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2020

state of green business

by Joel Makower and the editors at GreenBiz

GreenBiz group

Trucost ESG Analysis
S&P Global

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introduction

by Joel Makower
Chairman & Executive Editor,
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In this, the 13th annual edition of the State of Green Business, we offer the key data and trends to watch in the world of sustainable business. As in past years, the report is produced in partnership with Trucost, part of S&P Global, which provided the key data and metrics for the State of Green Business Index that begins on page 53. Our collective goal is to step back from the daily headlines to take stock of the progress, or lack thereof, in corporate sustainability practices, and to look around corners to see what's next.

It is fair to say that the issues we analyze in this report — and that we cover every business day on the digital pages of GreenBiz.com — are growing in importance by the week. The headlines, the research findings, the leading indicators all seem to be flashing red. There is growing concern that the climate crisis, not to mention biodiversity loss and worsening air and water pollution in some parts of the world, are approaching critical levels. Nature's feedback loops and other indicators are worrisome, to say the least.

What gives us hope is that companies around the world are moving more quickly than ever to reduce the business risk that comes with these threats to natural capital and human well-being. Indeed, many are moving far faster than their political leaders to make the necessary shifts in how they use resources more efficiently and create fewer waste streams. There's still much to be done, of course, but the progress is encouraging.

That is to say, the world's problems may be perilous, but they need not be paralyzing.

The first half of this report offers the 10 trends sustainability professionals should be tracking in the year ahead. Each year, GreenBiz editors and analysts identify emerging arenas and technologies we believe will be impactful as companies

address environmental and social challenges and opportunities. The trends reflect the potential of sustainable business: to create value for all society, balancing people, profits and the planet.

This year's trends reflect some of the major shifts taking place: the transition of building energy from natural gas to clean electricity, the evolution of oceangoing vessels to operate more efficiently, how companies are turning to nature-based solutions to mitigate climate and other risks, the shift of protein sources from animals to plants, the rise of employee activism, the growth of AI and bots in corporate sustainability reporting, and much more. I hope you'll dive in; it's a good read.

The back half of this report, the State of Green Business Index, tracks nearly 40 indicators of progress over the past five years — trends in resource efficiency, corporate reporting and transparency, risk assessment, investments in clean technologies and more. This year's data, produced by Trucost and covering the 500 largest U.S. publicly traded companies and the 1,200 largest global companies, also includes some new metrics, such as how much companies are aligned with the 2 degrees Celsius targets of the Paris Agreement, and companies' exposure to physical risks to their facilities and operations as a result of climate change. It's a rich trove of data that, individually and together, tells a story of where we've been and where we're likely headed.

That story continues to evolve, as we demonstrate daily on GreenBiz.com. How it unfolds in the year ahead will depend in large measure on how companies step up to the challenges and opportunities ahead — and also, of course, on the vagaries of Mother Nature and the planet she stewards.

We hope you enjoy this report and look forward to your feedback.

foreword

by Richard Mattison

Chief Executive Officer of Trucost, Part of S&P Global

Our annual assessment of the corporate sustainability performance of major global companies listed on the S&P Global 1200 index and major U.S. companies listed on the S&P 500® index for the State of Green Business Index tells a story of amplified awareness, engagement and commitment to the sustainability transition.

These companies have never been more focused on sustainable business. As our various State of Green Business Index indicators of planetary wellbeing show, it is clear that such focus has never been more critical.

In a nutshell: natural capital impacts topped $5tn for the first time, up 60% for U.S. companies and 40% for global companies since 2014; carbon emissions went up 1% for U.S. companies and 3% for their global counterparts over the same timescale; water dependency held tight to its average 9% yearly increase since 2015 across both groups; and water pollution costs have nearly doubled since 2014.

But such heightened corporate focus is, at least, cause for positivity.

Awareness. Amplified awareness of major companies is observable throughout our Index metric series. First, 86% of the US companies now publish a sustainability report, up 10% since 2014 (G&A Institute, 2019). Second, a large majority of companies are acknowledging their exposure to climate related risks, with 82% highlighting transition risks and 79% describing climate related physical risks. To explore the complex interplay of transitional and physical climate risks, we added a new chapter to this year's Index, 'Future Climate Risks', where a series of metrics assess how intensifying regulatory transition risks to manage climate change and physical risks from inaction on climate change could stack up for major U.S. and global companies. Our data shows that ambitious action to limit climate change, through carbon pricing mechanisms to reduce emissions, poses a 23% risk to earnings across the global company cohort. Conversely, our data shows that water stress, heatwaves and wildfires linked to increasing glob-

al average temperatures represent the greatest driver of physical risk across both U.S. and global companies if fossil fuels continue to dominate and carbon emissions continue to rise. Additional Trucost research published earlier this year, finds that 60% of major US companies and 40% of major global companies have at least one asset at high risk from these physical climate risks. Given the uncertainty around how the world will respond to the climate change challenge, such forward-looking scenario based assessments of transitional and physical climate risk recommended by the Task Force on Climate-related Financial Disclosures (TCFD), will be essential to inform risk mitigation strategies across corporate asset locations, as well as throughout supply chains and product lifecycles.

Engagement. Perhaps most indicative of amplified corporate engagement was that more than 90% of companies now report senior management level ownership of climate-related issues; up 45% for U.S. companies and 35% globally. And many companies are engaging far beyond their own walls to influence global suppliers on carbon and water emissions; 73% of major global companies are engaging with suppliers on carbon, up 30% since 2014. The most popular types of engagement were information collection to better understand behaviour and compliance alignment, with more than a fifth of programs being developed to positively incentivize and change supplier behaviour. Our Index analysis continues to demonstrate that for most companies more than 80% of natural capital risk is concealed in the supply chain, so this will surely be time well spent.

Commitment. Companies are signalling their commitment to sustainable business, with publicly disclosed performance targets. Around 55% of major global and U.S. companies now have carbon targets in place, up 16% since 2014 – and around 23% of companies have water targets in place, up 12% over the same timescale. While these are welcome improvements, major companies are accounting for just 25% of their required contribution to global climate goals. Clearly more ambition is required if we are to meet climate goals. As well as lacking critical context for corporate sustainability strategies, target setting laggards are likely to face increasing reputational risk into the future.

So what's needed to accelerate corporate progress towards global climate and sustainability goals?

While disappointment prevailed at the end of 2019 as the UN climate talks ended in political deadlock, sustainable investing is becoming a major force in global markets. The latest Sustainable Investment Review uncovered $30.7 trillion of assets under management are run according to sustainability objectives at the start of 2018 (sustainable investment was up 38% in the US to 26% of assets and 11% in Europe to 50% of assets, from 2016). But investors regularly complain that there is 'information gap', preventing them from identifying worthy companies for sustainable investment.

The Financial Stability Board's TCFD provides one answer. By helping companies to understand what financial markets want from sustainability disclosure

and encouraging firms to align their disclosures with investors' needs, critical capital flows to reward sustainable business may be unlocked.

As of December 2019, support for the TCFD has grown to over 930 organizations, representing a market capitalization of over $11 trillion.

We have also noted a significant change in the focus of financial market regulators – the EU now has its Sustainable Finance Action plan and many other jurisdictions are investigating mechanisms to align capital flow with sustainability outcomes.

With heightened corporate focus, increasing sustainable investment, and better informed decision making we remain positive that our various Index indicators of planetary wellbeing will commence their alignment with global climate and sustainability goals.

There is more private sector appetite to drive change than ever before. We will need to significantly accelerate progress if we wish to transition to a more sustainable global economic growth trajectory to address climate and sustainability goals. At the beginning of the new decade we may be at the dawn of the fourth industrial revolution that will transform the global economy. In order to achieve a stable and just transition we will need to deploy advanced intelligence and analytics, accelerate the pace of innovation, embrace new strategies and encourage greater transparency.


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Circularity 20 is the largest circular economy conference in the United States. Building on the success of a sold-out launch event, Circularity 20 will bring together more than 1,000 thought leaders and practitioners across industries and functions, and empower participants to turn circular economy concepts into profitable opportunities.
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Top Sustainable Business Trends of 2020:
The good, the bad, the unknown

by Joel Makower

Twenty-twenty promises to be a landmark year in the sustainable business realm. Besides turning the page to a new decade, it is the 50th anniversary of the first Earth Day, arguably the launch of the modern environmental movement. It is five years into the 15-year trajectory of the United Nations Sustainable Development Goals (SDGs), a time when the world's businesses and governments need to be done planning how to achieve its 17 audacious objectives and well on the way to actualizing those plans. This fall will bring a landmark United Nations climate conference in Scotland and another, focused on biodiversity, in China. (This year is also the 20th anniversary of GreenBiz.com, the website.)

Of course, when it comes to sustainability these days, and especially the climate crisis, every year seems to be a landmark: new records set for heat, drought and storms; new levels of melting polar icecaps; record deforestation; more species and habitat loss or degradation. And probably more inaction, or underwhelming action, by the world's biggest economies and polluters.

It doesn't have to be that way, of course. Any number of bold measures on the part of corporate boards, political leaders and legislatures could help slow or reverse some of these outcomes. The continued uptake of renewable energy, the surprising ramp-up of the circular economy, revolutions in food production and carbon removal, and the technologies and policies that support these things — all could provide much-needed momentum and optimism.

Still, a lot of troubling outcomes are pretty much baked in, the result of decades of needless dithering and debate by influential actors on the world's stage.

And therein lie enduring questions for sustainable business professionals: Do we celebrate progress, however insufficient, or bemoan the S.O.S. signals the planet is sending? Do we point to the leadership organizations, large and small, and encourage others to follow or berate the laggards in the hopes of moving them forward?

And, significantly: How do we keep from getting discouraged by bad news or blinded by the bright, shiny light of the newest, coolest, greenest thing?

Of course, it's an all-of-the-above, both-and world, a delicate dance of optimism and cynicism, amazement and befuddlement, hope and despair. These days, that's how a sustainability professional needs to roll.

There's no better demonstration of this duality than in the world of sustainable business. Each month, it seems, there's plenty to celebrate and berate. During 2019, for example, we read the usual assemblage of encouraging stories. A sampling of what we reported over those 12 months:

- The rise of ESG ratings by the world's largest investors
- The continued growth of sustainable food systems
- New entrants seeking to dramatically scale up renewable energy purchases
- Companies taking a significant bite out of food waste
- More businesses making zero-net-carbon commitments
- More brands committing to dramatically cut plastic waste
- Banks and insurers factoring climate risk into loans and policies
- Vehicle companies electrifying transportation
- Markets for carbontech products and services taking off
- Reuse models starting to ramp up

There are lots more of these encouraging trends, some of which can be found in the pages that follow.

But there is no end of discouraging news, too, from fossil-fuels companies doubling down on drilling and fracking, to auto companies supporting fuel-economy rollbacks, to food companies tolerating deforestation for key commodities.

And that's just the business news. Political leaders — in the United States, Europe, Asia and South America — are variously stalling or backsliding on their climate and other environmental commitments or, in some cases, actively dismantling them. And even a casual reader of the daily news knows that the human impacts of climate change are already devastating and likely to worsen.

How will all this affect the fortunes of companies and economies? No one really knows. And companies, for their part, aren't necessarily speaking up — or preparing for the worst.

And there you have it: The good, the bad and the unknown about business and the environment. As we've reported every year in these pages, there's plenty of good news and more than a fair share of things to be discouraged about.

To be glad or sad? That is the question.

01

TOP SUSTAINABLE BUSINESS TRENDS 2020

Shipping Sails Toward Decarbonization

By Heather Clancy

After decades of steering clear of specific climate commitments, the international maritime industry — responsible for 3 percent (and growing) of annual global greenhouse gas emissions — is navigating a course to halve its footprint by 2050. Not since Italian explorer Christopher Columbus set course for the New World in 1492 has the global shipping fleet faced such an uncharted challenge.

The voyage embarked in mid-2018 when the International Maritime Organization (IMO), the United Nations agency that sets policies and standards worldwide, embraced its first-ever decarbonization strategy. This course falls short of what's needed to achieve the 1.5 or 2 degrees Celsius temperature mitigation goals set by the Paris Agreement. Still, it is an important chart for the future.

The first port of call came in early 2020, when a regulation capping sulfur emissions took effect, forcing ship owners to start phasing out the low-cost bunker fuels that have been keeping fleets afloat but that have exacerbated air pollution in coastal cities. "As a bilateral agreement, it may be the best we can get," observes Ned Harvey, managing director of Rocky Mountain Institute, in charge of the think tank's work on pathways for heavy transport. "No goal is a disaster. A science-based goal is optimal."

Like the jetliners that transport business travelers and vacationers around the planet, the 50,000-vessel tanker, freighter and cargo ship fleet that floats trillions-of-dollars-worth of goods across Earth's oceans sits outside the decision-making authority of any one nation. But its impact on climate change is titanic. More than 90 percent of global trade is tied to international shipping: We're talking more than 10.7 billion metric tons per year. What's more, activity could triple by 2050, due to the boom in e-commerce, infrastructure investments (especially in China and India) and the ambition of emerging nations rich in natural resources (think Africa) finding their place in the global economy.

When the IMO set its compass heading in 2018, some countries such as the Marshall Islands, which controls the second-largest ship registry after Panama, called for higher ambition. Others — notably Brazil, Saudi Arabia and the United States that rely heavily on exports of natural resources — refused to agree to any emissions reductions in absolute terms. China has been setting progressively tighter emissions controls.

There are rough seas ahead, in part because of the huge technical and financial challenges. The IMO's head of air pollution and energy efficiency, Edmund Hughes, put it this way: Achieving a 50 percent reduction by 2050 requires every existing ship to reduce its individual emissions by up to 85 percent.

Complicating matters is the decades-long life expectancy of the existing fleet, a fact of life being addressed by banks that finance those assets. U.S.-based Citi, France's Societe Generale and Norway's DNB have teamed with two of the world's largest carrier companies, A.P. Møller-Mærsk and Cargill Ocean Transportation, to create the Poseidon Principles, which apply climate change considerations to ship financing decisions. Supporters include The Netherlands' ING, France's Credit Agricole and Britain's Lloyd's Register.

"Shipping's decarbonization will require unparalleled innovation," says Søren Toft, chief operating officer and executive vice president of Mærsk, the world's largest container shipping company, when the Poseidon Principles were launched in June 2019.

Maersk hopes to cut emissions 60 percent before 2030 and is steering toward a zero-carbon future by 2050. That will take billions of dollars of investment. "A modern ship is a highly capital-intensive asset with a typical life span of 25 to 30 years," Toft notes. "To deliver on ambitious climate targets, zero-emission vessels will need to enter the fleet by 2030. This leaves us only 10 years to develop the new marine fuels, propulsion technologies and infrastructures that will be required."

The short-term efficiency approaches being embraced by carriers and ship owners are myriad — ranging from relatively simple gestures such as applying paints from companies such as AkzoNobel that enable vessels to glide through water more smoothly; using digital services from the likes of Flexport or Freightos that aim to streamline logistics to optimize loads; and outfitting ships with futuristic retrofits, notably rotor sails that harness the power of wind to assist with propulsion. One company gaining notoriety in the latter space is Finland's Norsepower, which is testing 30-meter, cylindrical mechanical sails. During a year-long test on a Mærsk tanker, the sails cut fuel consumption almost 8.2 percent.

Over the long term, sustainable shipping will require major breakthroughs in low-carbon fuel and propulsion technologies. "When I look at the landscape of alternative propulsion technologies, I don't think there's going to be any one silver bullet," says Nico De Golia,

sustainable transport collaborator with BSR.

What's on the horizon? Some ideas making waves for their audacity are Vindskip, a hybrid vessel design using wind and liquid natural gas (LNG) that mimics the aerodynamics of an airplane wing; or Ecoship from NYK, which combines "flapping foil" propellers with hydrogen and solar power.

Practically speaking, however, the prime driver of what's viable will be energy intensity: Any fuel replacement must be easy to store on-board without compromising safety, weight or a ship's carrying volume. Among options being discussed actively are LNG, a big focus for U.S. carrier Crowley and certification body DNV GL, although most in the industry see this as bridge fuel; biofuels, problematic from an availability, infrastructure investment and sustainability standpoint; and hydrogen and ammonia, which carry special storage considerations that are a downside.

Aside from the IMO directive, carriers are being rocked by a rising tide of action, represented by the Clean Cargo alliance, a working group that includes big consumer products companies including Amazon, BMW, H&M Group, Heineken, IKEA and Levi Strauss, as well as massive carriers such as Mærsk, Crowley and Cosco, China's largest carrier. Several of those companies have allied with Mærsk and Norwegian car transport carrier Wallenius Wilhelmsen on an initiative to test a blend of ethanol and lignin, a bioproduct of papermills. Testing is expected during 2020.

Will that bold pilot have a ripple effect? This sort of corporate ambition will help the shipping sector set sail in the right direction, but to reach the elusive Port Zero Emissions will take expert navigation in untested waters.

KEY PLAYERS TO WATCH

Clean Cargo — the BSR working group includes more than 60 companies representing both shippers (Amazon, BMW and Nike) and carriers (Cosco, Crowley, Maersk, Wallenius Wilhelmsen).

Getting to Zero Coalition — a moonshot partnership between the Global Martime Forum, Friends of Ocean Action and the World Economic Forum dedicated to developing commercially viable, deep-sea, zero-emissions vessels by 2030.

Mærsk – the world's largest shipping company is steering toward a zero-carbon future by 2050 and is involved with testing myriad short-term efficiency and long-term fuel options.

Poseidon Principles – a group of financial services companies, including Citi and ING, and representing 25 percent of all ship financing, that has agreed to use climate risk considerations in their asset-investment decisions.

Wallenius Wilhelmsen — committed to a zero-emissions future, it transported more than 3 million vehicles to six continents in 2018 and is backing initiatives in sulfur reduction and alternative fuels.

Heather Clancy is Editorial Director at GreenBiz Group

02

TOP SUSTAINABLE BUSINESS TRENDS 2020

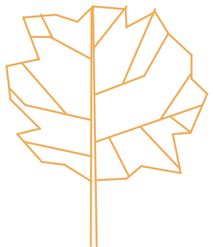
Companies Warm to Nature-based Solutions

By Joel Makower

In the never-ending quest to stave off the worst impacts of climate change, experts are turning to a solution that's as old as the trees: actual trees.

The idea of using mighty maples, ponderous pines, majestic evergreens and other arboreal wonders to absorb greenhouse gases is hardly new. For years, everyone from school-age kids to corporate executives has embraced the idea, a concept that's easily understood and in which nearly everyone can participate.

More recently, tree planting has been at the center of a larger set of so-called "nature-based solutions" that harness the power of ecosystem services to mitigate effects of the climate crisis. A global effort is shaping up to bring awareness — not to mention funding — to nature-based solutions that increase resilience and carbon sequestration while addressing a wide range of social and environmental challenges.



"Nature-based solutions are interventions which use nature and the natural functions of healthy ecosystems to tackle some of the most pressing challenges of our time," says the International Union for Conservation of Nature, a global environmental organization. "These types of solutions help to protect the environment but also provide numerous economic and social benefits."

And companies are lining up to participate, often as part of business alliances aimed at supporting nature-based solutions. A few leadership firms are working directly with local governments and communities around the world to leverage nature's inherent genius.

Regulating the climate is just one of the many services provided by healthy natural systems. Nature-based solutions are finding their place in food production, disease prevention, air filtration, water purification, waste minimization and other processes. All of these opportunities are coming

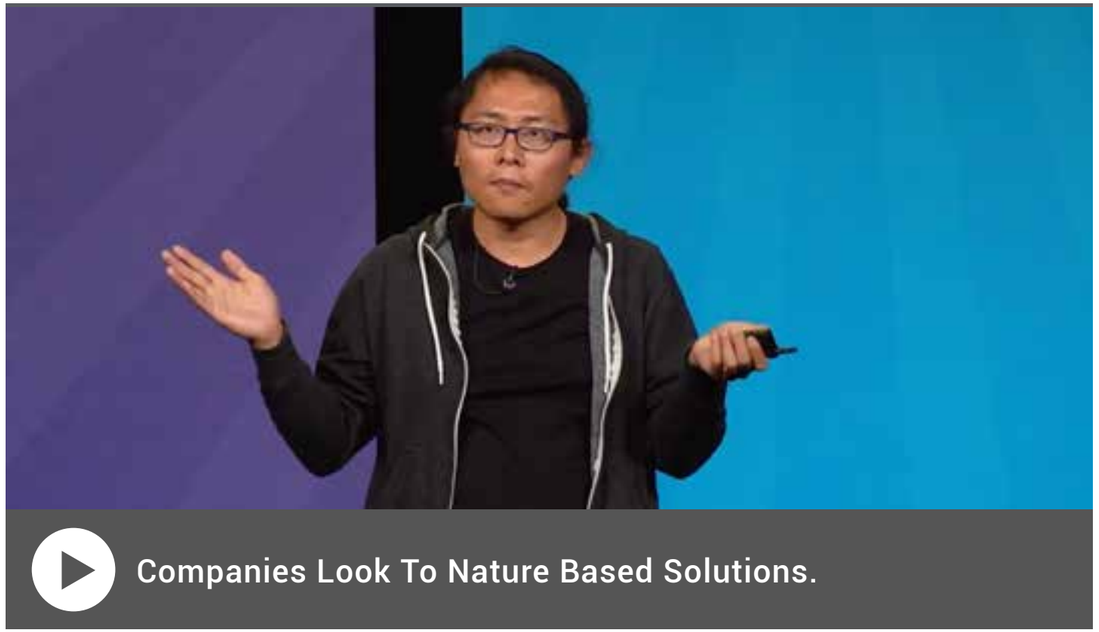
under the gaze of business and sustainability groups seeking to advance these relatively simple tools.

There's significant potential here. More than 30 percent of the cost-effective tools to address climate change by 2030 can be found in nature-based solutions and the shift to more sustainable agriculture and land use choices, according to a 2019 report from the Food and Land Use Coalition, known as FALU.

FALU is part of a larger coalition of nearly 40 organizations, called Business for Nature, whose goal is "to reverse nature loss and restore the planet's vital natural systems on which economies, well-being and prosperity depend." Its members include the World Economic Forum, World Business Council for Sustainable Development, the We Mean Business Coalition, the International Chamber of Commerce and other groups representing companies on nearly every continent.

Business for Nature lays out the rationale for companies to support nature-based solutions. It points out that nature loss has concrete and immediate costs and risks for businesses, including operational risks; supply chain continuity, predictability and resilience risks; liability risks; and regulatory, reputational, market and financial risks.

So far, more than 350 companies have made commitments to help reverse nature loss and restore vital natural systems on which economic activity depends. Most of these commitments are through business partnerships.



For example, through the AgWater Challenge — spearheaded by the nonprofit groups Ceres and WWF — ADM, Diageo and Kellogg are among those developing timebound and measurable commitments to reduce the water impacts associated with key agricultural commodities. Another coalition, led by We Mean Business and CDP, helps companies commit to removing commodity-driven deforestation from their supply chains. It includes General Mills, Kering, L'Oreal, Nestlé and Procter & Gamble. Still another, act4nature, whose members include BASF, Bayer, LVMH and Unilever, commits to "integrating nature — environments, animals, plants, ecosystems, interactions and genetic heritage — into our strategies and business models."

Business commitments for biodiversity will be front and center this October, when the United Nations Biodiversity Conference will take place in China. Billed by some as the "Paris for biodiversity," the gathering will help focus the world's attention on the role of nature-based solutions to simultaneously preserve biodiversity and mitigate climate change while addressing several of the Sustainable Development Goals (SDGs). Indeed, restoring degraded natural capital can contribute to addressing SDG goals 1, 2, 3, 6, 7, 13, 14 and 15.

The opportunities for applying nature-based solutions to companies, cities and communities are seemingly endless. In the built environment, for example, nature-based solutions include managing rainwater through green roofs, ponds and wetlands to improve the climate resilience of buildings and infrastructure. In agriculture, they include regimes to protect and pay for nature, especially tropical rainforests, and supporting the indigenous communities whose wisdom is critical to their stewardship.

Protecting watersheds is another. Pasuruan, for example, is home to Danone's second-largest bottled water facility in Indonesia. The natural spring that feeds the city is declining, and experts estimate the watershed could run dry by 2040. Danone joined forces with public authorities there to invest in land management along the watershed to improve water quality and quantity, and generate long-term benefits for people and nature such as soil fertility improvement, increased yield and biodiversity.

Air pollution is yet another problem where nature-based solutions can help. A study led by Ohio State University found that in 75 percent of the countries assessed, it was cheaper to use plants to mitigate air pollution than using technological inventions such as smokestack scrubbers. "The fact is that traditionally, especially as engineers, we don't think about nature; we just focus on putting technology into everything," said Bhavik Bakshi, lead author of the study and professor of chemical and biomolecular engineering at Ohio State.

Which brings us back to trees. As part of the 2015 Paris Agreement, many countries' Nationally Determined Contributions (NDCs) — the plans put forward to reduce emissions — include nature-based solutions. For example, more than half of the NDCs from 75 developing countries or emerging economies establish one or more goals in the forest sector, according to WWF, including targets for afforestation, reforestation and restoration, and for increasing forest cover.

Such measures won't be cheap and finding the capital could be a major challenge. Some of the funding could come from commercial opportunities in forestry, specifically from selling the offsets that these measures produce.

"The scale at which reforestation needs to take place, both to reduce

emissions as well as to replace the natural systems that have been degraded over many years, is going to require lots of land," said David Hone, chief climate change advisor for Shell. "Globally, we're talking about hundreds of millions of hectares that need to be converted from whatever purpose it's being used for today. And that's going to cost money in both land and reforestation itself." Last year, Shell announced plans to invest $300 million over the next three years in natural ecosystem-based projects. The oil giant said the new program will focus initially on reforestation partnerships in Europe.

Will other companies go out on a limb to launch similar efforts? They may have no choice. As the business case for nature-based solutions becomes clear, such investments will likely become part of companies' climate strategies — not to mention their efforts to succeed on a rapidly degrading planet.

KEY PLAYERS TO WATCH

Apple — aims to protect as much as 1 million acres of responsibly managed working forests, so as to have zero net impact on forests for its paper use.

Dow — its 2025 sustainability goal includes "Valuing Nature," a first-ever commitment by a corporation to consider nature in virtually all of its business decisions.

Shell — is one of the most established investors and traders of carbon credits in the world and views nature-based solutions as a platform for growing carbon trading markets.

UN Global Compact — maintains a program to increase nature-based solutions within national governance, climate action and climate policy-related instruments.

World Business Council for Sustainable Development — its "Natural Climate Solutions" initiative centers on building a collective voice to raise the profile of nature-based solutions.

Joel Makower is Chairman and Executive Editor at GreenBiz Group

03

TOP SUSTAINABLE BUSINESS TRENDS 2020

Last-mile Transportation Inches Closer to Home

By Katie Fehrenbacher

For many of us, December was a holiday season marked by last-minute, next-day Amazon deliveries. As boxes filled with your sister's fleece sweater and your nephew's LEGO kit piled up in your hallway, you might have paused over the environmental effects of all that packaging.

But just as big of a sustainability culprit are the hidden transportation-related emissions that come from the near-instant delivery of all those online boxed goods, which mostly reach your doorstep in delivery trucks powered by dirty diesel fuel. Delivery giants such as UPS, FedEx and Amazon are seeing their carbon emissions rise due to the boom of e-commerce and the promise of swift delivery.

At the same time, all those delivery trucks are causing many cities to see more congested streets and city residents to breath more polluted air. Freight movement is not only the fastest-growing source of greenhouse gas emissions, last-mile freight is a major contributor to local air pollution, often in disadvantaged communities.

But there's some good news amidst all this urban doom and gloom. Last-mile package delivery in cities is ripe for a clean and electric transformation.

In 2020, a growing number of firms are expected to start using electric delivery vans, as well as e-cargo bikes and scooters, which can reduce both emissions and traffic. A combination of corporate sustainability goals, municipal mandates and incentives and dropping batteries costs is leading to a growing interest in acquiring electric delivery vehicles.

While the market for electric delivery vans is still nascent, making forecasts difficult, recently announced purchase orders show an uptick. Late last year, Amazon announced a plan to buy 100,000 electric delivery vans that will be created by startup Rivian, which aims to deliver some of the first vans by 2021. Meanwhile, UPS ordered 950 electric vans from Workhorse, and FedEx is planning on adding 1,000 electric delivery vehicles from Chanje.

Delivery companies, particularly with operations in Canada and Europe, are also rolling out e-cargo bikes made by companies such as Coaster Cycles, a startup that builds its bikes in Missoula, Montana. The biggest cargo bikes can carry close to 800 pounds of goods, but can still ride in the bike lane and route around congested streets.

Buying electric vehicles isn't the only way that the delivery companies can clean up their routes. Fleet management software, artificial intelligence and data tools can also help make last-mile delivery routes much more efficient, slashing fuel use and making operations less energy- and carbon-intensive.

Delivery giants such as Amazon are also building more distribution centers closer to customers, so that the last-mile portion is becoming significantly shorter, requiring less fuel (though, the products still need to be shipped to the distribution centers). At the same time, the delivery companies are experimenting with delivery drones, which might one day offer a freight method that would be an alternative to road trips.

One of the most promising delivery trends is emerging from brands. Some retailers, particularly those with deep sustainability programs, are beginning to push on the delivery supply chain to go electric.

In 2018, IKEA's parent company Inkga Group committed to having electric vehicles deliver the last-mile portion of all of its product shipments — from ready-to-assemble lamps to bath mats — to customers by 2025. An interim goal will kick off with electric delivery in Shanghai, Paris, Los Angeles, New York and Amsterdam by the end of this year.

Since IKEA doesn't own its own vehicles — and its products are delivered via roughly about 10,000 partner vehicles — it has had to collaborate closely with its delivery supply chain. Already in 2019 in Shanghai, IKEA was able to reach its goal early by working with Shenzen-based electric vehicle leasing company DST and with IKEA's local warehousing partner Beiye New Brother Logistics Co.

But the reality is that retailers are just waking up to this trend, and IKEA, with its long history of sustainability leadership, is the exception. The real tip of the spear is cities.

Cities across Europe — such as London, Berlin, Madrid and Amsterdam — are establishing fossil-fuel-free (or carbon-emissions-free) zones in city centers in an attempt to slash air pollution, cut traffic and lower greenhouse gases. Companies looking to deliver goods in these city centers can do so only with low-emissions vehicles.

These new "green zones" appear to be working from an environmental perspective. London found that thanks to the removal of 13,500 of the most polluting vehicles (such as big diesel trucks) from its city center on an average day, nitrogen dioxide levels in the air had dropped by 36 percent between February 2017 and October 2019.

In addition to low-emissions zones, cities in China are trying other policy methods to get diesel-burning trucks out of the city centers, such as lotteries for license plates that offer more slots for electric vehicles. Other cities, such as India's New Delhi, are struggling to implement aggressive policy measures and are seeing hazardous air shortening the lives of the 20 million residents that live there.

The United States, with its ingrained love affair with the automobile, has been slower to be as aggressive as Europe has with ditching diesel from downtowns, but some American cities are trying out initial programs. New York will be the first U.S. city to adopt congestion pricing at the end of 2020; it will charge car and truck drivers to enter Manhattan's city center. Car drivers could be charged between $12 and $14 to enter the restricted zone. Truck drivers could be charged about $25 per entry.

While cities around the globe have been prioritizing reducing air pollution and traffic, more cities need better freight-specific plans, points out a GreenBiz report on "The Road To Sustainable Urban Logistics." "Urban infrastructure is often not designed to accommodate critical logistics services," notes the report, but better and more data can help cities get the information they need to help solve the logistics infrastructure gap.

Combining the policy might of cities, corporate sustainability goals and electric delivery vehicles that are getting better and less expensive, delivery routes are starting to get cleaner and smarter. Better last-mile delivery doesn't just help reduce greenhouse gases, and thus fight climate change, but it enables city residents to breathe easier on less-congested streets.

KEY PLAYERS TO WATCH

Amazon — the e-commerce behemoth led by Jeff Bezos surprised everyone late last year by placing a first-of-its-kind massive electric van delivery order with a startup.

Coaster Cycles — makes e-cargo bikes (in addition to pedicabs) in its factory in Montana and works with global urban shippers.

Inkga Group — the Swedish giant behind the IKEA brand has been one of the most aggressive retailers in the world to try to electrify the last mile of its shipping supply chain.

MIT Megacity Logistics Lab — one of the few academic institutions in the world that focuses on sustainable urban shipping, the lab helps public and private sectors find solutions.

Rivian — it appeared from almost nowhere to challenge Tesla's dominance as an independent electric vehicle maker and scored Amazon's game-changing purchase order.

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04

TOP SUSTAINABLE BUSINESS TRENDS 2020

Carbon Markets Get Real on Removal

By Jim Giles

Trey Hill's family has been working the land around Rock Hall, Maryland, since the early 1900s. Their company, Harborview Farms, now harvests corn, wheat and soy from thousands of acres. But something is different this year. The Hill family has a new crop: sequestered carbon, which they sell to individuals and companies across the United States.

Hill is doing his carbon farming in partnership with Nori, a Seattle-based startup that sells what it calls "carbon removals." Hill deploys regenerative agriculture techniques, such as the use of cover crops, to draw carbon dioxide from the air and lock it into the soils he works. Nori then helps Hill verify the amount of carbon that he has removed from the atmosphere and sell the associated credit as a carbon offset. For $15, anyone can now fund Hill — and soon, many other farmers — to remove one ton of carbon dioxide (CO2) from the atmosphere. (For comparison, a round-trip economy-class flight between San Francisco and London generates around a ton of CO2, according to the International Civil Aviation Organization).

The idea that companies can shrink their carbon footprints by paying other organizations to reduce greenhouse emissions is around two decades old. But Nori represents several game-changing trends, including the use of new technologies and an emphasis on removing CO2 from the atmosphere rather than reducing emissions. Together with the arrival of new buyers, most notably from the aviation industry, these trends will bring major changes to the market for carbon offsets in 2020 and beyond.

Until now, the bulk of the spending on offsets has gone to projects that avoid emissions. Some companies work with conservation organizations to prevent deforestation, for example. Others fund the development of renewable projects that displace fossil-fuel plants. This work remains essential, but recent reports from the Intergovernmental Panel on Climate Change have made it clear that emissions reductions alone are not enough — we also need to remove billions of tons of greenhouse gases from the atmosphere if we're to avoid the worst effects of climate change.

In anticipation of future demand for removal offsets, Nori has built a digital marketplace that connects buyers with projects that draw down and store CO2, starting with a focus on farmers using regenerative agriculture to increase levels of soil carbon. Another new marketplace, developed by the Finnish company Puro, is offering removal credits linked to the production of biochar (a charcoal-like substance used to safely store carbon) and construction materials made in part from greenhouse gases.

The arrival of these marketplaces looks to be well-timed, because a few first-mover companies have already announced plans to invest significant amounts in carbon removal. Last August, payment services company Stripe committed to investing at least $1 million a year in carbon sequestration projects. A month later, Shopify, which develops e-commerce software, matched that target and declared that it would focus on industrial-scale solutions that involve capturing CO2 from the air and storing it deep underground. “Our goal is to kickstart the demand and predictability of this market so industrial engineering can scale and the price can come down,” says Shopify CEO Tobi Lütke.

When Stripe and Shopify make their investments in carbon removal, they will have the option of working with Nori, Puro and other more established offsets sellers, such as Natural Capital Partners. Many of these firms are likely to see a surge in business as the demand for offsets of all kinds increases.

In 2018, the market for voluntary offsets more than doubled in size to 98 million tons, according to Ecosystem Marketplace, which collects data on market-based approaches to conserving ecosystem services. “In the past decade, a good year was always old companies doing new buying,” says Steve Zwick, the publication’s managing editor. Now major new buyers are entering the market. Companies are learning they can’t reduce emissions as deeply as they want to, and so are investing in offsets as well as reduction, explains Zwick.

One significant new buyer is Shell, which in 2019 committed to spending $300 million on forestry projects and other nature-based solutions over the next three years, in part to offset some of the emissions produced by the aviation fuel it sells in Britain and the Netherlands. Airlines will also likely be buying large quantities of offsets in coming years. British Airways and Air France have committed to offsetting 100 percent of emissions from their domestic flights starting this year.

And the industry as a whole has committed to capping emissions from international flights at current levels, which is forecast to require purchases of around 150 million tons a year by 2025.

Any company purchasing an offset should be asking hard questions about the ability of the project to reduce emissions. Offsets are sometimes criticized as unreliable, a complaint that surfaced again recently after an investigation by ProPublica into one class of offsets — forest-protection projects — concluded that polluters often "got a guilt-free pass to keep emitting CO2, but the forest preservation that was supposed to balance the ledger either never came or didn't last." Proponents of forestry projects noted that while ProPublica highlighted real problems, it also ignored known solutions to those problems. Nevertheless, the reputation of offsets probably took a knock.

It will always be challenging to plant and protect forests in remote areas of the world, particularly in regions of political instability. But another trend may help matters. Over the past few years, the resolution and coverage of satellite imagery have improved while prices have fallen. These changes make it possible to monitor forests at a new level of accuracy.

"You can identify someone who's cutting down a tree with one day of notice," Diego Saez-Gil, an entrepreneur working in this space, told Fast Company. Saez-Gil's startup, Pachama, combines data from satellites, drones and a laser-scanning technology known as lidar with machine learning to create a dashboard that estimates the amount of carbon stored in a forest.

The emergence of these technologies suggests that the market for offsets is going to grow both in size and impact. At a time when the governments of the world's two largest emitters, the United States and China, are failing to recognize the magnitude of the climate crisis, that's a welcome piece of good news — and a great example of how the private sector can help fill the gulf left by government inaction.

KEY PLAYERS TO WATCH

Nori — the Seattle-based startup is building a digital marketplace for carbon removal credits, backed by blockchain technology.

Puro — removal credits associated with biochar and other sequestration methods are available from this Finnish company.

Pachama — the Bay Area startup aims to boost the transparency and accountability of forest offsets using AI and satellite data.

Indigo Ag — the agricultural data company's Terraton Initiative is "a global effort to remove 1 trillion metric tons of CO2 from the atmosphere and use it to enrich our agricultural soils."

Climeworks — the Swiss direct-air-capture outfit is the first in its field to sell removal credits direct to consumers.

Jim Giles is a Carbon Analyst at GreenBiz Group

05

TOP SUSTAINABLE BUSINESS TRENDS 2020

Corporate Climate Reporting Gets Physical

By Lauren Smart

Watching the news in recent years has brought a sobering reality check about the physical effects of climate change. Events such as the recurring California wildfires and mudslides, hurricanes Harvey and Maria and Typhoon Hagibis — the largest to hit Japan in 60 years — have had catastrophic human and economic costs.

A recent report assessed the total damage and economic loss caused by the California wildfires in 2019 at $80 billion, on top of estimated costs of $400 billion in 2018 and $85 billion in 2017, not to mention the tragic loss of life. Similarly, Hurricane Harvey affected an estimated 13 million people, with nearly 135,000 homes damaged, 88 fatalities and total costs of $125 billion. Research by the European Central Bank has found that weather-related catastrophic losses accounted for 80 percent of all insured losses in 2018.

So, it is perhaps unsurprising that governments, regulators and investors have started to ask companies to disclose their climate risks, including physical risk. Physical risks refer to those that arise from weather-related events directly, such as damage to property, and indirectly through subsequent events such as disruption of global supply chains or resource scarcity.

The Financial Stability Board's Taskforce for Climate-Related Financial Disclosures (TCFD) has been a particularly prominent voice. Companies have been reporting on metrics such as carbon emissions for some time. What is different with TCFD is its call for businesses to assess and report the financially material impacts of climate change, including both transition risks and physical risks.

To understand their exposure under TCFD, companies must conduct scenario analyses based on different assumptions about the future and the impact across their businesses, including operations, supply chains, customers and markets. However, the feedback from companies in TCFD's 2019 progress report (PDF) is that they are finding scenario analysis difficult. Still, nearly 900 companies globally have signed on to TCFD, so we can anticipate increased disclosure and

increased sophistication in disclosure going forward.

Of course, nobody wants disclosure for disclosure's sake, so what will companies gain from reporting physical risks?

Risk mitigation, for starters. Research by Trucost highlights the scale of corporate exposure: almost 60 percent of companies in the S&P 500 (market capitalization of $18 trillion) and more than 40 percent in the S&P Global 1200 ($27.3 trillion) hold assets at high risk of physical climate change impacts. Identifying these exposures and building business continuity and resilience plans is critical.

It's not just companies in the obvious sectors, such as agricultural value chains or resource-intensive ones, that are vulnerable. For many U.S. financial companies, which may have thought their exposure to climate risks was minimal, 2012's Superstorm Sandy was a wake-up call. Sandy battered the U.S. Eastern Seaboard causing storm surges that led to extreme flooding in New York and New Jersey coastal areas. This included the financial district in Lower Manhattan, causing significant power outages, property damage and travel disruption.

As the American Insurance Group states in its TCFD report, the damage Sandy caused to AIG's Wall Street headquarters forced it to remain closed for several weeks, requiring the company to invoke its business continuity planning to mitigate the impact on employees and clients from service disruption. Research from Lloyd's of London estimates (PDF) that the 8 inches of sea-level rise since the 1950s increased Sandy's surge losses by 30 percent.

Insurance companies are feeling the impact. The number of registered weather-related natural hazard loss events has tripled since the 1980s, and inflation-adjusted insurance losses from these events have increased, from an annual average of around $10 billion in the 1980s to around $50 billion over the past decade.

Banks can be vulnerable through deterioration in the quality of loan exposures or investments resulting from such losses. Recognizing this, some banks have started to factor climate risk into their reporting and decision making. The Commonwealth Bank of Australia, for example, a large financer of the Australian agricultural sector, has conducted climate simulations on the impacts to farm profitability out to 2060. It also has introduced risk mitigation measures such as incorporating physical climate risk into its ESG Risk Assessment Tool process for business lending.

We are beginning to see the impact of climate and physical risks on corporate credit ratings. An analysis by S&P Global Ratings identified 299 cases in which the impact of extreme weather or other climatic or environmental factors resulted in or contributed to a corporate rating revision, or was a significant factor in S&P Global Ratings' analysis.. In 56 of these cases, climate-related risks had a direct and material impact on credit quality, resulting in a rating, outlook or CreditWatch action or notching of the rating; nearly 80 percent were negative in direction.

One of the most recent and prominent examples of climate-related risk is Pacific Gas & Electric (PG&E), the utility servicing northern and central California. After PG&E's grid was linked to deadly fires in 2017 and 2018, with losses nearly equivalent to the company's market value, the utility filed for bankruptcy.

Yet another risk looms for companies that fail to address the physical risks of climate change, one that PG&E knows only too well: liability risk to corporate boards.

In a 2017 keynote speech during the the annual forum of the Insurance Council of Australia, Geoff Summerhayes, executive board member at the Australian Prudential Regulation Authority, stated: "Company directors who fail to properly consider and disclose foreseeable climate-related risks to their business could be held personally liable for breaching their statutory duty of due care and diligence under the Corporations Act."

The former directors of Japanese power giant Tokyo Electric Power Company, or Tepco, which spent $10 billion to clean up groundwater pollution from its Daiichi nuclear power plant, damaged in the 2011 tsunami, narrowly avoided prosecution over its failure to act on information that showed the risks to the plant from a major tsunami. Prosecutors had argued that the directors should have understood the risk and had failed to take necessary safety measures. The estimated cost of dismantling the plant, decontaminating surrounding areas and compensating victims is about $200 billion.

As the severity and frequency of physical risks from climate change escalate, we can anticipate a growing number of legal actions against companies and their directors. We might also see more credit rating actions as banks and insurers increasingly factor physical risks into their assessments. Companies that are not taking the appropriate risk mitigation measures may find access to capital and insurance harder, more costly or impossible.

KEY PLAYERS TO WATCH

European Commission — is exploring a range of regulations about climate-related reporting and risk management as part of its initiative to finance a sustainable European economy.

Corporate Reporting Gets Physical

Intergovernmental Panel on Climate Change — is the United Nations body set up to provide policy makers with impartial, scientific information regarding the status of climate change and future risks.

Minter Ellison — is an Australian law firm with market-leading work on corporate and director liability risk from climate change.

S&P Global Ratings — is reporting on the impact of climate risk on credit ratings.

Taskforce for Climate-related Financial Disclosures — is the body catalyzing the change in corporate reporting to include physical risks from climate change.

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06

TOP SUSTAINABLE BUSINESS TRENDS 2020

Employee Activism on Sustainability Marches On

By Deonna Anderson

Last September, more than 1,700 Amazon employees pledged to walk out of work for the Global Climate March. They joined workers and students in the streets of cities around the world to demand climate actions from governments and companies.

It was one of the larger demonstrations of the growing power of employees to persuade their employers, policymakers and others to move further, faster on social and environmental issues. It's still early days, and the activism is largely limited to tech companies so far, but the actions to date may be an indicator of what's to come.

Employee activism is not new — trade unions have long advocated for workers' rights — but the current rise in activist employees mirrors a trend that has been growing for years, and which seems to be hitting a peak as millennials increase their presence in the workplace. With growing distrust of governmental institutions, these younger employees are using their voices to advocate for change and demand that their employers do so, too.

A succession of surveys has shown conclusively that employees want to work for companies they perceive to be good, just and "on the right side of history" on issues ranging from gun control to climate change.

Consider a 2019 survey by Swytch, a blockchain-based clean energy platform, which examined workforce sentiments about employers' corporate sustainability pursuits. Four in 10 millennials said they have chosen a job because the company performed better on sustainability than other choices — something only 17 percent of baby boomers said they had done. As for employee retention, 70 percent of millennials said they would stay with a company long-term if it had a strong sustainability plan.

It's not just the rank and file. CEO activism also has been on the rise. For example, last May, CEOs from about a dozen companies and a handful of nonprofits banded together to form the CEO Climate Dialogue, to urge the U.S. Congress to develop comprehensive climate legislation.

"CEOs need to reduce climate pollution within their own company operations, and they also need to unleash the most powerful tool they have to fight climate change: their political influence," says Fred Krupp, president of Environmental Defense Fund, part of the CEO Climate Dialogue. "Corporate voices matter to Congress, but the vast majority of businesses have been silent on the need for climate policy, or even opposed to it. Now is the time to reverse that trend."

Still, there's a big difference between CEO and employee activism. The former happens when a company's leadership takes a stance on an issue. The latter typically happens when company leadership fails to speak up on a critical issue, as rank-and-file employees hold companies or policymakers accountable or otherwise urge them to take action or be more vocal.

Occasionally, the two converge, such as when Lush, Ben & Jerry's, Patagonia and others closed their offices and stores to allow their employees to join the Global Climate Strike marches in September.

For companies, this can be tricky, as one corporate sustainability leader put it in a letter to her global team, about supporting those same strikes:

> *I have reached out to the group of companies who are supporting the protests in other ways, to see if we can help as a company to support with logistics of the strike days. However, I am VERY cautious about corporations taking the spotlight away from individual citizens in moments like these. So I strongly encourage us all to follow the lead of other NGOs and businesses following these guidelines. In other words, we should not be striking with our brand, we should be striking as citizens. If we help with logistics, it will be largely invisible.*

"Companies need to start thinking through the new era of employee activism," William Stewart, founder and president of communications strategy firm Povaddo, told GreenBiz in 2017, after the issues management firm released a survey that showed 65 percent of employees at Fortune 1000 firms want their companies and CEOs to publicly support the growth of renewable energy. A more recent survey of the same population showed that only 15 percent of employees rated their company's commitment to sustainability as excellent.

Along with lobbying their employers and marching, employee activists also are outlining demands and, on occasion, leaving when a company fails to be responsive. Take the resignations at the tech company GitHub in late 2019. Employees protested their company's contracts with Immigration and Customs Enforcement, the U.S. federal agency charged with enforcing immigration laws. Similar protests have been held by employees at Whole Foods and Ogilvy, whose companies also contracted with U.S. immigration authorities.

Such actions may become more common. A May 2019 report, "Employee Activism in the Age of Purpose: Employees (UP)Rising," from Weber Shandwick and KRC Research, showed that while 38 percent of workers identified as employee activists — those who either spoke up to support or criticize their employers' actions over a controversial societal issue — there is room for that number to increase: an additional 11 percent of employees have considered speaking out.

There is evidence that employees are just beginning to recognize their power.

In 2018, when more than a dozen Amazon employees filed identical shareholder petitions, Eliza Pan, an employee of the company, told the New York Times, "We realized we could use our position as employees and our power and our rights as shareholders to bring visibility of this issue to the board and the top leaders of this company."

While the shareholder resolution failed, their pressure played a key role in getting the company to commit to reduce its emissions and invest in 100,000 electric delivery vehicles. Still, the employee group Amazon Employees for Climate Justice maintained that it was "thrilled with our win, but we know it is not enough."

Amazon's employees plan to continue to hold their company accountable. The group is demanding it commit to zero carbon emissions by 2030, stop funding politicians who deny the existence of climate change, and end its Amazon Web Services contracts with fossil fuel companies.

For companies, such action is incremental – small changes over long periods of time. The question for leadership is whether that progress is sufficient, at least in the eyes of employees. And if not, they would be wise to be prepared to respond to their growing demands.

KEY PLAYERS TO WATCH

Amazon Employees for Climate Justice — a group of Amazon employees who believe it's their responsibility to ensure Amazon's business models don't further contribute to the climate crisis.

Google Workers for Action on Climate — a Google employee group pushing the company to commit to a comprehensive climate plan.

Microsoft Workers 4 Good — a faction of Microsoft workers who aim to hold the company accountable to its stated values.

Tech Workers Coalition — organizes and educates employees "guided by our vision for an inclusive and equitable tech industry."

WeWorkers Coalition — a group of WeWork employees seeking a seat at the decision-making table.

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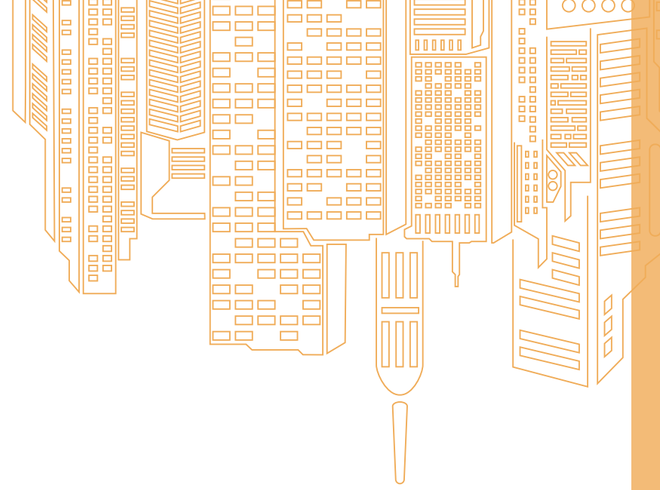
07

TOP SUSTAINABLE BUSINESS TRENDS 2020

Commercial Buildings Go All-Electric



By Sarah Golden

We're in the midst of a building boom. Commercial floor space is projected to grow by 40.5 percent by 2050. And once built, buildings stick around for a while: About half of all existing buildings were constructed before 1980.

That means the way we build today — the type of energy a building uses, its level of efficiency, the way it is designed — will lock us into a level of emissions for decades. With 40 percent of emissions coming from buildings, communities and companies want to get the next generation of buildings right.

To reach deep decarbonization goals, mounting research reveals buildings must be electrified — from homes to highrises.

The good news is that buildings are already most of the way there. With the notable exceptions of space heating, water heating, clothes drying and cooking, modern buildings are electric. The bad news is that the problem is distributed. About 93 percent of commercial buildings use some kind of non-electric heating fuel, according to the Lawrence Berkeley National Laboratory.

So, the time is right for electrification.

All signs point to the next generation of commercial buildings becoming all-electric. Major indicators include:

- **Policies restricting natural gas on new construction.** In the United States, there are more than 50 cities and counties, primarily in California so far (with policies emerging in New York, Massachusetts and Washington too), that are looking to enact, or already have enacted, some sort of restriction on new natural gas hook-ups. Many of the policies emphasize residential homes before commercial buildings, yet the move is sure to spur on the market for electric appliances, leading to more options and examples commercial construction could emulate.

- **The falling cost of renewables.** While natural gas was once thought of as the more environmentally friendly alternative to a coal-intensive electric grid, the grid is getting cleaner and cleaner, making electrification increasingly environmentally beneficial (and that doesn't even factor in methane seepage). Cheaper renewables also makes transitioning from fossil fuels more economically attractive, especially given the unknown infrastructure costs of the aging natural gas infrastructure.
- **The growing market of electric appliances.** While using electricity for heating was once inefficient, the equipment itself has become significantly better. For example, there are several electric heat pumps on the market that are two to three times more efficient at converting electricity into heat than conventional models. While the upfront costs of electric appliances can be more than for gas appliances — and cost is thought of as one of the primary barriers to electrification — a study from the National Resource Defense Council shows that added costs are more than offset by avoiding plumbing the building for gas. And as more buildings go electric, appliance costs are sure to fall.
- **Natural gas falling out of favor.** Natural gas use, which was once billed as a bridge fuel, is quickly growing to become one of the largest sources of greenhouse gas emissions in the United States. Meanwhile, studies show that natural gas leakage — in the form of methane, a potent greenhouse gas — is higher than originally thought, making the climate benefits of natural gas less attractive. Additionally, there is rising awareness around the indoor air pollution concerns associated with gas appliances.

All-electric commercial buildings early adopters are already here. Last summer, Adobe broke ground on its North Tower, which it says will be the first all-electric office building in Silicon Valley. The move is in line with the company's sustainability goals — and its spirit to set ambitious targets first and figure out how to make it work later.

"When you look at buildings and builds and new construction, it's easiest to go with what's tried and true and well-known," said Vince Digneo, Adobe's sustainability strategist, in an interview with GreenBiz in 2019. "It's really difficult to evaluate something that hasn't been done before."

By spearheading the project, Adobe recognizes that it's also creating a model for other companies to follow suit.

Adobe's Silicon Valley neighbor, Google, is in the midst of building its Mission Bay campus in San Francisco, which will be more than a million square feet and heated and cooled using electric geothermal heat pumps. The building looks like a dragon, with scale-like solar panels, adding a cool-factor one could expect from a brand such as Google.

Kilroy Realty, a commercial real estate developer and investor, already has 17 percent of its portfolio all-electric. Kilroy's approach doesn't put electrification front and center, which may help normalize the electric adoption. "There really is no reaction from tenants or buyers," says Sara Neff, senior vice president, sustainability at Kilroy Realty. "People don't know it's electric. They just want a comfortable space."

What excites design enthusiasts about the new generation of all-electric buildings is the potential for architects to reimagine these structures from the ground up. When looking at a building holistically, there's potential to improve how elements work together, essentially applying circular economy principles to building design. This could include elements such as incorporating heat recovery heat pumps, increasing efficiency and mitigating capacity constraints and including on-site renewables. When combined, there is potential for compounding benefits that make the system cheaper than those in a conventional building.

Much of the negative feedback about electric buildings comes from designs that simply swap out gas-based appliances and replace them with electric. Doing this is often more expensive to operate and have some of the same circulation losses as gas boilers.

The smarter early adopters are reconceptualizing how building elements work together — systems such as rainwater catchment, garden roofs and passive heating and cooling. Examples include the Bullitt Center in Seattle, which explicitly states that its goal "is to drive change in the marketplace faster and further by showing what's possible today."

A harder nut to crack is decarbonizing our current commercial building stock.

Adobe's Digneo says he'd like to fuel-switch his existing portfolio, but the other buildings in Adobe's portfolio were built 10 or 15 years ago and aren't made for natural gas to be taken out easily. "It's going to be the last mile, for sure," Digneo says.

There are numerous barriers to commercial retrofits: lack of knowledgeable contractors and architects, high costs, lack of education and awareness and lack of performance data, to name a few. It's also a distributed problem, with millions of existing residents and office buildings using gas-fire appliances that would require massive investments and education to address.

Still, some facilities are plugging in to the trend, including the University of California and Stanford University. Organizations such as the Urban Land Institute (ULI) Greenprint Center for Building Performance realize that as the market heads towards electrification, more resources are needed for commercial building owners on such details as technology, cost and feasibility to help guide decision-makers through retrofits.

Emily McLaughlin, director, ULI Greenprint Center for Building Performance, explains: “We’re increasingly hearing that while electrification may be inevitable, implementing the needed upgrades in existing buildings poses practical, technical, and financial challenges for which the market isn’t overwhelmingly prepared. As more local jurisdictions set net-zero energy building codes for new construction, owners realize that it’s only a matter of time before those apply to existing buildings as well.”

The barrier to retrofits also highlights the imperative to get buildings right the first time. Which is why energy- and climate-conscious companies are charging ahead.

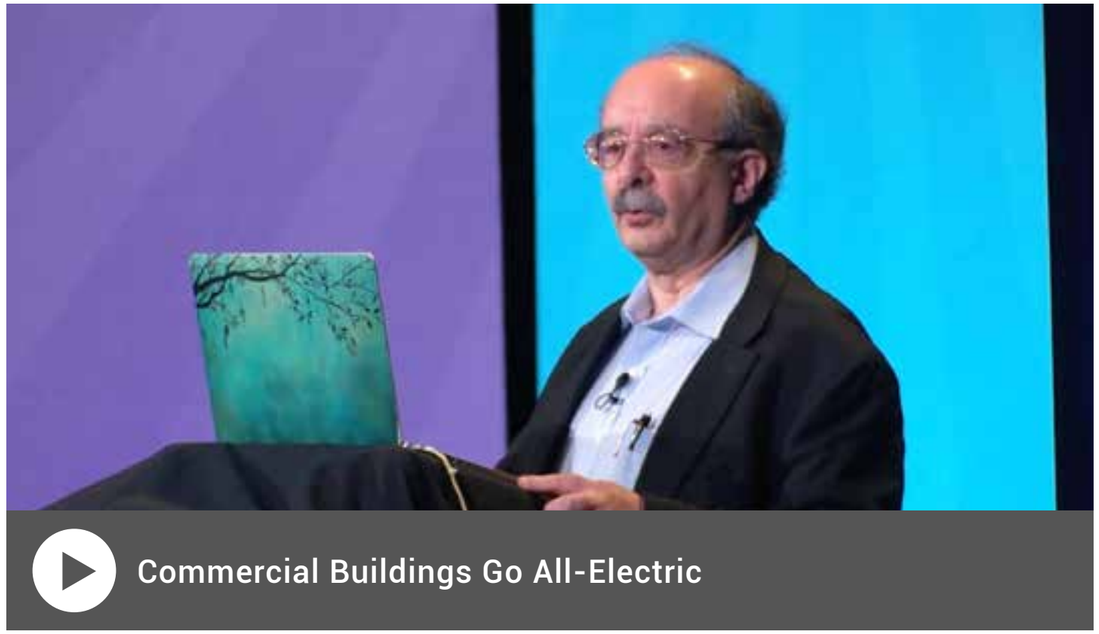
KEY PLAYERS TO WATCH

Adobe – as the North Tower gets built in San Jose, California, this tech giant will likely have many lessons to share. Given the software company also intends to eventually electrify existing buildings, it will likely also be a trailblazer in retrofitting existing building stock in coming years.

Beyond Carbon – a campaign coordinated by Bloomberg Philanthropies that provides localized resources to support cities and states meet their climate goals, with building electrification as a key element.

Building Decarbonization Coalition – with more than 140 members ranging from utilities to city leaders and researchers, this coalition has its finger on the pulse of the burgeoning electrification trends.

Kilroy Realty – the Los Angeles-based real estate developers have strong sustainability goals, including a commitment to more electric buildings. Its buildings reflect how cool future buildings can look and operate.



Urban Land Institute’s Greenprint Center – this alliance of real estate owners and developers is working on resources to make sustainable building easier.

Sarah Golden is Senior Energy Analyst and VERGE Energy Chair at GreenBiz Group

08

TOP SUSTAINABLE BUSINESS TRENDS 2020

Circularity Becomes Measurable

By Lauren Phipps

Having moved from fringe, mostly academic, conversations into the boardrooms of Fortune 500 companies and the halls of parliament around the world, the idea of a circular economy is growing up fast.

In its infancy, circularity's primary pain point was awareness and conceptual understanding — or a lack thereof. Now, in the impressionable days of early adolescence, its most consequential limiting factors are the lack of consistent metrics to understand inefficiencies within the current linear system, to measure progress over time and to contextualize circularity within global boundaries.

Existing anecdotal case studies of materials being cycled back into value chains aren't going to cut it.

While valuable storytelling tools, conceptual notions of circularity don't translate into effective government policies, industry norms and business strategies. But a growing number of tools and frameworks at the systems, company and product levels are beginning to provide the formal metrics needed for circularity to live up to its potential. And as countries, cities and companies commit to ambitious — albeit loosely defined — circularity goals, consistent measurement frameworks will enable data-driven decision-making, facilitate accountability and progress-tracking, and ultimately justify the value of a circular supply chain, business model or economy.

At the systems level, measuring circularity is primarily understood as a matter of quantifying material flows. According to an analysis by the Dutch consultancy Circle Economy, the world today is just 9 percent circular. The firm's 2019 Circularity Gap Report calculates global metabolism, quantifying the stocks and flows of materials in the global economy and highlighting the difference between materials extracted and disposed of.

In context, 9 percent of the 93 billion or so tons of minerals, fossil fuels, metals and biomass that enter the economy are captured and reused annually.

With countries such as the Netherlands committing to achieve 100 percent circularity, country-scale conceptions of circularity must take into account more than material flows, including the import and export of goods; end-of-life and waste management strategies; energy inputs, including of materials extraction; transportation of goods and materials; water usage and, in some cases, job creation and gross economic value-added.

At the business level, companies are beginning to use circularity frameworks as an internal tool to assess the full scope of material flows in their operations and to understand the potential value of circular strategies and tactics.

For example, WBCSD's just-released Circular Transition Indicators framework, or CTI, helps companies assess if its operations align with its ambitions, from design and procurement to new business models and resource recovery. Developed in partnership with a diverse group of about 25 global companies, including Royal DSM, Philips, Suez and Whirlpool, CTI provides a data-driven approach to weighing the holistic benefits of circular opportunities. This requires companies to calculate the inflow and outflow of all materials, including renewable energy and water, and can serve as a baseline to analyze the value of more circular options, such as new business models or substituting one material for another.

As more companies set audacious circularity goals, such as IKEA's aim to be a fully circular business by 2030, success can be as achievable or elusive as it sees fit, given that each organization currently defines progress on circularity in its own way. Although the conceptualizing of circularity varies widely from a chemical manufacturer to a furniture business to a software company, cross-sector metrics will enable companies to at least speak the same language.

At the product level, life-cycle assessment, or LCA, has been the dominant tool to calculate the environmental impact of goods and continues to serve as a relatively effective proxy for product circularity. However, LCA-driven decisions are sometimes at odds with seemingly more circular choices.

For example, while reusable foodservice ware may sound like a better option than its disposable counterparts, LCAs suggests that the material intensivity of reusables may not pencil out from an environmental perspective. Similarly, increasing plastic packaging can extend the shelf life of food items and cut food waste, and therefore reduce the

emissions of potent methane gas into the atmosphere when food decomposes in a landfill.

Set to launch its fourth version of the standard in 2020, the Cradle to Cradle Products Innovation Institute offers a set of metrics tailored specifically for the circular economy. It includes considerations of sourcing (e.g., recycled or renewable content), design (intentional end-of-life strategy such as disassembly), recoverable content (recyclability or biodegradability) as well as investment in investment in infrastructure to enable end-of-life strategies.

At all levels — systems, business and product — the development of specific and actionable metrics is a key accelerator for circularity at scale that allows data-driven decisions to be made, tracked and celebrated. Of course, the operative word is actionable. Quantifying circularity proves valuable only to the extent that the metrics align with planetary boundaries and science-based climate targets.

For many, adopting metrics and methodologies to calculate circularity won't mean starting from scratch. Organizations such as the Global Reporting Initiative and the U.S. Green Building Council are adapting their own standards to incorporate principles of circularity, which will be crucial to ensure alignment with the frameworks and goals that companies already have in place.

As metrics to operationalize circularity mature and scale, it will be important to acknowledge their shortcomings. A myopic understanding of data points and material flows as the key to a circular economy can overlook human, on-the-ground realities — and unintended consequences — of systemic shifts best understood through a qualitative lens.

Ultimately, circularity requires more than closing the loop on materials flowing through the economy. It invites a fundamental shift in business-as-usual towards regeneration, abundance and reimagined relationships with goods, suppliers, customers and one another. Formalized metrics are one point in the constellation of tools, best practices and proof points that will help us get there.

KEY PLAYERS TO WATCH

Cradle to Cradle Products Innovation Institute — set to launch in 2020, the fourth version of the Cradle to Cradle Certified Product Standard will feature an updated Product Circularity category, focused on sourcing, design and systems.

Global Reporting Initiative — its new global standard translates principles of circularity into waste disclosures, shifting the framing from an unwanted burden to a holistically managed material.

UL Environment — companies can pursue certification of UL 3600, which measures and reports on the circularity of products, facilities and organizations.

U.S. Green Building Council — in late 2019, USGBC launched a circular economy pilot credit in its LEED rating system, which includes considerations of supply chain circularity, zero-waste manufacturing, circular design and closed loop systems.

World Business Council for Sustainable Development — provides Circular Transition Indicators, a framework to assess a company's circularity, and quantify the value of shifting towards more circular approaches.

Lauren Phipps is Director & Senior Analyst, Circular Economy at GreenBiz Group

09

TOP SUSTAINABLE BUSINESS TRENDS 2020

Nutrient Diversity Goes Beyond Meatless Meat

By Holly Secon

The alternative protein market is beefing up. That's because it's not just beef anymore.

Imagine: Pigless pork. Chickenless chicken. Eggless eggs. Fishless fishmeal to feed fish. Not to mention fishless fish.

It's not science fiction — they're in labs today and on store shelves tomorrow. The past few years have seen major booms in synthetic biology and biotechnology investment, along with changing consumer tastes, which have enabled the creation of more "fake meat" options than ever before.

It's good timing, too. The changing climate and its impacts are threatening the world's food supply — temperatures and the frequency and severity of weather events on land and water are increasing, while crop yields are going down. Modern agri-food production systems also contribute to climate change, both directly from livestock emissions and indirectly through deforestation and biodiversity loss.

Meanwhile, the population of the world is growing, along with its appetite for protein and, along with it, the size and emissions of the animal livestock industry. In fact, global consumption of meat surged by 8 percent from 2013 to 2017, mainly due to rising incomes in developing countries. (Also leading to higher qualities of life and longer lives for these new animal protein consumers.)

The potential of lab-grown and plant-based protein as a solution to climate change and world hunger has already generated a great deal of buzz. Much of it has focused on the two first and most successful companies so far: Impossible Foods and Beyond Meat. The former is currently valued at approximately $2 billion, though it's still privately held, while the latter's initial public offering (IPO) far exceeded expectations. At year-end 2019, Beyond Meat's stock had roughly tripled from its $25 IPO price seven months earlier, for a market cap of nearly $5 billion.

Together, these companies' offerings are redefining the veggie burger — and the typical veggie burger consumer. Both companies have designed their offerings to maintain a realistic taste and mouthfeel to beef. Impossible's is made primarily from a soy-based version of the protein found in meat, while Beyond Burger's comes from mixing green pea protein and beet juice extract for color.

According to market research firm NPD Group, 228 million servings of plant-based burgers were bought at quick-service restaurants in 2019, up about 10 percent year over year. Interestingly, 95 percent of the people who purchased a plant-based burger during 2019 still eat conventional meat, NPD found. The reasons consumers give for buying are generally to improve health and reduce environmental impacts.

A great deal of that growth is due to the uptake of plant-based burgers on the menus of fast-food and fast-casual chains, including White Castle, Burger King, Hard Rock, Qdoba and TGI Fridays. However, due to the alternative protein's still-small production scale, prices remain higher than for beef. While partnerships such as these increase the accessibility (and visibility) of alt-proteins, the significant expense of production leads to prohibitive costs that can be barriers to purchase for many, at least until production levels increase.

But more restaurants and foodservice operations, big and small, are sinking their teeth into these foods, helping to bring the technologies and offerings to scale. Commercialization is the key to delivering on the promise and potential of feeding the world with minimal impact on the climate.

Of course, there's more than one way to create alt-meat. Some companies are going full plant-based, using proteins from different plants to create realistic meat-like substances via fermentation processes, such as the Impossible Burger. Some companies are using compounds pulled out of the air, processed by microbes and probiotics, to create edible protein powder, such as the startups Solar Foods and Air Protein. Others, such as Perfect Day and Finless Foods, are using cellular agriculture, which takes isolated animal cells from meat, fish, eggs and dairy and grows them in a lab. A few are 3D-printing meat cells, such as Aleph Farms and Redefine Meat.

There's more than one way to go to market, too. Many of these innovators have joined forces with bigger, more established partners to increase distribution channels, access to facilities

or simply receive cash infusions.

Take Tyson Foods, the biggest meat producer in the United States. It invested early in Beyond Meat — $34 million between 2016 and 2017, giving it a 6.5 percent ownership stake — an early vote of confidence in meat alternatives. It exited after Beyond Meat went public, only to go on to form its own alternative protein lines in-house, producing plant-based chicken nuggets along with burgers and sausages that blend real and alternative meat.

The food giant has investments in a veritable stampede of alt-protein startups. They include the Berkeley, California-based Memphis Meats, which produces meat from animal cells in a lab; Jerusalem-based Future Meat Technologies, which grows animal cells in bioreactors; Denver-based MycoTechnology, which uses vegetables in a mushroom-based fermentation process to produce protein-heavy ingredients; and San Leandro, California-based New Wave Foods, which is creating plant-based shrimp from algae and other ingredients. Its "shrimp" should be in grocery stores this year.

For Tyson, ingredients such as these represent new product lines. "For us, this is about 'and' – not 'or,'" says Noel White, president and CEO of Tyson Foods. That is to say, traditional burgers aren't going anywhere anytime soon.

Other companies seem to be taking a bite out of Tyson's strategy. Nestlé, the world's biggest food company, last year announced its own yellow pea protein-based offering: the ebulliently branded Awesome Burger, from

Sweet Earth Foods, which Nestlé acquired in 2017. One of the biggest consumer products companies in the world, Unilever, last year acquired plant-based startup the Vegetarian Butcher. Food producer Cargill, the biggest privately held company in the United States, invested in cultured meat through Aleph Farms and pea protein through Puris, which is Beyond Meat's pea protein ingredient provider.

It looks like Big Meat is embracing these startups to become Big Protein.

Such acquisitions, partnerships and investments could help smaller startups — many still in development mode — commercialize their products more quickly and efficiently.

Those products, from “air meat” to vegan cheese, are already finding widespread acceptance among consumers. Now, they’re approaching the right price point. They might be “alternative” now, but pretty soon, they’ll just be “proteins.” Increasing access to these protein alternatives promises to divert climate-change-causing land use while providing equitable access to necessary proteins.

As the market expands, there’s money to be made. Barclays predicts the alt-meat market could hit $140 billion in the next decade by capturing a 10 percent share of the $1.4 trillion meat market. By any measure, that’s a whopper.

KEY PLAYERS TO WATCH

FAIRR initiative — the Farm Animal Investment Risk and Return is a collaborative investor advisory and research network of asset managers who manage a total of $16 trillion, including investing in plant-based options.

Impossible Foods – its burger has grabbed countless headlines for its faithful imitation of beef as the company expand into overseas markets.

Motif FoodWorks — a well-funded B2B food ingredients startup that takes DNA from key plant and animal proteins and uses engineered microbes to make everything from camel milk to sturgeon eggs, which will be commercialized within the next two years.

NovoNutrients – this pre-revenue startup takes excess C02 that has been trapped from industrial uses such as cement and fertilizer production to create feed for protein-rich fish for human consumption.

Tyson Ventures — its venture arm was created to seek innovative food solutions as consumers’ tastes shift towards healthier and more sustainable options that nimble startups are providing.

Holly Secon is a contributing writer at GreenBiz Group

10

TOP SUSTAINABLE BUSINESS TRENDS 2020

The Bots Are Coming (to Ratings and Reporting)

By John Davies

Corporate reporting on sustainability — including environmental, social and governance (ESG) performance and achievements — has grown more than fivefold in the past 10 years. Roughly 20 percent of S&P 500 companies published a sustainability report in 2011. In 2018, that number rose to 86 percent. During that time, sustainability professionals have fretted about whether anybody reads their reports.

What we're beginning to see is that it may not be "who" but "what." Automation and artificial intelligence (AI) are being leveraged to both generate and evaluate ESG data.

The bots and AI are largely in response to the confusing world of ESG reporting. There are now more than 600 ESG ratings agencies globally, according to the Global Initiative for Sustainability Ratings, as ESG data becomes a greater factor in a company's valuation and its access to capital. The challenge is that current corporate ESG disclosures lack consistency and standardization.

What's a corporate reporter to do?

In years past, it meant slogging along with spreadsheets and constant nudges sent throughout the organization in an attempt to corral the data. As long as the report came out on time, the sustainability team could breathe easily and hope their investor relations folks took notice. Occasionally, efforts were rewarded by a good ranking on the Dow Jones Sustainability Index or one of the other coveted ratings.

But in the past year or so, there has been increased interest in understanding the differences among the various ratings and rankings organizations. This has become more pronounced since Institutional Shareholder Services, and its main competitor, Glass Lewis, started focusing more on E&S and not just G. These two prominent proxy advisory services provide institutional investors with assistance in voting their shares at corporate annual meetings.

The frustration for many corporate sustainability reporters is the general lack of transparency as to how their company is scored. Firms such as CSRHub seek to synthesize data from a myriad of sources, ranging from "best of" lists to ratings agencies, but the scores don't contain enough information and context for most investors.

Subscribing to a service such as CSRHub or Sustainalytics is often more about the data than the rankings. Firms such as these provide data services where software known as APIs can pluck data and populate a firm's database, where its internally developed algorithms can test and validate various investment hypotheses.

Taking this a step further are firms such as Sensefolio and Arabesque, which complement traditional ESG data with feeds from news reports, social media posts, job postings and review websites such as Glassdoor. This data is then leveraged with self-learning quantitative models to assess the performance and sustainability of globally listed companies.

These are strategies and technologies that mainstream investors have been deploying for some time, though it is still early days. According to MarketWatch, financial markets don't produce enough data to get the most out of AI and machine learning. AI functions best on billions of data points rather than millions, but three decades of daily share-price data for the benchmark S&P 500 Index would yield only about 4 million data points, a mere drop in the big-data bucket.

The takeaway is that AI works best when humans develop an investment thesis and machines test that theory.

For many investors, the technology doesn't have to be that exotic. For example, bot searches of companies' 10-Q and 10-K filings with the U.S. Securities and Exchange Commission can track and redline what has changed when it comes to sustainability and ESG topics. Investors take notice when a phrase in what may normally be seen as boilerplate shifts from "probable" to "likely" from one report to the next. A machine is more likely to spot such subtleties.

In response, investor relations and sustainability teams are striving to discover the best keywords to use to highlight strategic information. Regular checkups on a Bloomberg terminal of a company's publicly available information can help make sure the bots are getting the right data — and getting the data right. Organizations are also subscribing to software-as-a-service providers such as Datamaran to identify and monitor nonfinancial risks. The service tracks 100 nonfinancial topics for thousands of companies by sifting and analyzing millions of data points from publicly available sources.

It isn't only external data that's automatically collected, sifted and analyzed. For years there has been a niche market of vendors that have offered carbon accounting software. Adoption has been slow to scale as the cost of the software and even more so the services to implement and support it outweighs managing by old-fashioned spreadsheet.

One of the barriers to wider adoption has been CIO skepticism in buying from small vendors. That's where the Salesforce Sustainability Cloud may gain great-

er acceptance: The company's customer relations management, or CRM, software is already installed at more than 150,000 customers and has 3.75 million subscribers. The sustainability application focuses primarily on measuring and tracking energy consumption, climate emissions, waste generation and environmental data. Early users claim the ability to produce environmental data as fast as, or even father than, financial data. (Typically, environmental data lagged financial data by one or more quarters.) This will free up time for sustainability managers to focus on more strategic efforts.

The increase in automation is changing reporting in a significant way. In the past, sustainability executives felt pressured to keep their reports short and sweet. Now companies are expanding the amount of data they offer. Some are supplementing the annual sustainability report and creating a separate ESG information site on the investor web page.

Think of it as a welcome mat for the bots.

KEY PLAYERS TO WATCH

Arabesque – part of a new wave of companies bringing a new dimension to investing, using self-learning quant models and big data to assess the performance and sustainability of globally listed companies.

Bloomberg — a privately held financial, software, data and media company providing financial software tools and enterprise applications through its terminals.

Datamaran – a software-as-a-service provider of benchmarking data, materiality analysis and nonfinancial issues monitoring.

Glassdoor — one of the world's largest job and recruiting sites with a large database of company reviews that help prospective employees and others understand issues such as corporate culture and pay equity.

Salesforce — provides a CRM software platform that has been enhanced to measure and track energy consumption, climate emissions, waste generation and environmental data.

John Davies is Vice President and Senior Analyst at GreenBiz Group

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VERGE WEEKLY

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Key players to watch

Adobe – its North Tower building in San Jose will likely have many lessons to share. Given the company also intends to eventually electrify existing buildings, it will likely be a trailblazer in retrofitting existing buildings.

Amazon – the e-commerce behemoth led by Jeff Bezos surprised everyone late last year by placing a first-of-its-kind massive electric van delivery order with a startup.

Amazon Employees for Climate Justice – a group of Amazon employees who believe it's their responsibility to ensure Amazon's business models don't further contribute to the climate crisis.

Apple – aims to protect as much as 1 million acres of responsibly managed working forests, so as to have zero net impact on forests for its paper use.

Arabesque – part of a new wave of companies bringing a new dimension to investing, using self-learning quant models and big data to assess the performance and sustainability of globally listed companies.

Beyond Carbon – a campaign coordinated by Bloomberg Philanthropies that provides localized resources to support cities and states meet their climate goals, with building electrification as a key element.

Bloomberg – a privately held financial, software, data and media company providing

financial software tools and enterprise applications through its terminals.

Building Decarbonization Coalition – this coalition of more than 140 members, from utilities to city leaders and researchers, has its finger on the pulse of the burgeoning electrification trends.

Clean Cargo — the BSR working group includes more than 60 companies representing both shippers (Amazon, BMW and Nike) and carriers (Cosco, Crowley, Maersk, Wallenius Wilhelmsen).

Climeworks — the Swiss direct-air-capture outfit is the first in its field to sell removal credits direct to consumers.

Coaster Cycles — makes e-cargo bikes (in addition to pedicabs) in its factory in Montana and works with global urban shippers.

Cradle to Cradle Products Innovation Institute — the fourth version of its standard will feature an updated Product Circularity category, focused on sourcing, design and systems.

Datamaran – a software-as-a-service provider of benchmarking data, materiality analysis and nonfinancial issues monitoring.

Dow — its 2025 sustainability goal includes "Valuing Nature," a first-ever commitment by a corporation to consider nature in virtually all of its business decisions.

European Commission — is exploring a range of regulations about climate-related reporting and risk management as part of its initiative to finance a sustainable European economy.

FAIRR initiative — the Farm Animal Investment Risk and Return is a collaborative investor advisory and research network of asset managers who manage a total of $16 trillion, including investing in plant-based options.

Getting to Zero Coalition — a moonshot partnership between the Global Martime Forum, Friends of Ocean Action and the World Economic Forum dedicated to developing commercially viable, deep-sea, zero-emissions vessels by 2030.

Glassdoor — one of the world's largest job and recruiting sites with a large database of company reviews that help prospective employees and others understand issues such as corporate culture and pay equity.

Global Reporting Initiative — the first global standard that includes principles of circularity in waste disclosures, shifting the framing from an unwanted burden to a holistically managed material.

Google Workers for Action on Climate — a Google employee group pushing the company to commit to a comprehensive climate plan.

Impossible Foods – its burger has grabbed countless headlines for its faithful imitation of beef as the company expand into overseas markets.

Indigo Ag — the agricultural data company's Terraton Initiative is "a global effort to remove 1 trillion metric tons of CO_2 from the atmosphere and use it to enrich our agricultural soils."

Inkga Group — the Swedish giant behind the IKEA brand has been one of the most aggressive retailers in the world to try to electrify the last mile of its shipping supply chain.

Intergovernmental Panel on Climate Change — is the United Nations body set up to provide policy makers with impartial, scientific information regarding the status of climate change and future risks.

Kilroy Realty – these real estate developers have strong sustainability goals, including a commitment to more electric buildings. Its buildings are forward-leaning, reflecting what how cool future buildings can look.

Mærsk – the world's largest shipping company is steering toward a zero-carbon future by 2050 and is involved with testing myriad short-term efficiency and long-term fuel options.

Microsoft Workers 4 Good — a faction of Microsoft workers who aim to hold the company accountable to its stated values.

Minter Ellison — an Australian law firm with market-leading work on corporate and director liability risk from climate change.

MIT Megacity Logistics Lab — one of the few academic institutions in the world that focuses on sustainable urban shipping, the lab helps public and private sectors find solutions.

Motif FoodWorks — a well-funded B2B food ingredients startup that takes DNA from key plant and animal proteins and uses engineered microbes to make everything from camel milk to sturgeon eggs, which will be commercialized within the next two years.

Nori — is building a digital marketplace for carbon removal credits, backed by blockchain technology.

NovoNutrients – this pre-revenue startup takes excess carbon dioxide that has been trapped from industrial uses such as cement and fertilizer production to create feed for protein-rich fish for human consumption.

Pachama — the California startup aims to boost the transparency and accountability of forest offsets using AI and satellite data.

Poseidon Principles – a group of financial services companies, including Citi and ING, and representing 25 percent of the all ship financing, that has agreed to use climate risk considerations in their asset-investment decisions.

Puro — removal credits associated with biochar and other sequestration methods are available from this Finnish company.

Rivian — it appeared from almost nowhere to challenge Tesla's dominance as an independent electric vehicle maker and scored Amazon's game-changing purchase order.

S&P Global Ratings — is reporting on the impact of climate risk on credit ratings.

Salesforce — provides a Customer Relationship Management software platform that has been enhanced to measure and track energy consumption, climate emissions, waste generation and environmental data.

Shell — is one of the most established investors and traders of carbon credits in the world and views nature-based solutions as a platform for growing carbon trading markets.

Taskforce for Climate-related Financial Disclosures — is the body catalyzing the change in corporate reporting to include physical risks from climate change.

Tech Workers Coalition — organizes and educates employees "guided by our vision for an inclusive and equitable tech industry."

Tyson Ventures — its venture arm was created to seek innovative food solutions as consumers' tastes shift towards healthier and more sustainable options that nimble startups are providing.

U.S. Green Building Council — last year it launched a circular economy pilot credit in its LEED rating system, which includes considerations of supply chain circularity, zero-waste manufacturing, circular design and closed-loop systems.

UL Environment — offers certification of UL 3600, which measures and reports on the circularity of products, facilities and organizations.

UN Global Compact — maintains a program to increase nature-based solutions within national governance, climate action and climate policy-related instruments.

Urban Land Institute Greenprint Center – an alliance of real estate owners and developers working on resources to make sustainable building easier.

Wallenius Wilhelmsen — it transported more than 3 million vehicles to six continents in 2018 and is backing initiatives in sulfur reduction and alternative fuels.

WeWorkers Coalition — a group of WeWork employees seeking a seat at the decision-making table.

World Business Council for Sustainable Development — Circular Transition Indicators provides a framework to assess a company's circularity and quantify the value of shifting towards more circular approaches and its "Natural Climate Solutions" initiative centers on building a collective voice to raise the profile of nature-based solutions.

the State of Green Business

INDEX

Welcome to the annual State of Green Business Index, a review of trends in sustainability performance over the last five years for the largest 500 companies in the United States, as well as the largest 1,200 companies globally. Produced in collaboration with the environmental data and research firm Trucost, part of S&P Global, the 2020 assessment includes more than 30 corporate sustainability performance indicators including three new indicators that assess exposure to future climate risks.

Highlights of Key Findings

The Big Picture

The natural capital costs of the top 1,200 global companies exceeds

$5.0 trillion

Costs exceed net income by

1.5X

86%

of S&P 500 companies published a sustainability report in 2018, an increase of nearly 10% from 2014

Natural Capital Impacts

Absolute corporate carbon emissions increased by

1%

while corporate carbon intensity fell by

2%

compared to 2014 levels

Fossil fuel power generation down 3% to

57% share

and renewable power generation up 4% to

20% share

from 2014 to 2018

Corporate Performance

Current carbon targets contribute just

25%

of the reductions needed by the top 1,200 global companies to align with the Paris Agreement 2°C goal

58%

of companies set carbon targets, an increase of 16% over the past five years

25%

of companies set water targets, an increase of 12% over the past five years

Future Carbon Risk

23%

of top 1,200 global companies earnings are at risk by 2050 under a high carbon pricing scenario

01

STATE OF GREEN BUSINESS INDEX

The Big Picture

Each year in the State of Green Business Index, we assess what progress, if any, is being made by publicly traded companies in improving their environmental sustainability.

In this section, the metrics assessed provide an overview of key trends in corporate environmental performance.

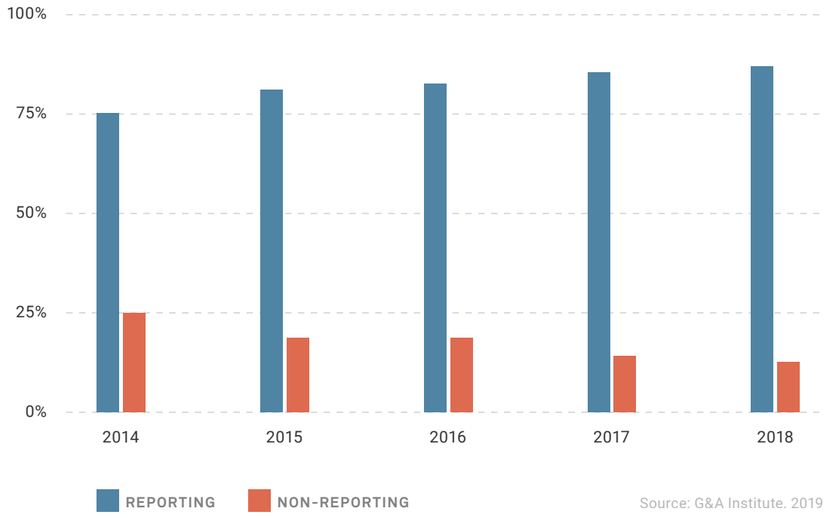
Over the past five years, there has been an increasing trend in the number of companies publishing sustainability reports, with 86 percent of the largest 500 companies in the United States reporting in 2018, a 10 percent increase in the number of companies reporting since 2014. This trend signifies the increasing interest among companies towards better management of sustainability performance.

The cost of companies' natural capital impacts — the dollar value of resources they extract and pollution they emit — has been increasing since 2015. These costs have increased by more than 50 percent in the U.S. and 40 percent globally since 2014, reaching a new high of $5 trillion in 2018.

Companies' natural capital costs are higher than their net income by more than 1.5 times, a trend consistent with previous years. That is, if companies had to internalize all of the natural capital costs associated with their business — for example, as a result of increased regulations or new carbon taxes — their profits would be significantly at risk.

A Growing Share of Companies are Publishing Sustainability Reports

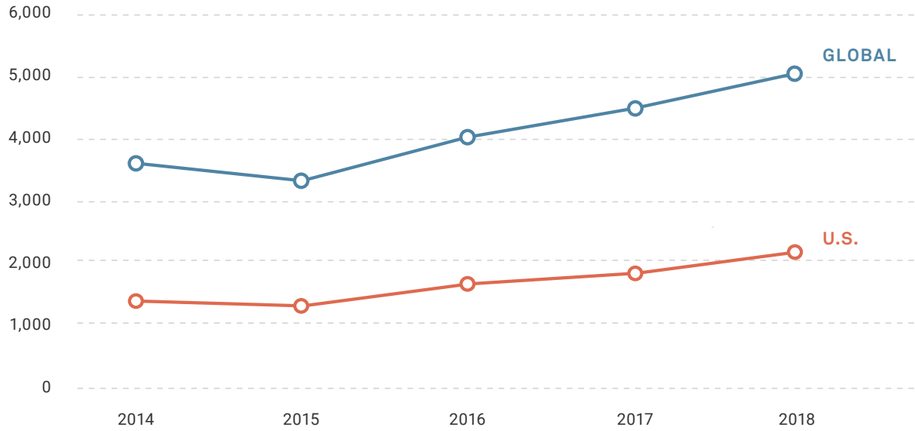
S&P 500 Companies Publishing Sustainability Reports



Source: G&A Institute. 2019

Global Natural Capital Cost Exceeds $5 Trillion for First Time

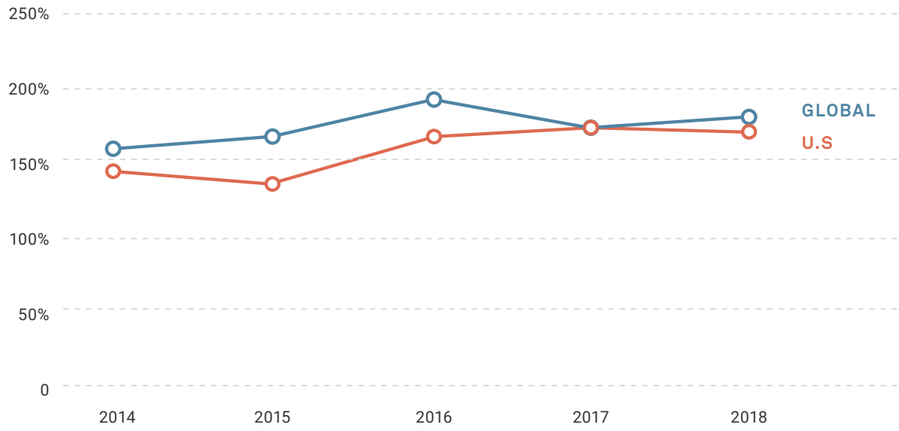
Total Natural Capital Cost (Billion USD)



Source: Trucost. 2019

Companies' Natural Capital Costs are Much Higher than Net Income Globally

Total Natural Capital Cost as Percent of Net Income



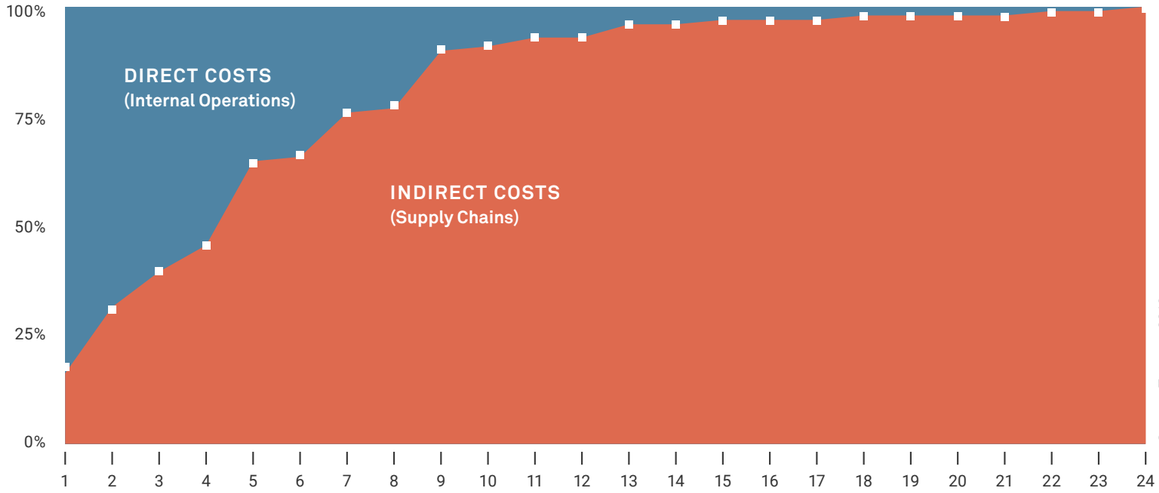
Source: Trucost. 2019

While overall natural capital costs continue to increase, the ratio of natural capital costs to net income has been relatively stable, signifying progress in decoupling financial growth from resource utilization. Efficiency improvements through better technological intervention can aid in reducing the strain on the environment and lower natural capital costs.

For the majority of sectors, most natural capital costs are embedded in the supply chain, representing 81 percent of total impact on average. This underscores the importance for companies to increase engagement with suppliers to better mitigate indirect impacts. Over time, suppliers are likely to face increases in expenditure due to constraints on resources such as water and carbon taxes implemented

Majority of Natural Capital Impact Costs Come from Supply Chain for Most Sectors

Natural Capital Costs (%)

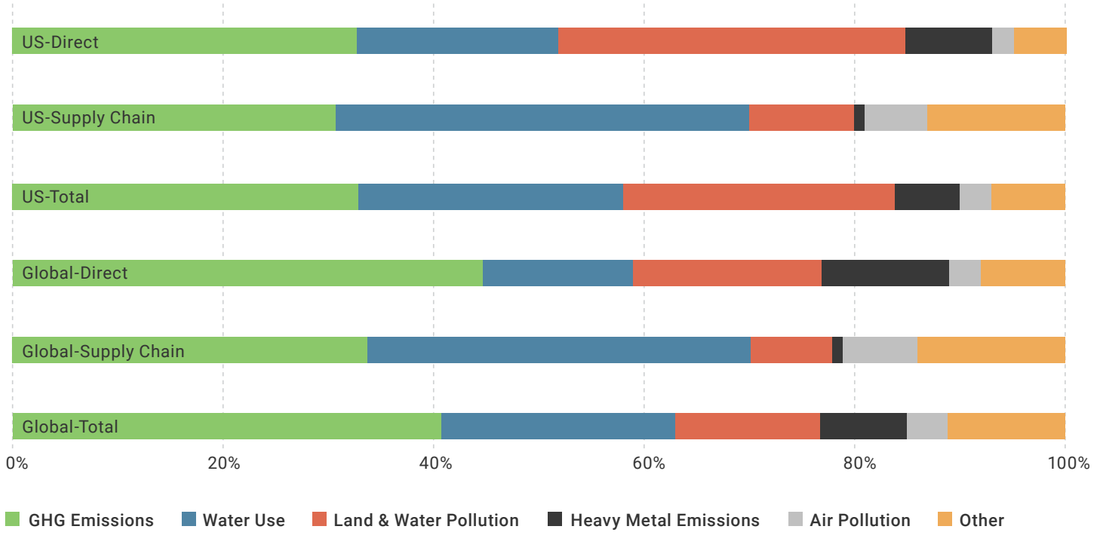


01/ Utilities
02/ Transportation
03/ Materials
04/ Commercial & Professional Services
05/ Real Estate
06/ Energy
07/ Diversified Financials
08/ Consumer Services
09/ Semiconductors & Semiconductor Equipment
10/ Pharmaceuticals, Biotechnology & Life Sciences
11/ Technology Hardware & Equipment
12/ Capital Goods
13/ Banks
14/ Retailing
15/ Consumer Durables & Apparel
16/ Household & Personal Products
17/ Health Care Equipment & Services
18/ Telecommunication Services
19/ Software & Services
20/ Media & Entertainment
21/ Automobiles & Components
22/ Food & Staples Retailing
23/ Food, Beverage & Tobacco
24/ Insurance

by regulatory bodies around the world. Increased expenses will trickle down to companies who will have to pay higher prices for goods and services.

While it is clear that the majority of natural capital impacts arise from supply chains, understanding the key contributors will help companies mitigate those impacts. GHG emissions and water consumption remain the most material impact categories across the value chain, contributing around 41 percent and 22 percent, respectively, to natural capital costs globally among the companies assessed. In the United States, land and water pollution contribute significantly to companies' total direct impacts and incur as much natural capital cost as GHG emissions. These three key performance indicators jointly account for 77 percent of total impact globally and 84 percent of total impact in the United States.

The Largest Natural Capital Impacts for Companies Come from GHG Emissions and Water



Source: Trucost. 2019

02

STATE OF GREEN BUSINESS INDEX

Natural Capital Impacts

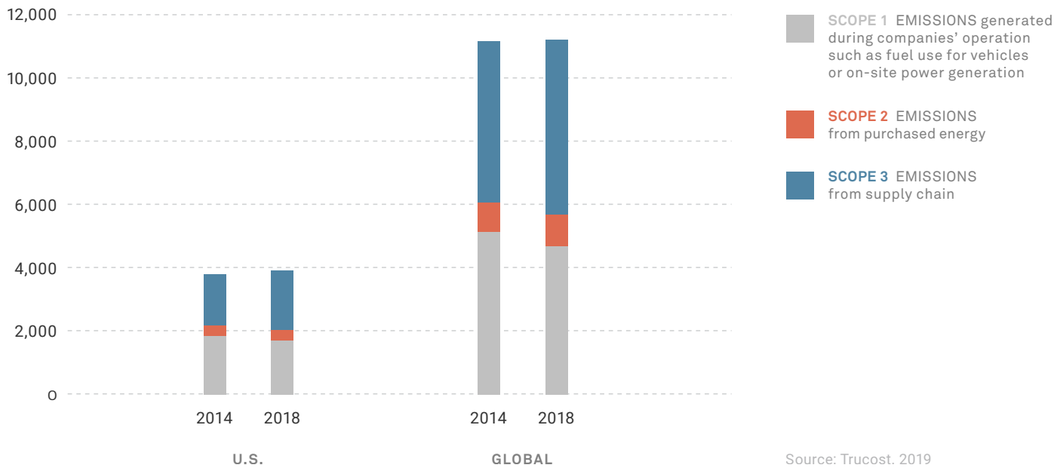
In this section, we provide more details on corporate natural capital impacts in the form of greenhouse gas emissions, water, waste and energy production. Overall trends show increased natural capital dependencies as companies continue their economic growth, though resource efficiency has improved, requiring fewer resources per dollar of revenue generated.

Global GHG emissions are slightly higher than they were in 2014. The emissions of the 500 largest companies in the United States increased 1 percent relative to five years ago, while the emissions of the 1,200 largest companies in the world increased 3 percent in the same period.

This is largely due to companies' Scope 3 emissions — emissions from supply chains — which grew 15 percent for U.S. companies and 9 percent for global companies and nearly equate to Scope 1 and 2 emissions combined.

Growing Share of Scope 3 Emissions Results in Slight Increase in Emissions

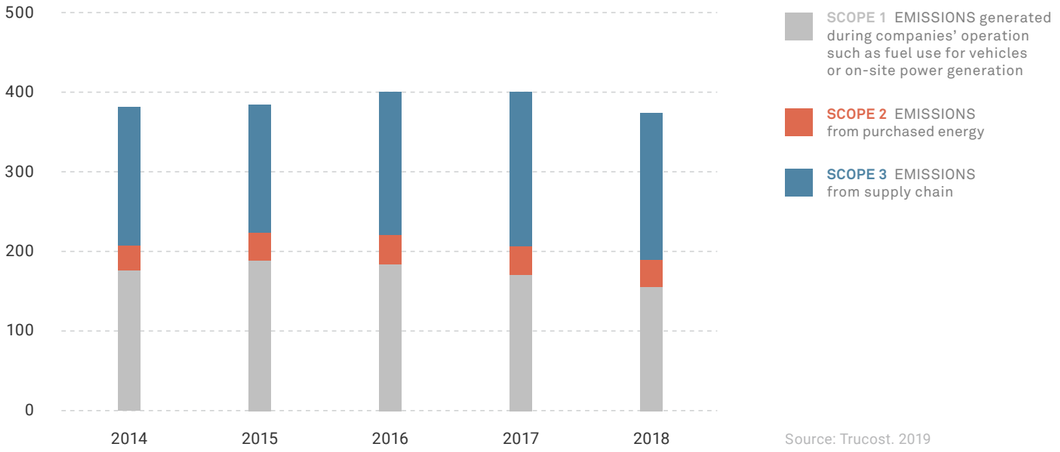
GHG Emissions (Million tC02e)



Source: Trucost. 2019

Companies' Emissions Intensity Lowest in Last Five Years

GHG Intensity (tC02e/Million USD Revenue)



Source: Trucost. 2019

This was nearly balanced by an 8 percent decrease in Scope 1 emissions across both U.S. and global companies. While the decrease in Scope 1 emissions is a move in the right direction, the increase in Scope 3 emissions underscores the importance of accounting for emissions beyond a company's own operations and the need to engage with suppliers to reduce overall impacts.

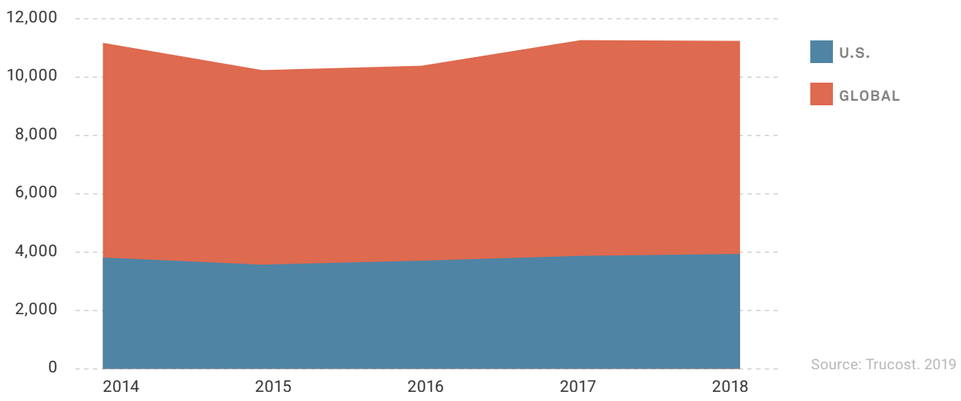
Despite limited changes to overall emissions, their emissions intensity — emissions per unit of revenue — is at the lowest point in five years. This is an encouraging sign that should continue to improve into the future as companies learn to decouple their economic growth from natural resource use.

While accounting for and managing companies' Scope 1, 2 and even supply-chain emissions is becoming a more common practice, downstream Scope 3 emissions are often overlooked. However, there is a pressing need to address these emissions as they account for more than 50 percent of total GHG emissions on average for the majority of sectors.

Downstream emissions can come from a variety of sources. For sectors such as Banks and Insurance, these emissions lie within their investments. For Automobiles and Energy, the emissions come from the use of their products, which involves combustion of fossil fuels.

Overall GHG Emissions Remain Stable

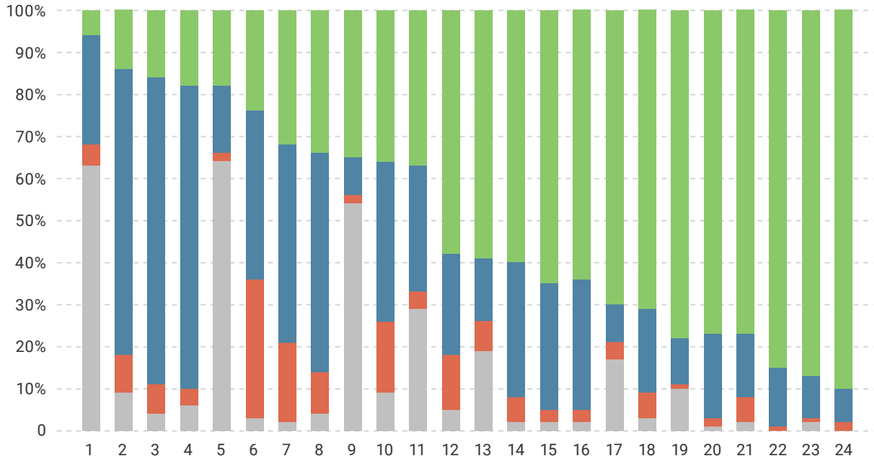
GHG Emissions (Million tC02e)



Source: Trucost. 2019

Scope 3 Downstream Emissions Are a Major Contributor to Total GHG Emissions

Percent of Total GHG Emissions



SCOPE 1 EMISSIONS generated during companies' operation such as fuel use for vehicles or on-site power generation

SCOPE 2 EMISSIONS from purchased energy

SCOPE 3 (Upstream) EMISSIONS from supply chain

SCOPE 3 (Downstream) EMISSIONS from use of sold goods and services

Source: Trucost. 2019

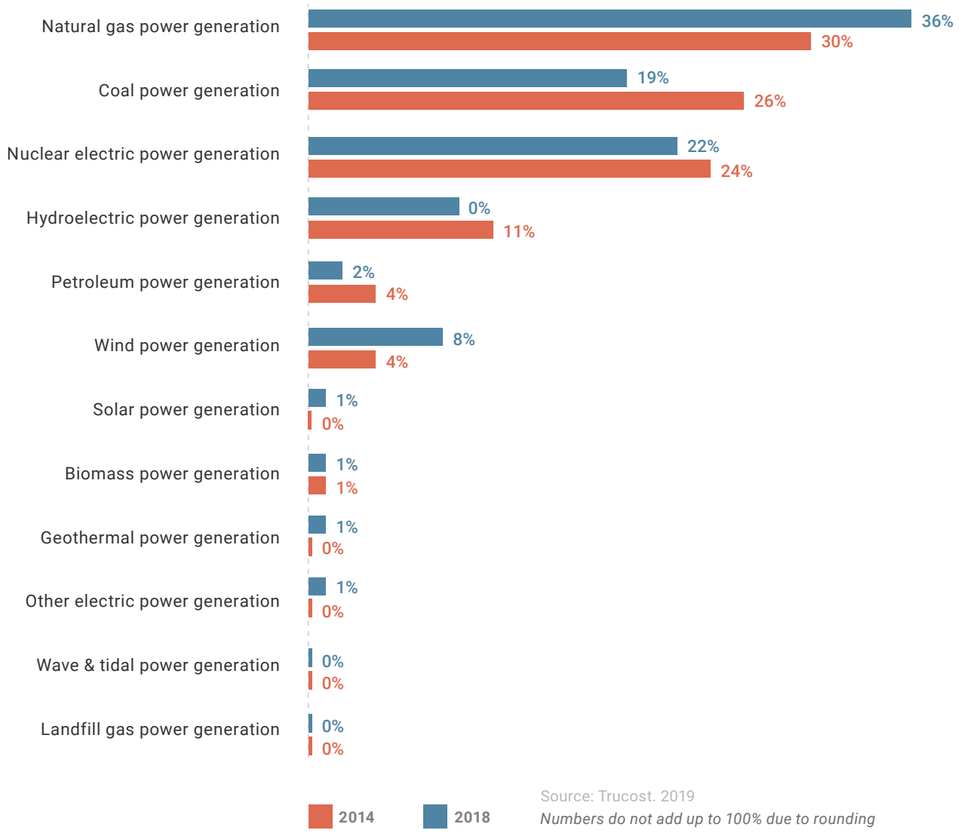
01/ Commercial & Professional Services
02/ Pharmaceuticals, Biotechnology & Life Sciences
03/ Health Care Equipment & Services
04/ Food, Beverage & Tobacco
05/ Transportation
06/ Telecommunication Services
07/ Software & Services
08/ Media & Entertainment
09/ Utilities
10/ Semiconductors & Semiconductor Equipment
11/ Diversified Financials
12/ Real Estate
13/ Consumer Services
14/ Technology Hardware & Equipment
15/ Household & Personal Products
16/ Consumer Durables & Apparel
17/ Materials
18/ Food & Staples Retailing
19/ Energy
20/ Automobiles & Components
21/ Retailing
22/ Insurance
23/ Capital Goods
24/ Banks

The global energy mix continues to shift towards lower carbon energy sources. The share of coal continues to decline, down 7 percent from 2014. Meanwhile, renewable energy share has doubled, led by wind power, which now accounts for 8 percent of power generation in the world's largest 1,200 companies. The largest growth, however, has been in natural gas, which grew by 20 percent since 2014, now accounting for 36 percent of power generation.

Company water use has averaged a 9 percent yearly increase since 2015, both for U.S. companies and globally.

The supply chain accounts for the largest share of companies' water use (55 percent), and also the highest water intensity. This indicates that, like GHG emissions, most water risk for companies is likely to be beyond their operations and direct control, which highlights the importance of corporate programs focused on managing supplier-related water risks.

Global Energy Mix Shifts Towards Lower Carbon Fuels

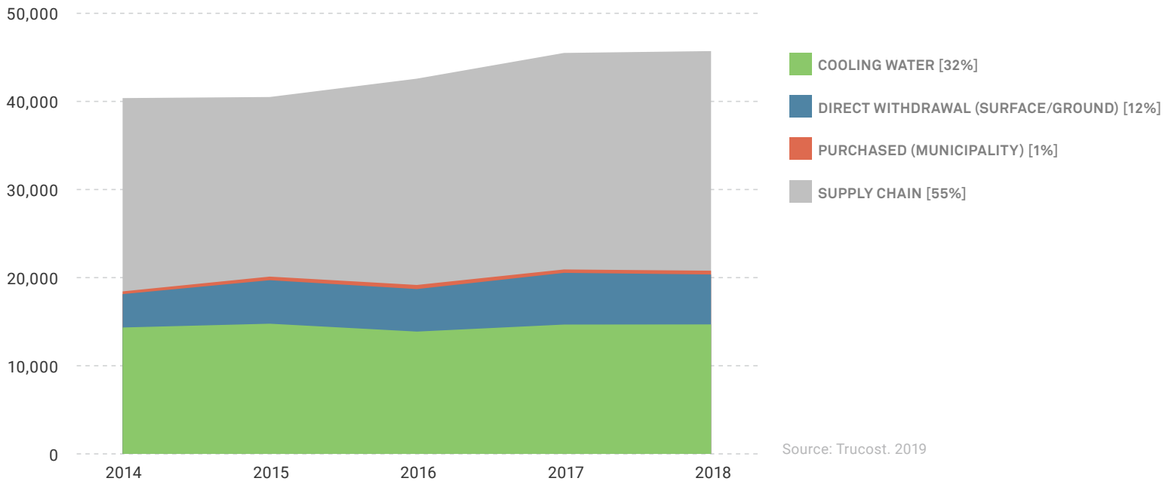


Source: Trucost. 2019

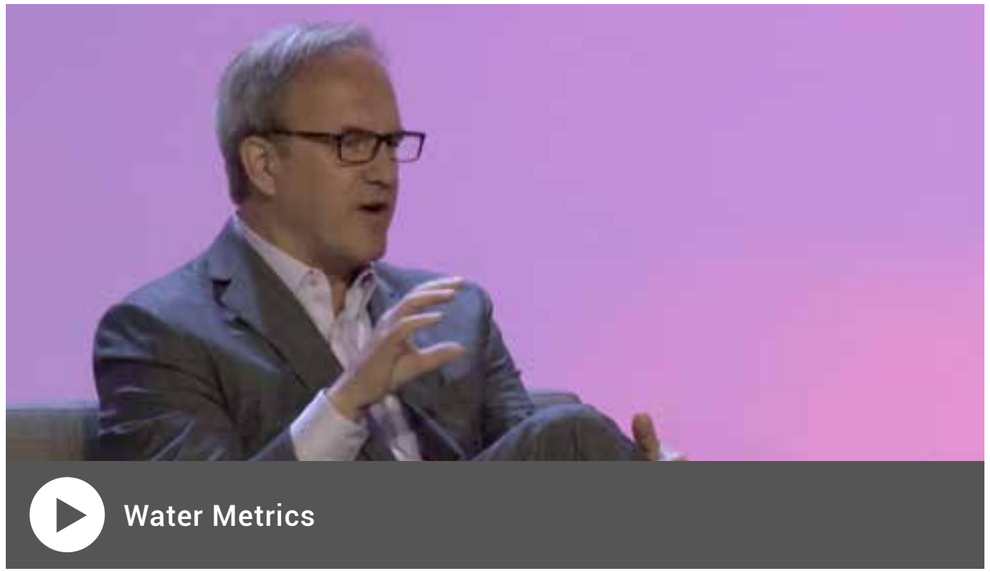
Numbers do not add up to 100% due to rounding

Water Intensity on the Rise, with Supply Chain Being the Largest Contributor

Water Use Intensity (cubic meters/Million USD revenue)



Source: Trucost. 2019

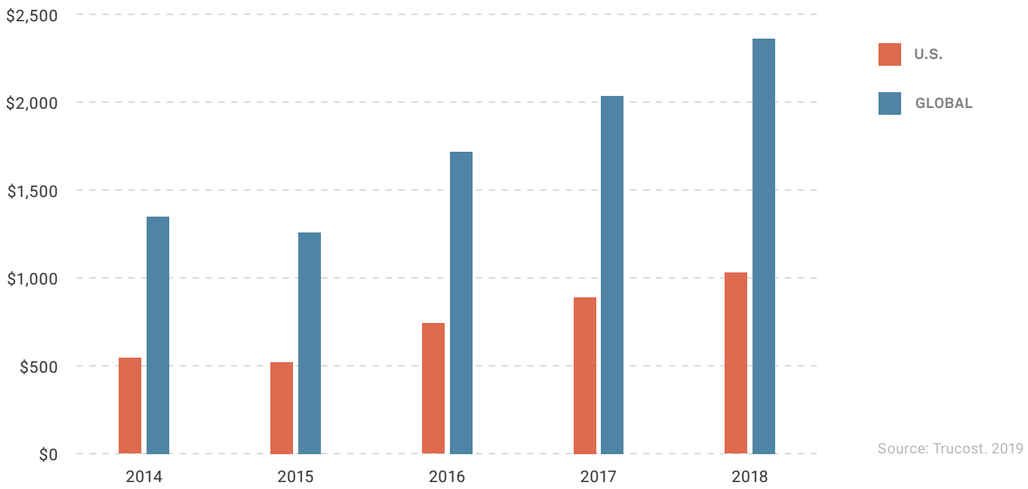


Water quality impacts associated with business activities have also been on the rise since 2015. The total environmental costs from water pollution doubled and nearly doubled for the largest companies in the U.S. and the world, respectively.

The amount of waste generated decreased by 4 percent compared to 2014 for the 1,200 largest companies in the world, at the same time waste generation increased by 18 percent for the 500 largest companies in the United States, due largely to continued economic growth. On a positive note, recycling, at the global level, accounted for the largest pathway for waste.

Water Pollution Costs Nearly Doubles Since 2014

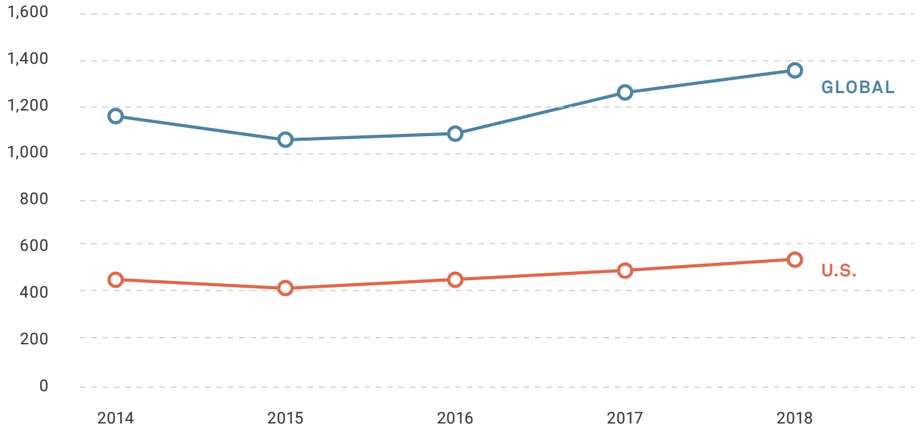
Total Environmental Cost of Water Impacting Pollution (Million USD)



Source: Trucost. 2019

Companies' Water Use Increasing Since 2015

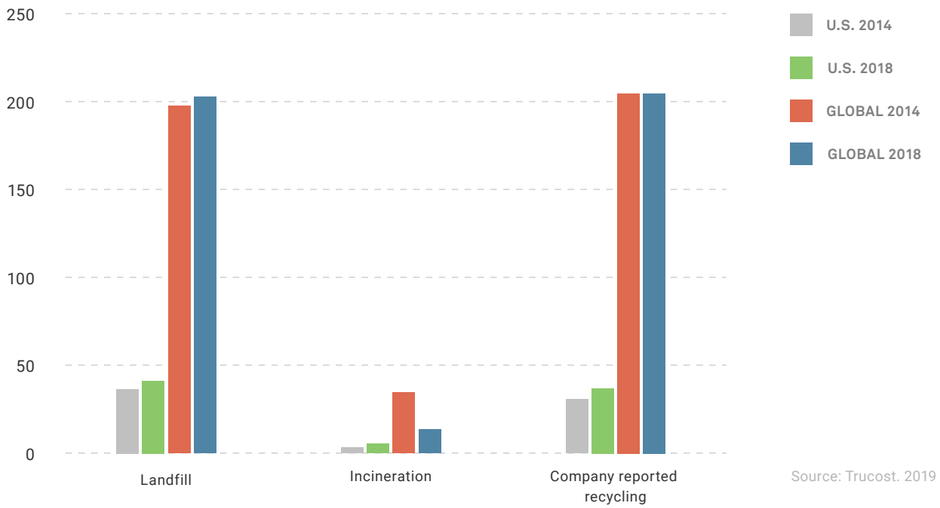
Total Water Use (Billion of Cubic Meters)



Source: Trucost. 2019

Waste Generated by Companies Declines Globally but Increases in U.S.

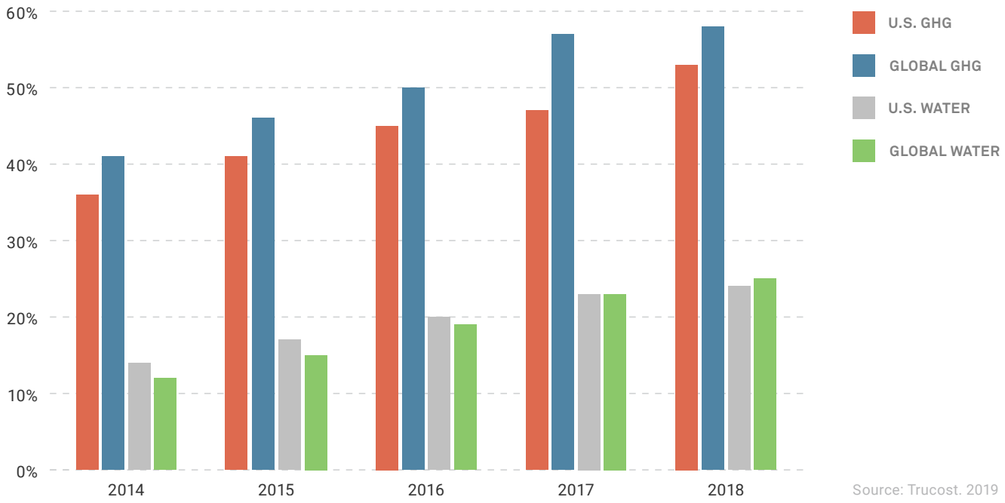
Total Waste Generated (Million Tons)



Source: Trucost. 2019

More Companies Set Carbon and Water Reduction Targets

Percent of Companies Disclosing Reduction Targets



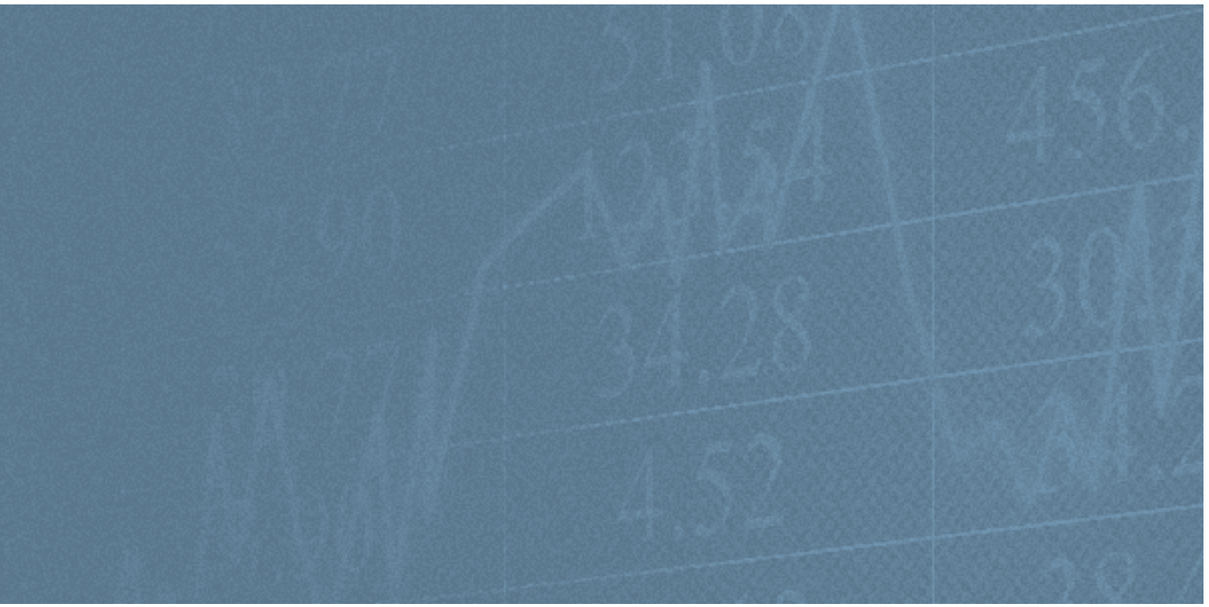
Source: Trucost. 2019

Companies are showing a growing commitment to further reduce environmental impacts and publicly disclose reduction targets. The share of global and U.S. companies disclosing greenhouse gas and water reduction targets grew by an average of 4 percent and 3 percent, respectively, year on year, resulting in a 16 percent increase in GHG targets and 12 percent increase in water targets since 2014.

03

STATE OF GREEN BUSINESS INDEX

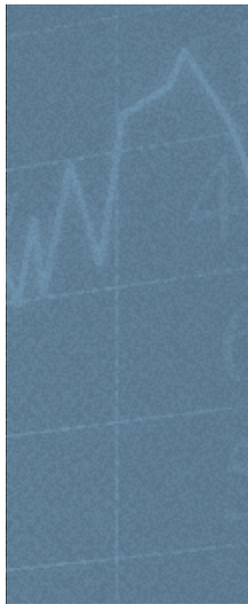
Corporate Performance



There has been a vast improvement over the last five years in corporate environmental risk management through more in-depth understanding of risks throughout the value chain, better disclosure and impact reduction projects.

Companies are becoming increasingly aware of the potential risks that environmental impacts could have for their business. Over 60 percent of the largest U.S. and global companies have reported on their efforts to mitigate these risks in the last five years. This section reviews what companies say they are actively doing to monitor and mitigate environmental risks.

There has been a substantial increase in the share of companies reporting on management-level ownership of climate-related issues, including incentives for management and having oversight at the board level.

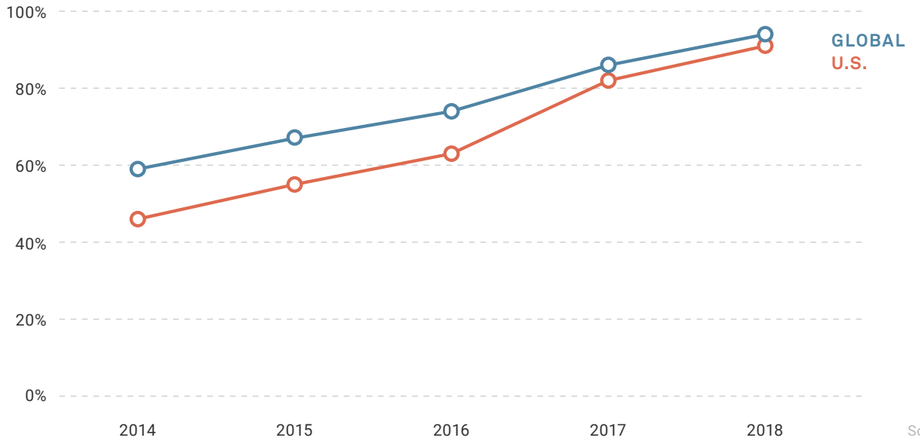


The percent of companies reporting management-level ownership increased 45 percent for U.S. companies and 35 percent globally, underlying the growing importance that climate risks have on business.

Companies have expanded the scope of impacts they assess and disclose beyond their direct operations. The percentage of companies disclosing on the environmental performance across the value chain has increased across the board, amounting to an average increase of 16 percent in reporting across all 15 categories of Scope 3. The top four categories commonly assessed by companies are business travel, purchased goods and services, fuel-and-energy-related activities (not included in Scope 1 or 2) and waste generated in operations.

Increasing Percentage of Companies Reporting on Management-Level Ownership of Climate-Related Issues

Percent of Companies Reporting Management of Climate-Related Issues

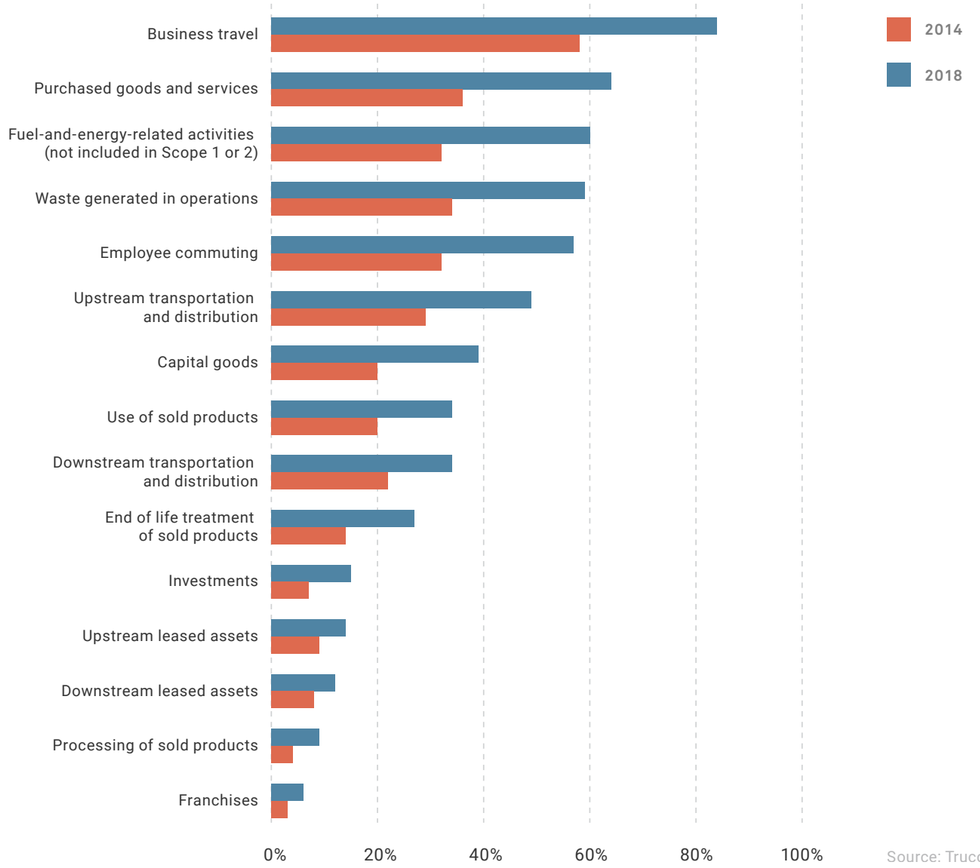


Source: Trucost. 2019

Reporting on the use and impacts of sold products, is not yet common practice, likely due to the difficulty in accounting for these emissions. However, there has

Companies Increase Transparency of Their Value Chain Emissions Across All Categories

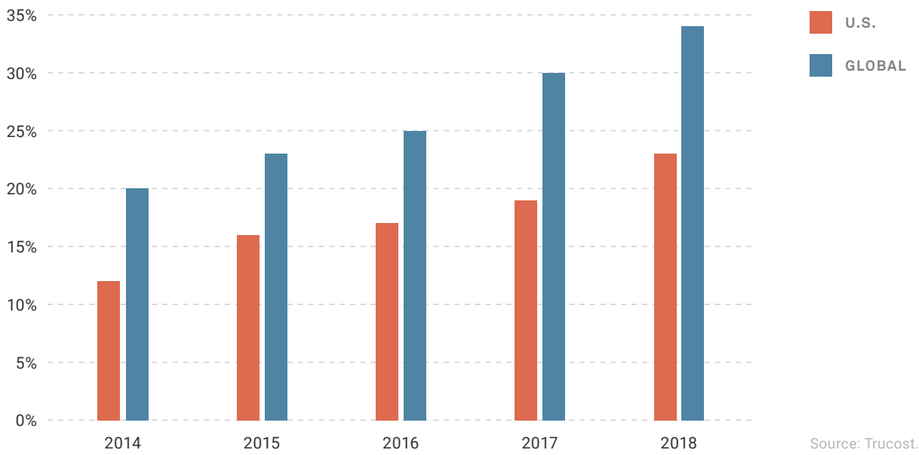
Percent of Companies Disclosing Each of the Scope 3 Categories



Source: Trucost. 2019

More Companies Report Emissions From Products

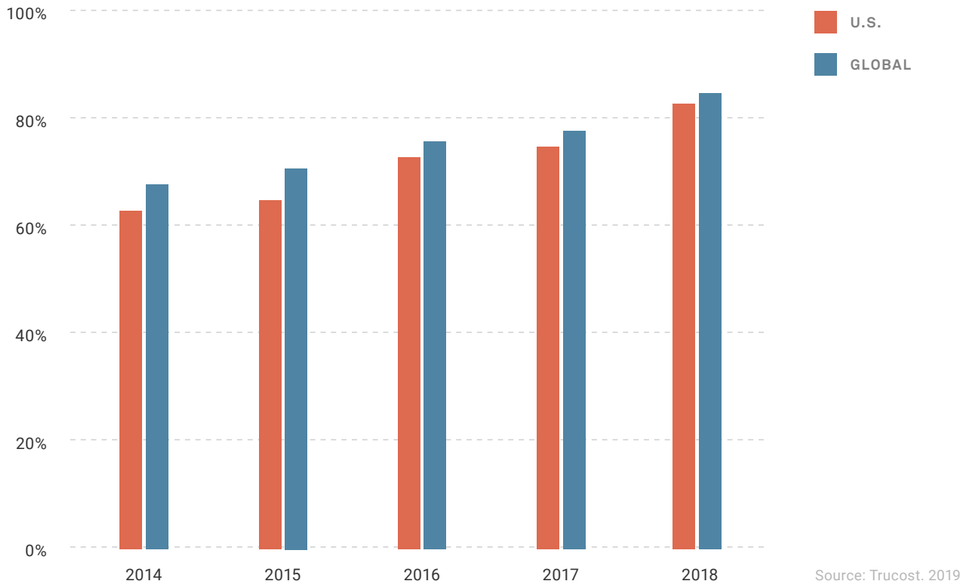
Percent of Companies Reporting Emissions from Product Use



Source: Trucost. 2019

A Substantial Share of Companies Are Reporting on Natural Capital R&D or Investment

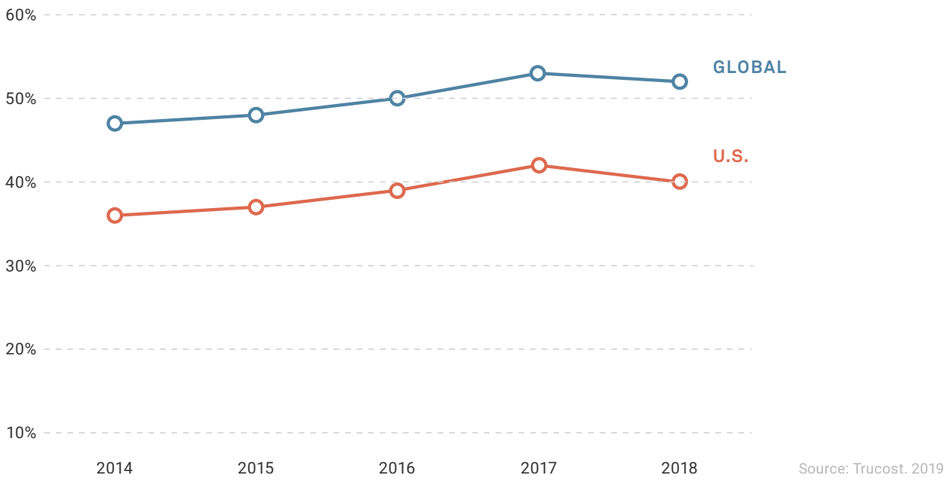
Percent of Companies Reporting on Natural Capital R&D or Investment



Source: Trucost. 2019

Disclosure of Natural Capital Costs Remains Mostly Stable

Percent of Companies Disclosing Natural Capital Costs



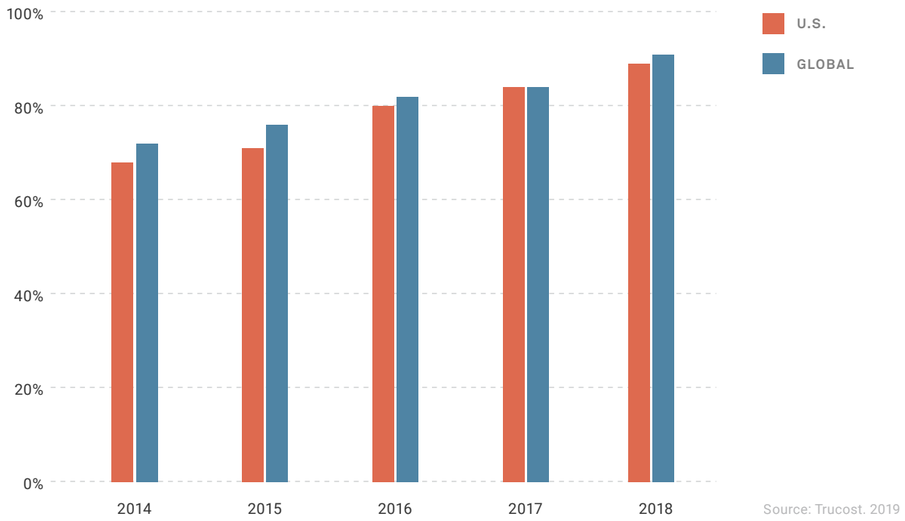
Source: Trucost. 2019

been significant improvement in this category in the last five years: Reporting has increased from 12 percent in 2014 to 23 percent in 2018 for U.S. companies, and from 20 percent to 34 percent globally. Given the high impacts downstream emissions can have, the continued improvement in accounting for and disclosing these emissions can help further improve management practices across the value chain.

Disclosure of natural capital costs has remained mostly stable over the last five years, up only 4 percent since 2014. However, a substantial share of companies are now reporting on natural capital R&D or investments as well as natural capital profits or savings. Over 80 percent of

More Companies Report Natural Capital Profits or Savings

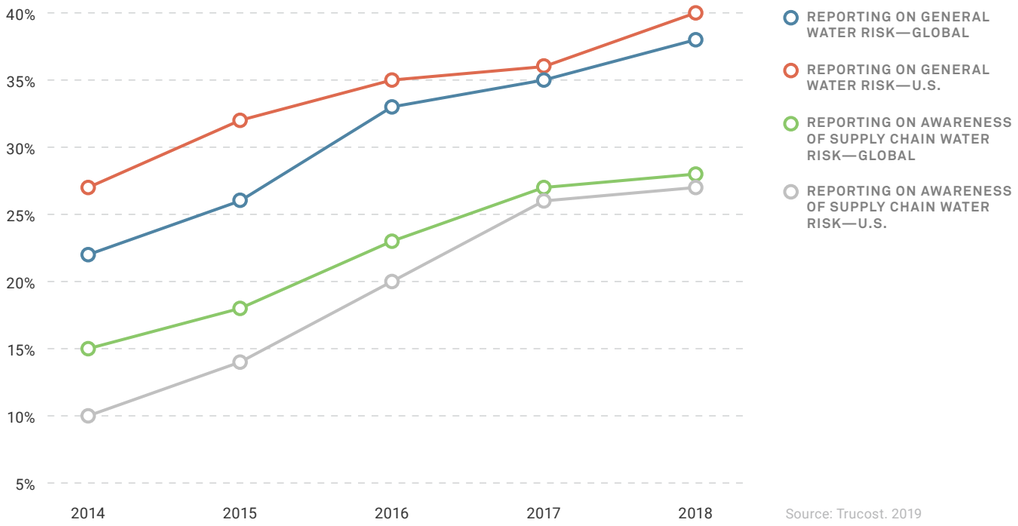
% of Companies Reporting on Natural Capital Profits or Savings



Source: Trucost. 2019

Reporting on Water Risk Is Increasing Globally

Percent of Companies Reporting on Water Risk



Source: Trucost. 2019

top U.S. and global companies reported research and development investments towards reducing natural capital impacts.

Based on their mitigation efforts, a roughly similar percentage of companies reported natural capital profit or savings, representing a substantial share of global companies making active investments that relate to natural capital.

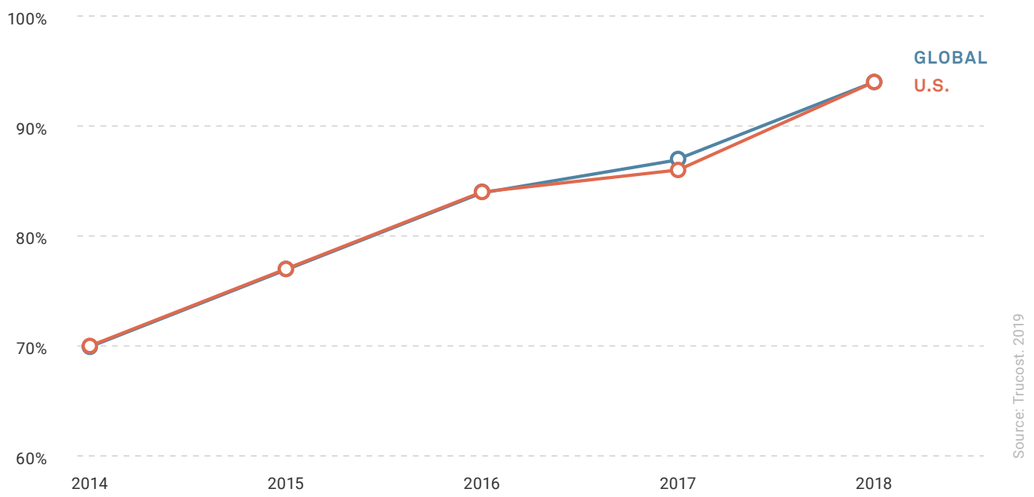
Reporting of water risk continues to rise as well. About 12 percent and 16 percent more U.S. and global companies, respectively, reported their general water risks, while roughly 14 and 17 percent more U.S. and global companies disclosed awareness on supply chain risks in 2018. Overall performance is better for general water risk disclosure when compared to supply-chain-related water risk. This highlights the necessity for more companies to identify risks beyond their direct operational boundaries and disclose them to stakeholders.

A large majority of companies report transition risks (82 percent) and physical risks (79 percent) associated with climate change.

To mitigate future climate impacts, more than 90 percent of the companies reporting disclose having GHG-reductions projects in place in 2018, up from 70 percent in 2014. While this is a welcomed improvement, the commitments are far short of the GHG reductions required using science-based or context-based target setting approaches. The global reduction needed by 2050 and 2100 to achieve the 2-degree reductions target specified in the Paris Agreement are 59 percent and 95 percent respectively from 2018 emissions. The current stated targets for U.S. and global companies amount to only 18 percent and 15 percent reductions by 2100 — 75 percent short of the required reductions by 2050 and 84 percent short by 2100.

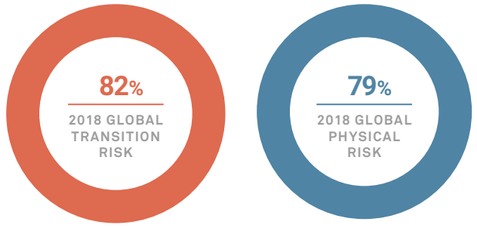
Companies with GHG Reduction Projects Up 24% Since 2014

Percent of Companies Having GHG Reduction Projects



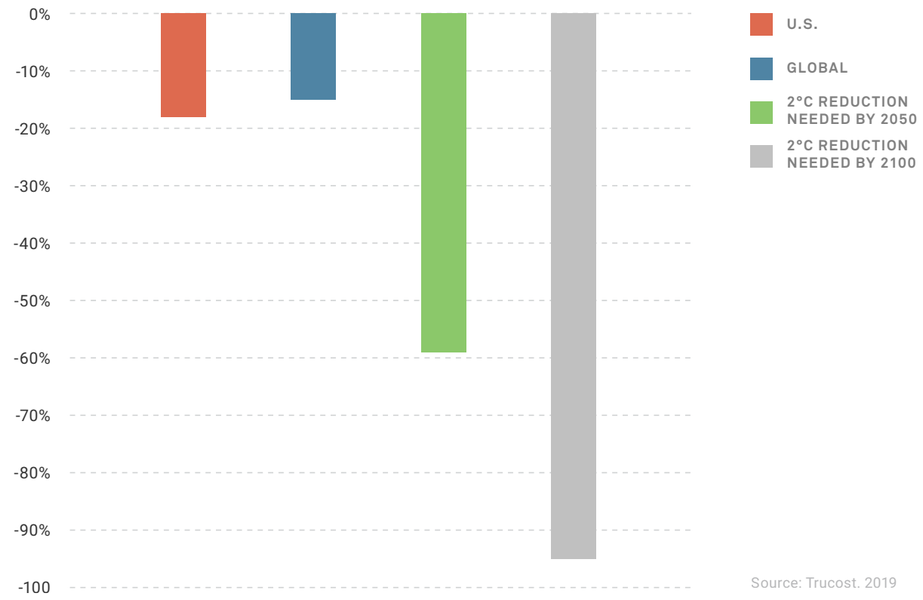
Large Majority of Companies Report Both Transition and Physical Risks

Percent of Global Companies Reporting on Exposure to Physical Risks and Transition Risks



Carbon Reduction Targets Set by Companies Fall Short of Their Contribution to 2 Degrees Celsius Target

Percent of GHG Emissions Reduction



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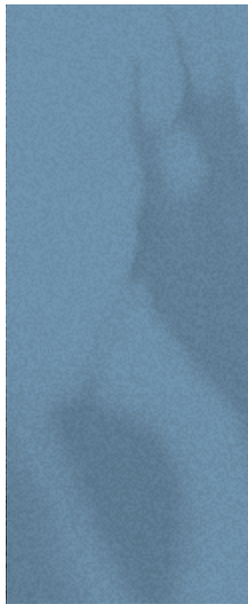
Stakeholder Engagement

Analysis of companies' stakeholder engagement shows a number of positive trends with regards to climate and environmental issues. There has been a consistent increase in the percentage of companies engaging with suppliers over carbon emissions and an even sharper increase in the percentage engaging with suppliers over water issues. Globally, the percentage of companies engaging with suppliers has increased an average of 30 percent since 2014.

The most popular type of engagement is through information collection to better understand supplier behavior. Another popular approach is compliance and onboarding to ensure regulatory alignment, accounting for 35 percent and 33 percent of engagement approaches. Nearly a fifth suggest they engage to positively incentivize and change supplier behavior



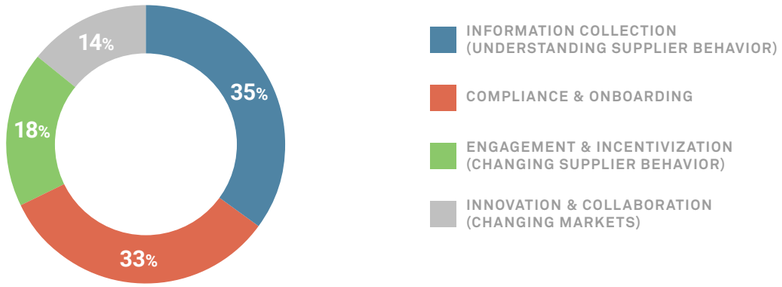
and the remaining 14 percent engage through innovation and collaboration to actively change markets.

The number of companies reporting customers as a key driver for carbon risks has dropped off since 2016, perhaps realizing that climate risk manifests itself throughout all areas of the value chain. This figure has remained relatively flat, and minimal for water risks, now reported by just 4 percent of companies.

Customer-driven opportunities to capitalize on goods and services that minimize negative impacts also slightly declined for carbon and water. However, both are at higher levels than in 2014.

Suppliers Mainly Engaged Through Information Collection

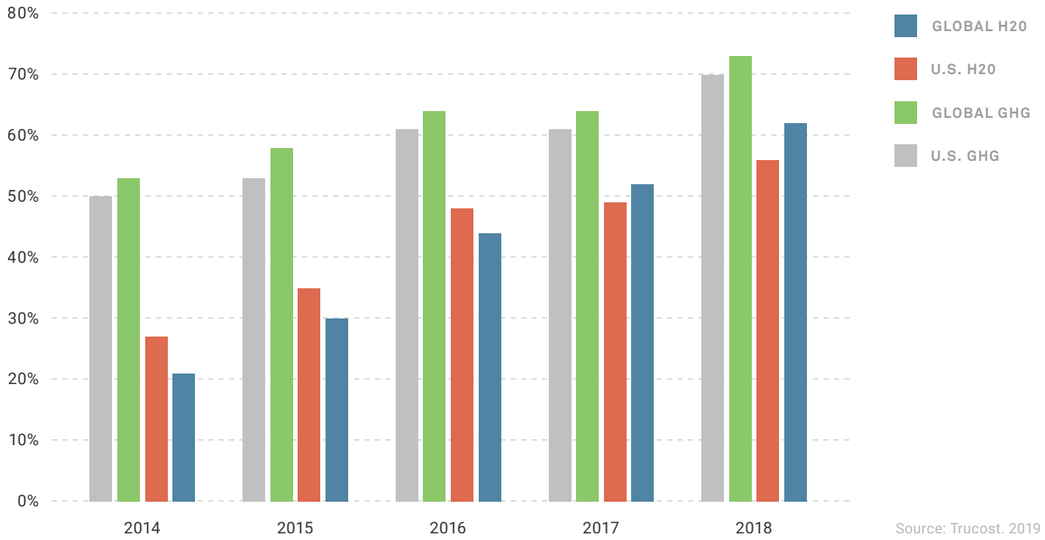
Type of Supplier Engagement



Source: Trucost. 2019

Majority of Companies Engage Suppliers to Assess Environmental Performance

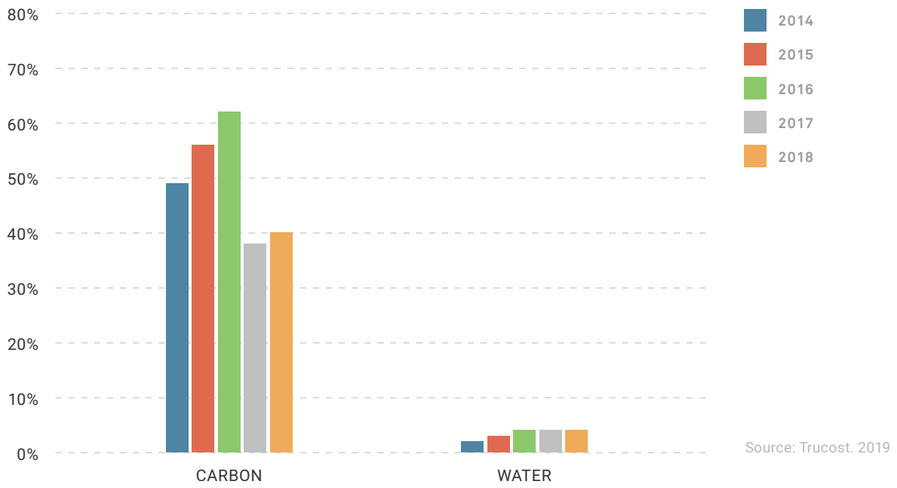
Percent of Companies with Supplier Engagement



Source: Trucost. 2019

Disclosures by Customer Have Declined for GHG Emissions While Remaining Stable for Water

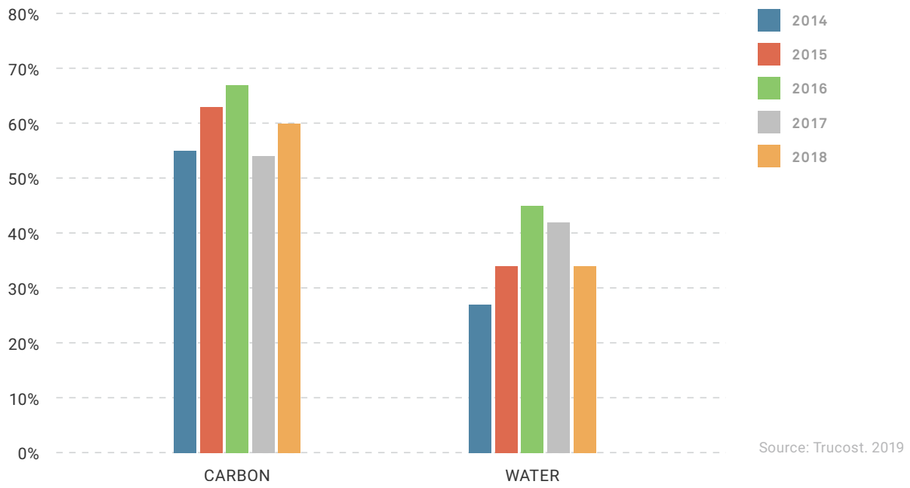
Percent of Companies



Source: Trucost. 2019

Opportunity Driven by Customers Peaks in 2016

Percent of Companies



Source: Trucost. 2019

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Sustainable Investments

This section provides a collection of metrics that illustrate how financial capital is being directed towards sustainable investments to support a low-carbon, more resource-efficient economy. The green bond market reached $250 billion in issuances at the end of 2019, with corporate green bonds reflecting over $100 billion of this total. The sharp rise in the issuance of corporate green bonds equates to over 600 percent growth since 2014, growing at an average annual rate of 50 percent per year.

While the U.S. corporate green bonds market has grown at a slightly faster rate than the global market, it still only accounts for 13 percent of total issuances.

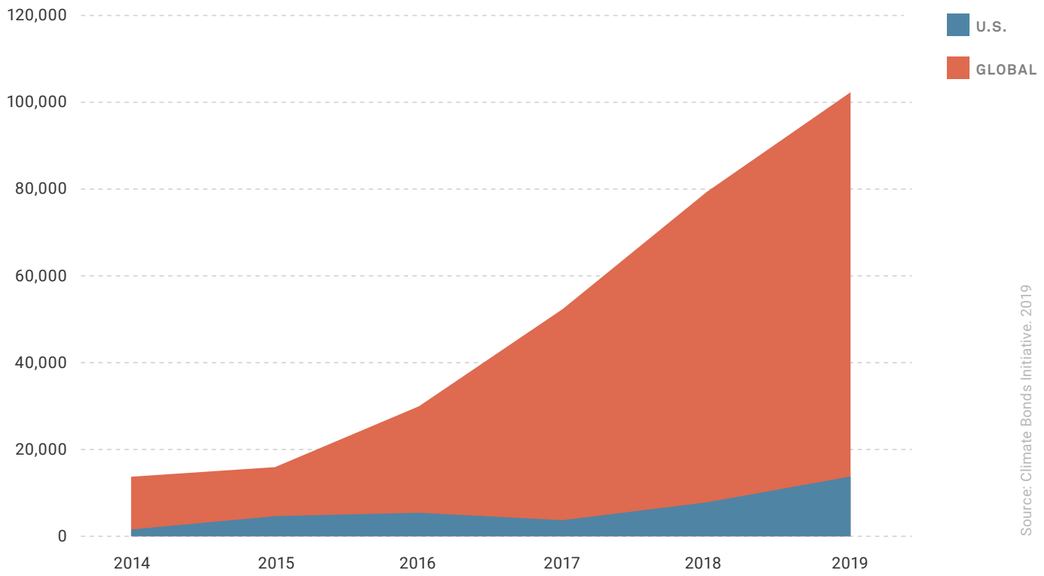
Since 2014, corporate green bonds issued have the potential to save over 4 billion metric tons of GHG emissions, according to Trucost analysis

of Climate Bonds Initiative data. The majority of GHG savings from corporate green bonds issued since 2014 comes from financing renewable energy projects (65 percent), followed by mixed project types or other projects such as water conservation.

In 2018, global investments in renewable energy exceeded $250 billion for the fifth consecutive year. However, investments were down 11 percent from the year prior. According to the UN Environment Programme and Bloomberg New Energy Finance,

Global Issuances in Corporate Green Bonds Have Sharply Grown in the Last Five Years

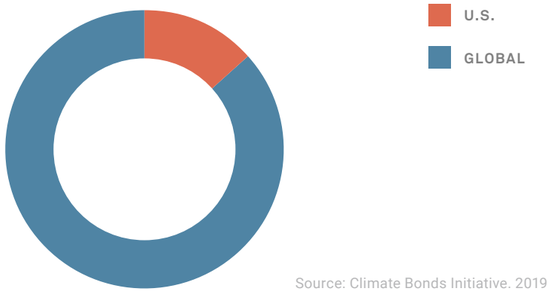
Green Bond Issuance (Million USD)



Source: Climate Bonds Initiative. 2019

U.S. Issuance of Green Bonds Still a Small Share of Total

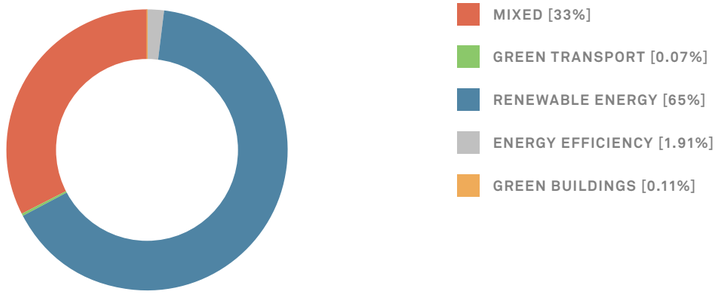
Green Bond Issuance (Million USD)



Source: Climate Bonds Initiative. 2019

Most GHG Emissions Savings by Corporate Green Bonds Come From Renewable Energy

Global GHG Emissions Reductions Resulting from Green Bonds Financing by Bond Purpose Type — Since 2014 (tC02e)

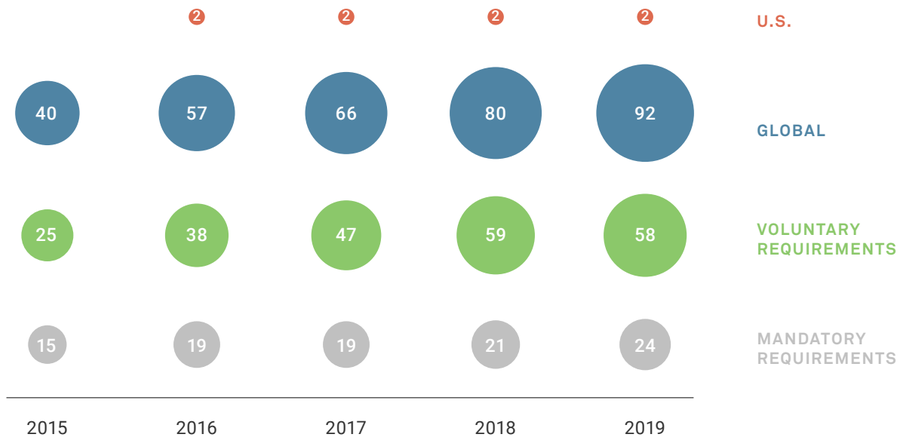


Source: Climate Bonds Initiative. 2019

this decrease is due to policy changes affecting financing of solar in China. Solar and wind projects continue to lead in terms of total investment, despite drops in the capital cost of such projects.

Stock exchanges are also getting involved in supporting greener business models. Nearly 60 percent of global stock exchanges have implemented or are in the process of developing environmental requirements for companies wanting to list with them. Many stock exchanges are developing these as part of the Sustainable Stock Exchanges Initiative. Although many of the environmental listing requirements are voluntary, the reach of these requirements is huge, with the potential to cover more than 50,000 companies listed on those exchanges.

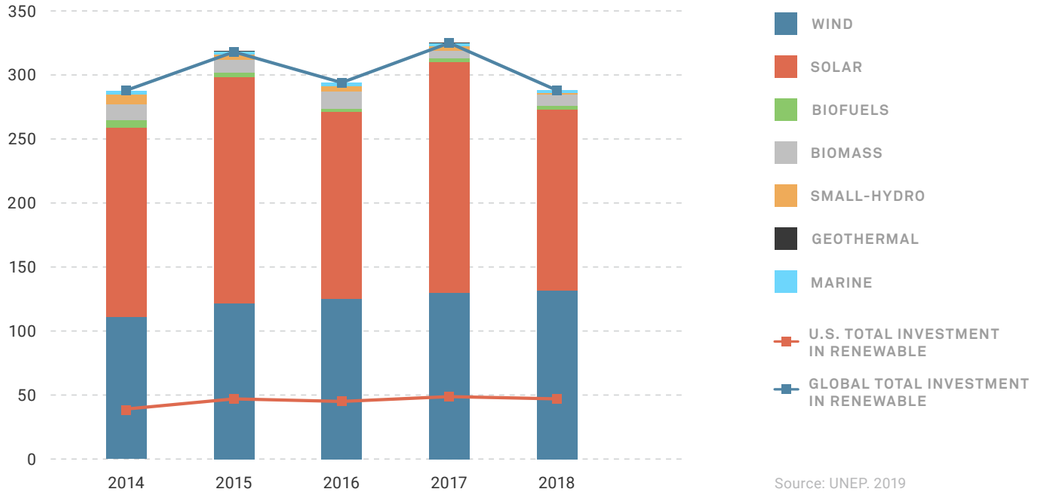
Stock Exchange Listing Requirement for ESG Reporting Is Growing, But Mostly Voluntary



Source: Sustainable Stock Exchanges Initiative. 2019

Investment in Renewables Takes a Dip in 2018

Total Investment (Billion USD)



Source: UNEP. 2019

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Climate Risks

The destructive impacts of climate change are already showing themselves, and with ever greater frequency. These impacts will affect how and where companies operate in the future, and their adaptation and transition will bear costs, while failure to adapt to future climate change may be even more costly. This Climate Risks section was added this year to provide greater visibility on the extent to which companies face future risks stemming from climate change.

Discussion on assessing climate risks and opportunities using scenario analysis is rising rapidly among investors, NGOs and regulators. Initiatives such as the Task Force on Climate-related Financial Disclosures (TCFD), which aims to help investors, lenders and insurance underwriters assess and price climate-related risks and opportunities, reflect the growing

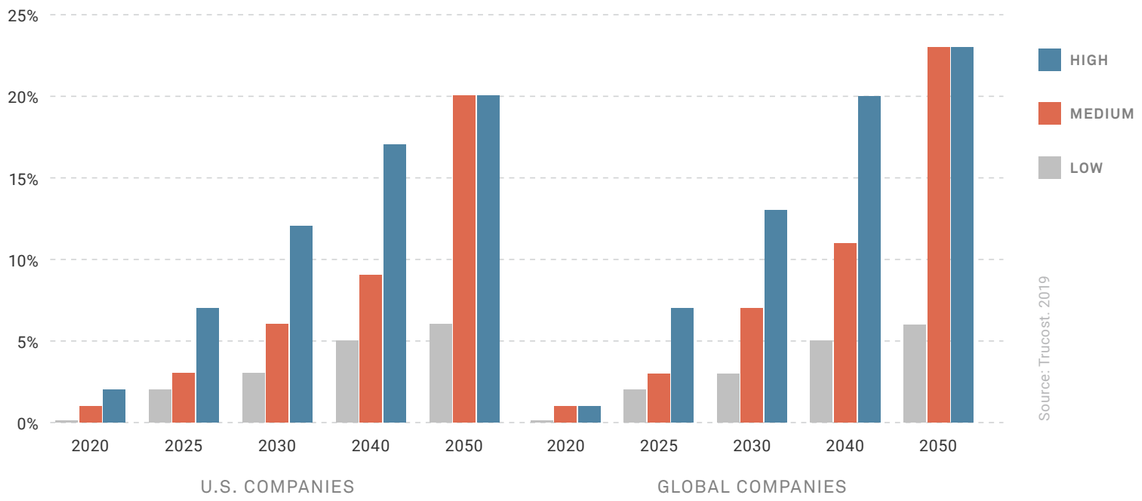
importance of transparent risk assessment to companies' access to capital.

One of the two major climate risks outlined by the TCFD recommendations is transition risk — the risk associated with any market, policy or technology disruption resulting from actions taken to adapt to and mitigate risks from global climate change. One such action is putting a price on carbon. Trucost's Carbon Earnings at Risk dataset quantifies the potential impact to company earnings today if companies had to pay a future price for their greenhouse gas emissions. Integral to this analysis is the calculation of the Unpriced Carbon Cost, which is defined as the difference between what a company pays for carbon today and what it may pay at a given future date based on its sector, operations and a given price policy scenario.

The "High Carbon Price Scenario" assumes the implementation of policies considered sufficient to reduce greenhouse gas emissions in line with the goal of limiting climate change to 2 degrees C above pre-industrial levels by 2100. The "Medium Carbon Price Scenario" assumes that policies will be implemented to reduce greenhouse gas emissions and limit climate change to 2 degrees C in the long term, but with action delayed in the short term. The "Low Carbon Price Scenario" represents the full implementation of country Nationally Determined Contributions (NDCs) under the Paris Agreement, some of which are not expected to meet the agreement's original goal of limiting climate change to 2 degrees C above pre-industrial levels by 2100 (later revised to 1.5 degrees C in 2016).

Global Earnings Are at Risk under a High-Carbon-Pricing Scenario

% EBITDA at Risk



Both U.S. and global companies face carbon pricing risks. The percent of companies' EBITDA at risk — the ratio of unpriced carbon costs divided by earnings — increases by year and pricing scenario. While costs may be low today, by 2050, even under the low scenario, up to 6 percent of earnings from the world's largest companies may be at risk.

In many cases, the low-pricing scenario is not expected to meet the Paris Agreement 2 degree goal. If countries are to aggressively pursue this goal, a medium- or high-pricing scenario is more likely. Under such scenarios, up to 20 percent of U.S.

company earnings and 23 percent of global company earnings may be at risk by 2050, which could have a significant financial impact on the global economy.

The shortcomings of the NDCs is a call to action to the financial market to help facilitate an adequate flow of capital toward a low-carbon economy. Scenario analysis is an aid to facilitate this by allowing investors to determine which companies and sectors are compatible with a below 2 degree C world and, thus, better positioned to withstand potential risks as a result of climate change.

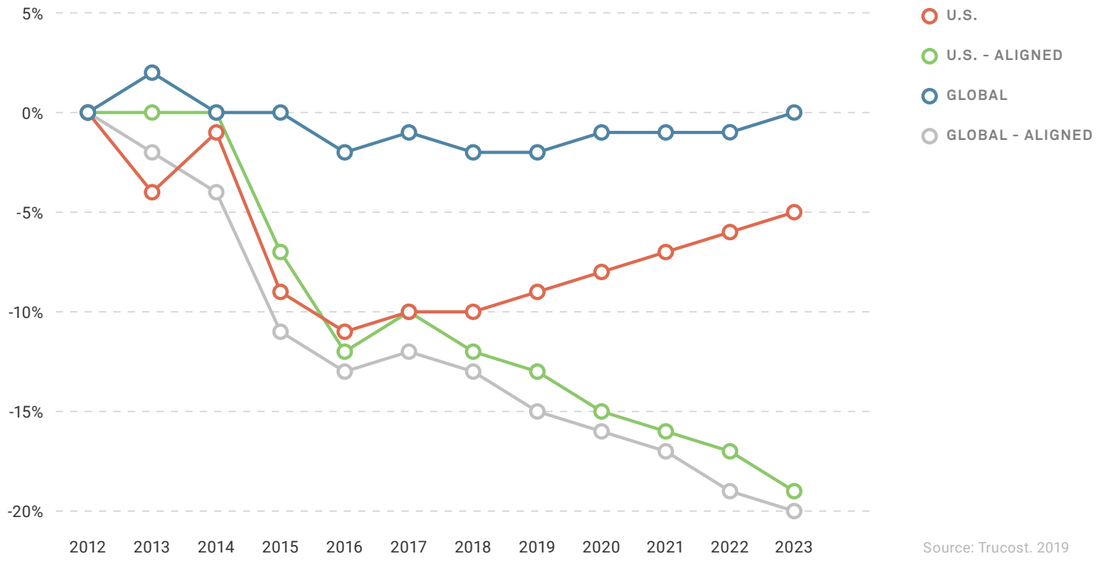
Trucost conducted a transition pathway assessment, which examines the adequacy of emissions reductions over time in meeting a 2 degree C carbon budget. It tracks company emissions and activity levels, including forward-looking indicators over a medium-term time horizon (six years of historical data and six years of projected future emissions).

While the 500 largest U.S. companies have recently performed in line with a 2 degree C aligned pathway, a recent uptick in emissions sets them on a trajectory that falls short of the needed reductions to align with a 2 degree C scenario, coming up 14 percent short of total reductions needed by 2023. Global companies require even greater emissions reductions to align with a 2 degree C scenario. The emissions of these companies are projected to be unchanged in 2023 from a 2012 baseline year.

The other major climate risk outlined by the TCFD recommendations is physical risk, which can be acute (driven by an extreme weather event such as a flood or storm) or chronic (arising from longer-term shifts in climate patterns or sea-level rise). Changes in climate change physical risks, such as droughts, floods and hurricanes,

Significant Emissions Reductions Needed to Align with A 2 Degrees C Scenario

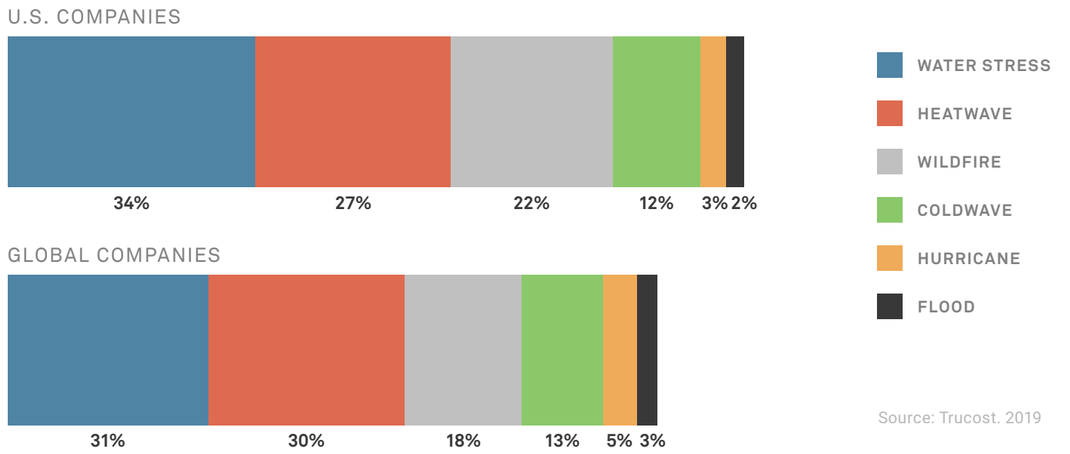
Percent Change from 2012 Emissions



Source: Trucost. 2019

Water Stress, Heatwaves and Wildfires Dominate Physical Risk Exposure

Physical Risk Score in 2050 under RCP 8.5



Source: Trucost. 2019

are expected to vary widely across the globe, with existing hazards increasing in intensity in some regions and other regions becoming subject to hazards not previously experienced. These changes, combined with the increasingly global nature of corporate operations and supply chains, may present significant variation in the intensity and range of physical risk exposures across capital markets in different regions.

Trucost analyzed the average asset-level physical risk exposure of the 500 largest U.S. companies and 1,200 largest global companies under a high-climate-change scenario in 2050, which would occur if fossil fuels continue to dominate and emissions continued to rise.

Water stress, heatwaves and wildfires linked to increasing global average temperatures represent the greatest driver of physical risk across all both U.S. and global companies. Water stress and wildfire risk make up a larger share of physical risks faced by U.S. companies when compared to global companies. However, globally, the occurrence of heatwaves is the dominant driver. While companies face lower exposure to extreme cold, hurricanes and floods, this exposure is slightly higher globally than in the United States.

These forward-looking assessments of climate risk are essential for understanding the relative preparedness of companies to handle climate change as well as the potential financial impacts on the global economy.

The world's largest companies account for just 25% of their required contribution to global climate goals*

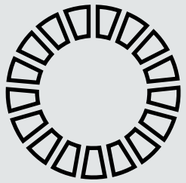
Trucost
ESG Analysis

S&P Global

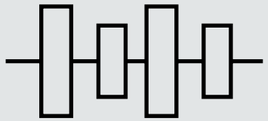
Gain fast-track insight to accelerate your sustainability strategy

Identify exposure to **physical climate change impacts**

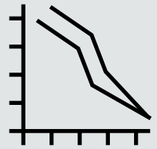
Quantity risk from **regional carbon pricing**



Assess alignment with **UN Sustainable Development Goals**



Align reporting with **TCFD recommendations**



Manage the contribution to **global climate goals**

Trucost's essential climate analytics are available at asset level and across company operations, supply chains and product portfolios. Contact us Trucostinfo@spglobal.com for the insights you need to align with global sustainability goals.

*Trucost for GreenBiz, State of Green Business 2020, The Index.

methodology

The State of Green Business Index derives from Trucost databases and models which use quantitative, scientific frameworks to assess the environmental and financial performance of the global economy. Trucost's approach accounts for environmental impacts in company's operations as well as supply chains, looking holistically at a wide range of environmental measures including greenhouse gas emissions, air pollution, water use and pollution, waste, and land use.

For the 2020 State of Green Business, Trucost aggregated corporate environmental performance data for both the S&P 500 index of U.S. companies and the S&P Global 1200, covering approximately 70 percent of global market capitalization. In addition to analyzing corporate environmental performance trends, Trucost also calculated the cost of companies' environmental impacts to provide insight into the economic consequences of those impacts.

Data sources

Corporate environmental performance data is sourced from the Trucost Environmental Register, a database covers approximately 15,000 companies, representing 98 percent of available global market capitalization. The Trucost Environmental Register is built on information from companies' annual reports, websites and other publicly disclosed data. Trucost's annual engagement program provides an opportunity for companies to review, improve and verify the research.

Modeling environmental impacts

Where company disclosure data is not available, Trucost applies a wide range of estimation techniques and environmental modeling tools, including standard and hybridized life cycle assessment (LCA) models to compare environmental impacts across companies, supply chains, regions, sectors and investment benchmarks. For the 2020 analysis, Trucost filled gaps in company disclosure with its environmentally extended input-output LCA model, which estimates the amount of resources a company uses (the inputs) to produce goods or services (outputs), as well as the pollution that results.

Trucost's analysis accounts for impacts from a company's own operations and its supply chain. This provides a means to understand business risk, and differentiate between low-impact supplied goods, such as renewable energy, and high-impact supplied goods, such as fossil fuel energy. The methodology models the purchases a company makes and the resultant environmental impacts. This analysis is extended to include first-tier suppliers that the company buys from, through subsequent tiers of suppliers until the supplier of the raw material is reached. In this way, Trucost can calculate the cost of supply chain impacts back to raw materials extraction.

Trucost's model calculates the environmental impacts of 464 standard business activities and has been further enhanced to provide additional detail for environmentally intense sectors. The environmental impacts for

each sector are allocated to a company according to its proportion of total revenue, using data from FactSet, Bloomberg, and company reports to segment revenues and map each company to a set of sectors. The model also incorporates sector-level inflation data to adjust calculations in line with annual inflation and movements in commodity prices.

Trucost's model draws on robust data from a wide range of government and academic data sources, such as the U.S. Environmental Protection Agency covering more than 700 environmental indicators including greenhouse gas emissions, toxic pollutants, water consumption and waste. The system is consistent with the United Nations Millennium Ecosystem Assessment. Data on emissions is combined with economic data from sources such as the U.S. Bureau of Economic Analysis to analyze interactions between economic productivity and the environment.

Valuing natural capital and environmental impacts

The production, use and disposal of most materials have environmental and social costs that are not reflected in the market prices of goods and services. Applying environmental or "natural capital" valuation techniques allows businesses to understand and communicate environmental impacts in monetary terms alongside traditional financial performance measures. These costs can also be factored into business and investment decision making, by considering tradeoffs between the implied costs and benefits of financial and economic activity. Natural capital accounting helps companies understand their environmental impacts and potential exposure to increased costs or increased competitiveness due to tightening environmental regulation (such as carbon taxes, reduced water allocations, or greater restrictions on use of toxic materials) or consumer pressure to improve environmental performance.

For the 2020 analysis, in addition to measuring environmental performance in physical units (such as metric tons of greenhouse gases or cubic meters of water), Trucost also valued in monetary terms the costs of these impacts. An environmental damage cost (natural-capital cost) was applied to each unit of resource and emission. The costs represent the quantities of natural resources used or pollutants emitted multiplied by the environmental damage costs to the economy and society. Trucost's natural capital valuations draw on extensive international academic research into environmental economics and are informed by an independent International Advisory Panel of leading academics.

For more information, visit www.trucost.com.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Since 2000, GreenBiz.com has provided deep-dive, forward-thinking content on a variety of sustainable business topics through six focused channels: energy, transportation and mobility, circular economy, carbon removal and offsets, sustainable food systems and the profession of sustainability. With more than 500,000 pageviews per month, GreenBiz.com is widely regarded as the most authoritative source of news and analysis on sustainable business and the clean economy.

GreenBiz Group events convene leaders in sustainability, technology and business from the world's largest companies, government agencies, startups, academia and NGOs. Our events combine actionable, solutions-oriented content with high-caliber mainstage presentations, hands-on workshops, deep-dive summits and unparalleled networking opportunities.

The GreenBiz Executive Network (GBEN) is a membership-based, peer-to-peer learning forum for sustainability executives from the world's largest companies. GBEN provides our more than 90 corporate members with access to the latest sustainability insights, through exclusive access to focused research, member-led meetings and a global network of peers.

By conducting monthly surveys of our 3,500-member GreenBiz Intelligence Panel, GreenBiz Group produces research reports on a wide range of topics related to business, technology and sustainability — including our annual State of Green Business report, as well as custom research reports for corporate clients.

www.greenbiz.com

ABOUT

Trucost ESG Analysis

S&P Global

Trucost is part of S&P Global. A leader in carbon and environmental data and risk analysis, Trucost assesses risks relating to climate change, natural resource constraints and broader environmental, social and governance factors. Companies and financial institutions use Trucost intelligence to understand their ESG exposure to these factors, inform resilience and identify transformative solutions for a more sustainable global economy. S&P Global's commitment to environmental analysis and product innovation allows us to deliver essential ESG investment-related information to the global marketplace. For more information, visit www.trucost.com.

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