

THE PRICE OF CLIMATE CHANGE
GLOBAL WARMING'S IMPACT ON PORTFOLIOS

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Summary

Climate change and its risks are going mainstream. What does the raft of new rules to curb carbon emissions mean for investing? How do you reduce climate risk in portfolios? We debated this with colleagues, clients and industry representatives during a one-day global videoconference in September. Our key conclusions:

- ▶ You may or may not believe man-made climate change is real or dismiss the science behind it. No matter. Climate change risk has arrived as an investment issue. Governments are setting targets to curb greenhouse gas emissions. This may pave the way for policy shifts that we could see ripple across industries. The resulting regulatory risks are becoming key drivers of investment returns.
- ▶ The momentum behind mitigating climate risk in portfolios appears to be building. Long-term asset owners worry about extreme loss of capital and/or “stranded” assets (holdings that need to be written down before the end of their expected life span). Do securities of companies most susceptible to physical and regulatory climate risks already trade at a discount to the market? We have not observed such a discount in the past — but could see one in the future.
- ▶ Global insurers have led the way in pricing natural disaster risks. A huge U.S. storm in 1992 (Hurricane Andrew) almost wiped out the industry, leading to a revolution in how it underwrites risks through an influx of capital, use of big data and increased capital requirements. Other industries may need to catch up.
- ▶ We discuss ways for asset owners to promote sustainability, including a focus on environmental, social and governance (ESG) factors. This is not just about saving the planet or feeling good. We view ESG excellence as a mark of operational and management quality. It means responsiveness to evolving market trends, resilience to regulatory risk, and more engaged and productive employees.
- ▶ Divesting from climate-unfriendly businesses is one option. The biggest polluting companies, however, have the greatest capacity for improvement. Engagement with corporate management teams can help effect positive change, especially for big institutional investors with long holding periods.
- ▶ The focus on sustainability has unleashed a torrent of new data. These can be used to measure physical and regulatory environmental risks, to mine for alpha opportunities or to reflect social values in portfolios. As examples, we analyze the carbon intensity of an insurer’s corporate debt portfolio and discuss research that ties improving carbon efficiency to equity outperformance.
- ▶ Securities markets are evolving to include emissions trading and green bonds, enabling investors to limit carbon exposures in portfolios and direct capital to projects that reduce emissions. Putting a price on carbon emissions is key for determining the value of energy-intensive industries, we believe. Carbon prices are mostly driven by policy, however, and currently offer little incentive to force emitters into palliative action and consumers to switch to non-fossil fuels.
- ▶ Efforts to mitigate climate change will produce winners and losers — but maybe not always the obvious ones. The oil industry and energy-exporting countries may look like losers, yet low-cost operators should do fine as de-carbonization will likely be gradual. Assets that may benefit from a transition to a low-carbon economy include renewable infrastructure debt and equity. We also like selected companies specializing in energy efficiency and clean technologies.

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Introduction

Climate change is gaining traction as a global policy initiative, a key risk factor and an emerging investment theme. This publication gives our views on the likely impact on investors and investment outcomes.

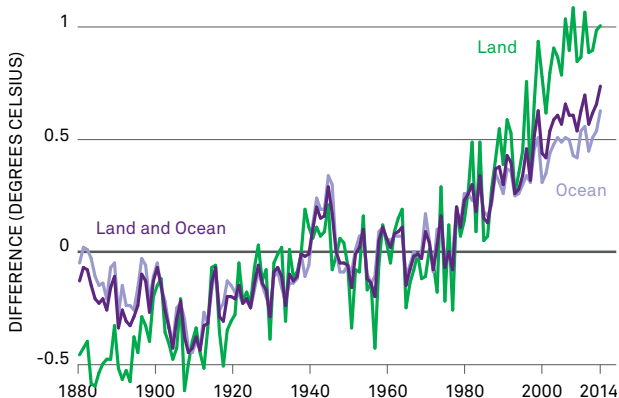
We are not going to debate the science of climate change, but note the following key points are driving the debate:

- ▶ Global average surface temperatures (land and ocean) have risen 0.88° Celsius (1.6° Fahrenheit) since records began in 1880, according to the U.S. National Oceanic and Atmospheric Administration.
- ▶ Seventeen of the past 18 years have been the hottest on record globally. See the chart below.
- ▶ Possible causes are many, including an increase in carbon and other heat-trapping greenhouse gas emissions.
- ▶ Rising temperatures help explain melting ice caps, rising sea levels, shifting precipitation patterns, droughts and floods.
- ▶ A warming of 2° Celsius or more (from the 1880 starting point) is seen by many scientists as an initial threshold for irreversible damage and severe weather effects.

Even if you are skeptical of global warming and its causes, we think it is prudent to appreciate the regulatory momentum behind it. Governments are moving to curb and eventually reduce greenhouse gas emissions.

TEMPERATURE RISING

Global Temperature Difference From Average, 1880 to 2014



Sources: BlackRock Investment Institute and U.S. National Oceanic and Atmospheric Administration, September 2015.

Note: The lines show the difference in global temperatures versus the 20th century average, measured in degrees Celsius.

REGULATION RULES

Policymakers are targeting fossil fuel producers and energy-intensive industries with tough and costly new rules. They are supporting technologies and companies that boost efficiency and/or harness renewable energy sources.

The Financial Stability Board, which monitors risks to the global financial system, is looking into stress testing of portfolios (starting with insurers) for carbon and eventually water risks. This will likely have implications for pension plans (which own many of the assets) and governments (which generate tax revenues from the resource industry).

Rules can have a material impact. Look no further than the European auto industry sell-off after Volkswagen admitted it had cheated on emissions tests. Or to the underperformance of European utilities after the 2011 tsunami in Japan led to a raft of new safety regulations and a phasing out of nuclear power generation in Germany.

We expect regulators to pay closer attention to standards and enforcement. This is likely to drive up the cost of doing business — much like it did for financial services companies after the global financial crisis.

CARBON MARKETS

It took more than a century and trillions of dollars to build the current carbon-intensive economy. It will likely take decades to transition to a lower-carbon world. Changes will not be smooth, linear or cheap. They will likely involve trade-offs with economic growth that may not be palatable.

Carbon markets are a case in point. They were introduced to establish a price for the right to emit above a government-set level. Yet governments historically have been overly generous with the allotments for polluting companies, in part for fear of hurting national competitiveness. Emissions also have been lower than anticipated in recent years. Reasons include tepid global economic growth and increased use of cleaner burning natural gas (oversupplied and inexpensive thanks to the U.S. shale energy boom).

The result: Carbon prices currently are too low to mitigate emissions. It is far easier to pay the current price of 8 euros a tonne than invest a multiple of that in a project with funding and operational risks. This shows the inherent conflicts policymakers face. Carbon markets may have more teeth in the future. Auctioning permits instead of awarding them, tougher caps on emissions and extending the remit to sectors that are mostly exempt currently (transport) would likely help carbon markets flourish.

Why Care Now?

Global business and policy leaders take climate change seriously. Extreme weather, natural catastrophes and failure of climate change adaptation ranked among the top 10 global risks in terms of likelihood in 2015, a [2014 World Economic Forum survey](#) of 900 members shows. See the table below.

Most of these events also were seen as risks likely to have the most impact in 2015. This high risk perception has put climate change on the global policy agenda.

Climate change creates uncertainty. Temperature rises make weather harder to predict (despite increased data) and raise the margin of error in modeling knock-on effects such as changes in sea levels, agricultural and weather patterns.

There are also economic reasons for climate change mitigation. China, for example, knows its credit-fueled and resource-intensive development will become unsustainable, and is shifting to a services-dominated economy. Its citizens are clamoring for cleaner air and water as part of a social pact with the ruling Communist party. This means Beijing is bent on cutting emissions.

The efforts to curb carbon emissions have evolved in fits and starts. The 1997 Kyoto Protocol required developed countries to cut emissions by 5.2% below 1990 levels by 2008-2012. The problem? Neither the U.S. nor China, which together produce one-third of global greenhouse gases, were party to the Kyoto agreement.

PREPARING FOR PARIS

It soon became clear governments were unable (or unwilling) to meet their Kyoto targets. The 2011 Durban climate meetings revived the effort, laying the groundwork for new emissions-reduction commitments from 2020.

The United Nations Climate Change Conference in Paris in December 2015 (also known as [COP 21](#)) will aim to ratify a new emissions-reduction framework based on the current patchwork of country-specific, post-2020 pledges. What can we expect from the gathering of thousands of delegates beyond intensive use of Paris' bicycle-sharing program?

We anticipate more country-specific commitments. Each country is required to submit intended nationally determined contributions (INDCs). These will be key signposts for progress — especially if the bottom-up approach can evolve over time into a legally enforceable global treaty. The pledges may also offer glimpses of future regulatory regimes.

An international deal to cut emissions has many obstacles: conflicting incentives, a poor economic backdrop and different development stages. Plus, the Intergovernmental Panel on Climate Change [2014 report](#) says the world needs to halve emissions between 2010 and 2050 to limit the increase in global temperatures to 2° Celsius from the 1880 level. If temperatures were to rise by more than 2°, the risk of climate disturbances would increase and adaptation become costlier. Recent pledges, especially those from the U.S. and China, have given treaty supporters some cause for optimism, however.

DISASTER PLANNING

Top 10 Global Risks: Likelihood and Impact, 2015

MOST LIKELY

1. Interstate conflict
2. Extreme weather events
3. Failure of national governance
4. State collapse or crisis
5. Unemployment or underemployment
6. Natural catastrophes
7. Failure of climate change adaptation
8. Water crises
9. Data fraud or theft
10. Cyber attacks

MOST IMPACT

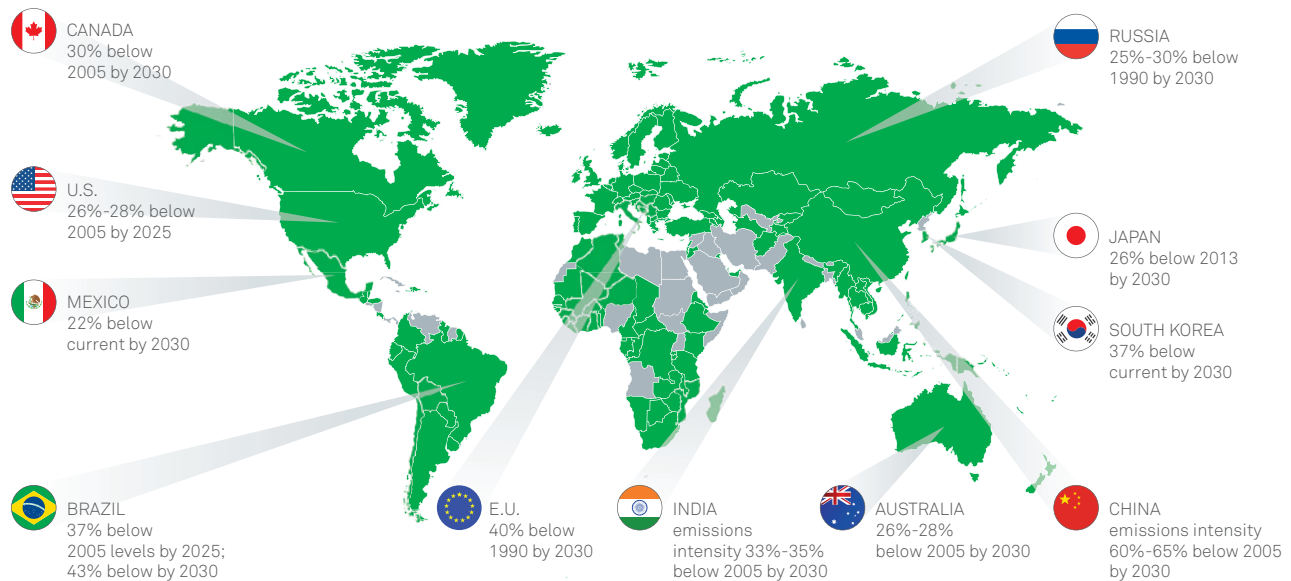
1. Water crises
2. Spread of infectious diseases
3. Weapons of mass destruction
4. Interstate conflict
5. Failure of climate-change adaptation
6. Energy price shock
7. Critical information infrastructure breakdown
8. Fiscal crises
9. Unemployment or underemployment
10. Biodiversity loss and ecosystem collapse

Sources: BlackRock Investment Institute and World Economic Forum, September 2015.

Notes: The risk rankings come from the World Economic Forum (WEF)'s latest Global Risks Perception Survey, which polled 900 WEF stakeholders in the summer of 2014. Climate-related risks are highlighted.

PROMISES, PROMISES

Countries With Pledges to Reduce Emissions After 2020



Sources: BlackRock Investment Institute and Bloomberg New Energy Finance, October 2015.

Note: The countries in green have submitted intended nationally determined contributions (INDCs) toward creating a lower-carbon world post 2020.

GOOD OR BAD COP 21?

Promises of emissions cuts are thick in the air. See the map above. Most countries will likely lowball their initial targets. This is not necessarily a bad thing. Some proponents of emissions cuts would say it is better to pick something achievable and ratchet up the target once you have proven it is possible to cut emissions without hurting growth.

China's target is a case in point. Most analysts expect its emissions to peak by the mid-2020s. Yet the country's official targets factor in a peak in 2030. This should allow China to give the appearance of overachieving (a diplomatic gift that keeps on giving).

It is also key to understand how emissions reductions are achieved. Europe's emissions, for example, are down by some measures — in part because growth has faltered. This is *not* a good model to export to the rest of the world.

A signpost of whether COP 21 will have teeth is whether the delegates can agree on regular reviews (say, every five years) that include gradual ratcheting up of targets.

Another signpost would be the adoption of accounting guidelines that help price climate risks across the financial system. International financial regulators appear to be moving toward eventually incorporating an assessment of climate risk into accounting standards.

CHANGE MANAGEMENT?

Will COP 21 actually mitigate climate change? We do not know, and doubt anybody does. Yet we keep at least three points in mind:

- 1 Politicians often take significant action only when they have their backs against a wall. This sense of urgency has been lacking — and it may not change soon.
- 2 Energy efficiency can reduce emissions significantly. The use of fuel-efficient vehicles and energy-saving appliances and lighting will save more than 700 million tonnes of oil equivalent annually by 2040, according to the International Energy Agency (IEA). This roughly equals the combined annual oil consumption of Germany, France and the U.K. today. Solutions will range from low-tech (insulation) to high-tech ("smart grids" that use technology to efficiently match electricity demand and supply). This is already happening. Regulations on emissions and efficiency standards will likely accelerate the change.
- 3 Other technology advances and shifting consumer preferences also have the potential to uproot the carbon status quo. Wind power has become cost competitive with traditional sources of electricity generation, according to the IEA. Solar panel prices halved between 2010 and the end of 2014. See page 11 for details.

Portfolio Applications

Asset prices are not immune to regulatory efforts to mitigate climate change. One way to measure potential portfolio impact is to treat climate change as one of many unknown, long-term threats and ask ourselves: Should we insure against it now? Insurance only makes sense if the perceived benefits of buying it outweigh the costs. Yet a simple cost-benefit analysis is difficult to apply to climate change:

- ▶ The predicted effects of rising greenhouse gas emissions are highly uncertain, making the associated physical costs and timing thereof hard to ascertain.
- ▶ The costs and benefits are not distributed evenly — there are apparent winners (renewable energy providers) and losers (flood-prone Bangladesh, oil-rich Saudi Arabia and traditional energy companies). See pages 10-11.

Natural disasters are difficult to capture in models, and globalization increases the risk of local events cascading across borders with unpredictable consequences. Japan's 2011 tsunami, for example, not only led to a major nuclear accident but also caused serious disruptions in the global supply chains of auto and electronics parts.

It is tempting to think the risks are hypothetical and that, if they were to erupt, could not have been foreseen anyway. This leads to complacency. Global insurers and reinsurers learned their lesson the hard way — the insurance sector was nearly wiped out (with 11 bankruptcies) after Hurricane Andrew in 1992, the costliest natural disaster before another U.S. storm, Hurricane Katrina.

This prompted a reassessment of the way global insurance companies price natural disaster and climate risks. Three big shifts lay behind this evolution from ruin to resilience, Willis Research Network argues:

- 1 New capital flooded into the sector, changing the way risks were viewed and priced. The opportunity? Profits from better underwriting of climate risk exposure.
- 2 The big data revolution transformed the modeling of catastrophe risk. Satellite observation and data analytics are helping us better understand weather risks.
- 3 A regulatory onslaught required insurers to hold enough capital to cover losses from one-in-200-year extreme weather events. Result: A record year of claims in 2011 left the industry largely unscathed.

CLIMATE CHANGE PREMIUM

Most industries lag insurers when it comes to properly accounting for and pricing risks of climate-related events. Many equity investors ignore climate risk, and credit investors and ratings agencies do not routinely assess it. Real estate markets often ignore extreme weather risk, even in highly exposed coastal areas. Most asset owners do not measure their exposure to potentially stranded assets such as high-cost fossil fuel reserves that may have to be written off if their use is impaired by climate change regulation.

Who can blame them? There is little evidence that assets more susceptible to climate change and related regulatory risks trade at a discount to the market. A simple analysis of monthly returns in the MSCI World Index shows low carbon-intensive equities (those with the lowest carbon emissions by revenues as of 2014) have outperformed those with the highest carbon intensity over the past 20 years. Yet this outperformance vanishes after stripping out the impact of common return factors such as size and geography, we found. In other words, we found there has been no climate change risk premium for equities.

Yet this does not mean there will be no premium in the future. In fact, we think there likely will be one. Many countries are set to adopt carbon taxes or cap-and-trade (emissions trading) programs to help meet their INDC targets. Greater transparency on climate risks and exposures will likely lead to a gradual discounting of companies and assets exposed to climate risk — and increase the value of those most resilient to these risks.

Some asset owners are already divesting from carbon-intensive equities, while others are “hedging” their carbon exposure by investing in renewables, energy efficiency and clean tech. It can be costly to underestimate environmental risks. Just ask BP's equity and debt holders.

WANTED: GOOD DATA

Rising risks increase the importance of having accurate data to monitor and help prevent climate change casualties in portfolios. We encourage corporate management teams to improve disclosure and support index provider MSCI's methodology for tracking ESG risks in around 5,500 companies. Scoring is still relatively crude, but it is quantitative and scalable. This helps investors recognize and monitor ESG risks in their portfolios (see page 7). We are building the ESG data set into our Aladdin risk management system. We are also taking advantage of emerging sets of carbon data to measure the carbon footprint of portfolios or to generate alpha (page 8).

SUSTAINABLE INVESTING

Many asset owners do not only want to identify climate risks in their portfolios; they increasingly want to make sure their assets reflect their values and deliver a long-term positive impact on the world.

Institutional investors managing \$24 trillion in total assets signed the *Global Investor Statement on Climate Change* in 2014. The pact commits signatories (which include BlackRock) to manage climate change risk as part of their fiduciary duty to clients. This involves working on initiatives to deploy capital toward a low-carbon economy; identifying low-carbon investment opportunities; and encouraging company disclosure of climate change risks.

Such initiatives are part of a larger move toward sustainable investing. Asset owners can have impact in three ways:

- 1 Prevent:** Screen out securities that do not align with their values, such as fossil fuels, tobacco or arms makers. Norway's parliament, for example, has voted to divest coal assets from its \$873 billion sovereign wealth fund.
- 2 Promote:** Focus on companies with strong environmental, social and governance (ESG) track records and integrate ESG factors into the investment process. Sustainable investment portfolios are an example.
- 3 Advance:** Target outcomes that have a measurable impact on the environment. Examples include direct investments in renewable or energy-efficient projects and green bonds.

ENGAGE TO INFLUENCE

Sustainable investing is not a passing fad. Our key points:

- ▶ This is not just about doing or feeling good. ESG factors cannot be divorced from financial analysis. We view a strong ESG record as a mark of operational and management excellence. Companies that score high on ESG measures tend to quickly adapt to changing environmental and social trends, use resources efficiently, have engaged (and, therefore, productive) employees, and face lower risks of regulatory fines or reputational damage.
- ▶ Some carbon-intensive companies have invested heavily in alternative energy. And the biggest polluters have the greatest scope to reduce future emissions. Many of them will be part of the solution. For large and long-horizon asset owners, it makes sense to engage with these companies and try to influence their behavior, we believe. Our engagement goes beyond sustainability issues and takes place across our holdings, as we focus on all ESG factors. For details, see our *21st Century Engagement* report of May 2015.

GREEN BONDS

How about using finance to bend the future curve on greenhouse gas emissions? Green bonds hold the promise of lowering carbon emissions through project finance.

BlackRock has helped develop *best practices* for green bonds to ensure consistency and credibility. An issuer must demonstrate how the debt financing will yield a material benefit for the environment. Green bonds should be about impact, not labeling. Therefore, issuers must explain how they plan to use the funds, report on progress and agree to a periodic outside assessment to verify compliance. For example, the proceeds of a recent \$1 billion Agriculture Bank of China green bond are earmarked for specific sustainability projects, with accountancy firm Deloitte checking on progress once a year.

The green bond market is still in its infancy with less than \$100 billion of debt outstanding, and plenty of questions remain. Standards, for example, discourage charlatans — but they also raise issuance costs. This possibly undermines the appeal of green bonds to issuers. Standards are also tricky. What constitutes a “green” project? Nuclear power is considered clean in France whereas neighboring Germany views it as too risky to be considered environmentally friendly. Then there are unsolved procedures. What happens if the issuer fails to reduce emissions? Who verifies and enforces compliance?

Our bottom line: This fledgling market has plenty of earth to move to make issuance more reliable and mainstream.

DOING WELL AND GOOD

Can investors do well (generate performance) while also doing good (have a positive social impact)? The two goals often appear pitted against each other, yet this may be a paradox.

Excluding some companies and/or overweighting others versus an index will likely result in a different return than holding the entire market. The quality and measurement of ESG factors is fast improving, and we believe smart use of these evolving data sets can help investors build resilient portfolios for the future.

Carbon Footprints

What is your exposure to extreme loss of capital due to climate change? Do you know your portfolio's overall carbon footprint: What is driving it, and how does it compare with your benchmark?

These are questions increasingly fielded by corporate executives, asset managers and financial advisors. Answers are incomplete at best — for now. Data and standards are in early stages, but asset owners and managers are pressuring companies to boost disclosure and uniformity of reporting.

The *Greenhouse Gas Protocol* separates emissions into three reporting categories. These “scopes” indicate whether companies are directly or indirectly causing emission of greenhouse gases. See the graphic below. A leading source for corporate reporting of annual carbon emissions is the *Carbon Disclosure Project* (CDP), which tracked 1,850 global companies as of 2014.

The CDP for now excludes indirect Scope 3 emissions. This is where many corporate risks may lurk, we believe. Think of the emissions of the Volkswagen diesel cars at the heart of the carmaker's scandal. We also see opportunities here: Scope 3 data would give a wind turbine maker credit for emissions reductions achieved by its products, making it attractive for a carbon-lite portfolio. Another drawback of the current CDP setup is that companies self-report. This leaves room for fudging the numbers and makes comparisons tough.

CARBON OPTIONS

Asset owners may seek to limit their exposure to industries that have the heaviest (direct) carbon footprints, such as utilities, materials and energy companies. If climate change regulation picks up steam, these sectors may have to write down assets that have declining or no economic worth (think coal-powered utilities). Successful investment is often as much about avoiding losers as picking winners, in our view.

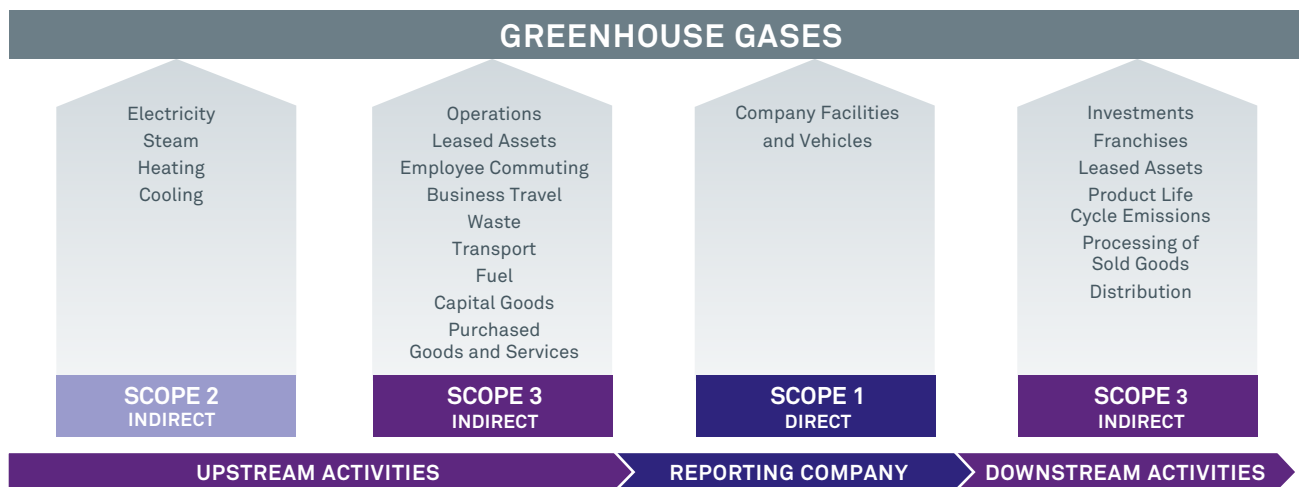
A low-carbon portfolio can generate similar returns to a conventional index — even if efforts to curb emissions go nowhere, a prominent Swedish pension fund believes. This would mean investors essentially get a free option on carbon: potential upside as markets start to price in carbon risks and some downside protection against loss of capital (a bigger risk to long-term investors than volatility). The fund's conclusion: The time to start decarbonizing portfolios is now.

This illustrates the value of calculating a portfolio's carbon footprint. A popular method is to calculate emissions per \$1 of revenues. We prefer to use total capital (the value of the company's balance sheet equity and its outstanding debt) instead of revenues. The reasons: Revenues alone do not capture the debt component, and both equity and debt holders have a theoretical claim on a company's capital.

Evaluating the carbon content of a corporate debt portfolio has additional challenges, we found when we quantified the carbon intensity of an insurer's debt portfolio relative to its benchmark. See the next page.

WIDENING THE SCOPE

Greenhouse Gas Emissions Reporting Categories

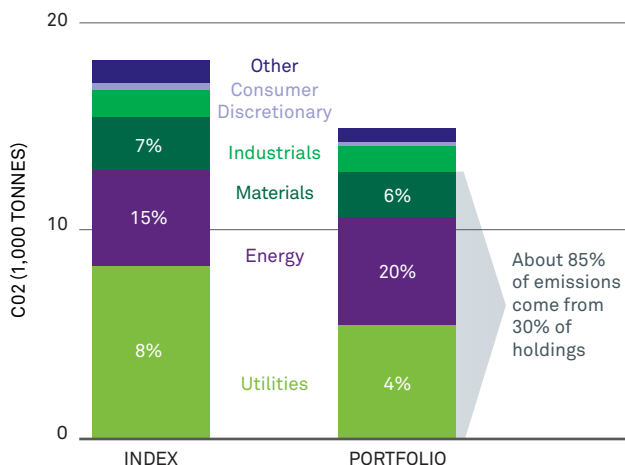


Sources: BlackRock Investment Institute and Greenhouse Gas Protocol, October 2015.

Notes: Direct emissions are those from sources owned or controlled by the reporting entity. Indirect emissions are those that result from the reporting entity's activities but are caused by sources controlled by other entities. Scope 1 refers to all direct emissions. Scope 2 refers to indirect emissions from the consumption of energy. Scope 3 refers to all other indirect emissions. This includes product life cycle emissions, or all the emissions associated with the production and use of a product over its life span.

HOW BIG IS YOUR FOOTPRINT?

Carbon Intensity of a Credit Portfolio vs. Index



Sources: BlackRock Investment Institute, MSCI, CDP and Bloomberg, October 2015.
Notes: The chart shows an insurer's credit portfolio, benchmarked to the Barclays Capital Intermediate U.S. Corporate Index (ex financials). Percentages in bars refer to the dollar holdings weight of that sector within the portfolio. For every unit of debt we calculate emissions per unit of total capital, then scale this by the index and portfolio net asset value to arrive at emissions per dollar invested.

CARBON EXPERIMENT

The result of our experiment: Three sectors (utilities, energy and materials) made up 30% of both the portfolio and index holdings but about 85% of carbon emissions. See the chart above. The portfolio was overall 18% less carbon intensive than the benchmark, partly due to its underweight in utilities.

Individual names made a difference, too. The portfolio's allocation to energy was about one-third higher than the benchmark's, yet this sector's contribution to emissions was only 13% more. In other words, the portfolio's energy companies were "cleaner" than the benchmark's. The reverse was true for the portfolio's utility holdings.

Plenty of questions remain: How about companies with no reliable emissions data? These made up 2%-4% of our portfolio and index. We left them out and adjusted the numbers accordingly. Should we count carbon offsets? These would give renewable equipment makers credit for their products' emissions reductions. We did not use offsets but may do so once Scope 3 data become available.

What to do with debt of private companies? We related emissions to the company's outstanding debt only. This is imperfect as the lower capital results in a higher carbon intensity (emissions per \$1 of capital) than for listed peers.

Our bottom line: Carbon footprinting for now is as much an art as a science. We should expect it to evolve.

CASHING IN ON CARBON

Can investors use emissions data to generate superior returns? Our Scientific Active Equity (SAE) team thinks so. Its thesis: A company decreasing its carbon footprint should essentially be improving its return on assets.

Companies that show the biggest progress on this front should outperform. The relative performance and the rate of change matter, not absolute emissions levels. It is arguably better to focus on the companies that are best in class—even if they happen to be within polluting industries.

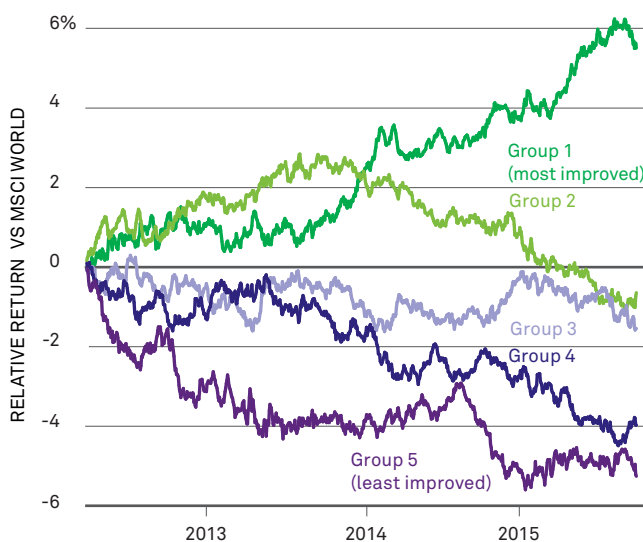
Companies that reduced their carbon intensity (emissions divided by sales) most on an annual basis have outperformed laggards in the past couple of years, SAE research shows. See the chart below.

There are plenty of caveats, starting with the tiny data set. Then there is the problem of self-reported emissions data. And the strategy does not appear to work as well in smaller markets. But we think the larger point is valid: Emerging climate data could help investors generate superior returns.

What's next? SAE has started to measure water risk by matching data on locations of company production facilities with water levels. The team's thesis: Companies that improve water efficiency should outperform.

CARBON EFFICIENCY

Relative Performance of Equities by Carbon Intensity, 2012-2015



Sources: BlackRock Investment Institute, ASSET4 and MSCI, September 2015.
Notes: Most improved means the top 20% of companies that posted the greatest annual decline in carbon intensity. The analysis calculates the carbon intensity of individual MSCI World Index companies by dividing their annual carbon emissions by sales. Companies are bucketed in five quintiles based on their year-over-year change in carbon intensity. We then analyze each quintile's stock price performance versus the MSCI World Index. Past performance is no indication of future results.

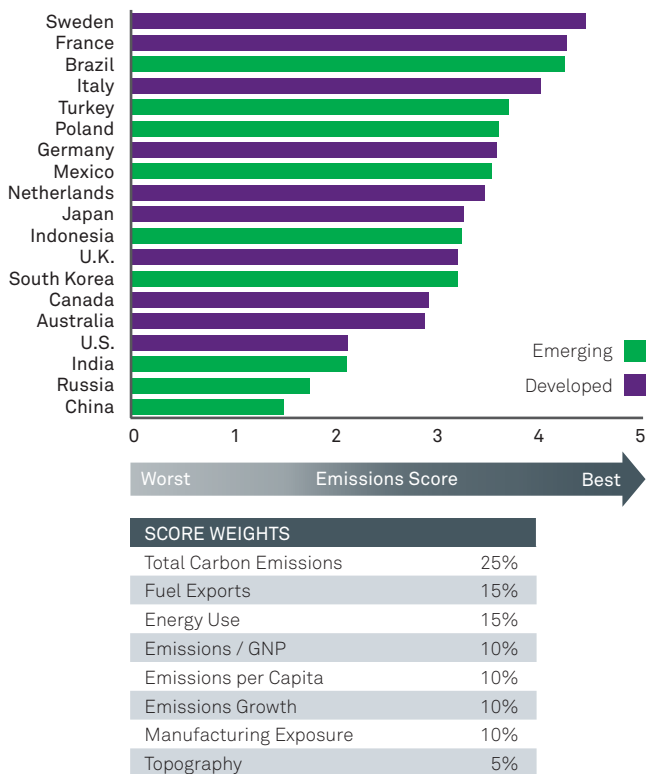
Winners and Losers

Which countries are best prepared for a less carbon-intensive world? Sweden and France look ahead of the curve thanks to their low emissions and high energy efficiency, according to our simple scoring system. See the chart below. The world's two largest emitters — China and the U.S. — score poorly, as do energy exporters such as Saudi Arabia.

Yet pinpointing winners and losers goes beyond emissions. Keeping the rise in temperatures below 2° Celsius requires an incremental 5%-6% of annual global fixed asset investment such as spending on renewables, fuel-efficient vehicles and insulation in buildings, McKinsey estimates. This involves spending today's cash against somewhat amorphous future risks, and explains the reluctance of governments to commit.

CARBON SAINTS AND SINNERS

Carbon Emissions Country Rankings and Scoring System, 2015



Sources: BlackRock Investment Institute, World Bank and Lund University, September 2015. Notes: Topography is a measure of geographical exposure to climate change risks, such as the share of the population living in flood-prone areas. Manufacturing exposure measures the share of energy-intensive industries in a country's manufacturing sector. Emissions growth is measured over the period 1990 to 2010. GNP refers to gross national product. Fuel exports are measured as a percentage of total merchandise exports. Data vary from 2000 (topography) to 2013 (fuel exports). Carbon emissions are as of 2009 and are calculated using the technology adjusted consumption based accounting method.

STRANDED DOWN UNDER?

The willingness of policymakers to shift toward a lower carbon economy is key — and this can change rapidly. Australia's Labor government, for example, imposed a revolutionary carbon tax for big emitters in 2012 to reduce greenhouse gases. The opposition campaigned against it amid a downturn in mining and rising electricity bills, and scrapped the tax when it came to power two years later.

The country is in a tough spot. Its largest export is coal, which also accounts for two-thirds of its electric power generation, according to the Australian Bureau of Resources and Energy Economics. Australia is still investing in coal mines and infrastructure. Some of these assets are at risk of becoming obsolete if demand for coal dries up and prices keep falling. We see two caveats:

- 1 Tumbling coal prices actually increase the cost advantage of coal-fueled power over renewables.
- 2 The need to cut carbon emissions has to be balanced against growing demand for energy (particularly from emerging Asia). New "ultra-supercritical" coal-fired plants are 35% cleaner than traditional plants and part of the solution, proponents say.

POTENTIAL WINNERS

Countries that import fossil fuels could be winners — provided they have the political will and capital needed to invest in renewables.

China consumes half the world's coal and generates 26% of global carbon emissions, according to the IEA. Its five-year economic plan emphasizes sustainable growth, increases regulations on air pollution and expands carbon trading. The falling cost of renewables could lead to a shift away from traditional energy sources. The country accounted for 29% of the world's renewable energy investment in 2014, according to Bloomberg New Energy Finance. It overtook Germany as the country with the highest installed solar capacity in 2014, according to the Global Renewable Energy Report.

Another potential winner is India — if it invests to improve power distribution and clean up worsening air pollution. The country has 15 of the 30 most polluted cities in the world by air quality, according to the World Health Organization. There are savings to be made. India's electricity transmission and distribution is inefficient. It loses 17% of electricity generated, compared with 6% in the U.S. and China, World Bank data show. Lower fossil fuel consumption would ease the fiscal burden of fuel subsidies amounting to 0.5% of India's economy in 2014-2015, according to the World Bank.

FOSSIL FUEL FUTURE

We expect the decarbonization process to be gradual. Oil and gas companies with low-cost reserves should do fine as a result, we think. Fossil fuels likely will be part of our energy infrastructure for decades to come. How else to satisfy BP's prediction of a 37% increase in global energy demand by 2035? We are, however, cautious on companies with high-cost reserves.

Increasing energy efficiency is likely to eat into oil demand, throwing up potential investment opportunities. It is spurring a wave of innovation across industries. Think of electric and hybrid vehicles, LED lighting, smart grids and lithium batteries. This is classic disruption, driven in large part by regulation meant to improve the environment.

Regulation matters a great deal. The U.S. Clean Power Plan, for example, aims for a 32% reduction (from 2005 levels) in carbon pollution from power plants by 2030. This would hurt the coal industry, and we would expect its share of U.S. electricity generation to wither. Conversely, it would be a boon for gas, wind and solar power in the long run.

It is important to keep in mind the ripple effects of such shifts. Take the coal industry. Its decline has implications for U.S. railways, which in 2014 relied on the industry for 39% of its tonnage, according to the Association of American Railroads. Ditto for seaborne coal shippers. Many of the companies in this space are highly leveraged.

The hard part? Long-term forecasts on the demise of fossil fuels tend to ignore how new technologies can lower carbon footprints. Example: Carbon capture and storage (collecting waste CO₂ and depositing it underground) are expensive now but could be part of future solutions.

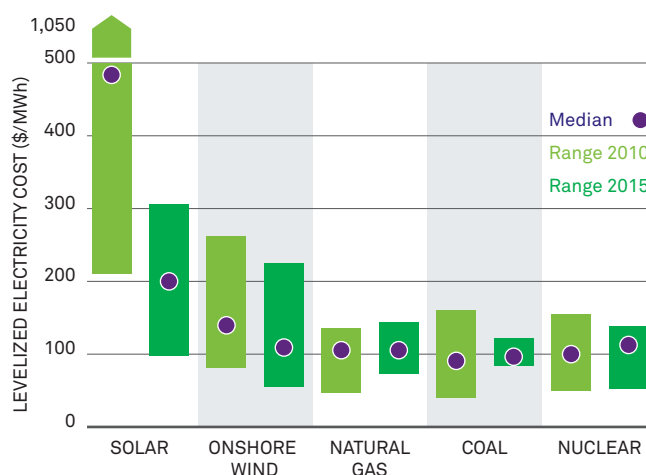
RENEWABLE POWER

Regulations promoting renewable energy are poised to boost the sector. Renewables such as wind and solar power will account for almost half the global increase in total electricity generation from now to 2040, the IEA estimates. This will benefit equipment makers, and create knock-on opportunities in the power grid and energy storage.

Global wind power capacity has grown at an annual clip of 25% since 1997, according to the Global Wind Energy Council. The rising efficiency of wind turbines is finally making wind power a viable substitute for traditional energy sources. See the chart above right. Solar is closing the gap fast. Advances in energy storage could make renewables more attractive by allowing households and businesses to go "off the grid," and help solar and wind parks smooth their output.

RENEWABLES RACE

Costs of Electricity Generation by Source, 2010 vs. 2015



Sources: BlackRock Investment Institute and International Energy Agency, September 2015.

Notes: The levelized cost of energy (LCOE) is calculated by summing all plant costs (investments, fuel, emissions, operation and maintenance) and dividing them by the amount of electricity produced after appropriate discounting. The analysis is based on 181 plants in 22 countries and does not include transmission and distribution costs. The results assume a carbon cost of \$30 a tonne and regional variations in fuel costs. Median values may not fully represent the cost of generation because they give equal weight to markets that may be less relevant globally.

Who will win the renewables race? We do not think there needs to be a clear winner and see a "generation mix." The relative attractiveness partly depends on geography. The best locations are often far removed from the areas where power is needed, adding to project and running costs. Operating discipline is crucial. The attraction of both solar and wind for utilities: Once built, there are no input costs. This makes it easier for utilities to forecast future costs, as opposed to trying to anticipate future swings in fossil fuel prices.

Investing in a high-growth sector such as renewables is not for the faint of heart. When too much capital chases limited opportunities, bubbles are created. Prices often fall as adoption rises and competition intensifies. Today's margin of scarcity is tomorrow's competitive opportunity for a disruptor. Warren Buffett's ex-post advice to investors seeking to profit from the nascent car industry in 1900 (short the horse!) is worth considering.

This is why we like to invest in renewable infrastructure projects, as detailed in *The Mainstreaming of Renewable Power* of September 2015. An influx of capital into the sector is pressuring returns on operational assets, but construction-stage projects often offer better value, we believe. These are long-term investments with limited liquidity. Patience and a stomach for volatility are key.

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