline fleet and seat configuration. One company in our portfolio 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.

Consumer Products: Companies aiming to strengthen their brands increasingly are looking deep into their supply chains. For example, in the area of deforestation, companies have made commitments to sustainably source palm oil by 2020. Others are incorporating sustainable practices into their product designs and manufacturing process. This includes a great deal of effort of working with suppliers to ensure products and materials are sustainably sourced and can enhance the overall product lifecycle analysis of products.

Materials: One of our portfolio companies is a global market leader in enzyme applications that help to enhance energy efficiency and enable customers to save over 60 million tons of CO₂ as well as to improve the overall environmental lifecycle of products.

Financials: Companies in the financial sector also have an important role to play in helping to mitigate climate change, particularly through their investment, lending and insurance underwriting activities. For example, within our portfolio, financial companies assess environmental and social risks through their extensive due diligence processes and have also adopted policies to avoid investments in coal. One company in particular functions as a clearinghouse for the European Union's carbon trading program and helps to promote sustainable stock exchanges and sustainability disclosure for listed U.S. companies.

Conclusion

Though commitment may be wavering at the federal level, a number of U.S. cities and states have maintained or even strengthened their commitment to productive climate change policy. Living in a 2-degree world will not be easy, and the business and investor community will be encouraged to help lead the transition to a low-carbon economy.

While it is widely accepted that climate change will have a broad range of impacts on economies and financial markets over the coming decades, assessing the impact of climate change on investment portfolios is challenging. Over the years, NB SRI has engaged and encouraged companies across a range of industries to enhance their transparency and disclosure across climate change-related factors so that it is complete, comparable and timely, allowing a more comprehensive look into the challenges and opportunities that may emerge. Within our impact framework, we have aggregated data across a set of key metrics that can help provide a comprehensive view of our portfolio, going beyond traditional carbon footprint analysis and to instead focus on a broader set of indicators that highlight the portfolio's climate change consistency and resiliency.

Neuberger Berman SRI Statement on Climate Change

- Climate change is real and can have material impact on businesses, communities and the environment.
- Environmental issues are relevant across all industries, up and down supply chains.
- Environmental considerations can create growth opportunities as well as contingent liabilities that need to be assessed when valuing a business as a prospective investment.
- Companies can impact climate change by contributing to it, mitigating it and providing solutions for it.
- Environmental impacts are important considerations for businesses and are an integral part of our investment analysis.
- We seek companies that recognize and understand climate-related risks and opportunities relevant to their business.
- We seek companies that have a demonstrated commitment to environmental stewardship and sustainability.
- We have shared our perspective through support for a number of investor-led environmental initiatives.

Summary of the Science

- There is near unanimous consensus in the global scientific community on anthropogenic climate change over the past century.
- To stabilize the earth's climate, the consensus goal is to stay within a 2°C global average temperature increase above pre-industrial levels.
- Scientists agree that to reduce the probability of a 2°C rise in temperature by 2050, the concentration of CO₂ in our atmosphere must be limited to 450 parts per million.

The Effects of Climate Change are Significant

- The earth's surface temperature has increased 0.8°C since 1900.
- Sea levels have risen 3.5 mm per year since 1993, twice the rate of the prior century (1.7 mm per year).
- Glacier volumes are declining sharply, at a rate of 0.58 meters water equivalent per year, twice the rate of previous decades.
- Ongoing ocean acidification presents risks to marine ecosystems, including crustaceans and fish.
- Extreme weather events—including hurricanes, drought, floods and wildfires—have increased in frequency and severity.

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S&P 500: Consists of 500 stocks chosen for market size, liquidity, and industry group representation. It is a market value weighted index (stock price times number of shares outstanding), with each stock's weight in the Index proportionate to its market value. The "500" is one of the most widely used benchmarks of U.S. equity performance. As of September 16, 2005, S&P switched to a float-adjusted format, which weights only those shares that are available to investors, not all of a company's outstanding shares. The value of the index now reflects the value available in the public markets.

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