10TH ANNUAL

THE TENTH ANNUAL STATE OF GREEN BUSINESS 2017

BY **JOEL MAKOWER** AND THE EDITORS OF **GREENBIZ.COM**

GreenBiz

TRUCOST PLC

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INTRODUCTION

Joel Makower, Chairman & Executive Editor, GreenBiz

When we set out to create the first State of Green Business report in 2007, our goal was simple: to step back once a year from the headlines and conferences to assess how, and how much, companies were integrating sustainability into business strategy and operations.

As we wrote in the introduction of that premiere edition:

> Amid the cacophony of developments there is progress, but it's not always obvious or straightforward. And the progress itself can be illusory. Which led us to ask: What's really going on? Does all of this amount to a sea change in business, or merely a midcourse correction? And, most importantly: Is it actually making a difference to the environment?

Today, as we launch the 10th annual edition of State of Green Business, our goal remains unwavering, those questions still driving our inquiry.

Beginning in 2013, we've published this report in partnership with Trucost, now a division of S&P Dow Jones Indices, which provides sustainability data and insight for companies, investors and others. The Trucost partnership allowed us to expand this report to provide a global view on sustainable business, from basic emissions to leadership attributes, such as how many stock exchanges around the world require listed companies to disclose environmental data, or the amount of money being divested from fossil fuel company stocks.

Together, these and more than two dozen other metrics help paint a portrait of the evolving sustainable business landscape — how much activity is taking place, and how much more there is to do.

The first half of each annual report offers 10 trends we believe sustainability executives should be tracking. With the publication of this 10th annual report, we have offered 100 trends in total over the years. We're proud to have spotted several of these long before they became well known within the sustainable business world, let alone to the larger world of commerce and consumers.

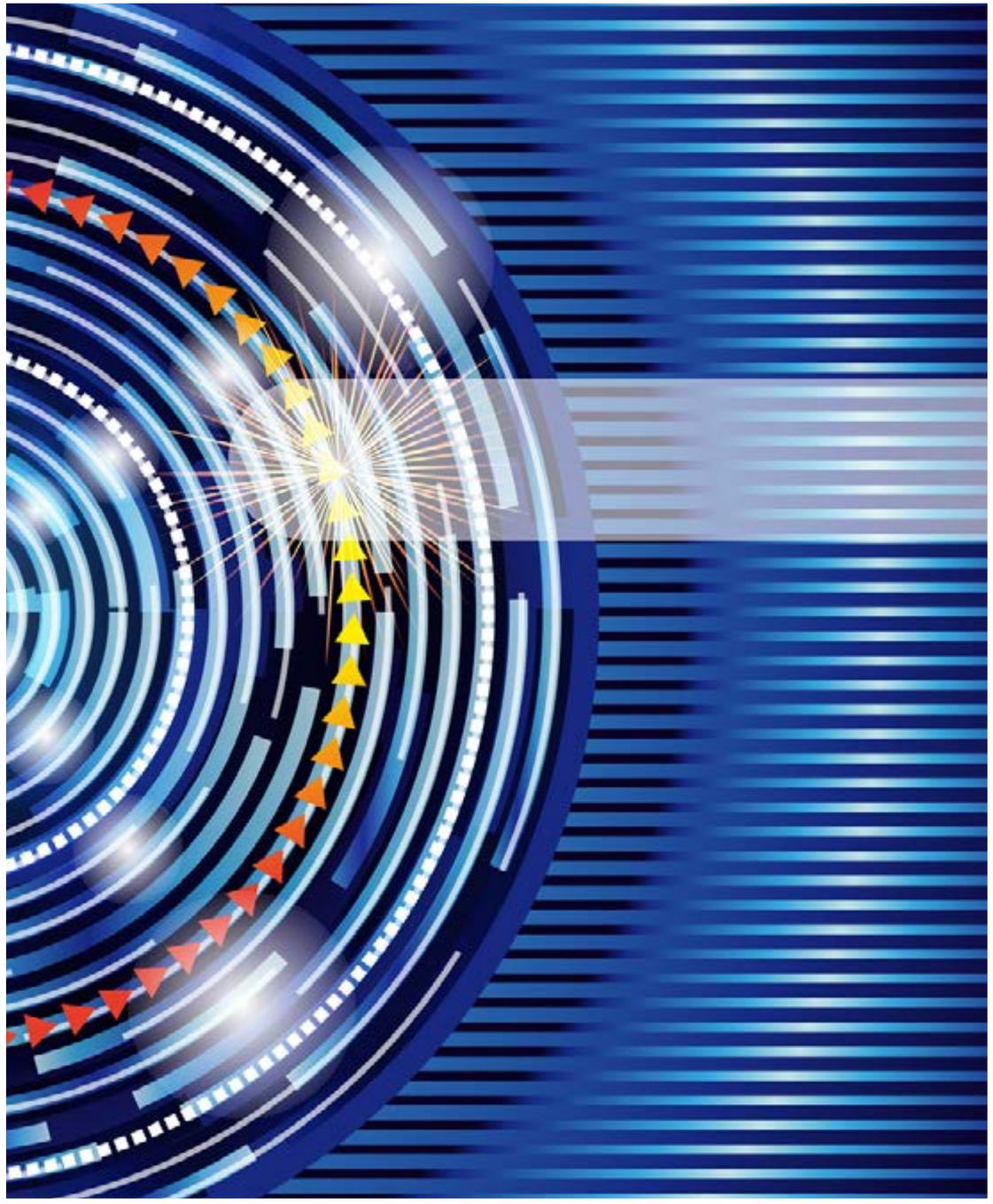
Given the uncertainty of the times, we believe that tracking and measuring corporate sustainability will be increasingly important. Sustainability is under attack in some circles, notably in the United States, where a new administration is poised to halt the progress made over the past quarter century, and perhaps to

reverse some of it. By measuring the aggregate performance of U.S. companies — in this case, the companies listed in the S&P 500 — we will be able to assess how much impact the vicissitudes of politics are having in the real world.

Such challenges notwithstanding, sustainable business continues to be exciting and inspiring to watch, as corporate leaders continue to push the barriers of what's possible, including transforming themselves into net-positive and regenerative enterprises.

That's the promise of sustainable business that we're pleased to track and illuminate through our editorial, events and research offerings every day at GreenBiz Group, and which is the basis for the pages that follow.

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



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FOREWORD

Dr. Richard Mattison, CEO, Trucost

2016 was undoubtedly a year of change. Aside from major political shifts, there were also significant shifts in climate action. The implications of the Paris Agreement at COP21 filtered through to both businesses and investors, leading to a number of breakthroughs in policy and behavior.

However, the fundamental fact is that we are still consuming natural capital — the limited stock of natural resources on which business and society depend for well-being, security and prosperity — at an alarming and unsustainable rate. Nearly half of the world's 1,200 largest companies would be unprofitable if they had to pay their fair share of the $3.4 trillion environmental and social costs of their resource consumption and pollution in 2015.

The good news is that our State of Green Business Index — a review of corporate sustainability performance over the last five years shows — without a doubt that many companies and investors genuinely understand the fundamental importance of sustainable business and are taking action to reduce environmental impacts.

During 2016, the CEO of ExxonMobil, Rex Tillerson, pushed for a tax on carbon emissions, joining a growing chorus: So far, more than 1,200 companies have either set an internal price on carbon or committed to using one, according to the CDP. Setting an internal carbon price helps companies better understand future policy scenarios and informs the capital allocation process — for example, in decisions regarding investment in carbon-efficiency projects.

These insights should help companies prepare for business in an environmentally constrained world by guiding them towards low-carbon, resource-efficient technologies and business models.

The Natural Capital Protocol was launched in 2016 to extend these benefits across other environmental and social costs not yet fully priced by the market. A growing number of companies are adopting this approach and putting "shadow prices" on a range of natural capital impacts and dependencies, from carbon and other pollutant impacts to water and other natural resource dependencies, to inform decisions and get ahead of the regulatory trend.

2016 was also a pivotal year for sustainable finance. Total assets invested that consider environmental issues have grown 77-fold since 2010 and now exceed $7.79 trillion in the United States. Investment focused on renewable energy and technology was more than $285.9 billion in 2015, and China recently announced that it will invest $361 billion in renewable energy by 2020. By then, renewables will make up half of all electricity generated in China. The growth of innovative financial instruments also accelerated, with the total value of the green bond market doubling in 2016 to $81 billion.

Investors are increasingly divesting from the fossil-fuel industry. The latest thinking is that if climate policy is effective it is likely that many assets in industries reliant on fossil fuels could be impaired or worthless — known as "stranded assets." Investors do not want to be exposed to the risk that equity holdings lose value as a result of action to tackle climate change. The amount of assets under management that investors have committed to divest from fossil-fuel companies reached a record $5 trillion in 2016.

Last September's G20 Summit, under the leadership of China, concluded that the adverse effects of climate change threaten economic resilience, growth and financial stability, and capital markets are best placed to finance the transition to the low-carbon economy, given the scale of investment required. The synthesis report called for accelerated integration of green finance into markets to finance a range of environmental initiatives, from pollution control to climate change mitigation. This was the first time that G20 Leaders referenced the importance of greening the financial system in the summit's annual communiqué.

There are also positive signals in the key performance indicators of sustainable business among the world's largest companies. Corporate carbon emissions are at a five-year low, down more than 10 percent since 2011. Water use is following a similar trend. Water pollution has fallen even more quickly, down more than 25 percent since 2013. Total waste generation is down 11 percent. Two-thirds of U.S. companies and four-fifths of global companies now disclose data on their environmental impacts. Overall, the cost of natural capital impacts has fallen by more than 15 percent since 2013.

But it is important to reality-check these findings. Reductions in natural capital impacts have taken place alongside falls in corporate revenue, suggesting that decoupling economic growth from resource use and pollution remains challenging for most companies. Although more than half of companies have targets for reducing carbon emissions, they account for only a fraction of the annual reduction needed by 2050 to keep global temperature increases to less than 2 degrees Celsius, as committed to under the Paris Agreement. Moreover, less than a quarter of companies are disclosing carbon emissions embedded in the goods and services they purchase and the capital investments they make — so-called scope 3 emissions — which account for around 90 percent of indirect emissions.

In December, the recommendations of the G20 Financial Stability Board's Task Force on Climate-related Financial Disclosure provided a clear signal to companies and investors to ramp up climate risk reporting. The international body, chaired by Michael Bloomberg and comprising senior figures from business and finance, states that climate change poses a serious risk (PDF) to the global economy. It recommends that all organizations, including companies and financial institutions, provide information about climate risk and opportunities in their approaches to governance, strategy, risk management, metrics and targets.

The recommendations further advise companies to integrate climate-risk management in forward-looking business strategies and financial planning, such as scenario analysis to align with government commitments to 2-degree Celsius energy transition pathways. Investors are advised to disclose the greenhouse gas emissions associated with each fund or investment.

The shifts in climate action are compelling. Companies will need to embed sustainability at the heart of business strategy to deliver shareholder value, while ensuring that their relationship with society is a positive one.

The challenge of 2017? To identify business models that decouple growth from resource use and pollution. Rigorous measurement and disclosure will be key.

Climate change threatens economic resilience, growth and financial stability, and capital markets are best placed to finance the transition to the low-carbon economy.

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TOP SUSTAINABLE BUSINESS

TRENDS OF 2017

It's hard to imagine a time more hopeful and horrifying for sustainable business.

On the one hand are great achievements and milestones. The Paris Agreement on climate change was ratified in 2016, faster than any United Nations pact in history, a powerful affirmation of the importance the nations of the world attach to combating climate change. Companies continued to ratchet up their commitments and achievements on renewable energy, greenhouse gas emissions, sustainable supply chains, water and land stewardship, the circular economy and other aspects of a sustainable enterprise. Technology continued its inexorable march, accelerating solutions in energy, buildings, transportation, food and just about everywhere else.

And yet.

The indicators continue to be troubling. Global atmospheric concentrations of carbon dioxide are unprecedented compared with the past 800,000 years, according to the U.S. Environmental Protection Agency, even after accounting for natural fluctuations. Global temperatures continue to rise, and the 10 warmest years on record worldwide have occurred since 1998. Other metrics — on coastal flooding, heat-related deaths, wildfires, polar sea ice, biodiversity and more — continue to go in the wrong direction.

The cost to companies and economies continues to rise, too. Air pollution will cause 6 million to 9 million premature deaths annually and cost 1 percent of global GDP by 2060, according to a report last year from the Organization for Economic Cooperation and Development. Meanwhile, more than 650 million people are living without access to an "improved" source of drinking water, according to The State of the World's Water 2016. Diarrheal diseases caused by unsafe water and poor sanitation are themselves the second biggest child killer — 315,000 young lives extinguished annually worldwide.

In most regions of the world, market consequences from climate change are projected to be net-negative, stated another OECD report. The macroeconomic costs from selected market impacts alone amount to between 1 and 3.3 percent of annual Gross Domestic Product by 2060. That year may sound a ways off, but it's roughly

The leading edge of companies are embracing "net-positive" strategies, where buildings, factories and supply chains create more beneficial impacts than negative ones.

the same time interval as the one between the end of the Vietnam War, in 1975, and today.

And that doesn't factor in the economic consequences of the loss of natural capital, from crop pollination and pest control to biodiversity and flood protection, which companies rely on both directly and indirectly. All of which could further roil markets and the companies that operate therein.

The Paris Agreement provided hope that nearly 200 nations would work in concert toward mitigating many of those impacts. But the 2016 U.S. presidential election — and, to a lesser degree, the U.K.'s vote last year to leave the European Union — muddied the waters, promising to slow progress, perhaps significantly. As this report is being published, barely two weeks into the administration of President Donald Trump, there is much about future climate action and environmental protection that is unsettled and unsettling.

Companies and markets dislike uncertainty, of course, so the coming year or two may see head-snapping policy shifts as the public and private sector grapple with two seemingly unstoppable forces: the political momentum of an increasingly nationalist and protectionist world, and the wrath of a changing climate on a civilization ill-prepared to cope. Which force will dominate is anyone's guess.

And yet.

Corporate innovation, boosted by technology's rampant pace, is enabling radical new levels of efficiency in materials, energy, water and other resources. The Internet of Things — the interconnected world of tens of billions of objects that can talk to one another, and to us, and make real-time optimization decisions — is enabling buildings, vehicles, power grids, factories and many other things to do far more with fewer resources. Corporate clean power continues to ramp up, with prices ever dropping and efficiency steadily growing. Cities and regions are accelerating their quest to become greener and more resilient, luring corporations to relocate amid transit hubs and culture centers. All of which provide a powerful bulwark against those seeking to slow or reverse progress in sustainability.

And the leading edge of companies are embracing "net-positive" strategies, where buildings, factories and supply chains create more beneficial impacts than negative ones. Interface, the Atlanta-based carpet company and a trendsetter in sustainable business, unleashed a new set of visionary goals last year, which included creating factories that function like the ecosystem they replace, providing such things as water storage and

purification, carbon sequestration, nitrogen cycling, temperature cooling and wildlife habitat. The carpet company is starting this audacious journey with a single factory in Australia.

Net-positive buildings are beginning to sprout — a trend that seemed merely fanciful just a few short years ago. Today, the notion of buildings and campuses that generate more power than they use, or sequester more carbon than they emit, is within reach. Meanwhile, net-positive companies are on the near-term horizon.

The trend is as remarkable as it is inescapable: companies shifting from inadvertently negative impacts to deliberately positive ones.

Net-net, will the positives outweigh the negatives — in factories, economies, politics and all the rest — and do so at the scale and speed needed to address the planet's greatest challenges? How much will proactive businesses counteract heel-dragging governments? Will market forces or ideologues rule the day?

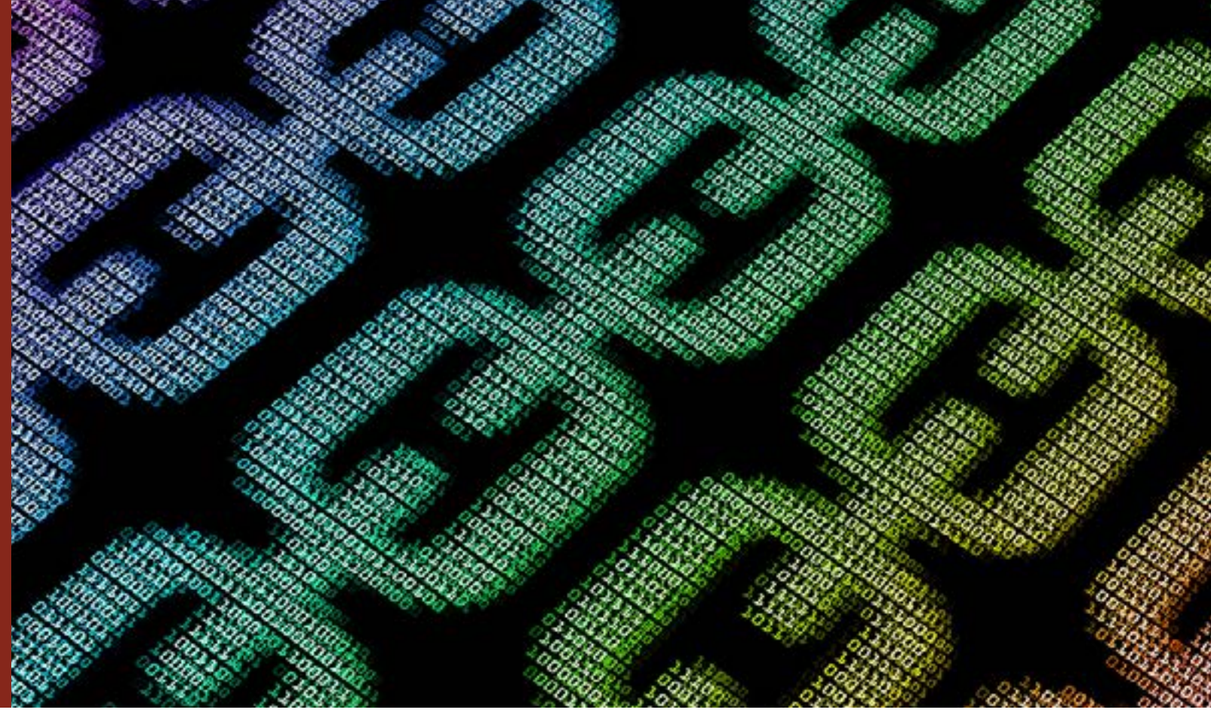
These are among the questions to which we'll seek answers during 2017, and likely beyond. Here, in no particular order, are 10 trends we'll be watching. ✤

The trend is as remarkable as it is inescapable: companies shifting from inadvertently negative impacts to deliberately positive ones.

1

THE BLOCKCHAIN SUPPORTS **SUSTAINABILITY**

Heather Clancy, Senior Writer, GreenBiz



Most of us would be hard-pressed to deliver an elevator pitch explaining "the blockchain," yet many are coming to believe this platform could become nothing short of revolutionary.

Picture, if you will, a tracking system that discreetly verifies the provenance of products as they move across a supply chain — sending proactive alerts about unexpected detours that could signal potential tampering or environmental conditions that might pose safety issues. Did we mention that it's virtually tamperproof?

Or, imagine a database that monitors the clean electricity generated by on-site solar panels, issues renewable energy certificates as certain production thresholds are achieved, then distributes them according to predetermined contracts. Automatically.

Most of us would be hard-pressed to deliver an elevator pitch explaining "the blockchain," an emerging technology that could power either of those hypothetical applications along with many other types of financial and non-financial transactions. Yet many are coming to believe this platform could become nothing short of revolutionary, not just in the financial world but for all manner of sustainable business applications starting with the ones imagined above.

How's this for a high-profile endorsement? In an essay published last November, IBM chairman and CEO Ginni Rometty drew this comparison between the blockchain and the "set of arcane standards" that eventually would become the Internet: "Few predicted the profound impact it would have on society. Today, blockchain — the technology behind the digital currency bitcoin — might seem like a trinket for computer geeks. But once widely adopted, it will transform the world."

At its heart, a blockchain is nothing more than a digital ledger. Think of it as a decentralized database that records transactions of almost any type and enforces contracts related to them automatically, based on conditions defined by the participants. The transaction history is appended to the "chain" rather than tracked via a paper trail. Because the system is distributed and encrypted, it's difficult to tamper with or hack.

Naturally, all of the world's largest financial services firms and banks are investing heavily in blockchain technology. The venture capital community poured almost $1 billion into related startups between 2014 and 2016, about 10 times the amount dedicated over the previous four years.

While the hype level seen during 2016 isn't likely to last — it sometimes seems every other tech headline is rife with blockchain promises — the next few years will usher a wave of experiments. Where sustainability professionals are likely to see the most action: among utilities or renewable energy developers seeking a more efficient way of pricing and selling clean power; at consumer products companies and retailers seeking a better way of validating supply-chain claims; and among banks and insurance companies interested in verifying the provenance of minerals, commodities or raw materials.

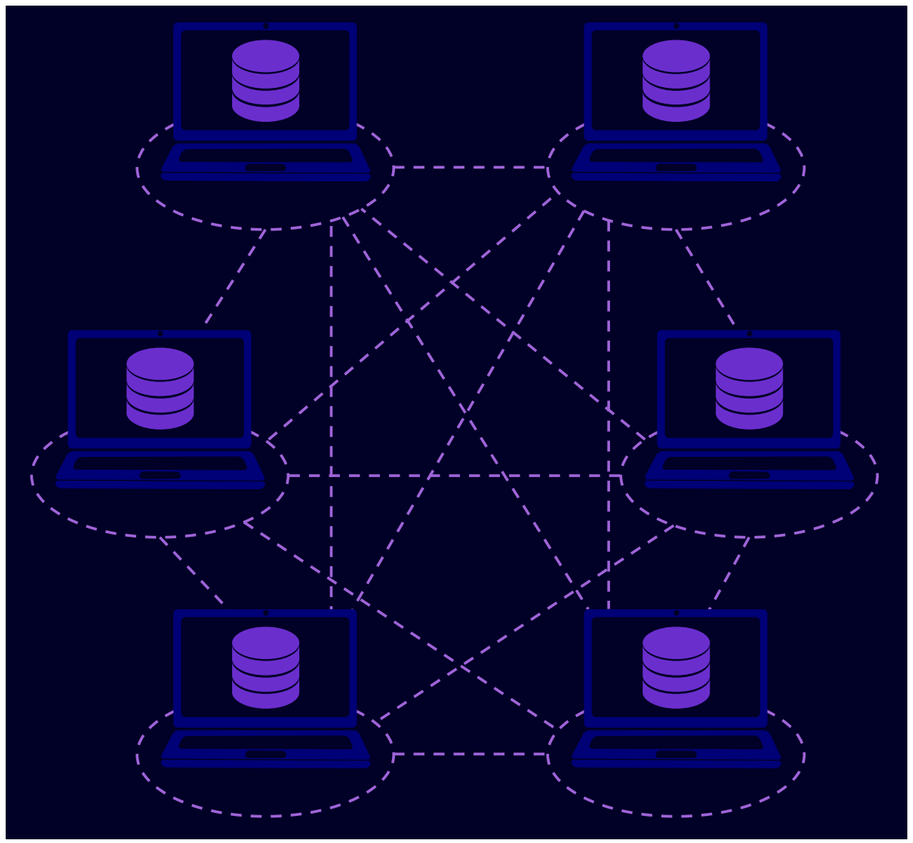
POWER PLAYERS

You can expect utilities to play an active role, for example, in testing how blockchain technology might be used to rethink how energy is priced and sold.

"Blockchain has the potential to disrupt power for several reasons: The power value chain relies on a plethora of cumbersome trading and clearing systems to support complex markets, opening the door for a leaner distributed system that can cut out middlemen and lessen associated fees," said Lux Research analyst Isaac Brown. "Furthermore, units of power and energy are a strong fit for smart contracts, as they are concrete and discrete, and meters can feed directly into blockchain logic."

The "owner" of a distributed grid, for example, might be able to sell excess power to virtually anyone within an open market. Or, a blockchain could be used to generate renewable energy credits (RECs) needed to back up certain reporting claims.

One experiment to watch closely is in Brooklyn, New York, where a startup called LO3 Energy is



using the blockchain to manage clean power trading across a solar-fed microgrid that covers a city block filled with both residential buildings and industrial facilities. The idea is that if one building produces more electricity than it can use, it can allow another building to consume it. "When each piece of the grid has a blockchain, it knows how to react," said Scott Kessler, director of operations for LO3.

In late 2016, the LO3 project attracted a notable new advocate: German energy management giant Siemens, which is considering LO3's technology as an addition to its own microgrid controllers. The CEO of Siemens' digital grid business envisions "tremendous opportunities" from this technology for both utilities and corporate customers. LO3 hopes to get at least two more demonstrations up and running in early 2017. "At this point, the only roadblocks to doing this are at the policy and regulatory level," Kessler noted.

GROCERIES AND GEMSTONES

Blockchain technology likewise could prove instrumental for improving a company's ability to track a product's entire lifecycle, verifying sources more explicitly and easily than is possible through most of the manual methods used currently.

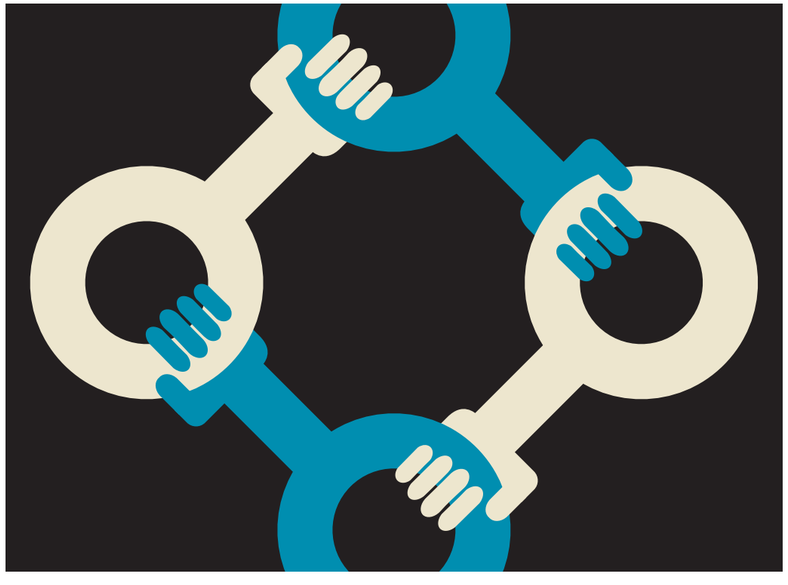
For example, Walmart is trial-testing a service it developed with IBM to monitor produce in the United States and pork in China. (For now, the test is limited to just two items, but it involves multiple stores.) The goal is to improve food safety by acting more proactively if an item may have spoiled or the source of something

is shown to be compromised. Think of it as a shelf-life indicator that also can include information about the farm where the vegetable or pig originated, with data about their operating practices. Radio frequency identification tags, sensors and barcodes, already widely used across many supply chains, are among the methods used to store the relevant data.

"With blockchain, you can do strategic removals, and let consumers and companies have confidence," Walmart's food safety chief Frank Yiannis told Bloomberg. "We believe that enhanced traceability is good for other aspects of the food systems. We hope you could capture other important attributes that would inform decisions around food flows, and even get more efficient at it."

The Blockchain also could make it easier to automate supply-chain certification processes. For example, it is central to a software application designed by startup Everledger to verify the provenance of rough-cut diamonds. The system is, in essence, a digital expression of the Kimberley Process, a certification created to curb the sale of gemstones mined within conflict zones such as Sierra Leone, while potentially enabling emerging economies in places such as Israel or India to participate more easily in legitimate, ethical ways. The certifications travel along with the diamonds and can be combined with existing labeling methods, such as shipment barcodes. Indeed, mining giant BHP Billiton plans to start using various blockchain services starting in early 2017.

Everledger Founder and CEO Leanne Kemp took about 18 months to negotiate the relationships needed to help make the service possible. That reality will be one of the bigger obstacles to broader adoption of blockchain applications over the next several years: Participants need to agree on the terms of a transaction or a contract. "What I encourage companies to do is understand



Once the rules are in place, blockchain systems could automate many processes sustainability professionals struggle to manage manually, enabling them to run far more efficiently.

the problem they need to solve," Kemp said. "This requires the cooperation of multiple participants."

The benefit: Once the rules are in place, blockchain systems could automate many processes sustainability professionals struggle to manage manually, enabling them to run far more efficiently. Let the negotiations begin.

KEY PLAYERS TO WATCH

IBM — sells a private cloud service that could help organizations develop and get blockchain applications up and running quickly. Its technology is behind pilots by retailer Walmart, for food safety, and Everledger, which certifies the origins of diamonds.

LO3 Energy — its TransactiveGrid system helps automate the trading of power across microgrids. The startup just scored a notable strategic partner, German energy management company Siemens. (A similar company is Australia's PowerLedger.)

Nasdaq — has been investing in blockchain technology for more than three years. Its Linq service could be the foundation for new business models, such as a system for issuing renewable energy credits automatically.

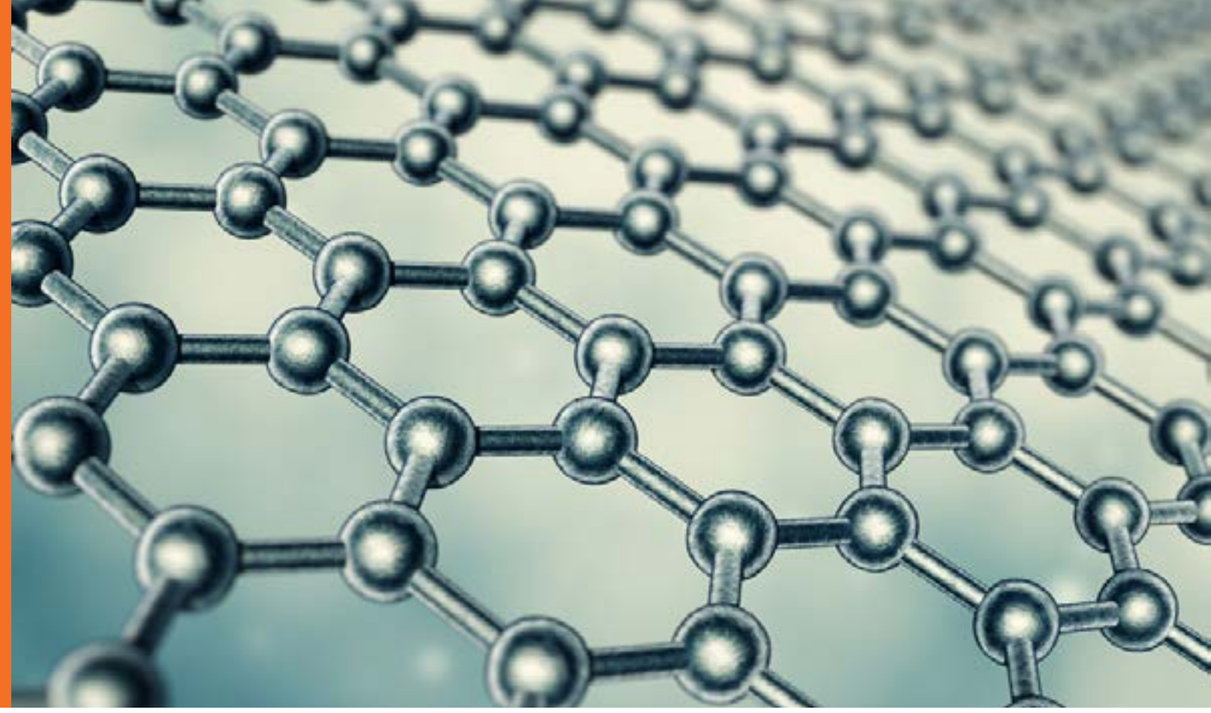
Provenance — a relatively low-key London firm has piloted the use of blockchain to track tuna supply chains in Indonesia and to monitor produce for British grocer Co-op Food. It wants to make it simpler for companies to verify sustainability claims.

Skuchain — the California startup's software is behind a test by Commonwealth Bank and Wells Fargo initially focused on trading cotton between Texas and China.

2

ADVANCED MATERIALS ADAPT TO A **CIRCULAR WORLD**

Joel Makower, Executive Editor, GreenBiz

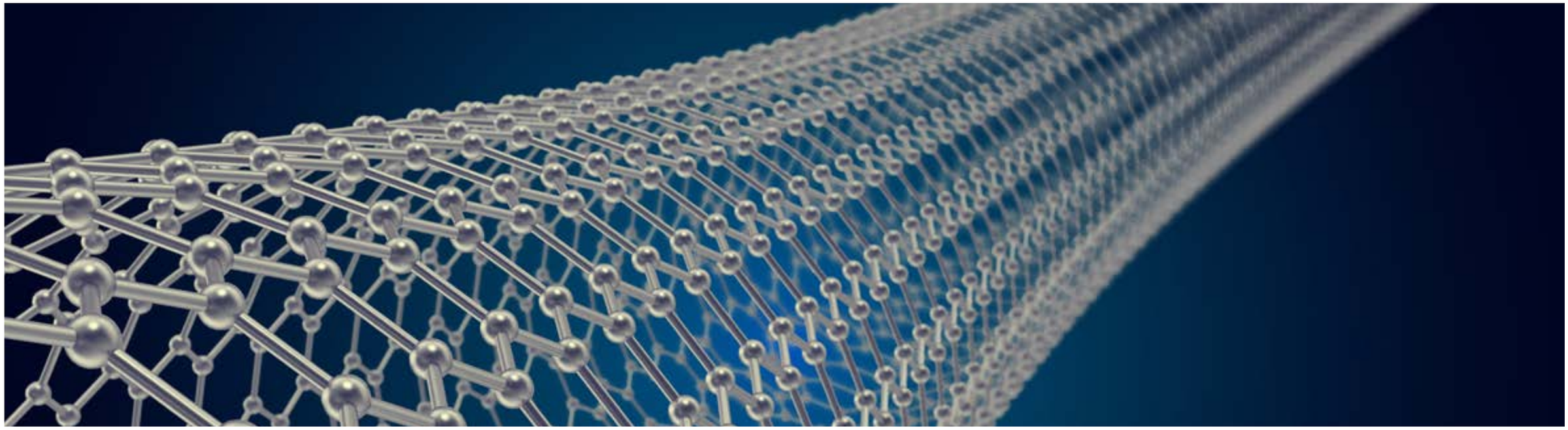


The past few years have seen a rapid growth of materials innovations, from plant-based plastics to green chemistry breakthroughs to materials recovered from waste, including plastics bobbing in the ocean.

There is a growing need for new and innovative materials that meet the requirements of a low-carbon and circular economy. And while innovations in textiles, construction, packaging and other materials-intensive sectors have been more or less continuous over the years, the challenges of sustainability — being able to provide for a growing global middle class without busting the planetary budget — have accelerated the pace of change.

The past few years have seen a rapid growth of materials innovations, from plant-based plastics to green chemistry breakthroughs to materials recovered from waste, including plastics bobbing in the ocean. Together, these innovations represent a dramatic rethinking of how things are made, and a shifting of supply chains toward innovators both large and small.

The need for new materials solutions stems in part from the growing environmental challenges that come from both their manufacture and disposal. Consider plastic. The difficulty of recycling many types of plastics, notably rigid and flexible plastic packaging items comprising various polymer types, is creating significant environmental challenges



— and costs. Estimates of the negative externalities of plastic packaging alone reach up to $40 billion per year, exceeding the actual profits that stem from plastic packaging in the first place, according to a 2016 report, The New Plastics Economy, by the World Economic Forum, the Ellen MacArthur Foundation and McKinsey & Company.

The push for plant-based plastics is more than a quarter century old, beginning in the late 1980s, when ag giant Cargill launched a research project focused on finding ways to use carbohydrates as a base for plastics. In 2003, that effort spawned NatureWorks, which converts cornstarch to polylactic acid (PLA), the first biopolymer to compete head-on with petrochemical plastics and fibers.

In 2009, the beverage industry weighed in with PlantBottle, refreshing the age-old "cola wars," as Coke and Pepsi vied to outdo each other with more bottles of higher-percentage plastic from plants, primarily sugar cane. By mid-2015, the Coca-Cola Company said it had distributed more than 35 billion PlantBottle packages in more than 40 countries, a number the company says will exceed 43 billion by 2020.

Such solutions aren't perfect — for example, biobased plastics often ignore the health and safety profile of biobased materials across their lifecycle — but they have attractive climate benefit: Manufacturing PLA, for example, produces 60 percent less greenhouse gases than the petrochemical plastics such as PET and polystyrene.

Plastics are just the beginning. Another concrete example is, well, cement. That industry alone is responsible for more global greenhouse emissions than Japan or Canada, mostly due to the huge amount of energy it takes to heat limestone, cement's key ingredient, and the subsequent chemical process it undergoes. The industry has been slow to change, despite that even a modest price on carbon could have devastating effects on the industry.

New technologies and approaches are being developed to cut down on cement's environmental downsides, such as using industrial byproducts to reduce overall cement usage, or producing self-healing concretes

Some of the materials innovations come from good, old-fashioned recycling, early manifestations of the emerging circular economy, where waste and other unneeded materials become feedstocks for new products.

that reduce the need for new cement, or creating entirely new materials. No perfect solution yet exists, but the opportunity is enormous: The global market for concrete was nearly $400 billion, according to Statista. Even a small chunk of that could provide the foundation for a sizeable niche market.

Some of the world's largest chemical companies are seeing paydirt in such materials innovations.

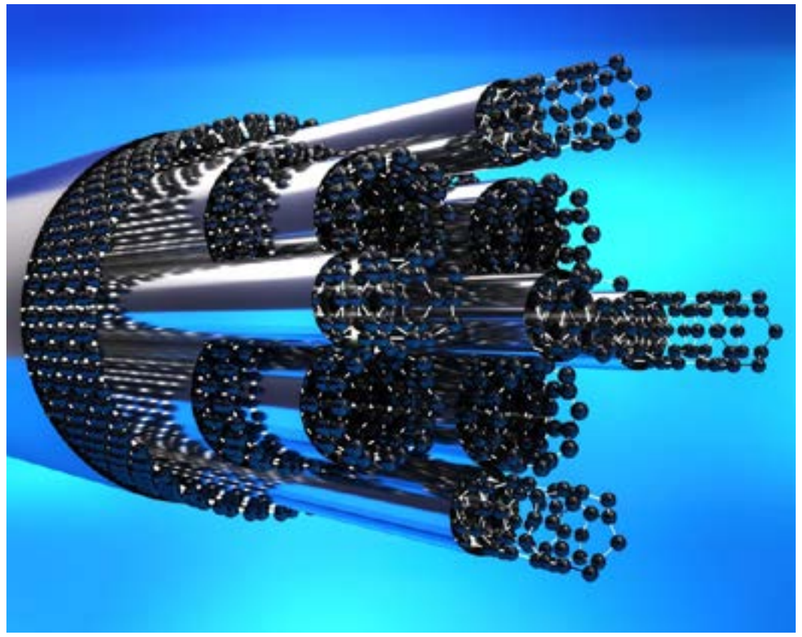
Consider Eastman Chemical. In 2011, it committed to ensuring that at least two-thirds of its new product revenue was tied to "sustainably advantaged" materials. Last year, the company reported that it was ahead of its goal, having brought to market such innovations as Tritan copolyester, a polymer that contains no bisphenol A, commonly used in a variety of consumer products and packaging but of concern to health and environmental advocates. Tritan can be for used for products traditionally made out of hard plastics such as small household appliances. Two well-known household brands, Hamilton Beach and Rubbermaid, have put it to use.

Another Eastman innovation is Tenite cellulosics, a series of plastics made with 40 percent renewable wood pulp, used, among other places, by electric guitar maker RKS, a company recognized for its dedication to using alternatives to endangered Indian ebony and Brazilian rosewood.

The success of such innovations is music to the ears of other chemical makers, particularly in light of the growing need for infrastructure investments in the United States and elsewhere in a climate-constrained world.

BASF and Dow, for example, see massive markets taking shape for advanced materials. Both are setting up research and development labs and multisectoral partnerships around the world, such as BASF's Network for Advanced Materials Open Research, a collaboration with Asia-Pacific region's leading universities and institutes, and the North American Center for Research on Advanced Materials, a partnership with Massachusetts Institute of Technology and the University of Massachusetts.

In late 2016, Dow announced an innovation center at its Midland, Michigan, headquarters, focusing on advancing materials for home and personal care products, energy-saving building technologies, critical infrastructure and lighter-weight automobiles. It joins with similar Dow



innovation centers, such as a five-building complex outside Houston.

Some of the materials innovations come from good, old-fashioned recycling, early manifestations of the emerging circular economy, where waste and other unneeded materials become feedstocks for new products. General Motors, for example, said that reusing and recycling materials now adds $1 billion in annual revenue. Meanwhile, Ford is evaluating the feasibility of turning retired dollar bills into plastic car parts — after all, that's where the money is. (Ford is also experimenting with other unconventional material feedstocks, such as a plastic using the dense fibrous properties of agave leaves, a waste product produced at tequila distilleries. Mustang Margarita, anyone?)

And then there's carpet manufacturer Interface, which last year pledged to "transform dispersed materials into products and goodness" as part of a new set of company goals dubbed "Climate Take Back." The company has set up a program called Net-Works, where residents in coastal villages harvest discarded fishing nets, an ecological blight that destroys coral reefs and mangrove swamps, to create raw materials for Interface's supply chain. The program, currently operating in the Philippines and Cameroon, has harvested nearly 100 tons of discarded nets to turn back into nylon fiber for carpeting.

Together, such efforts can be viewed as the early stages of a feedstock shift, where petroleum is extracted primarily for its valuable hydrocarbons and used for building, not burning, thus avoiding greenhouse gas emissions from burning while still finding uses for the tens of trillions of dollars of oil still in the ground but already on companies' books — so-called "unburnable carbon."

This is no pipe dream: Already, nearly one in five barrels of oil is used for advanced materials, specialty chemicals and other non-fuel purposes, and increasingly is being used to create new materials that substitute for those with higher greenhouse gas emissions, such as steel, aluminum and concrete.

There is a vast potential business opportunity in growing the percentage of oil used for such purposes. For example, thanks to materials such as carbon fiber-reinforced plastics, BMW's i3 electric vehicle uses no structural steel in its passenger module and has increased strength and dramatically reduced weight, lessening the size of the battery needed to move the car the same distance. It won't be that long before most vehicles are made this way.

Can the oil and gas industry become the climate's savior? It may seem farfetched, but when it comes to advanced materials, everything is on the table.

KEY PLAYERS TO WATCH

Ellen MacArthur Foundation — works to accelerate the circular economy, including groundbreaking research on "the new plastics economy."

Graftech International — one of the world's largest manufacturers of natural and synthetic graphite and carbon-based products

Newlight Technologies — its carbon capture technology combines air with methane-based greenhouse gas emissions to produce a plastic material called AirCarbon.

Novomer — a chemistry company whose technology enables carbon dioxide and carbon monoxide to be used as raw materials in the production of polymers and chemicals.

Warner Babcock Institute for Green Chemistry — works to develop nontoxic, environmentally benign and sustainable technologies, products and processes.

3

SDGs BECOME A BUSINESS **STRATEGY**

John Davies, Senior Analyst, GreenBiz

The gnawing question for most CSR and sustainability executives is how to get anyone outside their department to pay attention.

Sustainable development was defined by the United Nations Brundtland Commission in 1987, and our friend, author John Elkington, coined the phrase "triple bottom line" more than 20 years ago. But as far as business is concerned, there hasn't been a good yardstick for two out of three of those bottom lines.

That may change as more businesses develop strategies that align with the U.N.'s 17 Sustainable Development Goals (known variously as the SDGs or Global Goals), intended to frame the efforts needed by the world's businesses, governments and citizens between now and 2030. They include such aspirations as "End poverty in all its forms everywhere" (Goal 1), "Ensure access to affordable, reliable, sustainable and modern energy for all" (Goal 7) and "Conserve and sustainably use the oceans, seas and marine resources for sustainable development" (Goal 14).

It's not as if the sustainability profession hasn't kept score. There are environmental laws to comply with and volunteer hours to be counted. There are any number of "best of green" lists ranging from the suspect (do we

really need to call them out?) to respectable (such as DJSI and FTSE4Good). And those have been supported by a growing number of frameworks and surveys, from GRI to CDP to SASB and beyond. Countless hours are spent by organizations in responding to these requests, and those questionnaires aren't going away anytime soon.

The gnawing question for most CSR and sustainability executives is how to get anyone outside their department to pay attention. More important, does all the data in those reports mean we're doing much good for the larger world, or even our own organization?

This is where the emergence of a greater focus on materiality has come into play. In the past, organizations have solicited stakeholders for this input and then had them rate and rank the issues. What's been missing is any way to talk about the intersection of business and society.

The SDGs, or Global Goals, may provide a way to bridge this gap in a way that also engages the C-suite.

"The recent spotlight on the SDGs has provided us a tremendous opportunity to engage our internal stakeholders from various parts of the business in discussions about goal-setting, shaping our priorities and putting these priorities at the heart of our strategy," said Kim Marotta, MillerCoors' sustainability director. "This framework can open up opportunities for us to address our material issues in an integrated manner and develop transformative solutions that not only future-proofs our operations, but can also help our business remain

commercially sustainable."

Novozymes CEO Peder Holk Nielsen said the SDGs gave his company an opportunity to reengage in a discussion about its business purpose and strategy: "Our point of departure became the Sustainable Development Goals."

He explained: "There are a few where we can have a major impact, circling those on sustainable food supply, which is covered by two or three SDGs, and sustainable energy supply. We have translated this into five non-financial targets, which is our interpretation of where we can make a difference in the world… to deliver transformative innovations and create and catalyze partnerships."

Another supportive CEO is Unilever's Paul Polman, who has embedded sustainable business practices into his company's activities and has created added value throughout its supply chain: "The SDGs present a clear moral case for change, but companies must recognize that they represent the business opportunity of a lifetime too and must adapt to take advantage of it."

For many organizations, getting their arms around the SDGs has taken some time. The World Business Council for Sustainable Development president Peter Bakker noted that the SDGs' 17 goals and 169 targets are a lot for any company to keep track of. On top of that, the goals are closely interconnected, which adds further complexity.

Luckily, there are a number of resources to help businesses incorporate the SDGs into corporate strategy. For example, the U.N. Global Compact in partnership with KPMG developed the SDG Industry Matrix, which showcases industry-specific examples and ideas for corporate action related to the SDGs.

Thirty leaders from business, government and foundations committed to work together toward the SDG target to cut food waste in half over 15 years.

The WBCSD collaborated with the Global Compact and GRI to develop the SDG Compass, which provides guidance to companies on how to align business strategies with the SDGs and measure their impact. The alliance complemented these efforts by developing the SDG Business Hub, a dynamic online platform showcasing business insight, emerging tools and resources in this space.

Companies are turning to these tools to help them approach the SDGs holistically. "There's really not one SDG that we value over the others," said Rohini Anand, senior vice president of corporate responsibility and chief diversity officer for food services giant Sodexo.

For some, the focus is on a few specific goals. At GSK, a healthcare company, the main focus is to have an impact on Goal 3, on health. According to Priya Madina, director of government affairs and global issues at GSK, "We are not limiting ourselves to contributing solely to the implementation of this particular goal. Much of our work in the global health arena — such as strengthening healthcare infrastructure, fighting malaria, improving access to antiretroviral treatment for HIV, working to help prevent child deaths and tackling non-communicable diseases — all contributes to the SDGs."

Companies such as GSK and Sodexo won't be taking on these challenges by themselves. Indeed, Goal 17 recommends harnessing partnerships as a means of supporting the other 16 goals, and a number of collaboration models are emerging.

One example: A group of 36 agricultural businesses joined together to launch the Global Agri-business Alliance to tackle environmental challenges in farming supply chains and communities around the world. The CEO-led private-sector initiative is seeking to "contribute significantly" to the SDGs, particularly with regards to the second SDG on tackling hunger, nutrition, food security and sustainable agriculture.

Another: Thirty leaders from business, government and foundations committed to work together toward the SDG target to cut food waste in half over 15 years. Food waste and loss is a $940 billion problem in unrealized revenue to farmers and producers. And, because unharvested or uneaten food rots on fields or in landfills, food waste emits enough methane to account for 8 percent of global greenhouse gas emissions.

Educating the next generation of business leaders also will help ensure ongoing progress toward the SDGs. In 2007, the Global Compact and several academic institutions launched the Principles for Responsible Management Education. The initiative has grown to more than 650 academic institutions in over 85 countries and includes more than one-third of the Financial Times' top 100 business schools.

For all of the corporate embrace of SDGs, a long road is ahead. A 2016 report by DNV GL concluded that none of the Sustainable Development Goals will be met in all regions of the world by 2030, and not even half of the 17 SDGs will be met in any regions.

That's a sobering analysis but contains an important call to action: "Extraordinary action is not the exclusive domain of the private sector. But what business does best is innovate, and lead technological development that can leverage vast global changes."

KEY PLAYERS TO WATCH

António Guterres— for the SDGs to become reality, the United Nations will need to do a better job of developing those partnerships and alliances, and its new Secretary-General will be leading this effort.

AtKisson Group — creator of the nonprofit 17goals.org to help everyone everywhere learn about the SDGs and give them the tools to take action — and one of the best songs about the SDGs you'll ever hear.

Business and Sustainable Development Commission — a group of academic, NGO and business leaders has established their mission to make the case for why business leaders should seize upon sustainable development as the greatest opportunity of a lifetime.

SDGhub.com — a one-stop resource center for supporting business in aligning with the SDGs, produced by the World Business Council on Sustainable Development.

Unilever — CEO Paul Polman has been a strong business voice in support of the SDGs and we'll be watching how his company implements sound business programs in support of the Global Goals.

4

UNLIMITED WATER **BECOMES A GOAL**

Libby Bernick,
Global Head of Corporate Business, Trucost

The combination of quality issues with quantity challenges will require enormous investments in the coming years, whether for innovative water reuse and recycling or the infrastructure upgrades required to safely treat and convey water.

The World Economic Forum's 2016 global risk report ranked water crises as one of the top societal risks to the global economy ahead of fiscal crises, cyber attacks and even food crises. Megatrends are converging to create this vortex: a growing middle class with greater demand for water; a changing climate altering the availability of water; and global declines in water quality, reducing the supply of clean water, increasing the treatment cost and putting people's health and communities at risk.

The problems are widespread. For example, a 2016 USA Today investigation reported that tests of nearly 2,000 water suppliers serving over 6 million people in all 50 states found excessive and harmful amounts of lead. The combination of quality issues with quantity challenges — the projected 40 percent shortfall in clean water supplies by 2050 — will require enormous investments in the coming years, whether for innovative water reuse and recycling technologies or the infrastructure upgrades required to safely treat and convey water to customers.

Big problems such as global water crises require big solutions, which have

often focused on creating unlimited supply of fresh water through seawater desalination, especially in coastal cities. But desalination plants' huge demand for electrical power and high financial costs can put these assets at risk when there are changes in policy or environmental conditions. Circle of Blue reported in 2016 that four large desalination facilities in Australia in the waning days of a 10-year drought sit idle yet cost ratepayers millions for maintenance and contractual charges. New organizations like the Global Cleanwater Desalination Alliance, formed in 2015 to pursue new technologies and renewable energy, will help the desalination industry continue to innovate.

But it's clear that we will need a wide range of solutions to have a growing, water-resilient economy, not just solutions that increase supply (such as desalination), but also those that reduce demand for water, whether by reusing, conserving or recycling it. There's vast potential: less than 3 percent of wastewater is currently recycled. Promising signs are that the industrial water treatment and recycling market is set to grow over 50 percent the next five years, to almost $11 billion in 2020, and municipal wastewater reuse will increase by 61 percent in 2025, according to Bluefield Research.

Water technologies will need to be adopted at a scale never seen before. But the goal of "unlimited water," where continuous use and reuse of water eliminates shortfalls, is within reach.

Events such as droughts create crisis-driven awareness for water reuse and recycling, and also can trigger longer-term policy changes. Rebates to encourage customers to use water more efficiently are growing in water-scarce cities in Arizona, California and Texas.

In other regions, governments are re-evaluating subsidies. Saudi Arabia, a desert country with no running surface water, is the third-largest consumer of water in the world, with consumption rates twice the European average. Between interest-free capital and direct subsidies, Saudi Arabia spends about $10 per cubic meter to treat and deliver water to customers, who then pay about 3 cents to use it, for a total subsidy of 99.76 percent, as reported by Global Water Intelligence. The need for a more water-resilient economy led Saudi Arabia in 2016 to introduce water subsidies and increase water tariffs 500-fold.

Water prices continue to rise globally, and some regions such as sub-Saharan Africa and Latin America even saw double-digit rate hikes the past year (12.7 percent and 10.3 percent, respectively), according to Global Water Intelligence. Even with annual price hikes, water still will be underpriced, even in regions where it is scarce. As a result, saving water through conservation and reuse may not always add up to significant cost savings but it will help avoid big risks.

The financial impacts of water risks are

considerable. In 2016, companies disclosed to CDP that water scarcity — the lack of clean fresh water — resulted in more than $14 billion of costs, including fines, loss of production, new treatment systems and securing water from new sources. Water valuation tools such as the GIZ Corporate Bonds Water Credit Risk Tool or the Water Risk Monetizer produced by Ecolab and Trucost provide businesses with a "shadow" water price they can use to estimate these risks. China Water Risk, a leading NGO in Southeast Asia on water-related issues, will use these tools to apply shadow water prices to understand and value water risk for major power producers in the region.

A steady flow of new activity will be on the horizon for 2017, including businesses using shadow water prices and applying the principles of a circular economy, an emerging framework to transform the take-make-dispose linear system into a make-use-return circular system. Instead of treating water as an inexpensive commodity that is used once and disposed of, water is managed as an infinitely recyclable and reusable asset, a valuable resource on the balance sheet, just like fixed capital assets at a manufacturing plant that require periodic investment to maintain and keep clean.

Signs of this transformation are already under way. For example:

As part of a $2.85 million investment, Coca-Cola European Partners will be replacing and upgrading a water treatment plant at a Scottish manufacturing site, where the plant will save 9 million liters of water a year.

Aerospace and defense firm United Technologies

invested $1.7 million in water-saving infrastructure across its six sites in Southern California, an area on the brink of what NASA warned could become a "decades-long megadrought."

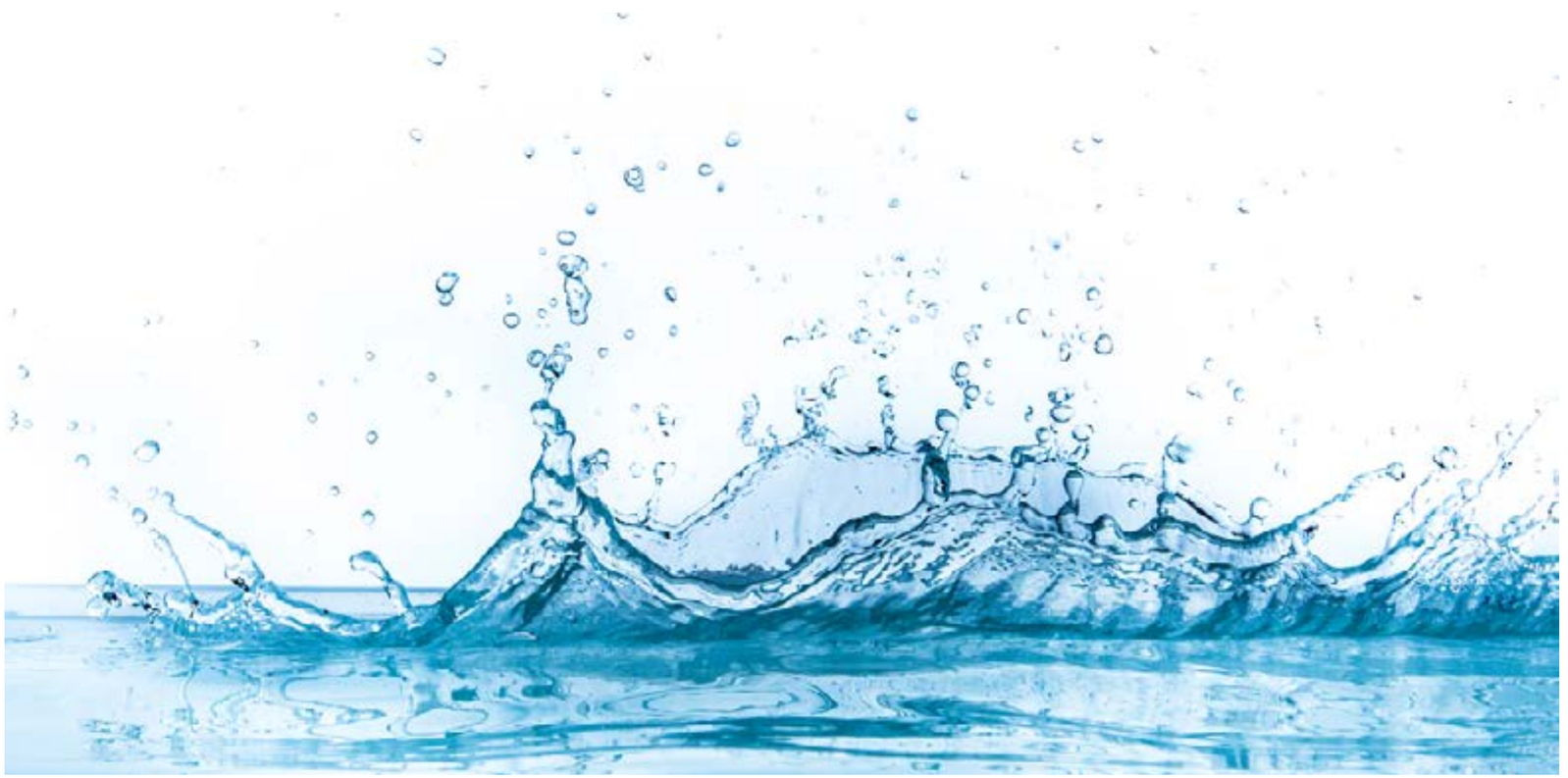
Diageo disclosed $2.4 million in conservation measures, where it saw the average cost of production more than double because of Brazil's drought.

A water-risk-resilient, circular economy will be enabled in part by digital and connected technologies. Businesses and cities are turning to data-driven solutions that capitalize on mobile technologies and the Internet of Things to improve water management and gain new insights about water use. Smart meters, once the domain of energy utilities, are making headway with water providers. Bloomberg New Energy Finance predicted water utilities will spend $2 billion on smart metering infrastructure through 2020.

Smart meters provide real-time data on water use and water losses, and can give customers information they need to conserve water, thereby lowering their water bills. Over 90 startups applied for the Water Data Challenge, organized by Imagine H2O, an organization aiming to accelerate the speed at which water solutions are commercialized.

Another example is Microsoft, which announced a partnership with Ecolab last year to use cloud computing and other technology to speed up the way industries tackle water scarcity, by capturing real-time information from processes anywhere around the world, visualizing it and getting predictive analytics to get insights and intelligence on water reduction and reuse.

Can unlimited water be a rallying goal for business in 2017? Given the uncertainty associated with a changing climate, there's an ever-greater need for systems that are



Can unlimited water be a rallying goal for business in 2017? There's an ever-greater need for systems that are more resilient to water risks and can make the business case to succeed.

more resilient to water risks and can make the business case to succeed.

KEY PLAYERS TO WATCH

Global Water Intelligence — this leading market research firm provides a global project tracker of water reuse projects, along with annual water tariff surveys.

Sourcewater — a new online exchange for conserving freshwater and creating market incentives for recycling water.

China Water Risk — nonprofit initiative designed to help investors, businesses and individuals understand and mitigate risk around some of the toughest water challenges in Southeast Asia.

Imagine H2O — provides water entrepreneurs with the resources to launch and scale successful innovative water businesses through a global network of industry leaders.

Apana — a water technology company whose tagline "manage water like inventory" provides businesses with data-driven insights to reduce and recycle water.

5

CORPORATE CLEAN ENERGY **GROWS UP**

Elaine Hsieh, VERGE Program Director, GreenBiz

Less than a decade after companies first started to sign large-scale, long-term power purchase agreements for renewable energy, corporate wind contracts outstripped utility demand.

Visionary solutions to climate change are unlikely to come primarily from top-down central government mandates, at least in the United States. Rather, they will come from voluntary decisions by customers, communities, corporations and others to choose clean and affordable energy options. And when more than 80 of the world's largest corporations — including Walmart, Microsoft and Google — commit to 100 percent renewable energy, the market responds.

A 2016 report by Advanced Energy Economy stated:

> Less than a decade after companies first started to sign large-scale, long-term power purchase agreements (PPAs) for renewable energy, corporate wind contracts outstripped utility demand. These purchases were dominated by a small number of large corporations, but as costs of renewables have become equal to — or often cheaper than — fossil-based sources, businesses large and small are increasingly seeking ways to invest in wind, solar, energy storage, fuel cells and other more sustainable energy technologies.

One major trend is that companies are increasingly moving from indirect to direct forms of procurement — moving from unbundled RECs to offsite PPAs, for example.

As the list of completed projects grows, the trend initiated by leadership companies is moving beyond the early adopters to the mainstream. In fact, 71 of the Fortune 100 and 215 of the Fortune 500 have a sustainability or renewable energy target, or both. The targets reach across industries — with hospitality, chemical and apparel in the lead.

These corporate renewable energy targets are also good news for states and provinces: The AEE report indicates that "companies are deploying their private capital to finance projects that will bring in new jobs and tax revenue while improving the resource diversity of the grid and, in some cases, decreasing reliance on imported electricity." But it's not uniform: In many jurisdictions, there are no clear mechanisms for companies to fulfill their commitment to procure renewable energy.

According to a recent Corporate Renewable Energy Buyers' Principles report, California, North Carolina, New Jersey, Texas and Virginia are the highest-priority U.S. states for renewable energy policy activities. Expect more action in politically "red" states that have much to benefit in the near future. Take Wyoming: Microsoft collaborated with local utility provider Black Hills Energy to design an innovative wind energy deal to deliver reliability without additional costs for ratepayers. It's a model that could be replicated elsewhere.

Companies such as Amazon, Ford, Walmart and General Motors often want to site projects close to their operations, which may be dispersed across many regions and nations. To address policy and regulatory challenges across jurisdictions, there are several proven strategies and trends for corporate renewables procurement.

One major trend: Companies are increasingly moving from indirect to direct forms of procurement — from unbundled RECs to offsite PPAs, for example. This is a key way to procure green power from large, offsite projects. But offsite PPAs are available only to companies in areas where a monopoly system of electric utilities has been replaced with competing sellers (as shown in this U.S. Energy Information Administration map). Through sleeved PPAs, however, the utility in a traditionally regulated market can serve as the go-between to help a company contract clean power via an offsite project.

For companies where a long-term PPA may not be feasible, there are other options. Green tariffs are an easy way for customers to opt-into their utility's renewable energy portfolio, as long as the tariff can be structured to the customer's needs. This is one of the newest

purchasing options, an area expected to grow in the coming years.

For companies with onsite resources that remain grid-connected, such as rooftop solar, energy storage or fuel cells, there are several purchasing structures. In some jurisdictions, companies have a range of options, but in others, legislation is needed to enable third-party ownership of onsite systems. And for companies that don't have distributed energy resources onsite, community renewable energy is a growing option where the customer shares the output of a single nearby offsite clean power project with multiple customers, both residential and commercial, via a subscription-based model.

Google in 2016 announced it would be 100 percent renewably powered by 2017 for its entire global operations — that's a whopping 2.6 GW of wind and solar. This required considerable ingenuity, and the declaration means something different depending on the location. The company's agreements cover at least 20 projects in five countries, all as close as possible to the company's far-flung data centers. That's about $3.5 billion in capital investment, according to Neha Palmer, head of energy strategy, global infrastructure at Google.

But what about the smaller companies that don't have the in-house energy expertise or massive cash reserves to tackle the complex deal structures often necessary to procure renewables? As the drum beats louder around this issue, creative solutions are emerging.

According to Rocky Mountain Institute's Business

Renewables Center, which has been instrumental in facilitating aggregated procurement models, these contracts need some sort of central organizer. Right now, several aggregation models are emerging, providing access to large-scale renewable energy projects for smaller businesses, real estate developers and institutions such as universities and hospitals. Companies as different as Etsy and Lockheed Martin are successfully leveraging this approach.

From a technology standpoint, wind is still the top source of renewable energy for corporate procurement. That said, solar power already costs less than traditional fossil-fuel-powered plants in many locations, and both rooftop and utility-scale solar prices are expected to drop 30 percent more by 2020. Process and product innovations will continue to drive down the costs of solar, wind and battery systems, leading to higher adoption rates. The improvements ahead are likely to come from continuous innovation in materials science and design, and from rapidly scaling production. Automating installation, thus reducing labor costs — the biggest cost of most solar projects — is another area ripe for disruption.

Locking in energy prices and reducing an organization's carbon footprint are two key drivers of corporate renewables procurement. But so is resilience. In areas vulnerable to natural disasters and other risk issues, microgrids — small and discrete hyperlocal electrical grids composed of primarily renewable energy sources — may become more of a corporate priority, as they can act independently of the grid when necessary. Technical challenges around grid interconnection and cybersecurity are still critical for many such projects, but solutions in these areas may be a longer-term prospect.

Speaking of utility challenges, there is mounting pressure on utilities to adapt more quickly to growing renewable

energy demands, or face the reality that their largest corporate energy customers may decide to take things into their own hands. In 2016, Apple decided to become a wholesale green energy supplier. MGM Resorts International made the bold move to pay $86.9 million for the right to defect from Nevada Energy in order to get its renewable energy production from other sources (including its own solar installations). As Cindy Ortega, the company's senior vice president and chief sustainability officer, put it, "We are leaving because it's the next in a natural progression of building a world-class sustainability effort… It's about being agile and smarter."

That should be a warning shot across the bow of every utility company.

KEY PLAYERS TO WATCH

Business Renewables Center — founded by Rocky Mountain Institute and several partners in 2015 with the aim of helping corporations procure solar, wind and other clean power. It seeks to help companies purchase 60 gigawatts of renewables by 2030.

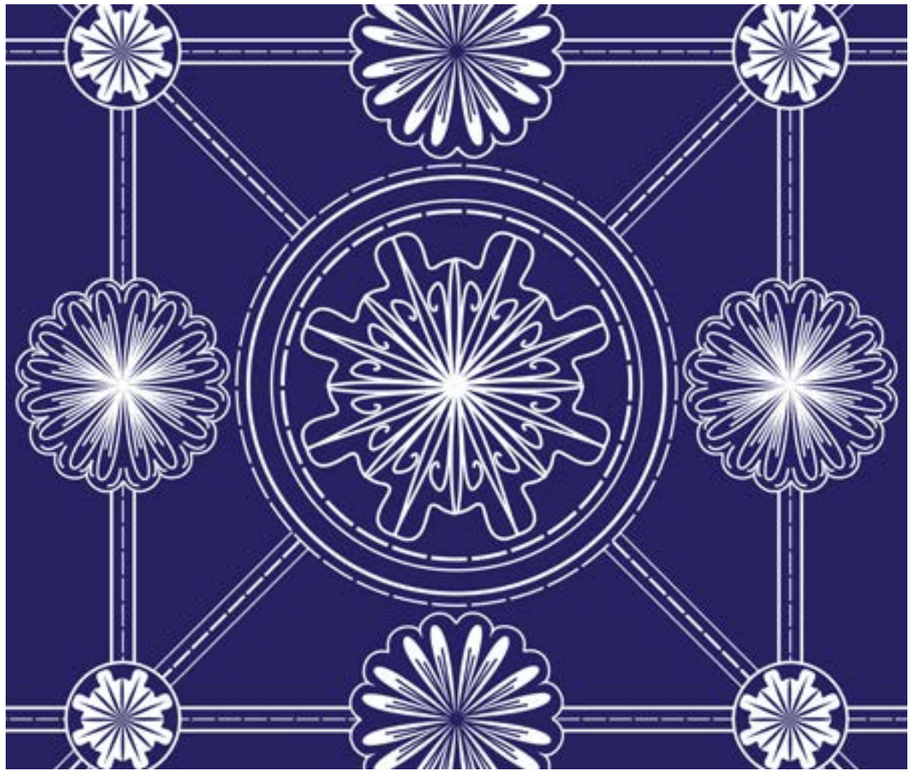
Duke Energy — helped create an innovative "Green Source Rider" tariff program in North Carolina that makes it more practical for the utility's corporate buyers to source solar energy.

Amazon —Was the largest corporate buyer of renewable energy in 2016, with its latest deal of five solar farms in Virginia announced in November. Considered in aggregate, contracts signed by the e-commerce and cloud services giant will bring approximately 580,000 megawatt-hours of clean power onto the grid.

Lockheed Martin — is allied closely with the federal government, said to be the second biggest buyer of clean power after Google. The defense contractor signed its first big solar power purchase agreement last year. Just as intriguing, it's applying its substantial technology expertise to emerging technologies, such as tidal power.

Renewable Energy Buyers Alliance — is pushing for better access to longer-term, fixed-price contracts for clean power. As of September, more than 62 large companies including Kellogg's and Starwood Hotels had stepped up to support the organization's founding principles.

There is mounting pressure on utilities to adapt more quickly to growing renewable energy demands, or face the reality that their largest corporate customers may take things into their own hands.



6

ENVIRONMENTAL PERFORMANCE BECOMES A FIDUCIARY **RESPONSIBILITY**

Libby Bernick,
Global Head of Corporate Business, Trucost

Four in five S&P 500 companies issued sustainability reports, and companies not disclosing are clearly in the minority.

The sustainable investing tide will rise ever higher in 2017 as more investors incorporate sustainability criteria into equity shareholder issues and consider sustainability criteria as part of corporate lending and credit risk. The net effect for corporations? Greater scrutiny and use of environmental disclosure data, as investors aim to uncover quantifiable links between environmental performance, risk and company value.

Corporate disclosure of environmental data continued to grow in 2016. This is unlikely to relent in 2017, given the added pressure created by the Paris Agreement on climate change. Four in five (81 percent) S&P 500 companies issued sustainability reports, and companies not disclosing are clearly in the minority. Last year also saw a spike in stock exchange disclosure requirements: 38 exchanges around the world now require some form of environmental, social and governance (ESG) disclosure from companies as a condition for listing.

The Forum for Sustainable and Responsible Investment 2016 annual investor survey tallied a 33 percent increase in one year in assets

under management that incorporate ESG factors, to $7.7 trillion in the United States. That's a remarkable rise, considering that fiduciary duty and sustainability have been uneasy bedfellows, particularly in the U.S.

Businesses and investors are increasingly aware of climate-related risks, whether the physical impacts (water scarcity or rising sea level) or policy risks if a carbon- or water-intensive asset becomes subject to policies or regulations that make it less valuable, or "stranded." New research by the United Nations Principles for Responsible Investing found that fiduciary duty is not an obstacle to asset owner action on these risks, and affirmed that sustainability is an important factor in the long-term success of a business. The U.S. Securities and Exchange Commission, whose 2016 public consultation considered the need for improved disclosure of ESG factors in SEC filings, is unlikely to provide any further clarity as a result of the new federal administration.

As the value of assets incorporating ESG considerations grew, so, too, did the number of investors measuring carbon risk and divesting from highly intensive carbon-emitting activities, such as fossil-fuels derived energy generation.

Large institutional asset owners — mostly pension funds and endowments — were some of the first investors to take steps to protect their portfolios from stranded asset scenarios or the physical risks from climate change. The Asset Owner Disclosure Project (AODP), which works to protect retirement savings from the risks posed by climate change, recorded a 63 percent increase in low-carbon investments last year, globally now at $138 billion. While leadership has historically been from the European Union and Australia, giants such as the $301 billion California Public Employees Retirement, $192 billion California State Teachers Retirement System and the $184 billion New York Common Retirement fund were recognized for their efforts to measure portfolio risks, engage with assets either directly or through proxy voting and invest in low carbon activities — efforts which will no doubt continue.

Despite progress, however, some asset owners have yet to get started. For example, according to AODP (PDF), the 4.8 million U.S. civil service retirees who will draw their pensions from the federal government's $439 trillion Thrift Savings Plan may be disappointed to learn that no such actions have been taken to manage climate risks and protect retirement investments. Expect to see more scrutiny over corporate pension funds in 2017, as employees and retirees begin to question the long term stability of their assets.

This should change as a wider range of investors become aware that ESG issues are not just an equity shareholder issue but also a credit risk for corporate lending.

Asset managers with big shoes are stepping in to join asset owners in evaluating carbon risks. BlackRock, the world's largest asset manager with almost $5 trillion in assets, issued a report (PDF) last fall recommending investors include climate risks in their decisions. "Investors can no longer ignore climate change," it said. "Some may question the science behind it, but all are faced with a swelling tide of climate-related regulations and technological disruption."

BlackRock is not alone. According to a survey by Morgan Stanley's Institute for Sustainable Investing and Bloomberg, nearly two-thirds of asset management

professionals say they are using sustainable investing strategies to achieve competitive market-rate financial returns. For the retail investor, Morningstar launched a sustainability rating system that enables individuals to evaluate the ESG factors of their 401K investment choices.

Perhaps the biggest trend for 2017 is that ESG factors will be considered in corporate lending and credit risk analysis. ESG factors can affect borrowers' cash flows and the potential to default on a debt, and therefore are important in considering creditworthiness.

For example, a drought can limit production (reducing revenue) or cause a spike in electricity prices (increasing costs), with significant implications to the bottom line. China's banks are exposed to costs of $1.6 trillion as a result of the environmental damage caused by industries they finance, according to research published at the People's Bank of China Green Finance Committee's annual conference in Beijing in 2016. Recognizing the importance of these ESG factors, six credit rating agencies (including Dagong Global Credit Ratings Group, Golden Credit Rating International, Liberum Ratings, Moody's Corporation, RAM Ratings, Scope Ratings and S&P Global Ratings) signed a statement last May agreeing to enhance the use of ESG in corporate credit ratings.

Further insights are expected from the Natural Capital Declaration's 2017 launch of a project with nine international financial institutions to pilot scenario modeling to stress-test corporate lending portfolios for environmental risk, and in particular the economic resilience of major industries to the risk of extreme droughts. The participating financial institutions represent more than $10 trillion in assets. Real money.

KEY PLAYERS TO WATCH

U.N. Principles of Responsible Investing (PRI) – works with investors to incorporate ESG factors into decisions and provides thought leadership on key topics, including guidance on fiduciary responsibility.

Sustainability Accounting Standards Board (SASB) — developing sustainability accounting standards to help public corporations disclose material, decision-useful information to investors on ESG issues.

S&P Global — a signatory to the U.N. PRI's 2016 Statement on credit ratings, look for the company in 2017 to launch a Green Bond evaluation tool to quantify impacts and an ESG Evaluation for corporate issuers.

Task Force on Climate-Related Financial Disclosures — this industry-led task force's new recommendations call for investors to report on climate-related financial impacts, including scenario and stress testing of business models and investment portfolios.

European Commission, Sustainable Finance — watch for the commission's report that will determine how to integrate sustainability considerations into the EU's rules for the financial sector.

7

COMPANIES PUT THEIR MONEY WHERE THEIR **SUPPLIERS ARE**

Lauren Hepler, Senior Writer, GreenBiz

Much of the activity in the food business is aimed at the estimated 450 million smallholder producers buried deep in corporate supply chains.

Quick: How many gallons of water did it take to make that burger? Better yet, what's the carbon footprint of that beer you're about to wash it down with?

Connecting the dots on the lifelong environmental impacts of our favorite foods and consumer products long has been an elusive goal in corporate sustainability. The challenge lies in the difficulty of shifting the status quo within the Wild West of global supply chains, which encompass both manufacturing behemoths and hundreds of millions of small operators with very different incentive structures.

More recently, however, large companies in the agriculture sector and beyond have shifted their supply-chain strategies to focus on finance. Among those that account for the uptick in targeted supply-chain investment are Kellogg, Kashi, Clif Bar and Mondeléz in the food business, plus companies such as IKEA and Interface in other sectors.

Much of the activity in the food business is aimed at the estimated 450 million smallholder producers buried deep in corporate supply chains.

Focused investment on forestry, materials innovation and renewably powered manufacturing are other hotspots that stand to have a major impact on the environmental implications of economic production. Still, the field also raises familiar questions about the tradeoffs between efficiency and sustainability in other areas, such as human rights, community development or animal welfare.

One thing that isn't in doubt: the massive financial opportunity that hangs in the balance.

Embedding sustainable business practices in the global food and agriculture industry alone could deliver an annual $2.3 trillion windfall, according to one study released last fall by the Business and Sustainable Development Commission.

"All stakeholders can share in the benefits: Smallholder farmers improve their livelihoods; suppliers gain increased security of supply with improved quality; and we reduce volatility and uncertainty with a more secure and sustainable supply chain," Unilever CEO Paul Polman recently wrote.

As Polman and other forward-thinking leaders know well, the natural resource calculations involved in agriculture are unique in their sheer scale. The sector consumes upwards of 70 percent of the world's fresh water, according to U.N. estimates — a dual challenge and opportunity spurring investment in emerging tech tools and boots-on-the ground training alike.

PepsiCo's Sustainable Farming Initiative, for instance, encompasses 28,000 growers in 15 countries and aims

to tackle the water used in its ag supply chain, with a goal to "yield more crop per drop," according to Vice Chairman and Chief Scientific Officer for global R&D Mehmood Khan. The company invested $80 million in water conservation from 2011 to 2015, which spans both efficiency upgrades and replenishing local watersheds.

Within the financial sector, new efforts are also forming to leverage impact investing specifically for supply chains. Livelihood Ventures, for instance, has launched the Fund for Family Farming that will invest $141 million over 10 years to smallholder farmers in Africa, Asia and Latin America.

Still, other individual companies are footing the bill for supply-chain initiatives. Mondelez International, the world's largest chocolate company, has put $400 million toward a 10-year plan to enhance supplier sustainability. One-quarter of the funds were earmarked for the estimated 75,000 smallholder farmers the company relies on in Côte d'Ivoire. The move followed a similar $70 million investment by subsidiary Cadbury, which also focused on suppliers in African nations, including Ghana, where the company reported initial double-digit growth in cocoa yields among participating farmers.

And although going organic isn't a silver bullet for supply-chain sustainability, companies such as Kashi and Clif Bar are also experimenting with new financial models to weather years that land must lie fallow before crops grown there can bear the organic label. Both food companies are piloting multi-year supplier deals that pay farmers for the lost production time.

Adding to the supply-chain sustainability push are the 17 U.N. Sustainable Development Goals, which include everything from eliminating hunger to encouraging economic development for women and girls worldwide.

Across sectors, the infrastructure that powers supply chains is also being fundamentally reexamined.

Both are spurring investment opportunities. And we're not talking small sums: The Business and Sustainable Development Commission estimates that unlocking the trillions in potential value trapped in supply chains would require annual investment of about $320 billion annually.

Kellogg, which relies on a network of some 65,000 smallholder farmers, is among the corporations investing in multiple facets of supply-chain sustainability. Although the company hasn't publicly disclosed how much it plans to spend on pursuing the SDGs, Kellogg has enlisted the international nonprofit TechnoServe to work with 12,000 women smallholder farmers in India by providing training in so-called "climate smart agriculture," plus access to financing, tools and agricultural inputs such as drought-resistant seeds.

Peer pressure is also coming into play with environmental risks posed by unsustainable supply chains. Institutional investors and advocacy groups such as Ceres are increasingly pressuring corporations that have lagged food industry peers — among them Kraft, Tyson and Dr. Pepper Snapple — to start by calculating risks that water and other environmental issues pose to their supply chains.

Optimal use (or reuse) of raw materials is another busy area of supply-chain investment, thanks in part to the growing circular economy models, where resources are constantly cycled back through supply chains. Groups focused on public-private collaboration to improve recycling infrastructure, such as the Closed Loop Fund, are certainly part of the equation. Large food players such as French dairy titan Danone are also getting on board, piloting new processes for extracting natural ingredients, such as the acid whey found in yogurt, to create complementary products, such as whey protein.

Across sectors, the infrastructure that powers supply chains is also being fundamentally reexamined. With its wider profit margins and smaller agricultural scale, large wine industry players such as Kendall-Jackson are experimenting with operations powered by renewable sources like wind. Large-scale operators of data centers such as Apple have invested in renewably powered manufacturing — not just at home, but also in production hubs such as China.

Outside of clean energy, other technologies with big implications for sustainability are also gaining traction and investment from corporate incumbents.

The technological evolution occurring in agricultural supply chains can be seen in the rise of precision agriculture. Tech providers such as the Monsanto-owned Climate Corporation rely on networks of sensors — or in some cases, drones — to compile data on current field conditions, which is then used to inform analytics showing exactly how much water, fertilizer or other inputs a crop needs to maximize yield. Looking ahead, disruptors in the field are moving quickly to push the notion of radical efficiency even further, offering up everything from fully automated vertical farms (Bright Farms) to improved meatless products (Impossible Foods) that skip the pasture entirely.

Bioscience, too, is attracting investment from large corporate buyers. The fishing industry, well known for running into natural supply constraints in overfished oceans, is on the cutting edge of supply-chain innovation. For example, Calysta, a Silicon Valley biotech startup backed by $30 million in funding from investors including food supply giant Cargill, focuses on improving the sustainability of farmed fish by pioneering fish food made from bacteria that eats methane and turns it into energy.

There are also potential drawbacks in the ever-evolving quest to increase agricultural efficiency and output. Improving robotics already are raising red flags about the potential for mass job loss due to automation. The conversation about genetically modified crops is always rife with conflict. Even the age-old livestock business is at the center of ongoing debate over whether industrial agriculture is an environmental blessing or bane.

For ag supply chains, the stakes are only getting higher as climate change roils growing areas and seasons. "As much as we're going to increase production, we're still going to have a demand problem," said Sara Menker, founder and CEO of food data provider Gro Intelligence, at an industry conference last year. "And we're doing this at a time of unprecedented change in the climate."

KEY PLAYERS TO WATCH

Monsanto/Climate Corporation — seed business and GMOs aside, Monsanto and tech subsidiary the Climate Corporation are at the head of the pack in optimizing ag.

Kellogg's — from supply chain emissions to smallholder initiatives focused on women in developing countries, the company is one to watch for broad-based food climate goals.

Clif Bar — on the front lines of experimentation in the economics of organic food.

Bright Farms — a pioneer in vertical farming, which could radically change the game for agricultural supply chain efficiency.

Interface — pushing the boundaries of manufacturing with year 2020 goals targeting targeting zero waste, zero emissions and zero adverse environmental impacts.

8

MOBILITY DRIVES A NEW TRANSPORTATION **PARADIGM**

Lauren Hepler, Senior Writer, GreenBiz

There are signs that the upheaval in personal mobility — like many industries being transformed by the sharing economy — is going corporate.

Electric vehicles are getting cheaper and driving farther. Shared rides arranged by smartphone are converging with age-old employee carpools to reshape commutes. Oh, and in case you haven't heard, self-driving cars — some of them super-sized 18-wheelers — are rapidly making their way onto public roadways.

The road to the future of transportation is nothing if not busy, especially if it's your job to figure out how to square new mobility technologies with existing automotive business models or large corporate fleets.

Depending where you sit on the glass-half-full spectrum, you might have heard that we're just years away from traffic-free roadways marked by fully optimized networks of shared, self-driving electric vehicles — ACES, as one Stanford professor and entrepreneur has taken to describing the prospects for Autonomous, Connected, Electric and Shared Vehicles (PDF).

On the other hand, you might also have been warned that we're heading for a "driverless nightmare," where personal robo-cars compound congestion,

It's not just electric and autonomous vehicles at play here. Good, old-fashioned gas- and diesel-powered cars, trucks and buses continue to go through technological tune-ups to improve their efficiency.

as they uncomfortably co-exist with today's human-controlled cars, which still spew fumes out of the exhaust.

Until now, auto and tech companies such as Tesla, Uber, Google and a slew of old-line automakers spinning off new mobility divisions have focused most of their high profile R&D efforts on the consumer side of the market. But there are signs that the upheaval in personal mobility — like many industries being transformed by the sharing economy — is going corporate. Evolving B-to-B offerings are surfacing as large-scale collaborative efforts form to help businesses and policymakers make sense of the smart mobility wave.

To date, much of the activity in the commercial market for sustainable transportation has revolved around hardware — in particular, powertrain innovations such as alt-fuels, hybrids and EVs — that hold immediate promise to reduce operating costs. It's a natural first step from an environmental standpoint, given that transporting goods to market takes 15 million barrels of oil per day, accounting for about one-fifth of global oil demand, according to a McKinsey analysis.

Of course, it's not just electric and autonomous vehicles at play here. Good, old-fashioned gas- and diesel-powered cars, trucks and buses continue to go through technological tune-ups to improve their efficiency.

A proposed "LEED for fleets" certification model is one effort to keep an eye on. Another is Business for Social Responsibility's (BSR) Future of Fuels initiative, which convenes companies such as Walmart, PepsiCo, UPS and others with major logistics operations looking to increase trucking efficiency. In 2016, the group released a Fuel Sustainability Tool that stacks up varieties of diesel and natural gas against more exotic alternatives such as algae-based biodiesel — a cocktail of fuel options that aviation companies such as Boeing and United also continue to explore.

Several individual companies with large fleets also find themselves approaching the end of five- or 10-year sustainability goals. Walmart, for instance, more than doubled fleet efficiency from 2005 to 2015, cutting 650,000 metric tons of emissions and saving more than $1 billion in fuel costs during 2015 alone. The company achieved the goal through a mix of low-hanging fruit — such as decreasing miles traveled when trucks are empty or underfilled — as well as more advanced vehicle light-weighting or fuel changes.

The next frontier in fleets, according to those watching the market: hybrid, plug-in hybrid and electric vehicles, with the most potential to reduce emissions in markets where charging networks can be powered by renewable energy. Given the magnified "range anxiety" around heavy-duty trucks, plus the fact that EVs still only account for about 1 percent of all vehicle sales, BSR projects that midsize vans and smaller trucks are likely to be converted first.

In the meantime, cities are also increasingly in the market for better EV charging networks and hybrid or electric buses. From Greensboro, North Carolina, to Silicon Valley, California, electric buses manufactured by large companies such as Duke Energy and upstarts such as Proterra (headed by an ex-Tesla exec) are increasingly making their way into public procurement processes.

Engines aside, one question for fleet buyers is how to integrate parallel developments in software and connected cars.

Efforts within the auto industry to adapt for accelerating demand for shared rides and shared cars is moving at breakneck speed. During 2016 alone, GM dropped $500 million on Lyft and spun out a mobility arm called Maven, joining Daimler offshoot Moovel and Ford Smart Mobility in the race to embrace distributed transportation tech. In the meantime, companies such as Uber, Lyft and Ride are moving to position themselves as commuter alternatives to offline carpools and public transit.

"Vehicle sharing is a very natural extension of our core model — to this point design, build, sell," Peter Kosak, GM's executive director of urban mobility, told GreenBiz. "It's instead of ownership or in addition to ownership. You're just distributing a fleet rather than distributing sales, and you're giving people access by the minute or the hour or the day or whatever."

While it's not uncommon for companies to offer Zipcars or other shared vehicles on corporate campuses, giving up owned fleets entirely would be a much bigger leap. GM and Daimler already are building upon the concept of shared cars as a real estate perk, offering tenants of partnered high-end buildings access to short-term rentals or commuter shuttles. But there's also the matter of making shared

transportation accessible from an economic standpoint, which is likely to become even more contentious as Uber and Lyft lobby local governments for subsidies once reserved for public transit.

Infrastructure for shared vehicles, and especially shared electric vehicles, is another unresolved issue. Automakers still have yet to agree on a standardized EV charging system, leading to competing charger networks that usually pit Tesla (and its growing battery business) against everyone else. One area to watch is how renewable energy, and particularly pooled access models such as community solar, do or don't merge with the buildout of EV infrastructure.

Perhaps the most interesting points of convergence is how trends toward EVs, shared vehicles and self-driving cars ultimately, um, collide.

While major automakers squabble about who can get a self-driving car to market fastest, will-they-or-won't-they questions surrounding Google's release of its long-discussed electric self-driving cars show no signs of slowing down.

In the meantime, alums of the company's secretive automotive division are branching out on their own. Google alum Anthony Levandowski, for instance, started Otto, pivoting to self-driving semis instead of consumer cars. The company recently ran a test run for Budweiser and was acquired in the fall by Uber. "Per truck, there's about eight time more CO2 emissions than a car," Levandowski said at the GreenBiz VERGE 16 conference in Silicon Valley. "I see it as an opportunity to have a much bigger impact."

While there's no shortage of activity involving vehicle technology, what happens to all the data generated by connected vehicles is another open question. Cities, auto companies and corporate fleet managers are all interested in getting their hands on more data to maximize efficiency and meet sustainability goals, but connected cars are also prime suspects in the conversation about unresolved data privacy and cybersecurity issues.

As part of the rush for transportation data, providers of transportation-related information and communications technology, or ICT, look poised to ramp up services that help track and analyze fleet data. The overall fleet-management market is expected to triple in the next five years, from a $9.5 billion market in 2016 to $27.9 billion in 2021, according to a projection by Markets and Markets.

The question now is how the pieces come together, and what their cumulative environmental impacts might look like.

Although the conversation around self-driving cars is still tinged with science fiction, very real logistical nightmares also loom in the form of the more than 3 million people currently employed as professional drivers. Insurance and legal issues, too, look likely to become increasingly thorny issues. If two driverless vehicles collide, for instance, who's at fault?

KEY PLAYERS TO WATCH

Tesla — not just for its cars, but also for its growing charger infrastructure offerings.

Ford Smart Mobility, GM's Maven, Daimler's Moovel — three massive auto incumbents, three new mobility-focused subsidiaries to watch.

Uber — keep an eye on the evolution of autonomous ridesharing, but also the looming battle between private carpools and public transit.

ChargePoint — along with NRG's EVgo, this third party EV charging company just landed a big investment round to keep growing its public charging business.

Walmart — long a bellwether for the corporate fleet crowd, watch where Walmart heads on powertrains and emissions for its busy trucks.

9

SUSTAINABLE STORYTELLING ADOPTS NEW MEANS AND MEMES

Heather Clancy, Senior Writer, GreenBiz

While all these reports are impressive exercises in data presentations, charts and flashy infographics full of big numbers, they're not as effective for keeping the general public abreast of progress.

Show, don't tell. It's rule No. 1 for writers and presenters. Yet, most sustainability disclosures still take the form of static, text-dense reports, usually delivered on an annual basis, that tell without showing.

The good news is that a large majority of big companies actually compile and release sustainability information compared with just four years ago; about 81 percent of all S&P 500 organizations in 2015, versus just 20 percent in 2011. That's a pretty impressive improvement, and a positive sign that investors are becoming more interested in declarations about programs for improving energy efficiency, conserving water, reducing waste and so on. It's a matter of "Trust, but verify."

Last year, some big U.S. companies went a step further, embracing integrated reporting, the idea of discussing how a company's positions and performance on environmental social and governance issues could shape results and "value creation" over the short, medium and long term.

Among those leading the way are Clorox, Jones Lang LaSalle and General Electric. "Public company reporting has become so complicated that

what matters to investors can get lost," said GE Chairman and CEO Jeff Immelt, in the letter framing his company's latest report (PDF). "Our priority is to provide meaningful information that all investors can readily access. For investors to make investment and voting decisions, we don't believe that more information is necessarily better. Instead, we've challenged ourselves to provide better information."

The dilemma is that while all these reports are impressive exercises in data presentations, charts and flashy infographics full of big numbers — all great for satisfying compliance requirements or reporting frameworks such as those maintained by the Global Reporting Initiative or the CDP guidelines — they're not as effective for keeping the general public abreast of progress in a way that's timely or accessible.

All of which is inspiring companies to experiment with new, highly visual storytelling methods.

THE VIEW FROM ABOVE

Consider the simple yet powerful impact of time-lapse photography taken from the vantage point of outer space.

Late last year, the satellite gurus at Google Earth released several sequences from more than 5 million images collected over the past three decades illustrating (among other things) the effects of climate change on a glacier in Antarctica and the human "footprint" of deforestation surrounding Alberta's Tar Sands region. The images are simultaneously vivid and gut-wrenching, showing clear degradation over the past 30 years.

It's easy to see, then, why a growing number of formal environmental monitoring systems are based on powerful data analysis technology along with satellite imagery (such as Google Earth) or interactive mapping software (such at the sort developed by Esri). It's a far simpler way to express critical data points at a surface level, which enabling those interested in more data to drill down more deeply into the numbers. Companies are beginning to employ these technologies to tell sustainability stories.

One example is the Global Forest Watch, a World Resources Institute project that logs information about deforestation. NASA's "Images of Change" project is equally spellbinding. Other great examples include Marks & Spencer's interactive supply chain map and SolarCity's "contagion" data visualization, basically a GIF showing the rapid adoption of solar panels across America.

If properly edited two-dimensional images can be that effective at helping people "see" what's changing, imagine the communications potential of far more immersive visualization experiences that depict scenes in three dimensions.

The concept of "virtual reality" (VR) has been a sci-fi staple for years, but new headsets from Google (especially its inexpensive Cardboard viewer) and

Microsoft (with its HoloLens "glasses") will make this technology far more cost-effective over the next couple of years. For the "viewer" – the more appropriate word may be "participant" — these gadgets reveal a 360-degree panoramic glimpse at an alternate world, even on a smartphone. Revenue for VR devices and a sister technology called augmented reality (AR) — a means of projecting animations or graphics on top of real-world objects and views — was around $5.2 billion last year but could skyrocket to almost $162 billion by 2020, according to market research firm International Data Corporation.

"We've been prisoners to somebody else's world version," noted Roy Taylor, a corporate vice president for Advanced Micro Devices, during a keynote presentation at the VERGE 16 conference. "Whatever we've looked at, whether it's through a personal computer or a tablet or a smartphone, someone else has created that and we've been on the other side looking through. Virtual reality, for the first time, gives us a chance to step through that window and to look around and to see something that is larger and greater than the person who, until now, controlled what we watched, what we saw."

Why should sustainability professionals pay attention to something often considered primarily the domain of gamers or thrill-seekers?

In the future, AR applications promise to be useful for visualizing supply-chain data. By "looking" at a product in a warehouse shelf wearing AR glasses, for example, a distribution center worker might call up more details

about its provenance. SAP is working on systems that use smart glasses from a company called Vuzix for just this purpose. Technology of this sort could make it far simpler, over time, for large organizations to collect more data from their suppliers automatically and for verification of their claims to be automated.

In a similar way, VR applications could add more dimensions to energy metrics or power consumption dashboards. Data center operator Aligned Energy, for one, is studying ways that the Microsoft HoloLens AR headset might play a role in helping microgrids tells their story far more visually.

More likely than not, however, we'll see companies and NGOs use VR applications to help "immerse" individuals in worlds that they might not otherwise encounter, either because the events happened in the past or haven't yet happened. Google has created dozens of different VR expeditions, many meant for school classrooms, which bring viewers into unknown environments using little more than its cardboard viewer and an Android smartphone. You can even take a deep dive underwater, into coral reefs.

Another company dabbling in high-tech storytelling is Owlized, which created a device resembling a tourist observation viewer that uses data models to display the potential impacts of climate change. "Sea level is a slow-moving crisis that's hard to see and harder to get people energized around, but this technology will help bring it home in a very tangible way," said Dean Kubani, chief sustainability officer for the city of Santa Monica, California, which is experimenting with the systems to help its citizens visualize the potential danger to its oceanfront.

In the future, augmented reality applications promise to be useful for visualizing supply-chain data.

The Sierra Club is one organization leading the drive toward messages that are far more visceral. One of its first such efforts was an awarding-winning public service announcement produced by media company RYOT (using software from YouTube and Facebook) that brings viewers into the heart of a melting glacier valley. "To us, this is by far the most exciting use case for virtual reality technology," said RYOT COO Molly Swenson. "When you're standing in the middle of a glacial ice cave, watching and hearing it melt rapidly from the inside out, you not only understand that climate change is real, but you feel compelled to do everything you can to halt and reverse it. VR is the best tool we've found for turning passive viewers into active participants."

When it comes to sustainability, as with so many things, seeing really is believing.

KEY PLAYERS TO WATCH

Esri — with almost 75 percent of the Fortune 500 on its customer list, it produces what is considered to be the world's most powerful interactive mapping engine.

Google — is investing millions to help organizations use its Google Earth satellite images to communicate changing planetary conditions. Meanwhile, its VR Expeditions series is connecting children with places they might never have the chance to see in person.

Magic Leap — the secretive software startup backed with more than $1.4 billion of investment is working on technology that superimposes highly realistic videos or animations onto a real-world view.

Microsoft — its HoloLens headset overlays holograms onto a real-world perspective. It isn't cheap: a development kit costs about $3,000.

Owlized — is developing viewfinder kiosks — an evolution of the ones you might look through at scenic overlooks — that visualize the likely effect of rising water levels and storms on coastal cities.

10

RESILIENCE BECOMES A SUSTAINABILITY **STRATEGY**

Joel Makower, Executive Editor, GreenBiz

Increasingly, a new word is on the scene, one that articulates a state of being and that acknowledges that meeting the needs of both present and future generations will involve myriad twists and turns.

For decades, "sustainability" has embodied the full measure of environmental and social goals — aligned, always, with economic ones. That triple bottom line has nicely described the overarching goal of a wide range of endeavors by individuals and families, companies and institutions, communities and nations.

Increasingly, though, a new word is on the scene, one that similarly articulates a state of being and that acknowledges that meeting the needs of both present and future generations in a dynamic and dangerous world likely will involve myriad twists and turns.

The word: resilience.

Unlike sustainability, resilience already resonates for the uninitiated: Being a resilient person means withstanding shocks of many kinds — job loss and financial setbacks, death of loved ones and other relationship endings, illness and disabilities and other life challenges. Being resilient means bouncing back from adversity, adapting to change and coping with whatever surprises come our way — in essence, being ready for anything.

So, too, for companies, communities and the planet.

In a world roiled by extreme weather, mass migration, political turmoil, cybersecurity, economic swings, terrorism, wars and other conflict, resilience has become a cornerstone of sustainability. As our brittle infrastructure and supply chains increase risk to organizations' finances, reputations and business continuity, being resilient is key to being sustainable, in every sense of the word.

The military gets this. Defense Department directive 4715.21, issued in early 2016, titled Climate Change Adaptation and Resilience (PDF), aims to facilitate federal, state, local, tribal and private- and nonprofit-sector efforts "to improve climate preparedness and resilience." It is the latest in a long series of assessments, strategy and planning documents from the Pentagon dating to 2003, during George W. Bush's first term as president.

The latest directive states: "All DoD operations worldwide must be able to adapt current and future operations to address the impacts of climate change in order to maintain an effective and efficient U.S. military."

Also last year, a coalition of 25 military and national security experts, including former advisers to Ronald Reagan and George W. Bush, warned that climate change poses a "significant risk to U.S. national security and international security" that requires more attention from the federal government. The DoD has called climate change a "threat multiplier" that could demand greater humanitarian or military intervention and lead to more severe storms that threaten cities and military bases, and heightened sea levels that could imperil island and coastal infrastructure.

The building and infrastructure sectors are also talking increasingly about resilience. Last year, the architecture and design firm Perkins+Will introduced the RELi resilience standard, aimed at encouraging city planners, project developers and companies to build and operate facilities that can better withstand superstorms, sea-level rise, drought, heat waves or even social unrest. Meanwhile, the U.S. Green Building Council, creator of the LEED green building standard, approved three LEED pilot credits on resilience in design.

And what's good for buildings is good for the cities where they reside. The resilient cities movement — spurred by the 100 Resilient Cities initiative, which supported the creation of Chief Resilience Officer positions in cities around the world — has helped metropolitan areas in harm's way of sea-level rise and other calamities improve planning and emergency services. And it's not just about climate change: Resilience for cities often means shoring up the social fabric, addressing housing and other inequities and creating a unified sense that in the face of shocks of any kind, everyone needs to come together.

What about companies? They, too, are recognizing they need to be prepared for shocks — climate shocks, of course, but also political, public health, economic and terrorism shocks — so that they can adapt and bounce back quickly. The experience of extreme weather events such as Superstorm Sandy in 2012 disrupted an estimated 10,000 manufacturing facilities in the Northeast U.S. and stalled an estimated 20 percent of the U.S. commercial trucking industry for a week or more, according to an assessment by the U.S. Department of Commerce. Local utilities found themselves without sufficient fuel to send trucks to fix the storm's damage, among other signs of a lack of preparedness for such inevitable natural disasters.

Around the world, Hurricane Katrina in New Orleans in 2005, the Sendai Earthquake and tsunami in 2011 in Japan, the 2012 floods in Thailand and Typhoon Haiyan in the Philippines in 2013 all have played critical roles in awakening companies to the risks of a changing climate, for both themselves and their suppliers.

Some company resilience initiatives play nicely into their business strategies. Consider AkzoNobel, a major

producer of global paints, coatings and specialty chemicals. It developed an urban resilience guide for cities — with an emphasis on how paints, coatings and chemicals can build both "hard" and "soft" resilience into city systems. The company is conducting projects in at least four cities that belong to the 100 Resilient Cities network. Each participating city will explore the contribution of color and coatings to a particular aspect of resilience — from improving public health to protecting urban heritage, from community identity to economic prosperity, from education to social connection and from reliable mobility to improving infrastructure efficiency.

In many ways, corporate efforts to address resilience are nothing new. Companies regularly assess threats and opportunities as they strive to maintain a competitive edge, a discipline called risk management. But for many organizations, there is a disconnect when it comes to the intersection of sustainability and risk management, as noted in a 2016 report by GreenBiz, Marsh & McLennan Companies and the Association for Financial Professionals. Simply put, the two departments within companies speak different languages.

"The role of enterprise risk management is to pull together all these different types of risks — whether they're financial, operational or strategic — into one place so that companies can start thinking through and prioritizing what is most impactful to the organization," explained Alex Wittenberg, executive director of the Global Risk Center at Marsh & McLennan Companies. "Often, companies establish a risk committee with representation from core areas of the business representing the ownership of these different risks."

Wittenberg added: "It is important for the sustainability professional to make the effort to actively engage with the risk and finance teams to more effectively integrate their thinking with those of the commercial operations of the organization."

Beyond ensuring business continuity and reducing downtime and disruptions, building resilience is also a key economic development strategy — what Judith Rodin, president of the Rockefeller Foundation, calls the "resilience dividend." (She's author of a book by that name.)

The dividend, said Rodin, comes from investing both money and resources: "It requires innovation to solve for known vulnerabilities but also for variables unknown. And it takes partnerships with the private sector, both to uncover weaknesses within systems, but to also unleash the full range of financing for resilience projects and infrastructure."

That's the kind of full-spectrum thinking that in any sector engenders resilience, the mindset that allows companies, communities and institutions to withstand the test of time with flying colors.

For many organizations, there is a disconnect when it comes to the intersection of sustainability and risk management.

KEY PLAYERS TO WATCH

100 Resilient Cities — spawned by the Rockefeller Fund, this initiative is helping cities around the world identify and address their biggest vulnerabilities.

Center for Resilience at Ohio State University — a research center dedicated to improving the resilience of industrial systems and the environments in which they operate.

Global Risk Center — a division of the Marsh and McLennan Companies, its focus is on global and emerging risks, resource security, risk-based decision making and multinational risk governance.

Resilience.org — operated by the Post Carbon Institute, this resource center focuses on local initiatives such as community gardens, local energy projects, timebanks, local currency projects, repair cafes and more.

U.S. Climate Resilience Toolkit — produced by an alliance of federal agencies, the online resource provides more than 200 tools to help build resilience, from engaging a community to developing a climate action plan.

50 KEY PLAYERS TO WATCH

100 Resilient Cities	Spawned by the Rockefeller Fund, this initiative is helping cities around the world identify and address their biggest vulnerabilities.
Amazon	Was the largest corporate buyer of renewable energy in 2016, with its latest deal of five solar farms in Virginia announced in November. Considered in aggregate, contracts signed by the e-commerce and cloud services giant will bring approximately 580,000 megawatt-hours of clean power onto the grid.
António Guterres	For the SDGs to become reality, the United Nations will need to do a better job of developing those partnerships and alliances, and its new Secretary-General will be leading this effort.
Apana	Water technology company whose tagline “treat water like inventory” provides businesses with data-driven insights to reduce and recycle water.
AtKisson Group	Creator of the nonprofit 17goals.org to help everyone everywhere learn about the SDGs and give them the tools to take action —and one of the best songs about the SDGs you’ll ever hear.
Bright Farms	Pioneer in vertical farming, which could radically change the game for agricultural supply chain efficiency.
Business and Sustainable Development Commission	A group of academic, NGO and business leaders has established their mission to make the case for why business leaders should seize upon sustainable development as the greatest opportunity of a lifetime.
Business Renewables Center	Founded by Rocky Mountain Institute and several partners in 2015 with the aim of helping corporations procure solar, wind and other clean power. It seeks to help companies purchase 60 gigawatts of renewables by 2030.
Center for Resilience at Ohio State University	A research center dedicated to improving the resilience of industrial systems and the environments in which they operate.

ChargePoint	Along with NRG's EVgo, this third party EV charging company just landed a big investment round to keep growing its public charging business.
China Water Risk	A nonprofit initiative designed to help investors, businesses and individuals understand and mitigate risk around some of the toughest water challenges in Southeast Asia.
Clif Bar	On the front lines of experimentation in the economics of organic food.
Duke Energy	Helped create an innovative "Green Source Rider" tariff program in North Carolina that makes it more practical for the utility's corporate buyers to source solar energy.
Ellen MacArthur Foundation	Works to accelerate the circular economy, including groundbreaking research on "the new plastics economy."
Esri	With almost 75 percent of the Fortune 500 on its customer list, it produces what is considered to be the world's most powerful interactive mapping engine.
Ford Smart Mobility, GM's Maven, Daimler's Moovel	Three massive auto incumbents, three new mobility-focused subsidiaries to keep an eye on.
Global Risk Center	A division of the Marsh and McLennan Companies, its focus is on global and emerging risks, resource security, risk-based decision making and multinational risk governance.
Global Water Intelligence	This leading market research firm provides a global project tracker of water reuse projects, along with annual water tariff surveys.
Google	Is investing millions to help organizations use its Google Earth satellite images to display changing planetary conditions. Its VR Expeditions series connects children with places they might never see in person. On energy: Sometime in 2017 it should be buying enough clean power for all data centers and offices.
Graftech International	One of the world's largest manufacturers of natural and synthetic graphite and carbon-based products.
IBM	Sells a private cloud service that could help organizations develop and get blockchain applications up and running quickly. Its technology is behind pilots by retailer Walmart, for food safety, and Everledger, which certifies the origins of diamonds.

Imagine H2O	Provides water entrepreneurs with the resources to launch and scale successful innovative water businesses through a global network of industry leaders.
Interface	Pushing the boundaries of manufacturing with year 2020 goals targeting zero waste, zero emissions and zero adverse environmental impacts.
Kellogg's	From supply chain emissions to smallholder initiatives focused on women in developing countries, the company is one to watch for broad-based food climate goals.
LO3 Energy	Its TransactiveGrid system helps automate the trading of power across microgrids. The startup just scored a notable strategic partner, German energy management company Siemens. (A similar company is Australia's PowerLedger.)
Lockheed Martin	The defense contractor signed its first big solar power purchase agreement last year. Just as intriguing, it's applying its substantial technology expertise to emerging technologies, such as tidal power.
Magic Leap	The secretive software startup backed with more than $1.4 billion of investment is working on technology that superimposes highly realistic videos or animations onto a real-world view.
Microsoft	Its HoloLens headset overlays holograms onto a real-world perspective. It isn't cheap; a development kit costs about $3,000.
Global Risk Center	A division of the Marsh and McLennan Companies, its focus is on global and emerging risks, resource security, risk-based decision making and multinational risk governance.
Monsanto/Climate Corporation	Seed business and GMOs aside, Monsanto and tech subsidiary the Climate Corporation are at the head of the pack in optimizing agriculture.
Nasdaq	Has been investing in blockchain technology for more than three years. Its Linq service could be the foundation for new business models, such as asystem for issuing renewable energy credits automatically.
Newlight Technologies	Its carbon capture technology combines air with methane-based greenhouse gas emissions to produce a plastic material called AirCarbon.
Novomer	A chemistry company whose technology enables carbon dioxide and carbon monoxide to be used as raw materials in the production of polymers and chemicals.

Owlized	Is developing viewfinder kiosks — an evolution of the ones you might look through at scenic overlooks — that visualize the likely effect of rising water levels and storms on coastal cities.
Provenance	The London firm has piloted the use of blockchain to track tuna supply chains and to monitor produce for British grocer Co-op Food. It wants to make it simpler for companies to verify sustainability claims.
Renewable Energy Buyers Alliance	Is pushing for better access to longer-term, fixed-price contracts for clean power. Large companies including Kellogg's and Starwood Hotels have stepped up to support the organization's founding principles.
Resilience.org	Operated by the Post Carbon Institute, this resource center focuses on local initiatives such as community gardens, local energy projects, timebanks, local currency projects, repair cafes and more.
S&P Global	A signatory to the U.N. PRI's 2016 Statement on credit ratings, look for the company in 2017 to launch a Green Bond evaluation tool to quantify impacts and an ESG Evaluation for corporate issuers.
SDGhub.com	A one-stop resource center for supporting business in aligning with the SDGs, produced by the World Business Council on Sustainable Development.
Skuchain	The California startup's software is behind a test by Commonwealth Bank and Wells Fargo initially focused on trading cotton between Texas and China.
Sourcewater	A new online exchange for conserving freshwater and creating market incentives for recycling water.
Sustainability Accounting Standards Board (SASB)	Developing sustainability accounting standards to help public corporations disclose material, decision-useful information to investors on ESG issues.
Task Force on Climate Related Financial Disclosures	This industry-led task force's new recommendations call for investors to report on climate-related financial impacts, including scenario and stress testing of business models and investment portfolios.
Tesla	Not just for its cars, but also for its growing charger infrastructure offerings.
UN Principles of Responsible Investing	Works with investors to incorporate ESG factors into decisions and provides thought leadership on key topics, including guidance on fiduciary responsibility.

U.S. Climate Resilience Toolkit	Produced by an alliance of federal agencies, the online resource provides more than 200 tools to help build resilience, from engaging a community to developing a climate action plan.
European Commission, Sustainable Finance	Watch for the commission's report that will determine how to integrate sustainability considerations into the EU's rules for the financial sector.
Uber	Keep an eye on the evolution of autonomous ridesharing, but also the looming battle between private carpools and public transit.
Unilever	CEO Paul Polman has been a strong business voice in support of the SDGs and we'll be watching how his company implements sound business programs that support the U.N. Global Goals.
Walmart	Long a bellwether for the corporate fleet crowd, watch where Walmart heads on powertrains and emissions for its busy trucks.
Warner Babcock Institute for Green Chemistry	Works to develop nontoxic, environmentally benign and sustainable technologies, products and processes.

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THE 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 data and risk analysis firm, Trucost, the 2017 assessment includes more than 30 corporate sustainability performance indicators.

The infographics shown on these pages are backed by detailed datasets and methodology, explained in the Appendix.

— **Dr. James Salo,** Head of Data Strategy & Operations, Trucost

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THE BIG PICTURE

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

In this section, the metrics assessed provide the "big picture" to help us answer the question: Are companies truly stepping up their efforts to address their full range of sustainability impacts?

This year's metrics show some positive momentum.

The cost of natural capital impacts caused by companies is down over 15 percent since its peak in 2013, continuing a trend observed in last year's report. Of all the environmental impact categories assessed, the largest contributors were the release of greenhouse gas emissions (more than 35 percent) and the associated effects on the Earth's climate, fertilizer-related nutrient and organic pollution (more than 25 percent), water use (18 percent) and heavy metal pollution (9 percent). These top four impacts account for around 90 percent of the total natural capital cost arising from the activities of publicly traded companies.

Continued management and reduction of these impacts is essential to make further progress. For companies in most sectors, environmental impacts coming from the goods and services that they purchase from suppliers contribute the vast majority of their exposure, so this should be a key area of focus.

Nevertheless, businesses have a long way to go to make meaningful progress towards environmental sustainability.

The largest 500 U.S. companies had a natural capital cost of more than $1.4 trillion in 2015, or 7.8 percent of the national GDP. For the largest 1,200 global companies, the 2015 natural capital cost exceeds $3.4 trillion.

In the context of corporate profits, if companies had to internalize the costs of the resources they consume and the pollution they generate, they would be massively unprofitable. In 2015, natural capital costs were more than double corporate profits for the largest 1,200 companies globally.

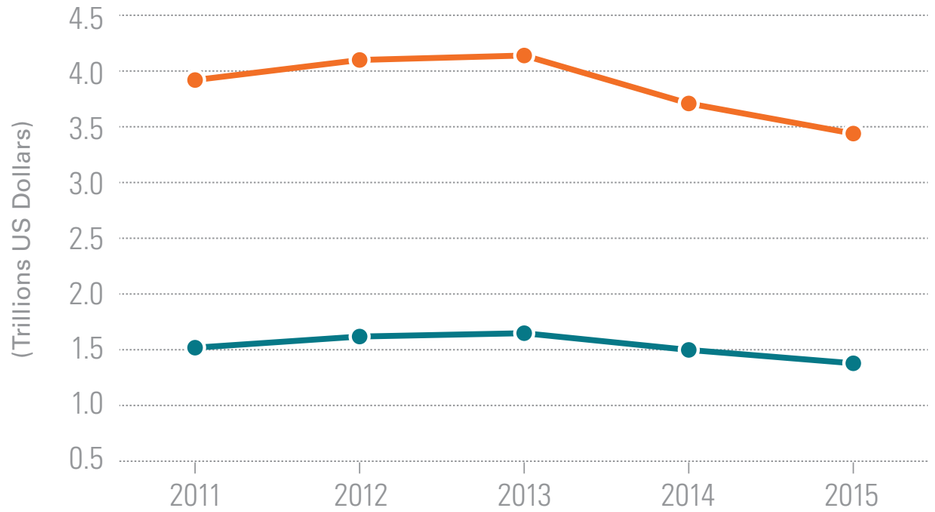
Overall, these indicators show that even with recent reductions in natural capital costs, exposure to business risk from environmental impacts continues unabated.

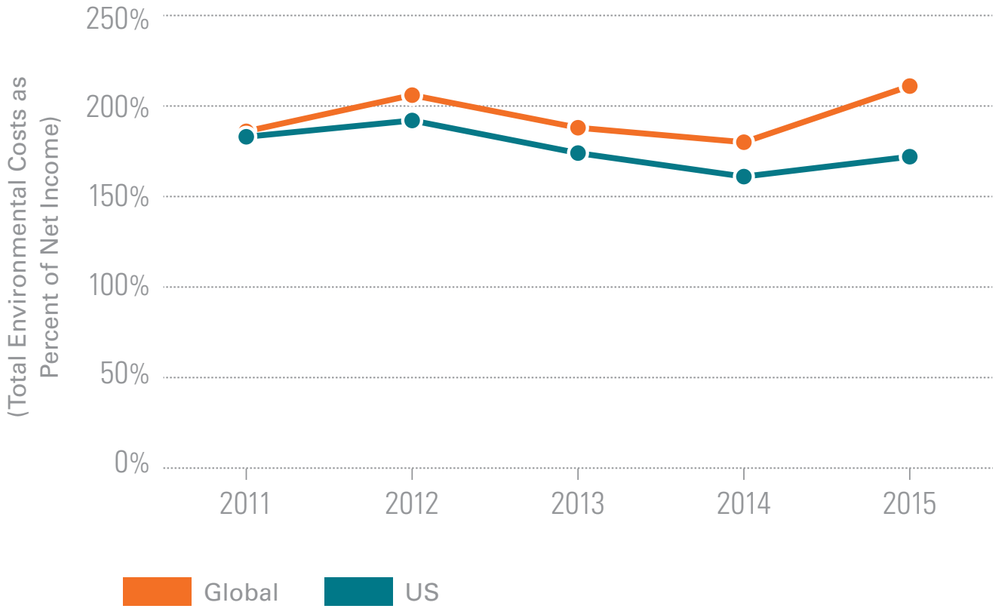
Natural capital refers to the limited stock of the Earth's natural resources upon which people and businesses depend for well-being, prosperity and security. It includes things such as clean air and water, land, soil, biodiversity and geological resources. The total value of natural capital to society globally has been estimated to be up to $72 trillion per year according to the United Nations Environment Programme.

Natural capital costs and environmental impact data, as measured by Trucost, combine hundreds of environmental indicators related to the resources consumed to create goods or services sold, as well as the pollution and waste impacts related to the production of those goods and services, both within a company's own operations and throughout its value chain. A full description of Trucost's methodology is available later in this report.

COST OF CORPORATE NATURAL CAPITAL IMPACTS FALLS, BUT PROFIT AT RISK INTENSIFIES

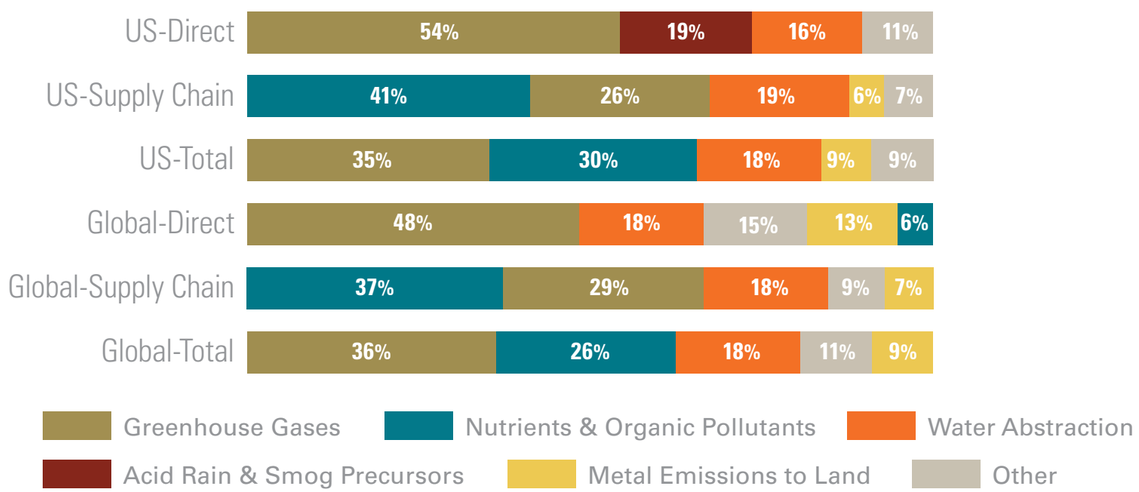
SOURCE: Trucost





GREENHOUSE GASES HAVE HIGHEST NATURAL CAPITAL COST ACROSS COMPANY OPERATIONS AND SUPPLY CHAINS

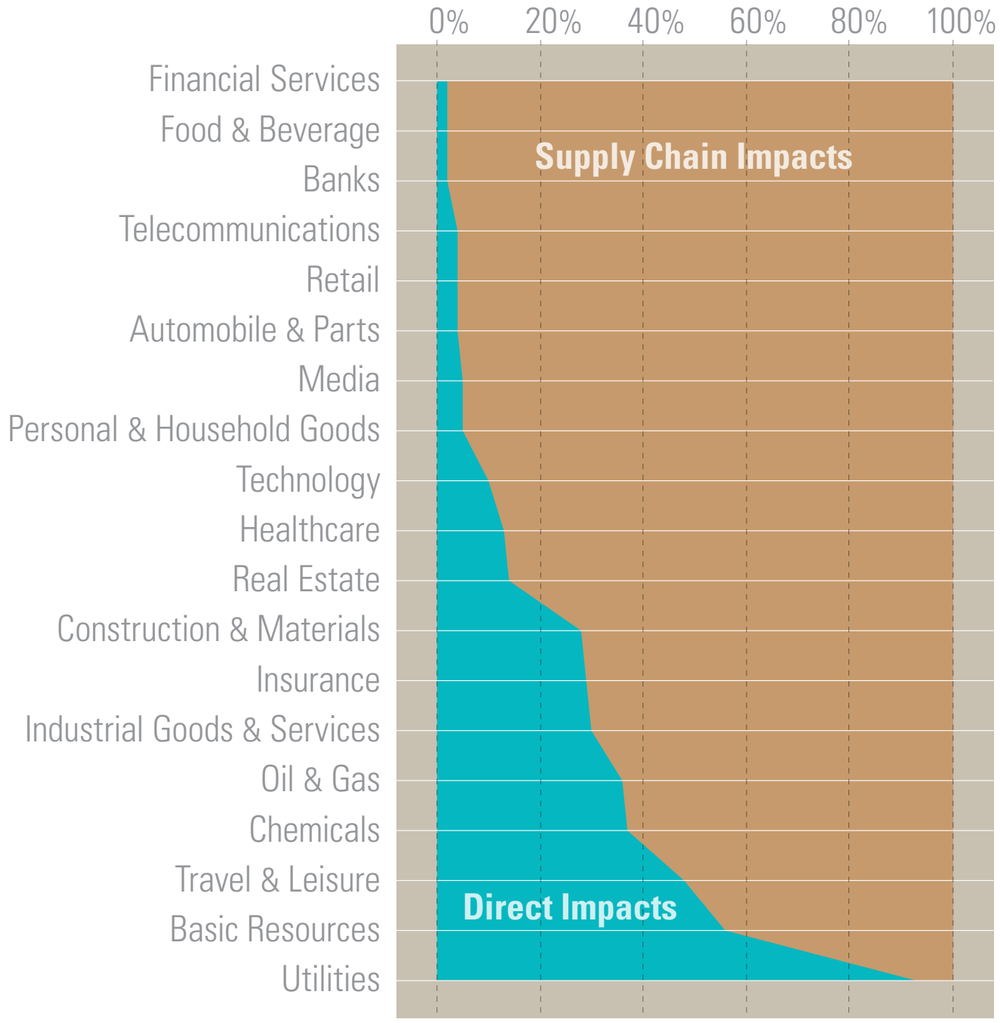
SOURCE: Trucost



FOR MOST COMPANIES, NATURAL CAPITAL RISK IS CONCEALED IN THE SUPPLY CHAIN

Where natural capital impacts occur, by sector

SOURCE: Trucost



INVESTMENTS IN GREENER
BUSINESS MODELS

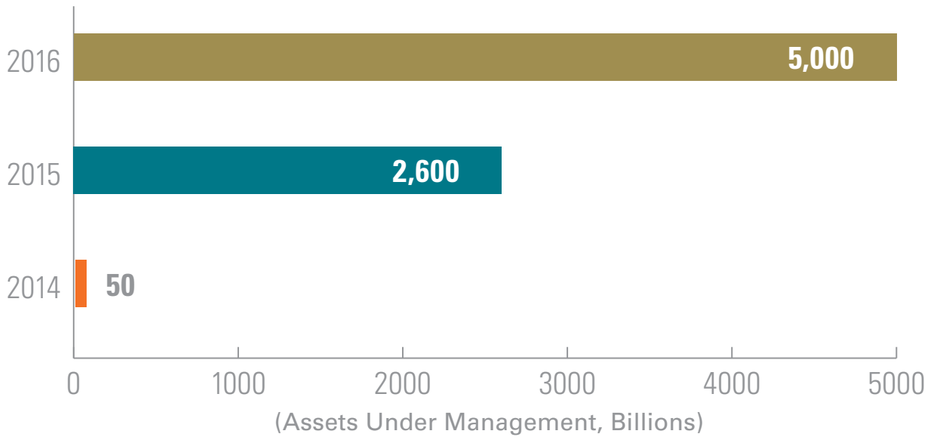
In this section, we provide a collection of metrics that illustrate how financial capital is being directed to support a low-carbon, more resource-efficient economy. This year's metrics show clear evidence of the evolution of financial markets towards greater acceptance of — and even preference for — businesses that have environmentally sustainable business models, and increased financial support for helping all companies improve their environmental performance.

Total assets invested in the United States that consider environmental issues have grown 77-fold since 2010 and now exceed $7.79 trillion. Investments focused on renewable energy generation and technology exceeded $285.9 billion in 2015, and the total value of green bonds offered to raise funds to support projects that have positive environmental benefits has grown 79-fold since 2012 and was valued at $38.4 billion in 2016.

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 are developing these as part of the United Nation's 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.

INVESTORS COMMIT TO DIVEST MORE OF THEIR HOLDINGS FROM FOSSIL FUELS

SOURCE: Arabella Advisors

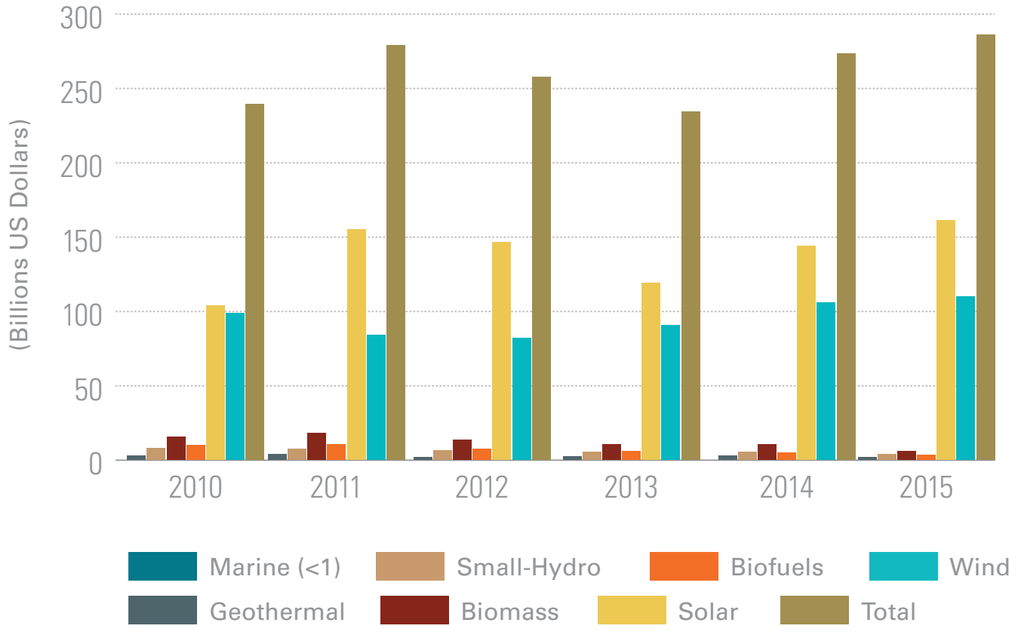


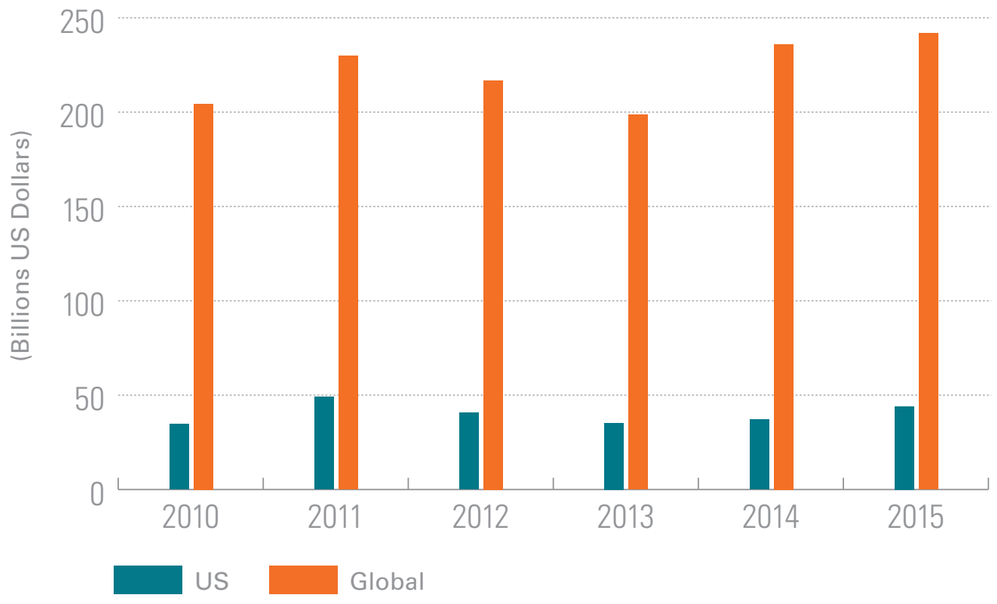
The data also shows a clear and growing shift away from businesses with unsustainable or environmentally harmful business activities. The amount of assets under management that investors have committed to divest from fossil-fuel companies reached $5 trillion in 2016 and almost doubled between September 2015 and December 2016. To date, 688 institutions and 58,399 individuals across 76 countries have committed to divest from fossil fuels motivated by both ethical and financial concerns, according to DivestInvest.

The benefits of this increased financial support for corporate sustainability is substantial and growing. Trucost estimates that the

RISING INVESTMENT IN RENEWABLE ENERGY; WIND AND SOLAR THE MAIN BENEFICIARIES

SOURCE: Trucost

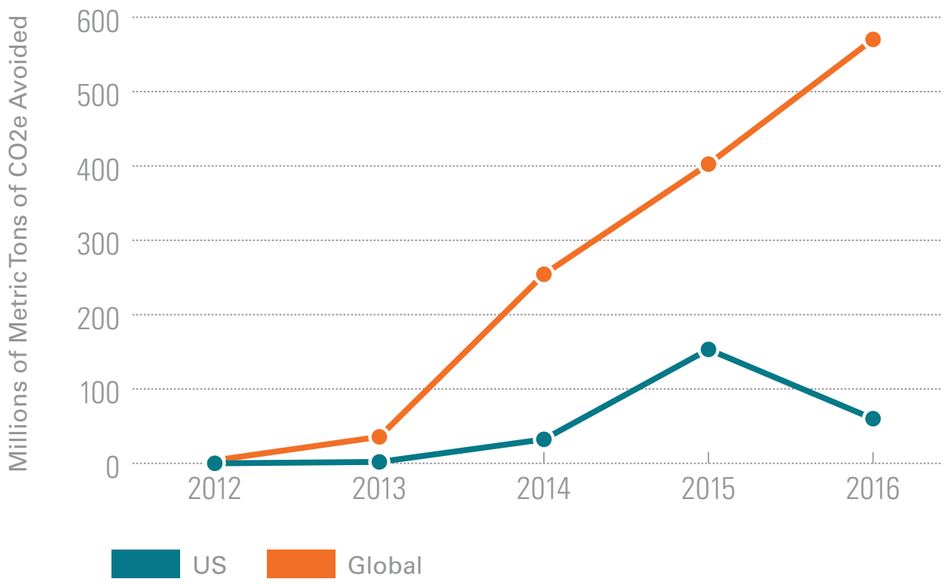




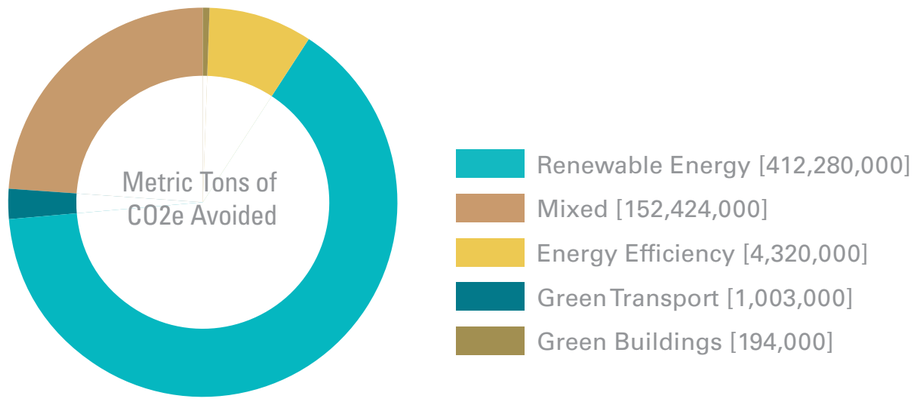
GREEN BONDS FLOURISH; SIGNIFICANT GREENHOUSE GAS REDUCTIONS FINANCED THROUGH RENEWABLE ENERGY AND ENERGY EFFICIENCY

SOURCE: Trucost

GHG emissions reductions resulting from green bonds financing



Green Bond Financed GHG Emissions



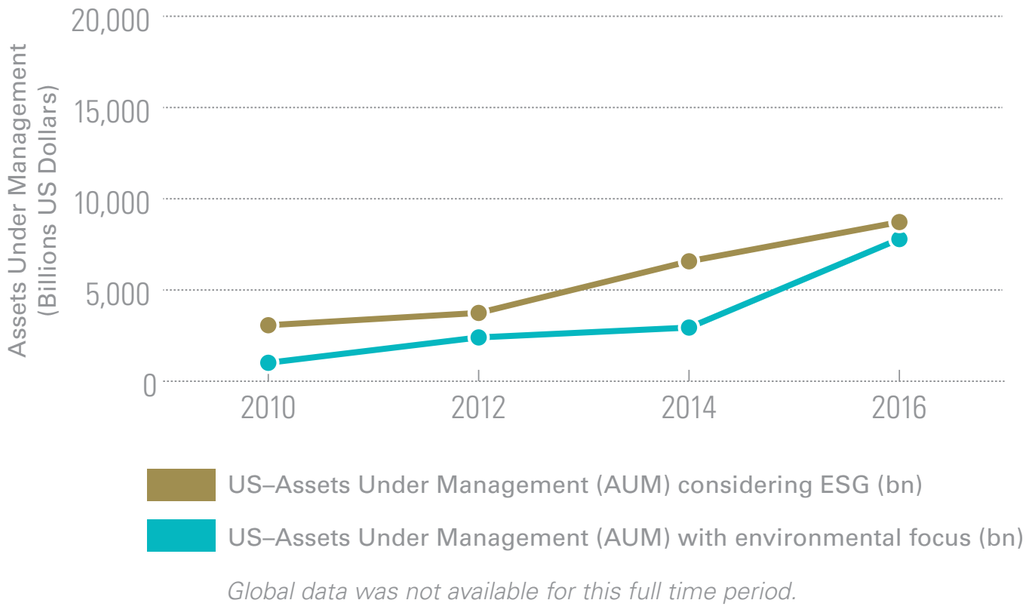
2016 Global

reduction of greenhouse gas (GHG) emissions enabled by green bond investments since 2012 will exceed 1.35 billion metric tons of GHGs over the lifetime of the projects. However, this is less than 6 percent of the reductions needed annually by 2050 to limit average global temperature increases to 2 degrees Celsius, as agreed by leaders of 195 countries at COP21 in Paris in 2015.

There is also evidence that companies are moving to internalize the cost of environmental impacts in anticipation of future regulation. More than 500 companies now have an internal price of carbon, and 150 of those companies disclose the actual price of carbon that they use. The average internal price of carbon reported is currently around $33 per metric ton of carbon dioxide equivalents, which is close to the $36 per metric ton that the U.S. government uses as an estimate of the social cost of

INVESTORS CONTINUE TO FACTOR ESG IN DECISION-MAKING; SHARP RISE IN ENVIRONMENTALLY FOCUSED STRATEGIES

SOURCE: US SIF



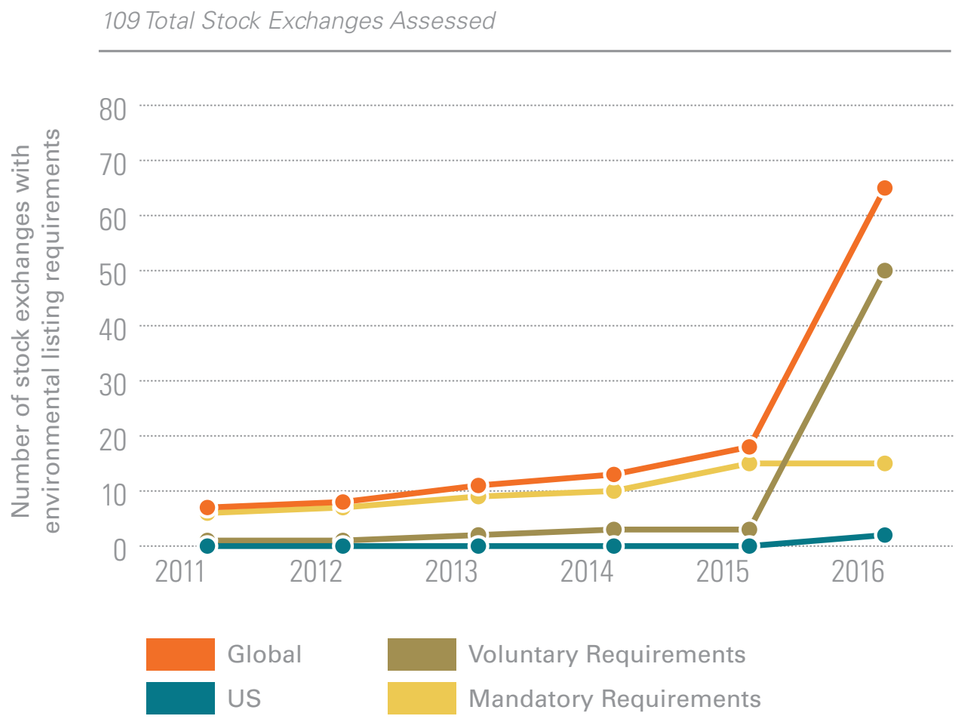
Global data was not available for this full time period.

carbon for emissions emitted in 2015 when calculating the costs and benefits of federal regulations, and is substantially more than the $10 per metric ton that is most common under regulatory systems such as carbon taxes or emission trading, as reported by the World Bank.

These metrics show that investors are encouraging more environmentally sustainable activities and that companies are beginning to respond by providing greener products and services.

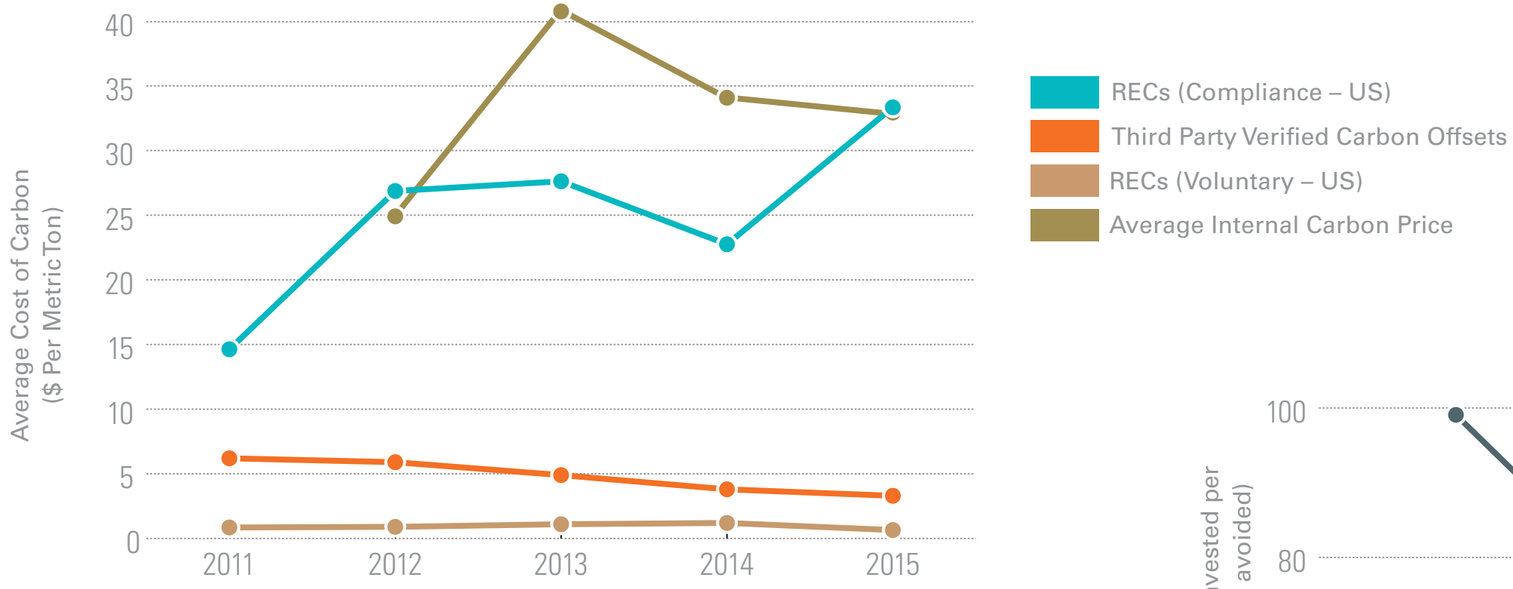
STOCK EXCHANGES DRIVE TRANSPARENCY ON ENVIRONMENTAL RISK

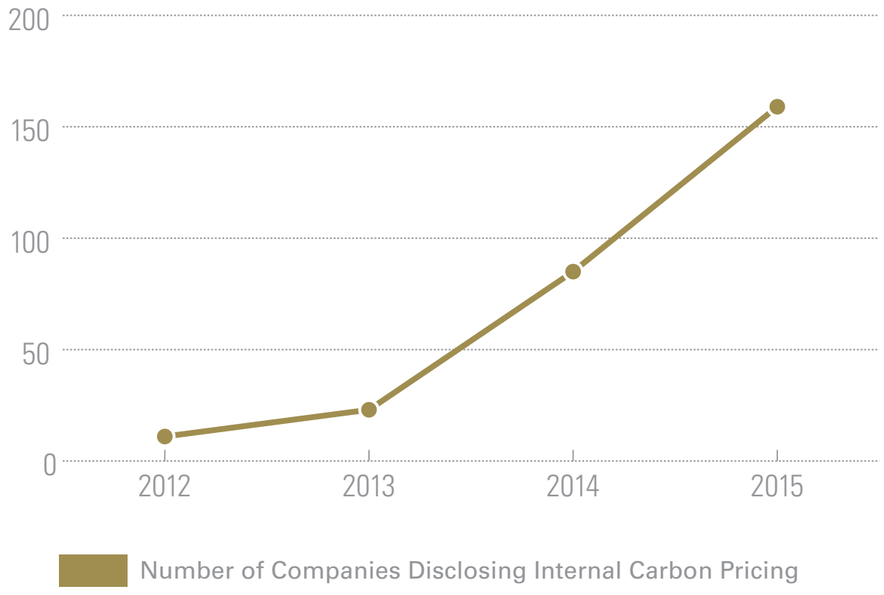
SOURCE: Trucost

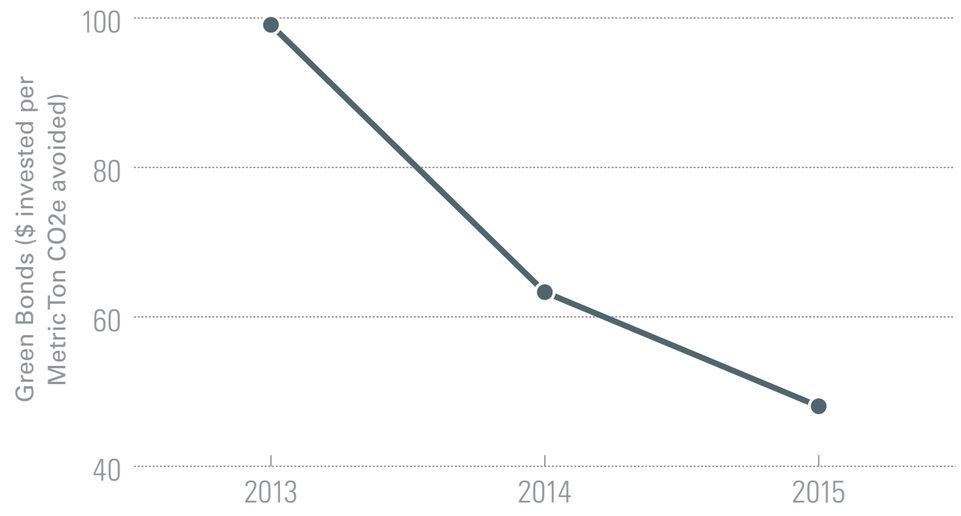


THE COST OF CARBON CONVERGES

SOURCE: Trucost







CORPORATE
PERFORMANCE

The 2017 State of Green Business Index uses greenhouse gas emissions, energy-generation mix, water use, and waste generation as key measures of the outcomes of corporate environmental sustainability initiatives. This year, we also added water pollution, measured by the total natural capital cost of the environmental impacts from heavy-metal and pesticide pollution, or from excess fertilizer use causing algal blooms.

While many of the key measures show positive reductions in 2015, this is largely the result of lower revenue. In other words, decoupling economic growth from natural resource use and pollution remains a challenge for business.

Still, corporate GHG emissions are at five-year low, down more than 10 percent since 2011. The rise of natural gas as an alternative fuel for electricity generation, replacing coal and oil, has been a major reason for this reduction, while renewables installed by utility companies remain a relatively minor component.

The use of wind, solar and hydro by utility companies has stagnated and even regressed slightly since 2011. Electric utilities and the oil and gas sector account for more than 40 percent of total GHG emissions, which highlights the importance of the transition to renewables to reducing companies' overall GHG emissions. Current GHG-reduction projects account for less than 7.5 percent of what is needed to be achieved every year between now and 2050.

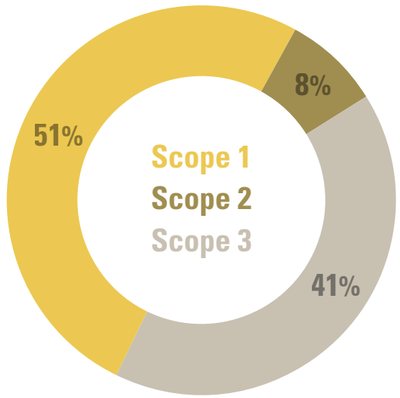
About half of the companies studied have public targets to reduce GHG emissions, but these account for only 7.3

COMPANY GREENHOUSE GAS REDUCTION TARGETS FALL SHORT: ONLY 7% OF ANNUAL REDUCTIONS REQUIRED TO MEET 2050 PLANETARY LIMITS

SOURCE: Trucost

Sources of Greenhouse Gas Emissions

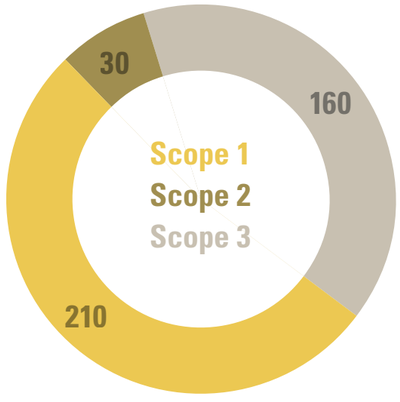
Percent of GHG emissions



2015 Global

Intensities of Greenhouse Gas Emissions

GHG Intensity: Metric tons CO2e per million dollars of revenue

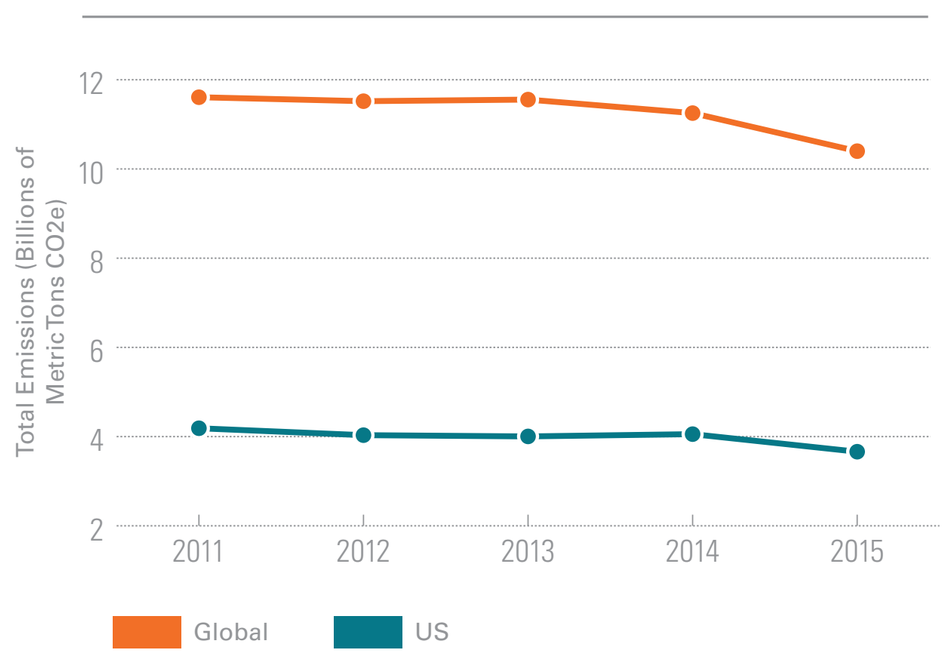


2015 Global

percent of the reductions required every year to 2050, and they likely overlap with the reductions from current projects.

In addition, most companies do not disclose their most significant sources of GHG emissions, which suggests they are not managing them. Emissions from the use of sold products, purchased goods and services and investments are the three largest contributors to Scope 3 GHG emissions and account for more than 86 percent of the indirect GHG emissions for global companies and 90 percent for U.S. companies, but less than a quarter of the companies studied reported these categories. In contrast, about half of all companies report emissions associated with business travel, which represents less than 0.25 percent of Scope 3 emissions.

Greenhouse Gas Emissions

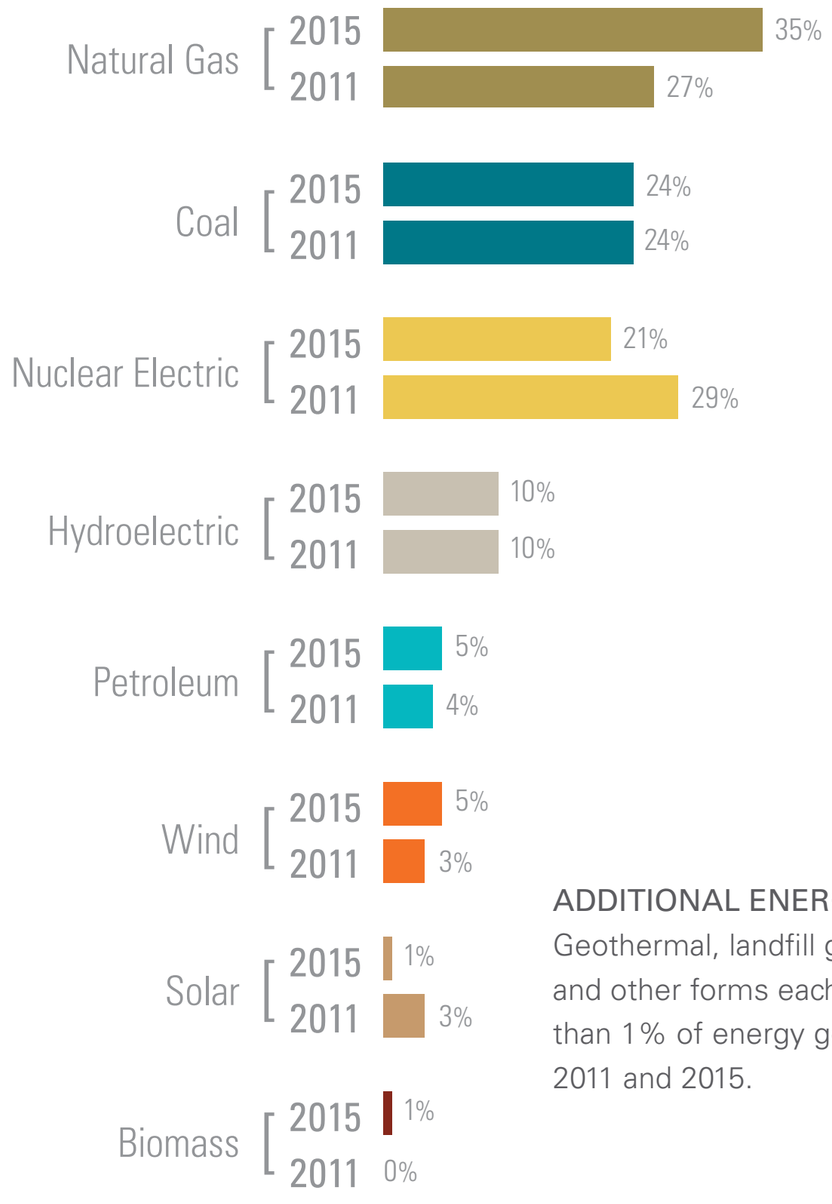


Water use within companies has followed a similar trend, down about 10 percent since 2011. Utilities make up the largest portion of corporate water use, accounting for more than 40 percent of the total, with the food and beverage sector accounting for another 13 percent. Total corporate water use over the last five years accounts for less than 0.1 percent of the total available freshwater from ground water, lakes and rivers. However, the water is not always located where it is needed.

An increasing number of companies are assessing the risks associated with water scarcity for their operations and for the products they manufacture. Almost a quarter of companies currently report on how water may pose a risk to their business, accounting for 23 percent of total corporate water use. A similar percentage have water-use reduction targets. This is a concern, as it suggests that more than three-fourths of companies may not

NATURAL GAS GAINS WHILE COAL DROPS IN ENERGY MIX

SOURCE: Trucost



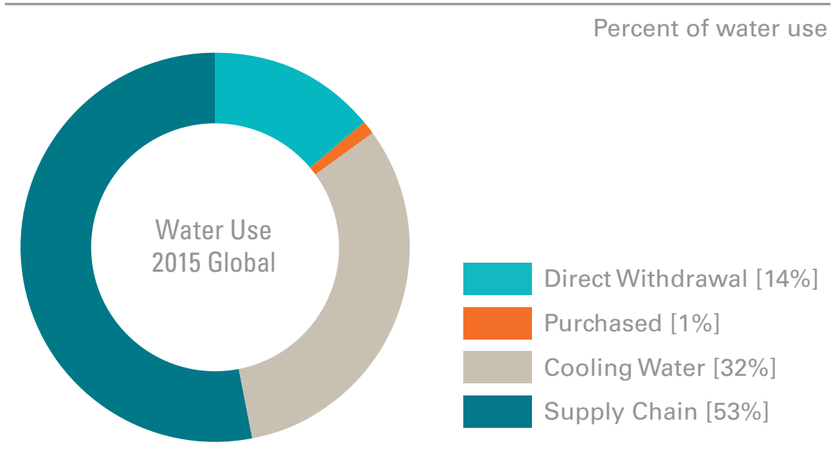
ADDITIONAL ENERGY TYPES

Geothermal, landfill gas, wave and tidal and other forms each represented less than 1% of energy generation in both 2011 and 2015.

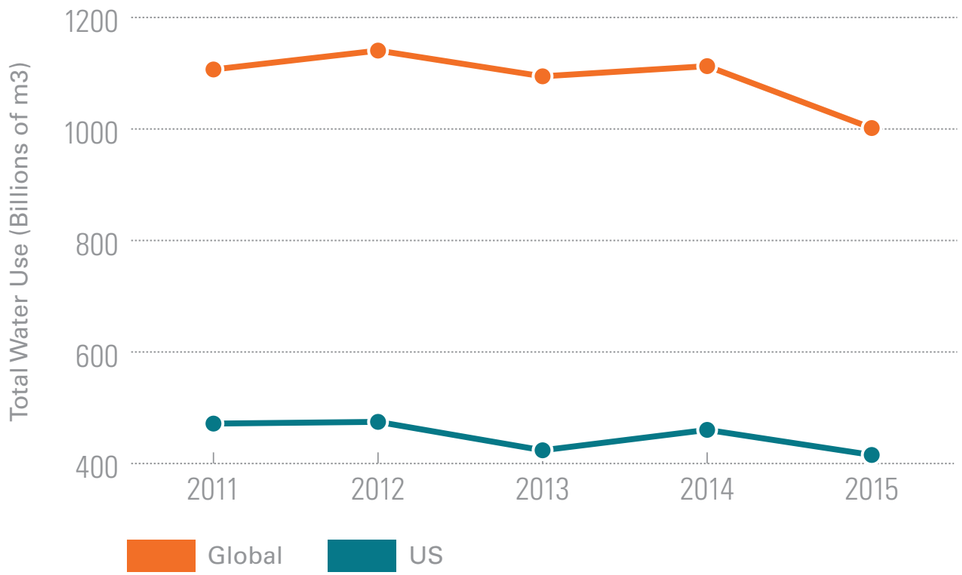
CORPORATE WATER USE DROPS, BUT MOST COMPANIES DON'T MEASURE OR MANAGE RISKS

SOURCE: Trucost

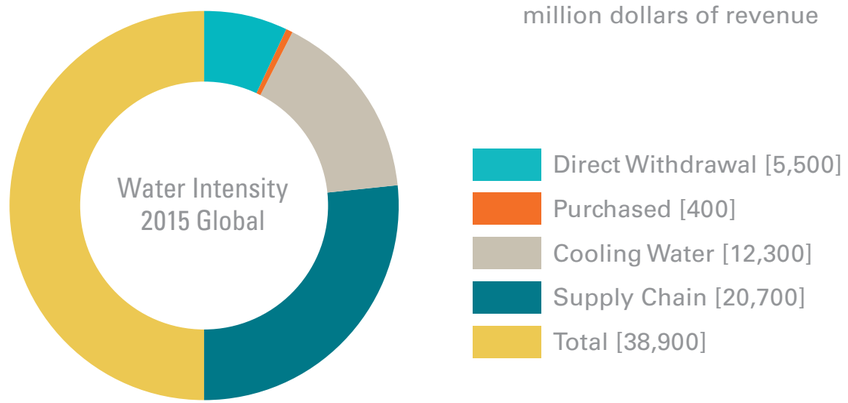
Water Use by Source



Water Use



Water Intensity by Source



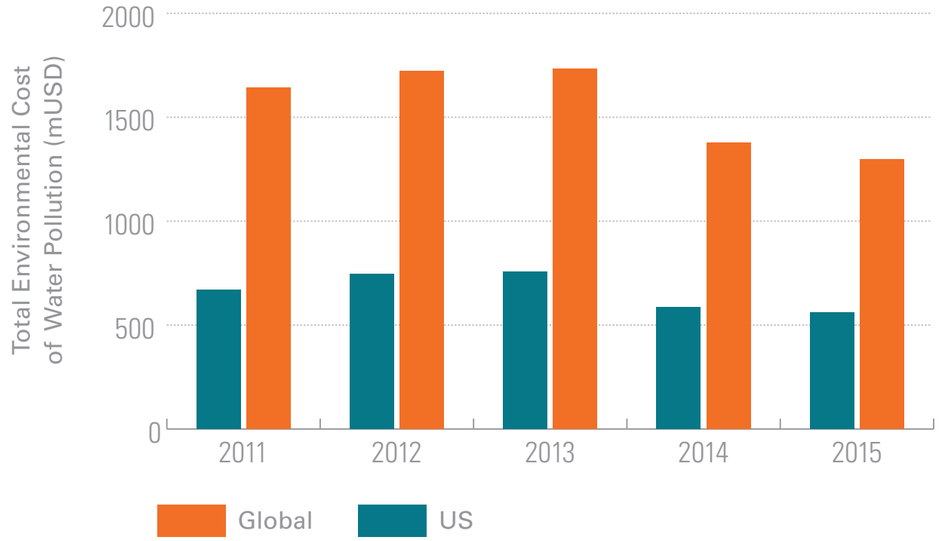
be assessing the risk of water scarcity or managing how it might impact their business operations or supply chains.

Impacts from water pollution have fallen even more quickly than GHG emissions or water use, down by more than 25 percent since their peak in 2013, but will remain a key issue, particularly as the consequences of natural gas fracking become better understood.

Total solid waste generation is down 11 percent globally. Unfortunately, this is largely in line with recent decreases in corporate revenues, suggesting that it is likely to increase again in lockstep with future corporate revenue growth.

ENVIRONMENTAL COST OF WATER POLLUTION HIGH, BUT FALLING

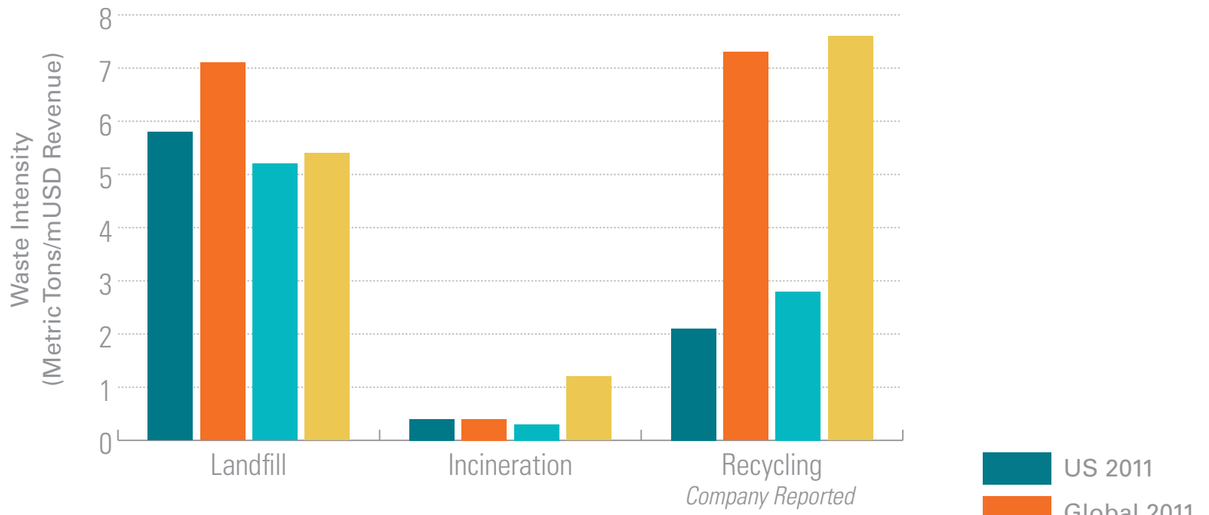
SOURCE: Trucost



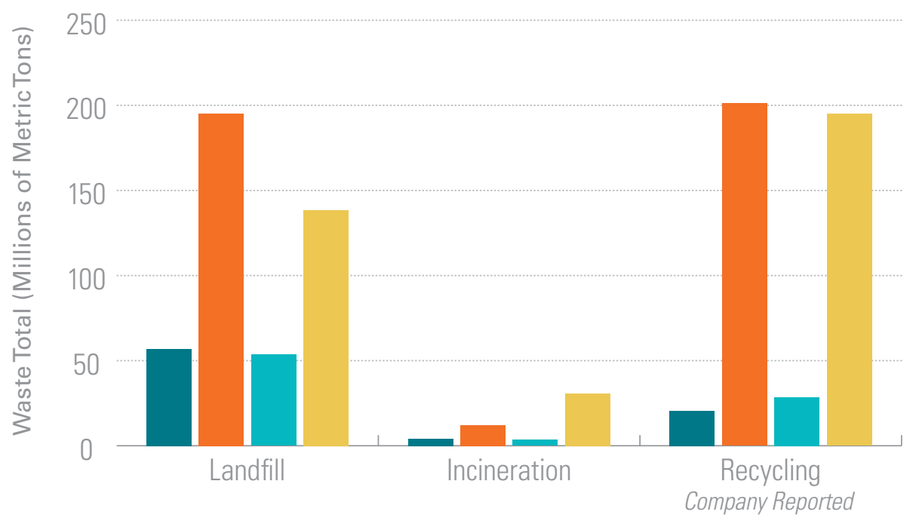
US COMPANIES LEAD ON WASTE RECYCLING, GLOBALLY WASTE INCINERATION RISES

SOURCE: Trucost

Intensity of Waste Generation — US and Global



Total Waste Generation — US and Global



CORPORATE
LEADERSHIP

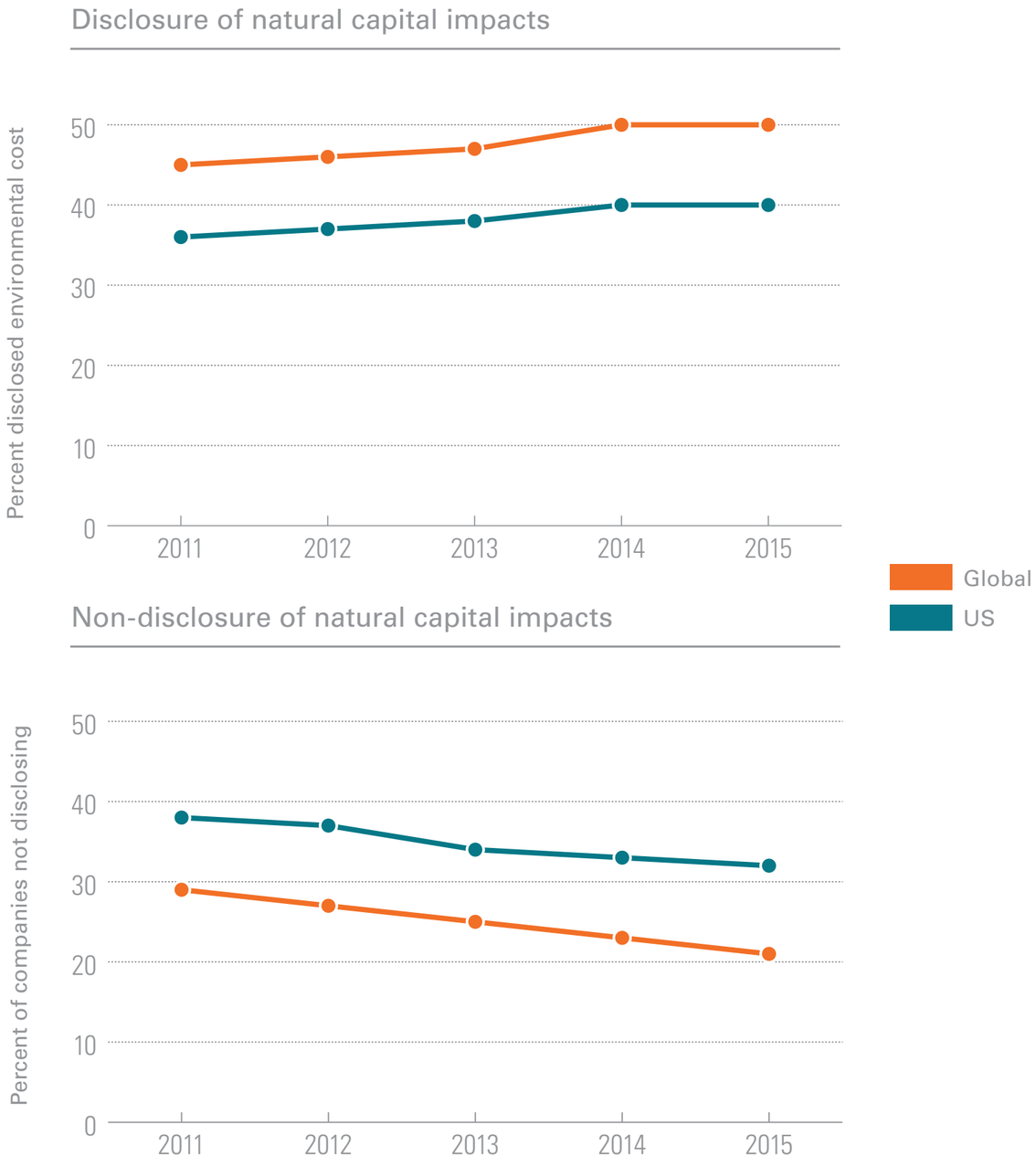
In this final section of the State of Green Business Index, we review ways companies are demonstrating leadership to transition their businesses towards more sustainable operating models, such as publicly reporting their environmental impacts, participating in initiatives to value natural capital and investing in environmental solutions and technology.

We found that about a third of U.S. companies and a fifth of global companies still do not disclose any data on their environmental impacts, representing about half of total natural capital costs borne by business. Improvements in disclosure have been slow over the last five years, raising the question: Are we reaching the limit of what is possible through voluntary disclosure?

While disclosure may be slowing, the interest of companies in understanding the value of natural capital is surging, as companies look to reduce their exposure and communicate the benefits of their operations or products. The number of companies undertaking natural capital valuations has nearly quadrupled since 2012, with the greatest efforts from the industrial goods and services sector as well as utility companies.

COMPANIES DISCLOSE LESS THAN HALF OF ENVIRONMENTAL COSTS

SOURCE: Trucost

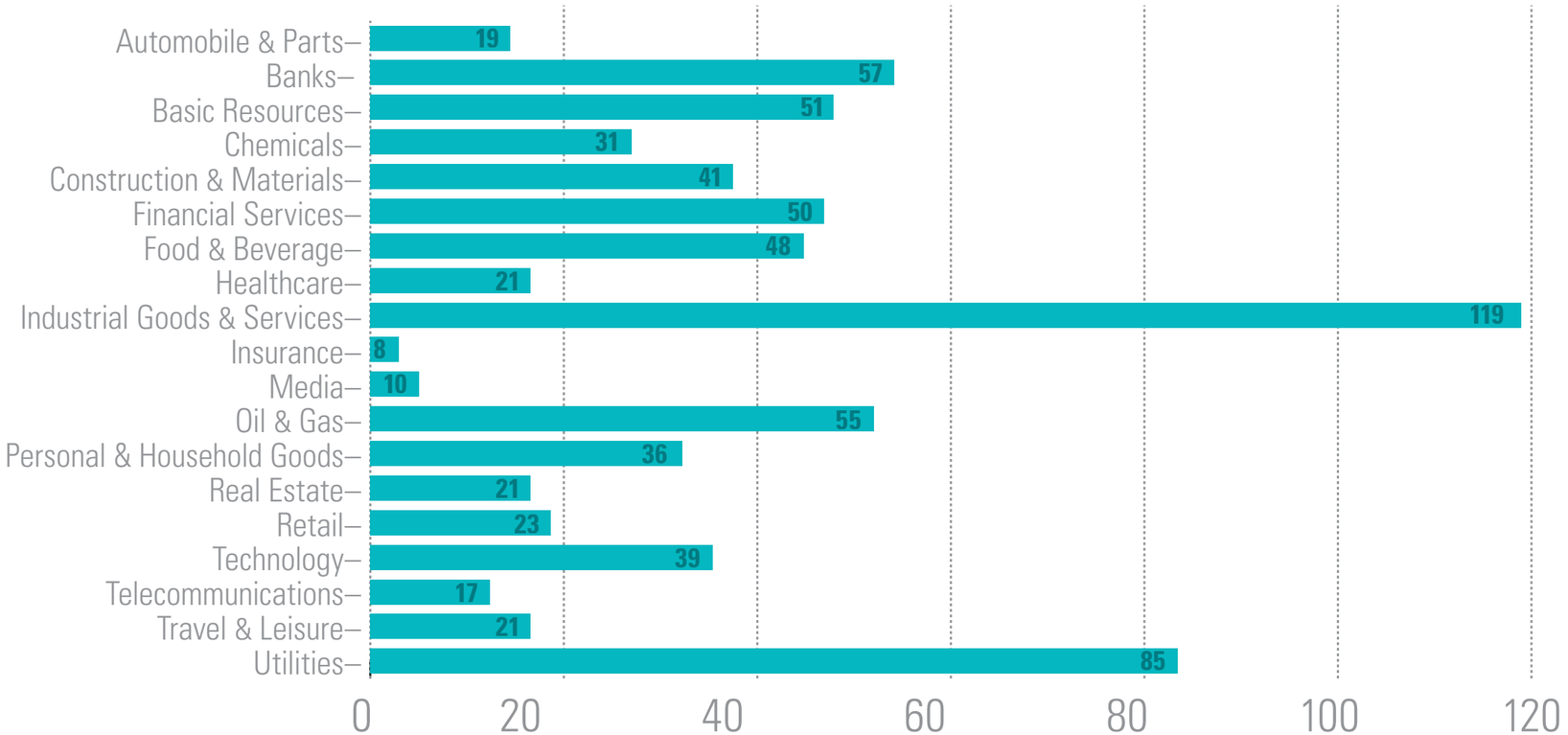


Many companies are recognizing the opportunity presented by innovative green technologies and are investing in bringing them to market. More than six in 10 of the companies studied are investing in environmental performance improvements, and more than half report that they are generating profits or savings from these improvements.

We found that business involvement in these leadership activities is widespread and increasing, a positive indicator for the transition of their businesses toward sustainability. Time will tell if these efforts lead to absolute reductions in pollution and resource use.

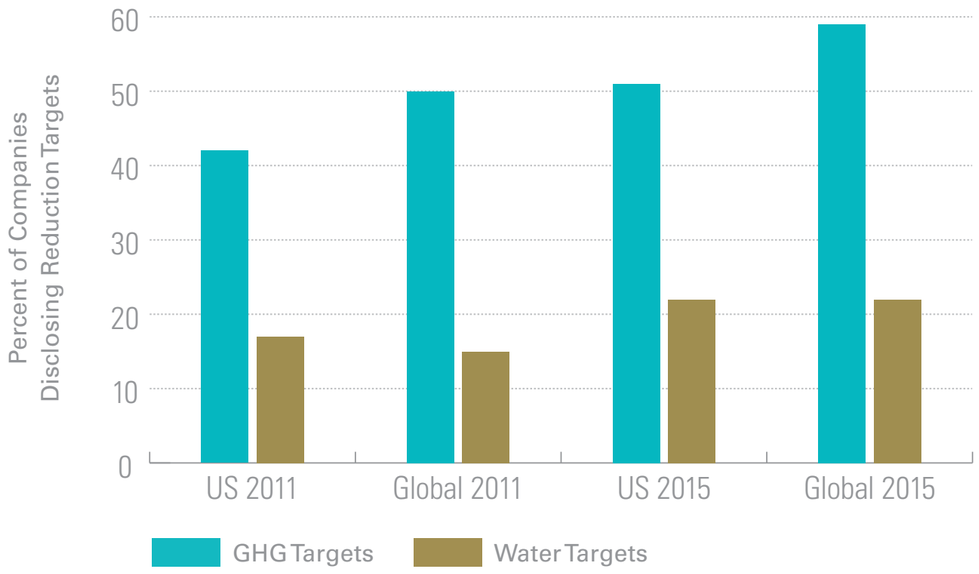
MORE COMPANIES PARTICIPATE IN NATURAL CAPITAL ACTIVITIES

SOURCE: Trucost



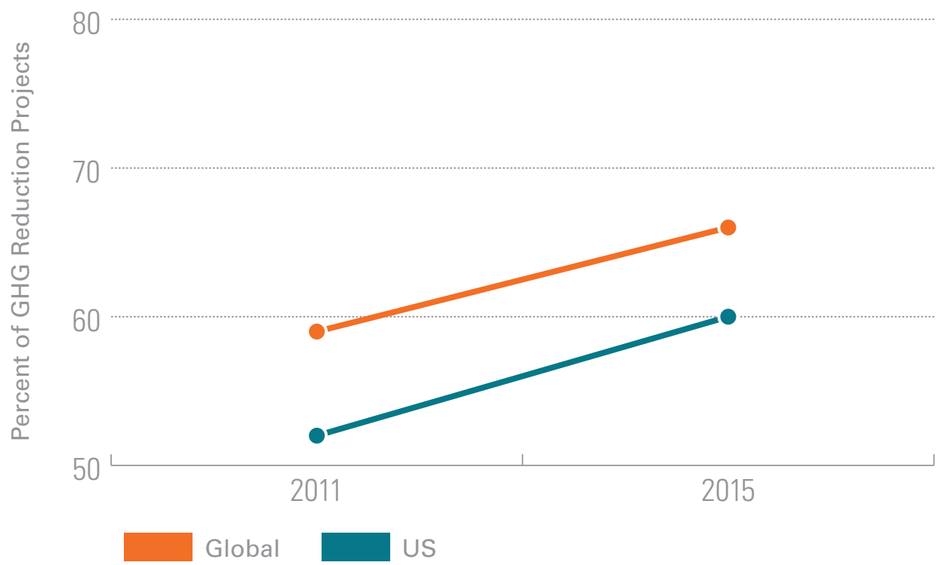
STEADY PROGRESS ON TARGET SETTING, BUT FAR FEWER COMPANIES SET WATER REDUCTIONS

SOURCE: Trucost



TWO THIRDS OF COMPANIES GLOBALLY HAVE GREENHOUSE GAS MANAGEMENT INITIATIVES

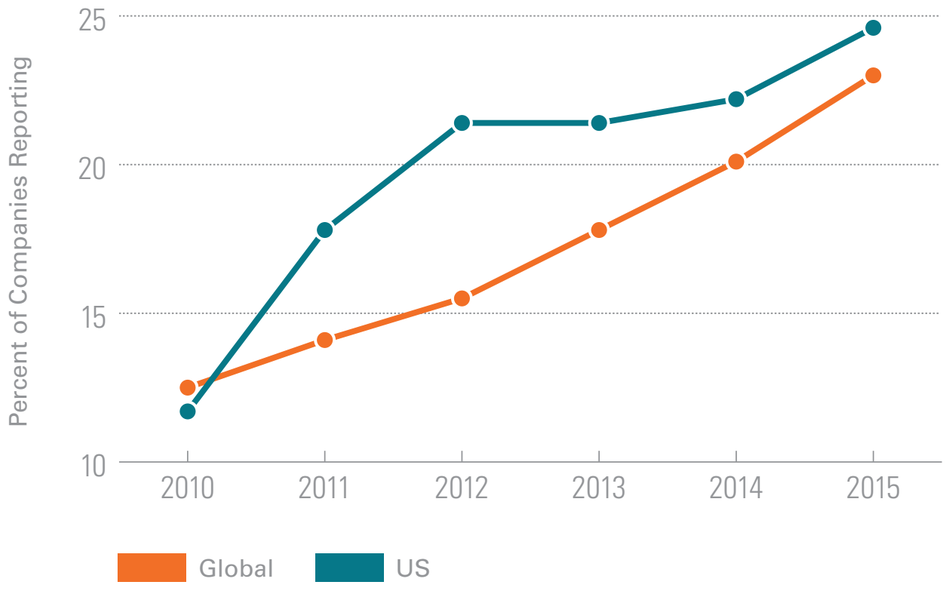
SOURCE: Trucost



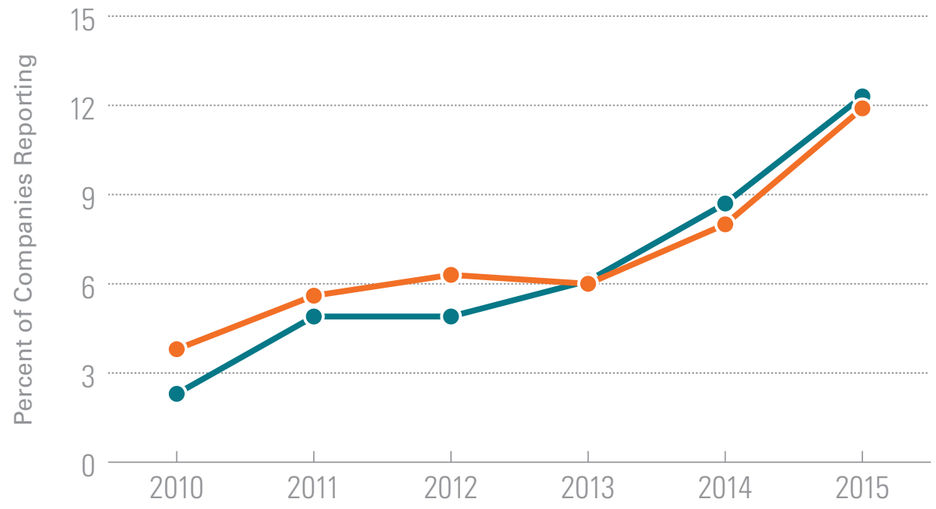
MORE COMPANIES REPORT ON WATER RISK; ACROSS OPERATIONS AND SUPPLY CHAINS

SOURCE: Trucost

Reporting on Water Risk

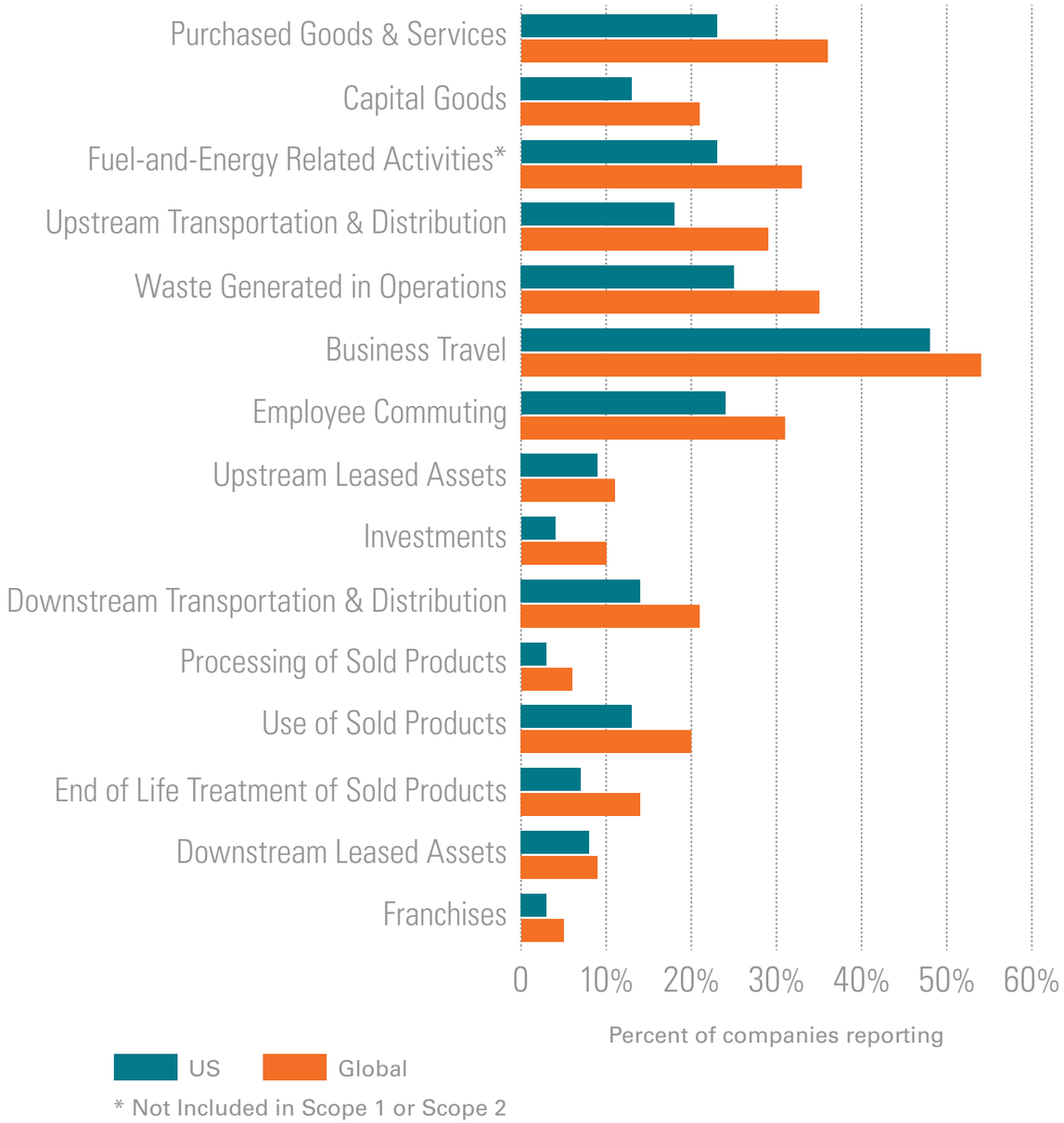


Reporting on Awareness of Supply Chain Water Risk



COMPANIES FAIL TO DISCLOSE MOST SIGNIFICANT SOURCES OF GREENHOUSE GAS EMISSIONS

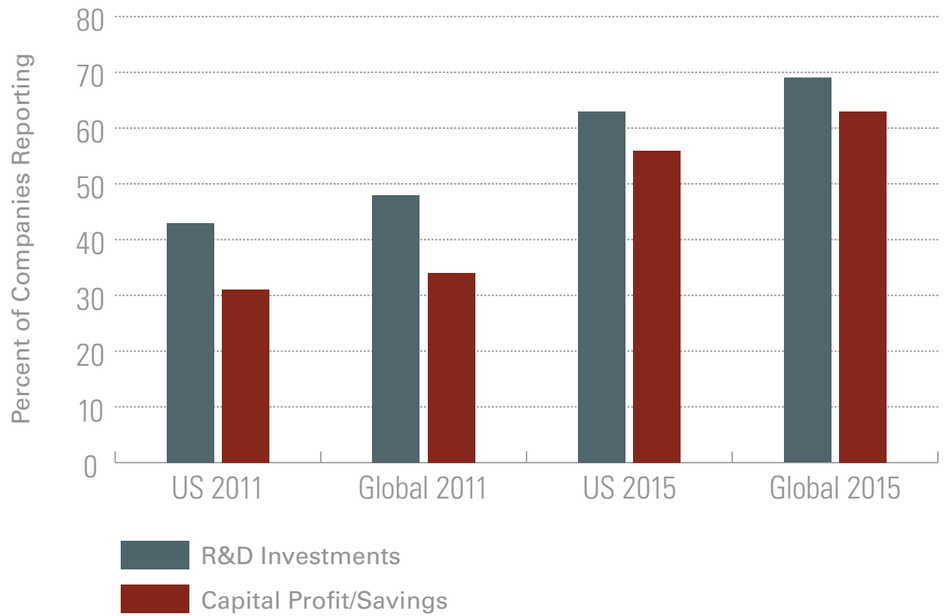
SOURCE: Trucost



* Not Included in Scope 1 or Scope 2

GROWING TREND TOWARDS DISCLOSURE OF NATURAL CAPITAL INVESTMENT AND PROFIT

SOURCE: Trucost



VERGE

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METHODOLOGY

The State of Green Business Index is derived 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 companies' 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 2017 edition of this report, 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 accounting for the environmental performance of more than 12,000 companies worldwide, representing 93 percent of global markets by market capitalization. The 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 2017 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 to 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 includes first-tier suppliers from which the company directly buys, and extends all the way back to the suppliers of raw materials. In this way, Trucost can calculate the cost of supply-chain impacts back to the well, mine, forest or other source of raw material.

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 of 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 not reflected in the market prices of goods and services. 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.

Applying 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.

For the 2017 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. A natural-capital cost — the monetary cost of environmental damage — 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**

ABOUT GreenBiz

GreenBiz Group is a media and events company advancing opportunities at the intersection of business, technology and sustainability. Through its websites, conferences, membership network and research, GreenBiz Group promotes the potential to drive transformation and accelerate progress — within companies, industries and in the very nature of business.

GreenBiz.com provides intelligent, focused content on business, technology and sustainability for professionals from every industry and discipline. Since 1991, GreenBiz Group has chronicled and been a catalyst for aligning environmental responsibility with profitable business practices.

The GreenBiz conference series, held each February in Phoenix, Arizona, offers an unparalleled look into the pressing challenges, emerging trends and largest opportunities in sustainable business today.

The VERGE conference series explores the latest technologies, tools and trends accelerating the clean economy.

The GreenBiz Executive Network is a member-based, peer-to-peer learning forum for nearly 100 sustainability executives from the world's largest companies. Its unique combination of expertly facilitated meetings and resource sharing enables members to benefit from the insights of their peers across a wide range of topics and sectors.

GreenBiz research produces insights on a wide range of topics related to business, technology and sustainability, including the annual State of Green Business report. GreenBiz also produces custom research reports for corporate clients, by conducting monthly surveys of the GreenBiz Intelligence Panel.

www.greenbiz.com.

ABOUT TRUCOST PLC

Trucost helps companies and investors to achieve success by understanding environmental issues in business terms. Our data-driven insights enable organizations to manage risks and identify opportunities for growth.

We are the world's leading experts in quantifying and valuing the environmental impacts of operations, supply chains, products and financial assets. By putting a monetary value on pollution and resource use, we integrate the environment into business and investment decisions.

With offices in Europe, the United States and Asia, Trucost works with businesses worldwide to increase revenues, improve communications, meet marketplace expectations and comply with regulatory requirements.

www.trucost.com

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Cost of corporate natural capital impacts

(Million U.S. dollars)

	2011	2012	2013	2014	2015
U.S.	$1,521,000	$1,620,000	$1,650,000	$1,502,000	$1,384,000
Global	$3,920,000	$4,102,000	$4,140,000	$3,712,000	$3,447,000

Source: Trucost data

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Profit at risk from natural capital impacts					
	2011	2012	2013	2014	2015
U.S.	183%	192%	174%	161%	172%
Global	186%	206%	188%	180%	211%
Source: Trucost data					

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Where natural capital impacts occur in the value chain		
	Direct	**Supply Chain**
Financial Services	2%	98%
Food & Beverage	2%	98%
Banks	2%	98%
Telecommunications	4%	96%
Retail	4%	96%
Automobiles & Parts	4%	96%
Media	5%	95%
Personal & Household Goods	5%	95%
Technology	10%	90%
Healthcare	13%	87%
Real Estate	14%	86%
Construction & Materials	28%	72%
Insurance	29%	71%
Industrial Goods & Services	30%	70%
Oil & Gas	36%	64%
Chemicals	37%	63%
Travel & Leisure	48%	52%
Basic Resources	56%	44%
Utilities	93%	7%

Source: Trucost data

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Largest natural capital impacts								
	Impact 1		**Impact 2**		**Impact 3**		**Impact 4**	
U.S.								
Direct	Greenhouse Gases	54%	Water Abstraction	16%	Acid Rain and Smog Precursors	15%	Acid Rain and Smog Precursors	4%
Supply Chain	Nutrients and Organic Pollutants	41%	Greenhouse Gases	26%	Water Abstraction	19%	Metal Emissions to Land	6%
Total	Greenhouse Gases	35%	Nutrients and Organic Pollutants	30%	Water Abstraction	18%	Metal Emissions to Land	9%
Global								
Direct	Greenhouse Gases	48%	Water Abstraction	18%	Metal Emissions to Land	13%	Nutrients and Organic Pollutants	6%
Supply Chain	Nutrients and Organic Pollutants	37%	Greenhouse Gases	29%	Water Abstraction	18%	Metal Emissions to Land	7%
Total	Greenhouse Gases	36%	Nutrients and Organic Pollutants	26%	Water Abstraction	18%	Metal Emissions to Land	9%

Source: Trucost data.

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Fossil Fuel Divestment

Number of investors participating and total value of assets under management in fossil fuel divestment

	2014	2015	2016
Amount ($bn)	50	2,600	5,000

Source: Arabella Advisors

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Low Carbon Investment		
New investment commitments for Renewable Energy (technology development, equipment manufacturing, or projects) by type ($bn)	**2010**	**2015**
Wind	98.9	109.6
Solar	103.7	161
Biofuels	10.1	3.1
Biomass & Waste-To-Energy	15.7	6
Small Hydro	7.9	3.9
Geothermal	2.8	2
Marine	0.3	0.2
Total	239.2	285.9

Low Carbon Investment		
New investment commitments for Renewable Energy (technology development, equipment manufacturing, or projects) by Geography ($bn)	**2010**	**2015**
United States	34.7	44.1
Global	204.5	241.8

Source: Global trends in renewable energy investment.
United Nations Environment Programme (UNEP) (2016).

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Green Bond Financing

GHG emissions reductions resulting from green bonds financing

Metric tons of CO2e avoided	2012	2013	2014	2015
US	0	1,894,000	32,282,000	153,208,000
Global	4,037,000	35,605,000	254,299,000	402,443,000

Source: Arabella Advisors

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Green Bond Financing

Global GHG emissions reductions resulting from green bonds financing by bond purpose type

(Millions of US Dollars)	**2014**
Green buildings	194,000
Energy efficiency	4,320,000
Renewable energy	412,280,000
Green transport	1,003,000
Mixed	152,424,000

Source: Trucost

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Investor use of corporate environmental data

Global data wasn't available for this full time period

Total number of funds/AUM considering ESG in their investments	2010	2012	2014	2016
US	3,069	3,743	6,572	8,723
Total AUM being invested using environmental focused strategies	**2010**	**2012**	**2014**	**2016**
US	101	240	2,940	7,790

Source: Source: US SIF (U.S.); Global Sustainable Investment Alliance (Global)

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Number of Stock Exchanges

Number of stock exchanges with environmental listing requirements

	2011	2012	2013	2014	2015	2016
US	0	0	0	0	0	0
Global	7	8	11	13	18	65
Voluntary requirements	1	1	2	3	3	50
Mandatory requirements	6	7	9	10	15	15

Source: US SIF (U.S.); Global Sustainable Investment Alliance (Global)

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Carbon Pricing

Average annual cost of carbon ($ per metric ton)

	2011	2012	2013	2014	2015
RECs (voluntary - US)	$0.85	$0.9	$1.1	$1.2	$0.65
RECs (compliance - US)	$ 14.63	$26.87	$27.62	$22.75	$33.34
Third-party verified carbon offsets ($ per ton)	$6.2	$5.9	$4.9	$3.8	$3.3

Source: Trucost

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Carbon Pricing

	2011	2012	2013	2014	2015
Number of companies disclosing their internal carbon price	-	11	23	85	159

Source: Trucost

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Carbon Pricing

	2011	2012	2013	2014	2015
Green bonds ($ invested per ton avoided)	-	-	$99.08	$63.31	$48.04

Source: Trucost

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GHGs emissions and percentages by scope					
Total emissions (million metric tons)					
	2011	**2012**	**2013**	**2014**	**2015**
U.S.	4,187	4,032	4,004	4,055	3,661
Global	11,608	11,519	11,555	11,252	10,399
Percent of emissions					
U.S.	**2011**	**2012**	**2013**	**2014**	**2015**
Scope 1	49%	48%	48%	49%	50%
Scope 2	8%	8%	8%	8%	9%
Scope 3	43%	44%	44%	42%	42%
Global					
Scope 1	47%	48%	47%	49%	51%
Scope 2	8%	8%	8%	8%	8%
Scope 3	45%	44%	44%	43%	41%

Source: Trucost

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GHGs intensity by scope

Metric tons CO2e per million dollars of revenue

U.S.	2011	2012	2013	2014	2015
Scope 1	210	190	190	190	180
Scope 2	40	30	30	30	30
Scope 3	180	180	170	160	150
TOTAL	420	400	390	380	360
Global					
Scope 1	200	200	190	190	210
Scope 2	30	30	30	30	30
Scope 3	190	180	180	170	160
TOTAL	420	410	410	400	400

Source: Trucost

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Global Energy Mix

Electiricty mix of large cap Global benchmarks

	2011	2012	2013	2014	2015
Natural Gas	27%	32%	31%	32%	35%
Coal	24%	24%	25%	25%	24%
Nuclear	29%	22%	21%	22%	21%
Hydroelectric	10%	11%	11%	10%	10%
Petroleum	4%	6%	7%	6%	5%
Wind	3%	3%	3%	4%	5%
Solar	3%	0%	0%	0%	1%
Biomass	0%	1%	0%	1%	1%
Geothermal	0%	0%	0%	0%	0%
Other Electric	0%	0%	0%	0%	0%
Wave & Tidal	0%	0%	0%	0%	0%
Landfill Gas	0%	0%	0%	0%	0%

Source: Trucost

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Water use

Million cubic meters

U.S.	2010	2011	2012	2013	2014
Direct withdrawal (surface/ground)	36,246	38,632	32,921	27,580	36,744
Purchased (municipality)	3,754	3,062	3,174	3,338	3,253
Cooling water	171,521	177,229	169,297	171,450	154,913
Supply chain	231,161	232,855	253,198	266,737	243,005
TOTAL	442,682	451,778	458,590	469,105	437,915
Global					
Direct withdrawal (surface/ground)	89,067	103,969	114,780	112,854	117,220
Purchased (municipality)	9,568	9,550	9,052	9,534	9,073
Cooling water	446,982	463,615	470,815	486,131	428,773
Supply chain	658,307	687,500	747,817	757,077	694,778
TOTAL	1,203,924	1,264,634	1,342,464	1,365,596	1,249,844

Source: Trucost data

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Water use Percentage by scope	
Global	**2015**
Direct withdrawal (surface/ground)	14%
Purchased (municipality)	1%
Cooling water	32%
Supply chain	53%

Source: Trucost data

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Water intensity

Water Intensity by Scope
(m3/mUSD revenue)

Global	**2015**
Direct withdrawal (surface/ground)	5,500
Purchased (municipality)	400
Cooling water	12,300
Supply chain	20,700
TOTAL	38,900

Source: Trucost data

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Water use

Total Water Use (m3)

	2010	2011	2012	2013	2014
U.S. Total	471,600,000,000	474,705,000,000	423,713,000,000	460,332,000,000	415,342,000,000
Global Total	1,106,667,000,000	1,140,575,000,000	1,094,397,000,000	1,112,695,000,000	1,001,634,000,000

Source: Trucost data

Water quality

Total environmental cost of water impacting pollution (mUSD)

	2011	2012	2013	2014	2015
U.S.	$668,000	$747,000	$756,000	$585,000	$561,000
Global	$1,641,000	$1,723,000	$1,733,000	$1,376,000	$1,297,000

Source: Trucost data

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Waste intensity

Metric tons per million dollars revenue

U.S.	2011	2012	2013	2014	2015
Landfill	5.8	5.4	5.4	5.5	5.2
Incineration	0.4	0.4	0.4	0.3	0.3
Company-reported recycling	2.1	2.3	2.5	2.7	2.8
Global					
Landfill	7.1	8.7	7.0	6.0	5.4
Incineration	0.4	0.4	0.4	0.4	1.2
Company-reported recycling	7.3	7.0	6.7	7.4	7.6

Source: Trucost data

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Waste generation

Million Metric tons

U.S.	2011	2012	2013	2014	2015
Landfill	568,000	54,100	55,900	57,700	53,500
Incineration	4,200	3,700	3,800	3,400	3,500
Company-reported recycling	20,500	22,700	25,800	28,000	28,600
Global					
Landfill	195,100	242,600	200,200	169,600	138,500
Incineration	12,200	11,800	12,100	10,900	30,600
Company-reported recycling	201,200	196,000	192,100	208,000	194,900

Source: Trucost data

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Disclosure of natural capital impacts

(Disclosed Environmental Cost USD/ Total Environmental Cost USD)

	2011	2012	2013	2014	2015
U.S.	36%	37%	38%	40%	40%
Global	45%	46%	47%	50%	50%
Companies Disclosing No Environmental Impact Data					
U.S.	38%	37%	34%	33%	32%
Global	29%	27%	25%	23%	21%

Source: Trucost data

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Participation in natural capital valuation initiatives

Number of participating companies

Automobiles & Parts	19
Banks	57
Basic Resources	51
Chemicals	31
Construction & Materials	41
Financial Services	50
Food & Beverage	48
Healthcare	21
Industrial Goods & Services	119
Insurance	8
Media	10
Oil & Gas	55
Personal & Household Goods	36
Real Estate	21
Retail	23
Technology	39
Telecommunications	17
Travel & Leisure	21
Utilities	85
TOTAL	752

Source: Trucost data

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Total Companies With GHG Reduction Targets		
	2011	**2015**
U.S.	42%	51%
Global	50%	59%

Total Companies With Water Use Reduction Targets		
	2011	**2015**
U.S.	17%	22%
Global	15%	22%

Source: Trucost data

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GHG reduction projects*

Number of companies with active emissions reduction projects and initiatives

	2011	2015
U.S.	52%	60%
Global	59%	66%

Source: Trucost data

*Total annual GHGs savings associated with the reduction projects in 2015 for the 752 global companies = 395,900,000 metric t CO2e

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Reporting of water risk						
Reporting on general water risk						
	2010	**2011**	**2012**	**2013**	**2014**	**2015**
Global	11.7%	17.8%	21.4%	21.4%	22.2%	24.6%
U.S.	12.5%	14.1%	15.4%	17.8%	20.1%	23.0%
Reporting on awareness of supply-chain water risk						
Global	2.3%	4.9%	4.9%	6.1%	8.7%	12.3%
U.S.	3.8%	5.6%	6.3%	6.0%	8.0%	11.9%

Source: Trucost data

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Value Chain Environmental Performance

Number/percent of companies disclosing each of the 15 GHG scope 3 categories in 2015

	U.S.	Global
Purchased goods and services	23%	36%
Capital goods	13%	21%
Fuel-and-energy-related activities (not included in Scope 1 or 2)	23%	33%
Upstream transportation and distribution	18%	29%
Waste generated in operations	25%	35%
Business travel	48%	54%
Employee commuting	24%	31%
Upstream leased assets	9%	11%
Investments	4%	10%
Downstream transportation and distribution	14%	21%
Processing of sold products	3%	6%
Use of sold products	13%	20%
End of life treatment of sold products	7%	14%
Downstream leased assets	8%	9%
Franchises	3%	5%

Source: Trucost data

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Reporting of natural capital R&D or Investments					
Number of Companies					
	2011	**2012**	**2013**	**2014**	**2015**
U.S.	203	219	231	242	297
Global	546	584	619	644	789
Percent of Companies					
U.S.	43%	48%	49%	51%	63%
Global	48%	51%	54%	56%	69%

Source: Trucost data

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