

STATE OF GREEN BUSINESS 2016

By Joel Makower and the editors of GreenBiz.com

GreenBiz





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INTRODUCTION

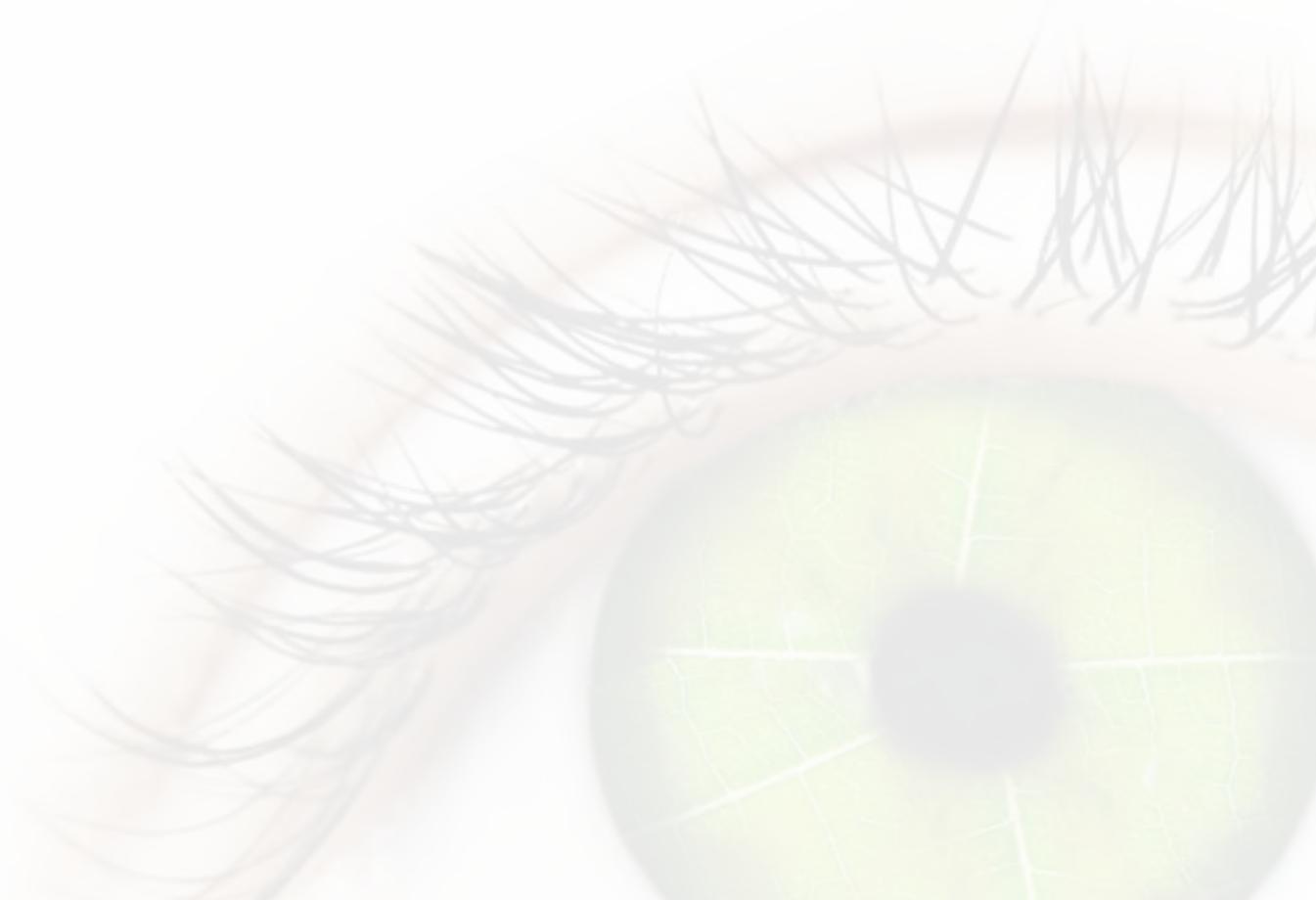
Joel Makower, Chairman & Executive Editor, GreenBiz Group

Our ninth annual State of Green Business report, produced in partnership with Trucost, continues our tradition of taking the pulse of corporate progress in sustainability, in the United States and around the world. It looks at both common measures (energy, waste and carbon) and some less-common ones (corporate reporting of natural capital profit or savings, for example, or companies' low-carbon investments) over the past five years).

Compiling these, along with naming 10 trends we think are worth watching in the year ahead, allows us to step back from our week-in, week-out coverage and analysis of sustainable business and clean technology developments to assess progress, or lack thereof.

That perspective is particularly important as we emerge from the success of COP21, including the Paris Agreement that resulted. It sets a course for companies and nations to transition to what some call the "low-carbon economy" — a diverse array of innovations and business and financing models that accelerate markets for clean energy, electrified transportation, advanced materials, water-efficient processes and many other things that will enable the world's citizens to simultaneously live the good life and improve the lot of their children and all who follow.

It's an exciting time to be in business, from the perspective of innovation that can improve people's lives while addressing some of the planet's most pressing challenges — and making a good profit in the process. That's the promise of sustainable business that we're pleased to track and illuminate through our editorial, events and research offerings at GreenBiz Group, and which is the basis for the pages that follow. 





FOREWORD

Dr. Richard Mattison, CEO, Trucost

Last year, in the [2015 State of Green Business](#), we addressed an elephant in the room.

We called it sustainable growth.

At the time the trend was alarming. The largest 500 U.S. companies' natural capital costs — the unpaid cost to the economy from pollution, natural resource depletion and related health costs — were up 22 percent since the economic downturn. For more than 1,600 companies listed on the MSCI World Index, natural capital costs were up 26 percent.

The challenge was clear: Identify successful business models that decoupled revenue growth from environmental impact.

Is this the year that we can say we turned a corner?

This year's analysis shows that prior to 2013, the average annual growth in natural capital costs was 5 percent, which slowed to 2 percent in 2013. In 2014, this growth slowed further, to 1 percent for the U.S. companies and decreased by 8 percent for the global companies.

These are positive signals, but it may be too soon to determine whether we have reached a turning point and are headed in the direction of sustainable growth.

With less caution, we can say that 2015 was the year that the investment community made critical commitments to finance sustainable growth.

There was collective action. [The Montreal Pledge](#), which commits investors to measuring and disclosing the carbon footprint of their portfolios on an annual basis, attracted 120 signatories representing just over \$10 trillion in assets under management. And the [Portfolio Decarbonization Coalition](#), formed to help cut greenhouse gas emissions by mobilizing institutional investors committed to decarbonizing their portfolios, smashed through its initial target of \$100 billion, and is now overseeing the decarbonization of \$230 billion in assets under management.

There were also independent statements. U.S. public pension giant California Public Employees' Retirement System (CalPERS) — responsible for \$274 billion in assets — announced it would start to engage more companies on climate change to ensure underlying companies in its portfolio are "aligned with the transition to



a low-carbon economy.” And PGGM — the heavyweight Dutch pension asset manager with \$199 billion in assets — said it would “take considerable first steps towards halving the carbon footprint of investments in 2020.” These are strategic shifts that have the potential to create change across the entire investment industry.

And a wealth of innovative financing vehicles began to boom, from “carbon-efficient” indices and funds to green bonds. According to the Climate Bonds Initiative, the green bond market soared to almost \$42 billion in 2015, tripling over the past two years. And in December, China became the first country to issue rules on issuing green bonds, aimed at kickstarting a thriving green bond market to raise the \$330 billion annually to invest in the country’s transition to a green economy.

At Trucost, we have been helping companies to provide investors with relevant environmental information since 2000. Our advice to companies is simple: Don’t make the mistake of thinking that investors aren’t taking account of environmental factors in their decision making simply because they aren’t asking. If you want to stand out from your peers and capitalize on green financing vehicles, you need to demonstrate that your company is well positioned to de-risk and decarbonize investment strategies — rigorously and consistently.

We can also say 2015 was the year 196 countries reached a historic agreement in Paris on climate change to limit global warming to “well below” 2 degrees Celsius and “pursue efforts” to limit temperature increases to 1.5° C. While the carbon reduction plans of individual countries are only enough to achieve a 2.7° C limit, the agreement establishes a mechanism to “update and enhance” them.

It is undoubtable that 2016 is the year for companies to best position their business models to capitalize on sustainable growth opportunities.

Around half of the largest U.S. and global companies have GHG emissions-reduction targets and even more have GHG emissions-reduction projects already underway.

More organizations are extending their reporting to value chain impacts — and more are assuring their data.

The number of companies taking a more holistic, business-focused view of their environmental and social impacts by participating in natural capital initiatives is also on the up: 611 had made public commitments as of 2015, up 71 percent from 357 in last year’s State of Green Business and up 217 percent from the 2014 report.

Amidst all the positive signals we must distinguish a startling shortfall in the reported management of vulnerable water supplies.

The scarcity of fresh water is increasingly acknowledged as a major economic risk, compounded by intensifying demand and a changing climate. Our findings show that relatively few companies report on their exposure to water risks — 23 percent of the largest 500 U.S. companies and just 16 percent of the largest companies globally, up from 12 percent and 10 percent in 2010. Given the widespread attention to water shortages across the globe — and the costs incurred by businesses in drought-stricken areas like California, large portions of the Middle East and Southeast Asia, and Sao Paulo, Brazil — we urge companies to address this critical issue. To start their journey, companies can take advantage of the [Ecolab/Trucost Water Risk Monetizer](#) — a free online tool identifying site locations and profits at risk.

And our view into the future?

Companies with mature sustainability programs need to ensure they stay ahead of the game by integrating environmental shadow costs in financial decision making, conducting net-positive assessments and setting science-based targets, including carbon, broader pollution impacts, water dependency, land use and other natural-resource inputs. For companies that have yet to consider how their business will remain profitable in a low-carbon, resource efficient world, the writing is on the wall.

Now is the time to capitalize on sustainable growth. 

TOP SUSTAINABLE BUSINESS TRENDS OF 2016

If ever there was an inflection point in the world of sustainable business, it took place in December in Paris. The days after the U.N. COP21 climate talks may not have felt particularly different to those whose jobs involve leading their company's sustainability efforts, but something fundamentally changed: For the first time, the world seems on an inexorable course to transform business as usual.

Incantations about a low-carbon economy were everywhere in Paris. And while that term does not appear in the agreement adopted by nearly 200 countries, it was implicit, if not explicit, that the world would operate increasingly using technologies and systems of commerce different than today's, in terms of how they impact the climate.

For business, this may mean more of the same — at least for now. Most large companies are already on a path that, at least slowly and incrementally, improves their environmental (and sometimes social) performance year over year. That's not likely to accelerate much in most cases, especially since the Paris Agreement doesn't even kick in until 2020. But the market signals emanating from Paris are loud and clear.

It may not take the rest of the decade for such signals to turn into strategy. The commitments and goals already being set by companies seem bolder than in the past across a range of topics: reducing carbon emissions, curbing water use, reducing or eliminating waste streams, preventing biodiversity loss and other environmental measures. Some social measures have been taken up, too: reducing poverty and hunger, creating jobs and economic opportunities, promoting sanitation and good health, ensuring economic equity and mobility.

Still, the question remains: Are companies truly stepping up their efforts to address the full range of sustainability impacts, or is it just a few leaders?

It's not easily answered. There's no standard, as far as we know, for corporate sustainability metrics — at least one that would compare, apples to apples, the quality and quantity of publicly stated company goals. Any answers to this question are bound to be subjective.

Whatever the answer, the outcomes of COP21 mean that the pace of change will likely accelerate during the latter part of the decade.



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In some ways, the business world didn't even need a U.N. climate conference to spur progress. A convergence of trends and technologies has enabled the private sector to rethink how products and services are sourced, produced, delivered and consumed — and then what happens to them after that.

The notion of a “circular economy,” while not particularly new, is gaining traction in some large leadership companies. The idea of closed-loop systems of production and commerce, where there is no waste and little degradation of resources from one generation of goods to the next, has gone from reverie to reality.

So, too, have other once-audacious goals. The idea that a company, supply chain or city could be powered entirely by renewable energy is no longer a pipe dream. The vision that farming could be restorative, both to the land and climate, is taking root. The concept of tapping nature's wisdom to build infrastructure to enhance the resilience of cities and industrial systems has morphed from evangelism to engineering.

As a result, opportunities abound. Carbon is no longer seen as just an atmospheric pollutant, but a building block for a new generation of molecules to make concrete, plastics and fuels. Greenhouse gases are no longer unwanted byproducts of industrial agriculture; they are now a valuable input. Finding value in waste streams is no longer just an innovative idea; it is an expectation and competitive necessity. In other words: It is tomorrow's business as usual.

COP21 wasn't the only development of 2015 that will have lasting impacts on business strategy and operations. The [Sustainable Development Goals](#), gaveled into adoption in September by the U.N. General Assembly, represent a



global aspiration to address environmental and social challenges. U.N. Secretary-General Ban Ki-moon hailed them as “a universal, integrated and transformative vision for a better world.”

The 17 SDGs, as they are known, span the gamut of sustainability challenges facing the world, from climate change and ocean health to quality education and gender inequity. They could become a de facto standard against which companies — and entire economies — will be judged going forward. No doubt they will become the basis for benchmarks, scorecards and ratings by activists, investors and media seeking to identify leaders and laggards.

The road from here to sustainable development and a low-carbon economy will be paved in no small part by advances in technology. Some of these, like solar and wind energy, have been long in coming, hastened in recent years by what have become natural innovation cycles. The cycles begin with R&D leading to the creation of startups (and across the treacherous “valley of death” most tech startups encounter on the road to commercialization), through early adopters, regulatory enablers, economies of scale and — ultimately — mass adoption.

What technologies are next along this path, already traversed successfully by LED light bulbs, renewable energy technologies and, only recently, electric vehicles? Smart buildings and homes, connected cars, intelligent supply chains and green infrastructure projects will all be mainstream by the end of the decade. Each represents markets in the tens of billions, even trillions, of dollars — opportunities as big as the Internet, mobile technology

and wireless communications. Behind (or even alongside) them are advanced materials, renewable fuels, protein alternatives and a number of products and services made from harvesting carbon dioxide instead of emitting it into the sky.

That’s the new promise of sustainability. At long last, it is seen as a catalyst for innovation, not just as a regulatory burden or marketplace demand. And it’s not all about technology. Some innovations are financial, such as creative ways to fund both private- and public-sector projects. These include partnerships that spur private-sector investments — smart roadways, green infrastructure or community microgrids, for example, which in the past have been the domain of government or monopolistic utilities, but which are now profitable business endeavors. Other innovations relate to business models, or low-tech solutions to complex challenges.

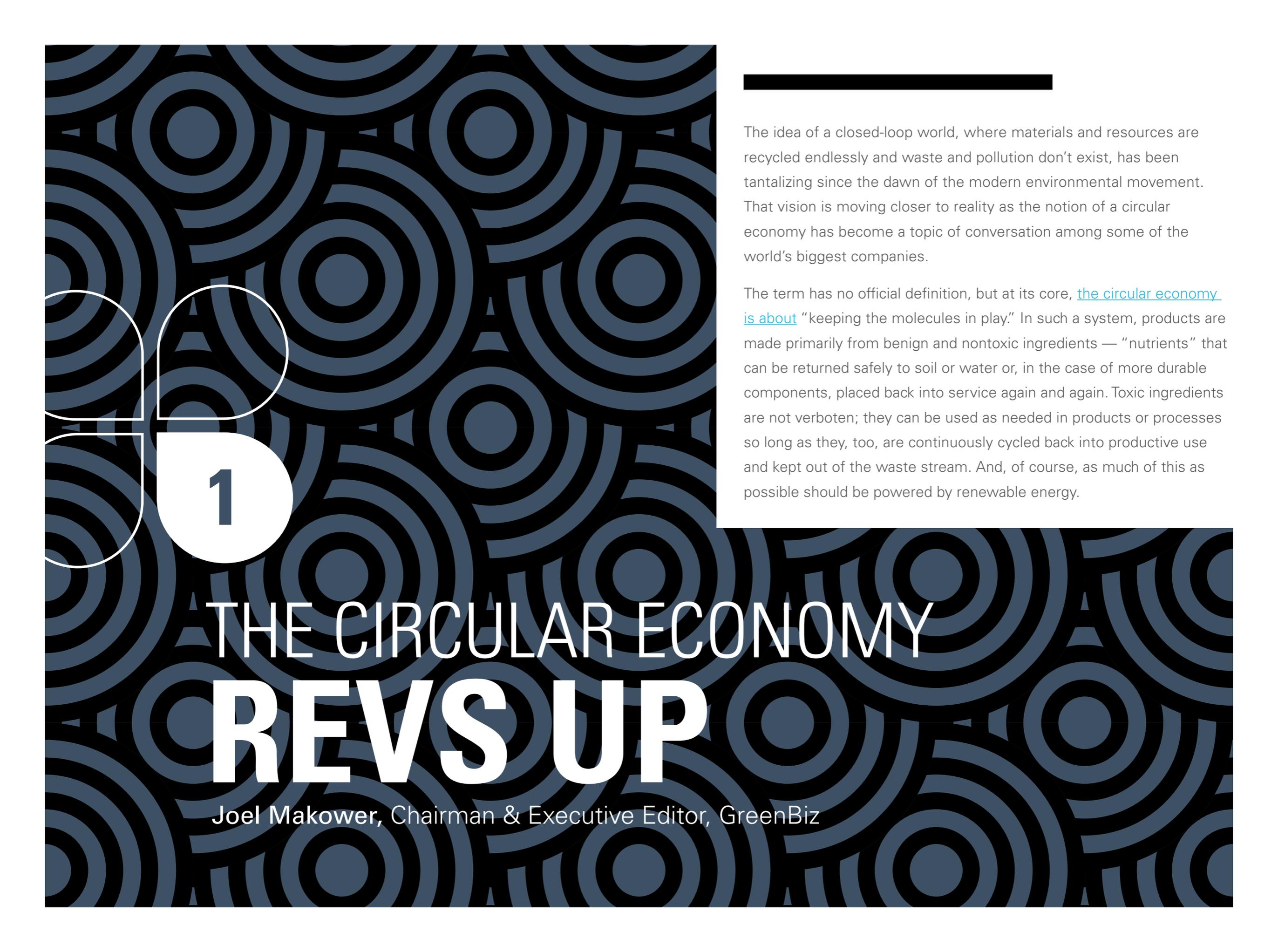
When it comes to sustainability, money talks pretty loudly. Witness the rise of green funds and renewable-energy bonds (which we singled out in [last year’s trends](#)), two novel funding mechanisms for investors to back a wide range of renewable energy and other sustainability projects. Then there are the nine-figure commitments to fund low-carbon technologies made over the past two years by many of the world’s biggest financial institutions. And the divestment movement is, at least symbolically, sending signals about the priorities of many institutional investors.

That doesn’t even count the money poured into companies’ own R&D and venture departments, which are competing fiercely to invent greener, cleaner and



more efficient solutions in industries ranging from chemicals to cars to computers. Add it all up and it augurs well for the goals of COP21, the SDGs and companies seeking to lead, or at least stay competitive, in the coming years.

All of which is to say, 2016 is shaping up to be yet another exciting year in the world of sustainable business. Here, in no particular order, are 10 trends we’ll be watching. 



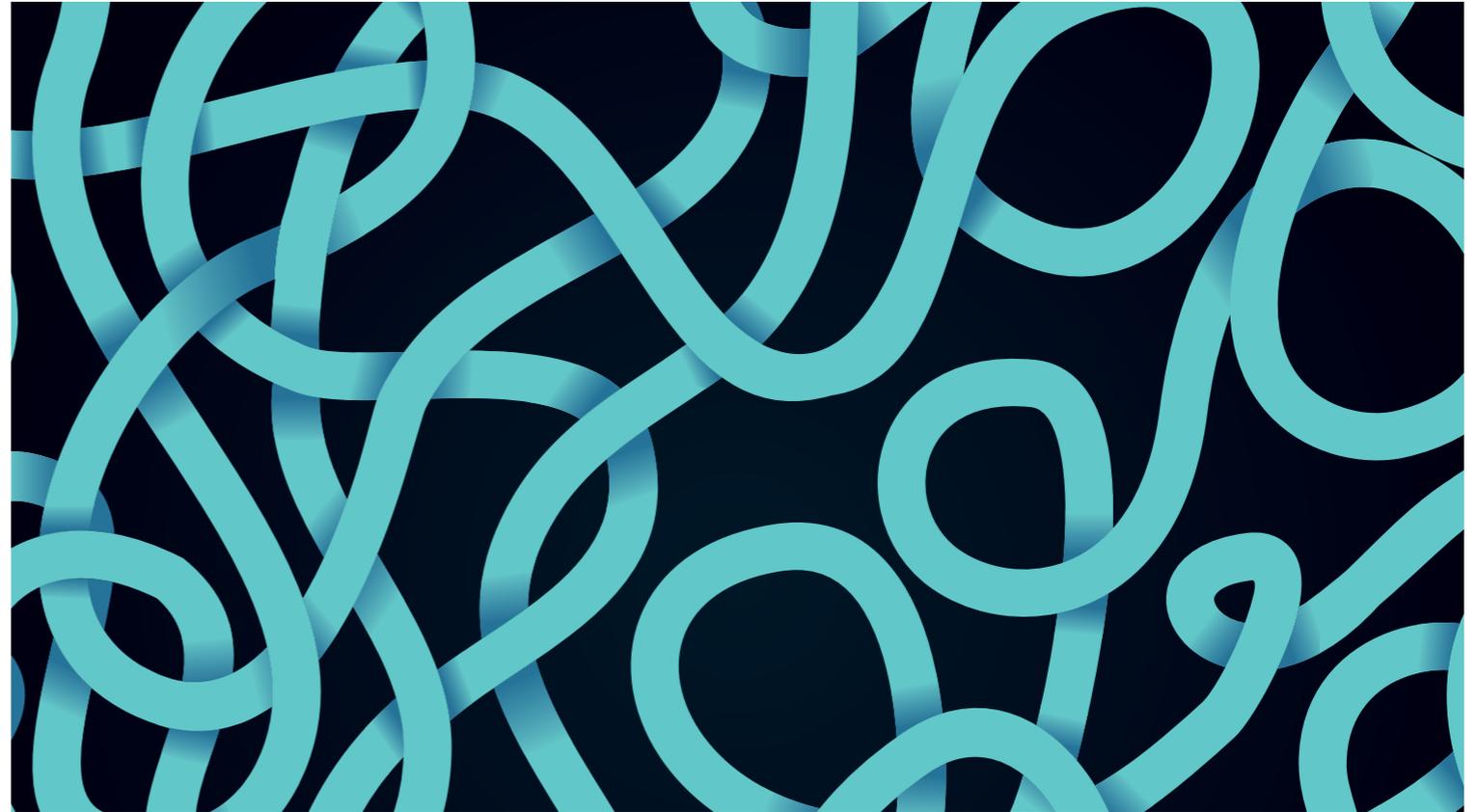
THE CIRCULAR ECONOMY REVS UP

Joel Makower, Chairman & Executive Editor, GreenBiz

The idea of a closed-loop world, where materials and resources are recycled endlessly and waste and pollution don't exist, has been tantalizing since the dawn of the modern environmental movement. That vision is moving closer to reality as the notion of a circular economy has become a topic of conversation among some of the world's biggest companies.

The term has no official definition, but at its core, [the circular economy](#) is about "keeping the molecules in play." In such a system, products are made primarily from benign and nontoxic ingredients — "nutrients" that can be returned safely to soil or water or, in the case of more durable components, placed back into service again and again. Toxic ingredients are not verboten; they can be used as needed in products or processes so long as they, too, are continuously cycled back into productive use and kept out of the waste stream. And, of course, as much of this as possible should be powered by renewable energy.

The circular economy involves a fundamental rethinking of products, materials and systems of commerce. It is not simply next-gen recycling.



The lack of a widely accepted definition of the term risks confusion, misunderstanding, even greenwashing. If you ask sustainability executives point blank, “Is your company looking into the circular economy?” you’ll likely get a lot of affirmative answers. But when you drill down to specifics, you’ll often find that the term is being used to describe warmed-over initiatives like product recycling, takeback programs and reuse.

While all of these may be part of the circular economy, they’re just one important part. The circular economy involves a fundamental rethinking of products, materials and systems of commerce. It is not simply next-gen recycling.

What’s more encouraging are the big companies actively thinking about what the circular economy means to them, and discussing it internally as well as with peer companies that are part of their value or supply chains.

Over the past few years, Dame Ellen MacArthur, formerly a professional sailor who set a world record for solo circumnavigation of the globe, has been promoting the circular economy through her foundation, which has become a driving force in this arena. The [Ellen MacArthur Foundation](#) has spearheaded some of the best research on the circular economy, in partnership with the World Economic Forum, McKinsey & Company and others.

MacArthur joins other visionaries, such as William McDonough, the architect and designer whose [Cradle to Cradle methodology](#) and [product certification system](#) paved the way more than a decade ago. Before him was the Swiss architect Walter Stahel, whose [Product-Life Institute](#) first came up with the concepts that undergird the circular economy and Cradle to Cradle — way back in the late 1970s and early ‘80s. Like many aspects of sustainable business, this is a movement whose moment has been long in coming.



But coming it is. Last year, at the World Economic Forum's annual conclave in Davos, Switzerland, the organization launched a ["Meta-Council"](#) to define and accelerate the idea of a circular economy, particularly among its big-company members.

That such conversations are happening in unlikely places underscores the potential magnitude of the shift underway. Among the founding members of the [Circular Economy 100](#) created by the Ellen MacArthur Foundation are Cisco, Coca-Cola, Dell, Google, IKEA, Lexmark, Michelin, Philips, Ricoh, Unilever and Vodafone. Granted, membership does not mean any of these companies are close to developing truly circular models. But their engagement is a sign that the movement is being taken seriously by some of the world's most iconic brands.

Meanwhile, the World Economic Forum has organized [the Circulars](#), an annual award for individuals and organizations that "have made a notable contribution to driving circular economy principles — where growth doesn't depend on the use of scarce natural resources." The awards debuted last month in Davos. True, the state of the art may seem a tad nascent for award-winners to declare victory, but that's how such movements get attention.

Creating circular models for some materials won't be easy. Consider plastics, which undergird, coat or package so many of the things we buy. Besides being some of the global economy's most ubiquitous materials, they are also among the most environmentally irksome. [Recycling many plastics](#) has proved difficult, or at least uneconomical, and plastic trash has become widespread — literally from sea

to shining sea. Still, plastic consumption continues to rise, growing an average of 3 percent annually since the mid 2000s, according to market intelligence firm ICIS.

Dow Chemical, whose plastics division is the company's largest, is [experimenting with several circular economy-inspired initiatives](#), according to its vice president of corporate sustainability, Neil C. Hawkins. The company is piloting an "energy bag" technology where customers collect non-recyclable plastics, such as utensils and packaging, which Dow turns into synthetic crude oil.

Dow knows it's an imperfect solution, since the resulting polymers are worth more per pound than the fuel it yields. "If we can recycle materials back into materials, we'll always want to do that first," says Dow plastics global sustainability leader Jeff Wooster. Dow competitor BASF is [similarly working](#) on a way to do this.

Recycling plastics — and most other things — can be a labor-intensive exercise, which is one reason the idea of a circular economy is by no means limited to developed economies. Indeed, this is another place where developing economies might leapfrog more industrialized nations. China, for example, is facing significant resource constraints, not to mention sky-high levels of pollution and environmental degradation. Its government has developed a national circular economy strategy, part of a 50-year plan to address sustainable growth objectives and challenges, and has made substantial investments in circular economy-oriented pilot projects, [according to the Ellen MacArthur Foundation](#).



There's sound business rationale for all of these countries and companies to be jumping aboard the circular-economy bandwagon, beyond the obvious sustainability benefits and other do-goodism. In short: This stands to be a massive business opportunity.

According to modeling by the Ellen MacArthur Foundation, the circular economy represents a net materials cost savings opportunity of \$340 billion to \$630 billion annually just within the European Union. The biggest opportunities were found in the automotive sector, followed by machinery and equipment. Another of the foundation's reports looked at fast-moving consumer goods, this time at the global level. It concluded: "The full value of the circular opportunities, globally, could be as much as \$700 billion per annum in materials savings, or a recurrent 1.1 percent of 2010 gross domestic product."



As Peter Lacy, global managing director at Accenture Strategy, put it, the circular economy could be “the biggest economic revolution in 250 years.”

Sure, reorienting the global economy into a circular model may sound like some futuristic, utopian vision: factories with no smokestacks, drainpipes or dumpsters, powered by the sun and wind, making products sourced benignly from nature, then continuously recycled with no waste. And not long ago, it was, indeed, an unattainable idyll.

Then again, not long ago, you could have said the same thing [about “zero-waste”](#) factories, where nothing goes into landfills, or buildings that generate more energy than they use. Now, both are becoming commonplace. 

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2

SUPPLY CHAINS GO HIGH TECH

Lauren Hepler, Senior Editor, GreenBiz

Whether the finished product is a smartphone, a shirt or a sapphire ring, tracing component parts back to their original sources has [long proved](#) an elusive quest.

Supply-chain sustainability hotspots vary widely from sector to sector. Deforestation is closely linked to food and consumer goods, while conflict minerals pervade the electronics, jewelry and automotive markets. But the lack of transparency and centralized systems to track products from inception to sale make the field ripe for disruption, particularly as consumers, investors and activists gain more awareness of the issues at hand — and make their concerns known to companies.

For individual businesses, the potential repercussions include operational, financial and reputational damage stemming from supply-chain dysfunction (or at least opacity). Combine those [concerns](#) with the increasing availability and affordability of advanced sensors, the global



The first thing to understand about the rise of connected supply chains is how many companies are vying for a slice of the market.

proliferation of mobile technology and increasing corporate reliance on cloud software systems. You get the [supply-chain technology boom](#) impacting industries across the board.

It may sound dull to dive into the details of convoluted global production routes, but make no mistake: The amount of money changing hands along a typical supply chain adds up to monumental sums. Transportation logistics alone is a nearly [\\$5 trillion](#) global industry. Manufacturing revenues now top [\\$11.5 trillion](#) annually.

The first thing to understand about the rise of connected supply chains is just how many companies are [vying for a slice](#) of the market. Some providers start with the basics, seeking new ways to vet individual suppliers and put that information online. Beyond that, there's the push to better [verify and communicate supplier data](#) through secure digital channels. Others are more focused on better inventory management software, or using hardware to track products through the manufacturing process. At the end of the chain, a range of providers are honing new logistics offerings covering the last few miles of getting products to market.

These efforts are propelled in large part by better understanding of risk management and the pursuit of supply-chain resilience. In other words, companies realize they need to be able to withstand unexpected shocks to any facet of a global business operation.



One area of increased company interest is the capability to respond to weather patterns made more volatile by climate change. The threat of superstorms and the potential downtime in their aftermath is pushing companies to seek advanced analytics for expected crop outputs to gird their commodity supplies, or to assess multiple delivery options amid changing weather conditions and fuel prices. Another area of focus is the more abstract idea of a “social license to operate,” where a company’s ability to operate in a given region is jeopardized by local resistance.

“The next 10 years are going to see a level of change that is outside of our experience,” said Volans founder John Elkington at a 2015 [GreenBiz VERGE event](#) on supply-chain transparency and traceability. “Part of our challenge, collectively, is to recognize those things early enough.”

So, how does technology stand to help? Though business models in the supply-chain tech space differ, the new generation of technology and service providers are solving for two primary variables: efficiency and accountability.

The efficiency case is straightforward, usually involving a data-centric offering to better track natural-resource inputs. Beer giant Anheuser-Busch InBev, for example, is [reaching back into its agricultural supply chain](#) to experiment with sensors and software designed to maximize barley yields while minimizing water and fertilizer used in the process.

In the realm of accountability, companies like EcoVadis are building a database of supplier report cards based on data points such as audit performance, major accident reports and other information available online — an endeavor that uses Big Data to build out more robust profiles than those afforded by old-school surveys or random inspections. Supply-chain labor and safety are two of the biggest liability concerns for companies. That has compelled providers like LaborVoices and the nonprofit Good World Solutions to create tools for [crowdsourcing real-time information](#) on working conditions from laborers with access to cell phones.

While data collection and analysis have gotten easier and more cost-effective, the scope of supply-chain sustainability challenges has only gotten more difficult, with global networks now encompassing all manner of extractors,





processors, intermediaries, manufacturers, packagers, shippers and more.

This landscape looks likely to continue evolving quickly as production technologies and market trends such as additive manufacturing, robotics and urban agriculture improve. Some speculate that these innovations could combine with consumer forces, like the trend toward locally produced goods, to [re-localize commerce](#). For example, goods that were once shipped to Asia from Europe or North America for processing, then shipped back to consumers in those markets, would instead be handled regionally.

Today's supply-chain cloud software and on-demand service providers aren't the first to recognize the need to modernize the field. Over the years, supplier surveys and radio-frequency identification, or RFID, are two of the tools sold as ways to increase transparency and oversight. But their success has been limited, at least in terms of engendering wholesale transparency.

One reason is that countries regulate pollution and natural impacts very differently. Nagging challenges, like reducing the burning of Indonesian forests to clear land for palm oil plantations, demonstrate that a cause du jour among consumers and activists in the Western world doesn't always translate to immediate corrections upstream. International labor systems, meanwhile, vary widely in their ability to help the poorest secure better working conditions.

Beyond that, there's the issue of ensuring that new technologies actually work. What good is a fancy sensor if

there's no way to upload the information to the cloud from Dhaka or Dongguan?

"Some of them are just vaporware, some of them are driving real action," says Pierre-Francois Thaler, co-founder of EcoVadis. "It will take a long time before you can solve this problem just with technology."

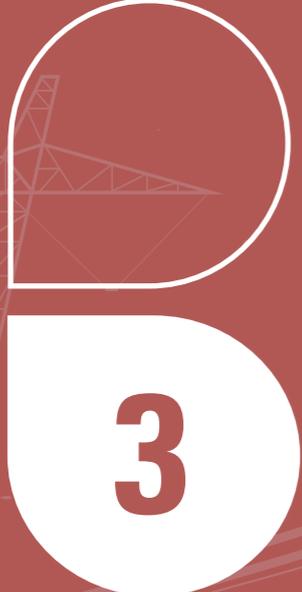
While the array of supply-chain functions that stand to be re-ordered by technology can be a bit dizzying, it's the last part of the chain — the logistics of getting finished products to market — that has become a particularly active breeding ground for innovation. Just look at the upstart Cargomatic, which sells on-demand, short-haul trucking services. Flexe, meanwhile, operates an Airbnb-for-warehouse-space marketplace. Cloud Logistics offers services such as vendor-to-vendor communication, inventory tracking and other logistics data-analysis tools. All are part of the growing B-to-B sharing economy. (See Trend 9.)

In this realm, too, the key selling point from a sustainability perspective is operational efficiency. Specifically, it can be more cost-effective to buy short-haul trucking or warehouse space as a service only when needed, rather than paying to purchase and maintain a bigger fleet or real estate portfolio.

If it all pans out, such technologies will help reduce fuel costs, waste and related emissions while keeping the wheels of commerce moving — literally — in an ever-changing world. 🍀



What good is a fancy sensor if there's no way to upload the information to the cloud from Dhaka or Dongguan?



3

GREEN INFRASTRUCTURE GROWS LIKE A WEED

Heather Clancy, Senior Writer, GreenBiz

The long-term effect of the landmark Paris Agreement guiding global emissions reductions won't be clear for years. But there's one place where its impact is being seen almost immediately: private-sector investments in low-carbon alternatives for energy, water, transportation and other critical infrastructure projects. We're talking billions, if not trillions, of dollars of committed money.

The first hint came before the COP21 climate summit even began, when billionaire philanthropist Bill Gates announced the creation of the [Breakthrough Energy Coalition](#), a multibillion-dollar fund for clean-energy alternatives that includes a Who's Who of entrepreneurs, from Virgin Group's Richard Branson to Facebook's Mark Zuckerberg.

Their mission is to scale and innovate in reliable, low-cost, carbon-free energy. (They don't actually use the "green" label.) Their imperative? The

The world moves far too slowly on this agenda due to both political and economic forces. If you consider the history of fossil fuels, it took more than four decades for oil to supplant coal.



world moves far too slowly on this agenda due to both political and economic forces. After all, if you consider the history of fossil fuels, it took more than four decades for oil to supplant coal.

“Energy is already a trillion-dollar market, and clean energy could one day be a multitrillion-dollar market,” writes Gates, [in an essay](#) rationalizing the coalition’s creation. “But private investors are reluctant to get into the field, for the same reason that energy companies tend to underinvest in R&D: Breakthroughs can take decades to play out and their inventors see relatively little reward.”

The Breakthrough Energy Coalition, Gates argues, will help get innovation out of the lab and into the marketplace faster. Its public-sector counterpart is [Mission Innovation](#), a group of 20 countries — which currently provide roughly 80 percent of all clean-energy R&D — that have pledged to double funding levels for these technologies over the next five years.

It’s not just energy. Another group likely to shape the agenda is the Green Infrastructure Investment Coalition. The group represents the Climate Bonds Initiative, which promotes large-scale investment in a low-carbon economy; the Principles for Responsible Investment, an investor group representing more than \$1 trillion in assets; the U.N. Environment Programme (UNEP) Inquiry group, responsible for suggesting and advocating policy options; and the International Cooperative Mutual Insurance Federation. Together, they represent at least \$69 trillion in assets.



The goal isn't just to minimize negative potential impacts, it's to maximize resilience by playing to the strengths of the natural world.

"One of the key gaps identified by the UNEP Inquiry was the absence of a common platform at the international level to mobilize global debt and equity capital markets for the transition to a green economy," explains the organization's co-director, Nick Robins. "This new coalition will help to fill this gap and deliver practical guidance on how to build on the power momentum we have seen in 2015."

It's important to note that the term "infrastructure" covers many different concepts, depending on the company in which you use it. Energy infrastructure is just one small piece.

From a CEO's standpoint, infrastructure probably conjures up images of office facilities and capital equipment. A public official, on the other hand, likely associates infrastructure with roads, bridges and water management systems. The common thread is this: [Green infrastructure investments](#) consider the impact on natural ecosystems far more carefully. The goal isn't just to minimize potential negative impacts, it's [to maximize resilience](#) by playing to the strengths of the natural world.

One oft-cited corporate example is a [wetlands project in Seadrift, Texas](#), spearheaded by Dow Chemical subsidiary Union Carbide. When faced 20 years ago with the choice of building a traditional wastewater treatment facility or opting for one that borrowed filtration ideas from nature, the team in charge opted for the green infrastructure approach, where natural ecological systems, not chemicals, treat the water. That system wasn't just cheaper to build; it so far has delivered more than \$200 million in other benefits to the community, including freshwater habitat for dozens of species.



From the municipal point of view, the [green infrastructure](#) concept has gained more credibility thanks to projects in [New Orleans](#), which rethought its coastal management system with an eye toward resilience after the devastation of Hurricane Katrina; and [New York City](#), which started prioritizing bioswales, green roofs and other natural systems for handling stormwater runoff even before [Superstorm Sandy](#) exposed the city's vulnerabilities.

Canada's Prime Minister Justin Trudeau made headlines last fall when he emerged as a huge supporter of green infrastructure, describing it both as a defense against climate change and a way to grow the national economy. His administration has budgeted more than \$4 billion over the next four years to apply the concept to wastewater treatment and floodwater mitigation systems, and about the same amount to public transportation projects. It established the Canadian Infrastructure Bank to provide low-cost financing.

Still, green infrastructure has its share of criticism. The biggest is that there's no real way, yet, to measure the real impact of a project on the creation of a low-carbon economy.

But the reality is that green infrastructure is taking root. There were more than \$39 billion worth of [green bonds](#) issued in 2014, more than double the dollar amount of the previous year. Much of this money will be used to finance clean-energy projects. The annual value could reach \$1 trillion by 2020, according to a report by the Climate Bonds Initiative, UNEP and the World Bank. Some of the fastest growing markets: Brazil, China, India and Mexico.

"Readying the world economy for the climate change challenge can be seen as a major investment opportunity, one that goes far beyond the energy sector, in all asset classes, sectors, industries and countries," the report notes. "This includes low-carbon transport, such as railways and urban metros, and low-emission buildings, both new constructions and retrofitted existing buildings."

Pick your focus. The fact remains: Real investors, representing real money, finally are ready to finance infrastructure projects that harness nature's services at their best. ❀





4

THE MINING INDUSTRY TRIES TO CLEAN UP ITS ACT

Elsa Wenzel, Managing Editor, GreenBiz

Environmental impacts are business as usual in mining and other extractives. Yet amid an uptick in the demand for metals, minerals, fuels and rare earths that feed everything from cars to construction to clean energy technologies, the mining industry — squeezed by ever greater forces — is slowly shifting, and even cleaning up its act.

There's no question that the mining industry finds itself in a hole, reputationally speaking. Activists have long targeted mining titans over working conditions, most recently in electronics and [jewelry supply chains](#). Then there's outrage over ecological degradation.

Yet more potent than lawsuits or sanctions is the market — the slow unraveling of the fossil fuel-based economy. As the price of commodities skyrocketed during the Great Recession, mining spiked, too. That ["supercycle" is dead](#), but real ["structural change"](#) (PDF) is also



underfoot. Coal is no longer king; even its reigning companies are suffering steep drops in stock prices, and dozens of [coal companies have filed](#) for bankruptcy.

The industry is also getting shafted by the [fossil-fuel divestment movement](#) led by [350.org](#), which counts \$3.4 trillion divested and includes 499 institutions, including [major banks](#) and the [Rockefeller Brothers Fund](#). Tools abound, such as the Institutional Investors Group on Climate Change guide, to help investors nudge mining company boards toward resilience and sustainability.

A PwC report on shareholder activism and trends in mining didn't mince words, saying, "[The gloves are off.](#)" A CDP report asked if miners are "[chasing fool's gold.](#)" noting, "Some companies have not set targets to reduce their emissions over time, despite the fact that several are using internal carbon prices of up to \$50 per ton, which could potentially reduce their profits by \$10 billion a year."

[CDP recently ranked 11 big mining](#) companies on climate-related factors, such as energy and water resilience and exposure to coal and carbon costs. It found

the sector to "fare poorly" against other high-emitting sectors. Vale, BHP Billiton and Sumitomo ranked best, with Glencore, First Quantum Minerals and Vedanta Resources at the bottom of the heap.

Following the Paris Agreement, a cleaner era in energy appears to be digging in. The renewable energy economy is already larger than the coal economy: The U.S. solar installation sector employs 77 percent more people than the domestic coal mining industry, according to the Solar Foundation's [National Solar Jobs Census 2015](#) (PDF). In the United States, President Obama's Clean Power Plan and rejection of the Keystone XL pipeline are signs of the times.

And of all unlikely suitors, Greenpeace piped up to purchase one of Europe's largest coal mines, along with its associated power plants. Greenpeace didn't actually bid, but hinted at a lowball offer. Whether it was a stunt or a real attempt to transition the coal operations to renewables, the move spotlighted the burden of [stranded assets](#) for fossil-fuel behemoths.

More corporations are making their policy preferences known — such as [Volvo, which left the National Mining Association](#) because it was lobbying against the Clean Power Plan. Still, the NMA boasts an 85 percent drop in mercury emissions from metals mining, and a 69 percent drop in coal emissions over the [past 20 years](#). It says the value of materials recycled in the U.S. has risen by 82 percent and mine reclamation by 80 percent. That's progress.

As the industry's voice for sustainability, the [International Council on Mining and Metals](#) (ICMM) describes its five guiding principles as "care, respect, integrity, accountability and collaboration." The group's 23 companies include African Rainbow Minerals, AngloAmerican, Sumitomo and Teck. Together, they make up more than half of the world's extraction of copper and 30 percent of gold.

The [ICMM joined the chorus of corporates](#) supporting a strong COP21 outcome with carbon pricing, stating that it ultimately seeks to increase the use of renewables. (European oil and gas companies said something similar, but their U.S. counterparts seemed to keep their heads in the ground.) These mining CEOs aim to account for climate risks in planning, and adapt operations and communities to climate change realities. Of course, they're not ready to give up on coal just yet.





BHP Billiton recently produced a “[Climate Change Portfolio Analysis](#).” Royal Dutch Shell canceled Arctic drilling plans (although for lack of profitability, not for sustainability reasons). Shell also launched an [Energy Transitions Commission](#) involving BHP Billiton, Statoil and others, seeking to “identify pathways for change in our energy systems to ensure both better growth and a better climate.”

More companies, from 3-M Energy to ZTC Petro Investments, are sharing information about what’s in [their fracking cocktails](#). A fracturing roundtable [led by the American Chemical Society’s Green Chemistry Institute](#) and Apache includes BASF, Dow and Marathon Oil as founding members.

There are growing efforts to create standards for responsible drilling and mining. For example, Equitable Origin, an upstart company, is creating standards to clean up oil and gas exploration in developing regions, and is seeking to do the [same for wind and solar farms](#).

Mining requires vast amounts of energy, especially to tap harder-to-access ores. Energy makes up 20 to 40 percent of mining operating costs, and is set to [grow by 36 percent by 2035](#) globally. Most mines are [powered by diesel or the grid](#). As a result, renewable energy is an untapped opportunity for remote mines. Investment in renewables by mining companies could grow from \$2 billion in 2018 to [\\$3.9 billion by 2022](#), according to Navigant Research.

The Carbon War Room [recommends hybrid solar-diesel systems](#), which offered a four-year payback for chrome mine operator Cronimet. Ironically, energy powered by the wind, sun or sea relies on a melange of materials that must be mined, from copper to rare earths.

Another way to lessen the impact of mining is to not do it in the first place. [Circular economy practices](#) can reduce the need for raw materials, and recycling can retrieve metals and minerals already in circulation. More copper is currently “mined” from recycled products than from earthen ores. [Honda and Mitsubishi are recovering](#) rare earths from batteries and air conditioner compressors, respectively.

Ideally, innovations in recycling could more easily extract materials from such used goods, and do so profitably for all involved. [Best Buy](#) has enjoyed a cut of the sales of gold, lead and nickel recovered through its electronics takeback program. [Group Machiels](#) of Belgium recently opened a “closed circle” landfill mining operation, while “urban mining” reclaims scrap metals from abandoned buildings, [such as in Detroit](#). However, such practices aren’t yet scaling to meaningfully dent the need for mining.

The seafloor is yet another untapped vein of materials, such as copper and rare earths. Yet seabed mining promises [new ecological risks](#) to already fragile and exploited environments.

That’s not to mention a nascent market for mining asteroids, likely rich in metals. A new [law allows](#)

[Americans](#) to mine and sell material from space (we’ll see how that law holds up internationally). Startups vying for a piece of the rock include [Planetary Resources](#) (tagline: “the Asteroid Mining Company”), backed by billionaires including Larry Page of Google, and [Deep Space Industries](#) (“Creating Wealth and Opportunity from Space Resources”).

It goes to figure that just as we start to clean up mining on Earth, a much larger frontier comes into view. Watch this space. 🌸





5

AGRICULTURE PLANTS THE SEEDS OF REGENERATION

Joel Makower, Chairman & Executive Editor, GreenBiz

The need to radically reform our agricultural sector in the name of sustainability has been talked about for decades. And while small, incremental changes have inched the ag sector forward, it remains hopelessly unsustainable for people and the planet.

Consider: Organic agriculture, which became mainstream starting in the 1990s, still represents only a small fraction of farmland in the developed world. In the United States, for example, just over 2 percent of the roughly 234 million acres of farmed land is certified organic under the federal government's definition. Organic food sales are double that — about 4 percent of total U.S. food sales in 2014, according to the Organic Trade Association.

Organic, of course, is just one slice of the pie. Indeed, the alt-ag movement has sowed a cornucopia of methodologies, including, alphabetically: [agroecology](#), aquaponics, biodynamic farming, biological



Simply put,
regenerative
agriculture means
farming in a way
that doesn't bite
the land that
feeds us.

farming, conservation tillage, controlled environment agriculture, good agricultural practices (or GAP), holistic management, integrated pest management (and its offshoot, bio-intensive IPM), low-input agriculture, natural (or nature) farming, permaculture, sustainable agriculture and whole-farm planning.

Each offers an approach that counters industrial ag's relative blunt-force use of fertilizers, pesticides and water in favor of limited inputs used with precision in harmony with natural cycles and conditions.

And while some large-scale "conventional" farmers may claim to do these things using technology to pinpoint the need for inputs — "precision agriculture" is yet another meme — its improvements are only a matter of degree; precision ag may use fewer inputs than conventional farmers, but still more than most other alternatives.

Of course, when it comes to farming, what's "conventional" is debatable. As former New York Times columnist Mark Bittman, [speaking at a 2014 food conference](#), explained: "In terms of feeding people, land use and commonality, peasant farming is far more conventional. Peasant farming produces more than two-thirds of the world's food. In its reliance on high tech, fossil fuels, overuse of resources, monocropping, and chemicals, industrial ag is, in fact, completely unconventional. It's downright anomalous." And, he might have added, unsustainable.

Feeding a growing global population will require more from farming than incremental improvements. Fortunately, recent years have seen a growing movement toward "regenerative agriculture," employing farming techniques that not only reduce inputs and environmental damage, but actually restore the environment.



Simply put, regenerative agriculture means farming in a way that doesn't bite the land that feeds us.

The term was coined by Robert Rodale, son of J.I. Rodale, father of the modern organic farming movement. "Regenerative" made sense to Robert Rodale because, "enhanced regeneration of renewable resources is essential to the achievement of a sustainable form of agriculture," and because "the concept of regeneration would be relevant to many economic sectors and social concerns."

After decades of fits and starts, regenerative ag is taking root. We are gaining both the technology and the know-how to produce food more sustainably, and to harness nature's genius to sequester carbon and enhance soil, in the process drawing down greenhouse gases already in the atmosphere.

One reason for optimism is that Big Food — the companies that bring agricultural products to market — is jumping on the bandwagon, variously responding to consumer pressure, stakeholder concerns or the specter of supply-chain disruptions created by climate change. For example, [General Mills](#) and [Kellogg's](#), two of America's biggest packaged-foods marketers, announced plans in 2015 to integrate ambitious sustainability goals into their supply chains, affecting the far-flung network of farms, mills and processors from which they source food. Behind them are dozens of other large players, from commodities conglomerates like ADM and Cargill to supermarkets and restaurant chains.

Technology is helping, enabling farmers to harvest the explosion of data coming off their fields and farms. Technology incubators and accelerators are fueling the growth of data-based farming tools, as well as [collaborative entities and tech platforms](#), such as the [Farmer Business Network](#), backed by some of Silicon Valley's biggest venture capitalists. Investments in ag tech soared to about \$4 billion in 2015, nearly doubling in just a year. In addition, Big Food companies poured countless millions of R&D money into bringing precision farming to their supply chains, recognizing that plentiful water and arable land won't last forever in a climate-constrained world.

One area of growth is in urban ag, the capability to produce food at scale inside cities, by harnessing warehouses, rooftops, empty lots and other unused spaces. [It's not small potatoes](#); according to the U.N. Food and Agriculture Organization, 800 million people worldwide grow produce or raise animals in cities, producing up to 20 percent of the world's food. In developing nations, city dwellers farm for subsistence, but in the U.S., urban ag is more often driven by capitalism or ideology. Whatever the reason, a small industry is growing up to help urban farmers produce crops indoors, using hydroponics and other techniques.

One example of [urban agriculture's promise](#) is Boston-based Freight Farms, launched in 2010 with the goal of cutting down on the number of miles it takes to get greens from farm to table. The company converts shipping containers into mobile "smart farms" that are insulated, digitally controlled and outfitted with Wi-Fi, enabling them to be remotely monitored.

As world population and food production demands rise, keeping our soil healthy and productive is of paramount importance.



Indeed, a farm field these days can seem as wired as an airport.

And then there's the new technology of soil conservation, vital to feeding 9 billion hungry bellies globally by mid-century. "As world population and food production demands rise, keeping our soil healthy and productive is of paramount importance," says the U.S. Agriculture Department's Natural Resources Conservation Service. "So much so that we believe improving the health of our nation's soil is one of the most important conservation endeavors of our time."

Healthy soil provides a number of essential biological functions, such as regulating water, helping control where rain, snowmelt and irrigation water goes. It filters, buffers, degrades and detoxifies pollutants, including industrial and municipal runoff. All told, soil provides 11 distinct services, according to the U.N. Food and Agriculture Organization. And it's not easily replaced; it can take between 500 and 1,000 years to create just a single inch of topsoil through the interaction of bedrock, climate, topography and living organisms.

But that buried treasure is eroding in many parts of the world, including in America's breadbasket. According to the University of Michigan's Global Change Program, 96 percent of North America's soil erosion comes from food production, the majority in the U.S. heartland. Globally, half of the planet's



topsoil has been lost in the last 150 years, according to the World Wildlife Fund, leading to a wide range of environmental problems, from increased pollution to worsened flooding.

Riding to the rescue are what have been dubbed “[soil carbon cowboys](#),” a new breed of farmers who see profits and productivity in soil-management techniques dubbed “carbon farming,” which not only restore soil quality but also sequester carbon.

Carbon farmers spread cow manure on their fields, which increases the amount of nutrients in the soil, enabling the growth of lush foliage, which captures carbon dioxide in plants as well as the soil. [Cows or other livestock](#) eat the foliage, moving around the farm to give plants time to recover, enabling them to produce up to 70 percent more forage. The increased fodder draws even more carbon out of the atmosphere, sending it into roots and soil, where it can sit for a decade or more, sequestering carbon while helping to heal degraded soil by infusing it with vital nutrients.

The process also eliminates the need for disposing of animal manure through other means, turning what had been a waste product and potential liability into a valuable asset. There are also water-retention benefits: Carbon-rich soils soak up heavy rainfalls; carbon-depleted soils don’t. The result is that the soil improves, yields increase, water is saved, and carbon is captured from the atmosphere and kept underground for long periods of time.

In other words: regenerative ag. 





6

CARBON RECYCLING'S GROWING PROMISE

Libby Bernick, Senior Vice President, Trucost North America

Global efforts to address climate change have focused to date on reducing emissions of greenhouse gases through such measures as using energy more efficiently, switching to renewable power and electrifying vehicles.

But what if the carbon in waste gases from power plants, cement plants, waste digesters or steel works could be captured and used to make things, thereby turning pollutants into products? A small but growing band of companies is trying to do just this through a group of technologies one could call "carbon recycling." They use the carbon in greenhouse gases, such as carbon dioxide (CO₂) or methane, as a raw material to make products like plastic or cement.

A common misconception about carbon recycling is that CO₂ from the atmosphere can be used, directly reducing greenhouse gas concentrations. That's not the case. The atmosphere is mostly



nitrogen and oxygen; CO₂ makes up well under 1 percent, so extracting it from the atmosphere is costly and inefficient. Industrial emissions, however, provide a concentrated source of carbon that can be economically extracted while keeping it out of the atmosphere.

Turning CO₂ waste into materials is nascent technology, to be sure. Understanding the feasibility of this concept requires answering three questions before the technology can be seriously considered as a solution to climate change:

1. Wouldn't it be better to invest in technologies that don't release carbon in the first place, such as renewable energy?
2. Can carbon recycling advance beyond the R&D stage to become fully commercial businesses that put a dent in the 36 billion metric tons of carbon dioxide released globally each year from burning fossil fuels?
3. Do carbon-recycling technologies have genuine net environmental benefits that can be quantified and communicated?

In answer to the first question: The world needs every solution it can get, given the enormity of the climate challenge. Renewables are vital, of course, but many new energy-hungry economies are continuing to invest in new fossil-fuel power plants that could operate for 30 years or more. Given that stopping greenhouse emissions altogether isn't going to happen anytime soon, we need solutions to prevent these emissions from entering the atmosphere.

One of the most promising carbon recycling companies is Newlight Technologies. Founded in 2003, the California company developed, patented and commercialized the world's first carbon sequestration technology able to produce high-performance plastic that can match the performance and price of petroleum-based plastic.

Newlight's plastic product, which it calls AirCarbon, is made from methane, a carbon-rich waste gas from farms, landfills and water treatment plants. By taking methane from industrial and agricultural facilities and locking it up in plastic, rather than releasing it into the atmosphere, Newlight stands to make a contribution towards reducing global warming.

Several companies have started using AirCarbon, such as [Sprint for cell phone cases](#) and Dell for packaging computers. Last year, cosmetics company The BodyShop, a



unit of L’Oreal, announced a research and development partnership with Newlight to use AirCarbon to make containers and caps.

As far as carbon recycling’s commercial prospects, Newlight last summer [signed a deal](#) with chemicals company Vinmar to supply more than 19 billion pounds of AirCarbon plastic over 20 years, securing the future for Newlight’s planned 50 million pound per year production facility. That qualifies as going well beyond mere R&D.

Plastic isn’t the only application of carbon-recycling technology. New Jersey-based Solidia Technologies has developed a type of cement that is produced at lower temperatures, and through a different chemical reaction that generates less CO₂ than conventional cement. The cement is hardened by injecting it with CO₂ from industrial sources.

Since 2013, global cement giant Lafarge has collaborated with Solidia to commercialize the technology, including conducting full-scale trials at two Lafarge sites in the U.S. and Europe. The cement was used to produce pre-cast concrete products, such as paving blocks and roof tiles.

In answer to the third question about the feasible environmental benefits of carbon recycling, Solidia says that the carbon footprint of its concrete is 70 percent smaller than that of conventional concrete. Tom Schuler, Solidia’s president and CEO, says that the cement industry’s commitment to cut CO₂ emissions 20 to 25 percent by 2030 could be achieved now if cement companies switched to Solidia’s cement.

Several other companies are developing interesting carbon-recycling technologies related to other types of materials.

Novomer has developed a way to transform waste CO₂ into high-performance, low-cost chemicals called polyols for use



in applications such as coatings, adhesives, sealants, elastomers and foams. These contain up to 50 percent CO₂ by mass. Overall, the carbon footprint of Novomer’s polyols is at least a third less than comparable petrochemical products, the company says.

Even better, the products outperform their conventional counterparts. Novomer, based in Massachusetts, says that in addition to waste CO₂ being a very low-cost raw material, it also gives products greater strength and durability. For example, German industrial adhesives company Jowat uses Novomer’s polyols in its polyurethane hot-melt adhesive applications.

There’s more. [Liquid Light](#), based in New Jersey, uses low-energy catalytic electrochemistry to convert CO₂ into chemicals, such as ethylene glycol, a raw material for plastic bottles. Austin-based Skyonic Corporation turns CO₂ emissions from power plants and industrial processes into products to manufacture baking soda.

As an additional incentive, the \$20 million NRG COSIA Carbon XPRIZE, launched last year, will be awarded to companies that can demonstrate new technologies to take carbon from power-plant emissions and turn it into products and materials. That should prime the pump for further innovations. ❁



7

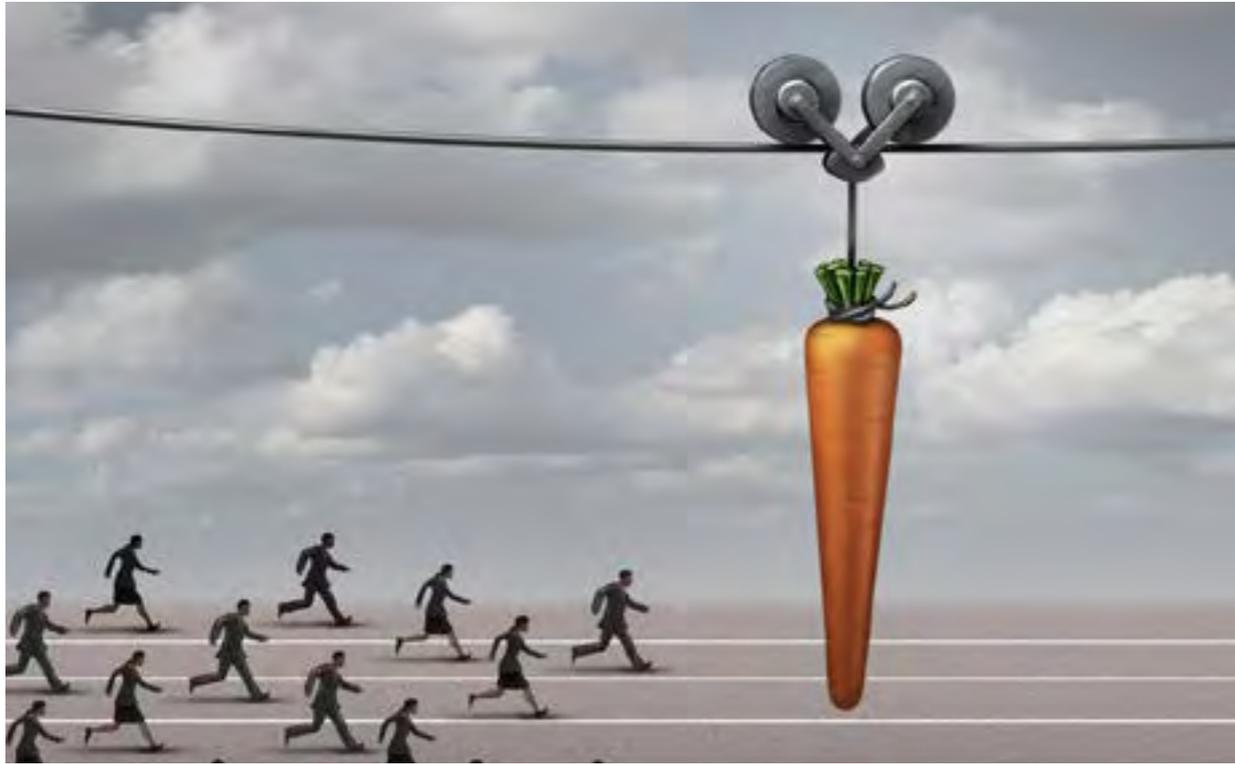
SUSTAINABILITY BECOMES AN EMPLOYEE PERK

Heather Clancy, Senior Writer, GreenBiz

When it comes to creative corporate benefits, Facebook is no slacker. But one of its newer employee incentives — [a \\$10,000 bonus](#) for those who move closer to its corporate campus — underscores the value it sees in encouraging employees to embrace sustainability.

To be fair, a large part of the motivation is the San Francisco Bay area's notorious traffic jams and housing costs. But it's also an acknowledgement that long commutes aren't great for Facebook's environmental credentials, not to mention employee morale. Supporting a culture that encourages long drive times runs counter to at least two of the tech giant's [five core values](#): "Focus on impact" and "Build social value." Long commutes are unsustainable over the long term.

Ask any accomplished business leader the secret of his or her company's success, and invariably the answer points to an elusive concept: corporate culture. To quote GE's legendary CEO Jack Welch:



A growing number of firms are embracing sustainability goals and offering incentives to employees to act on them.

“The essence of competitiveness is liberated when we make people believe that what they think and do is important — and then get out of their way while they do it.”

Culture is a notoriously difficult thing to define or measure. But if you’re looking for clues about whether a company really believes sustainable business practices are important, you should start with its mission statement or its declared core values. Increasingly, the organizations that really care about sustainable business practices — and that want to attract millennial workers who care about how their employers treat the planet — are embedding the notion of environmental responsibility right into their central corporate belief systems.

Great examples include Unilever, which wants to “make sustainable living commonplace.” Or PepsiCo’s [“performance with purpose”](#) declaration, which requires “delivering top-tier results in a way that sustains and respects business, society and the planet.” Caterpillar even officially amended its code of conduct in 2015 to add a fifth core value to its existing four. The company now urges employees to prioritize “Integrity, excellence, teamwork, commitment and sustainability.”

“It is not appropriate to have a huge sustainability department,” Caterpillar’s global sustainability chief Tim Lindsey [noted in an interview](#) two years prior to the wording switch. “More can be accomplished having a culture of sustainability. It’s a lot like quality and safety, too. Everyone is responsible. I want to move sustainability forward to that point.”

The good news is that a growing number of businesses are embracing a similar mantra by embracing sustainable development goals and, in some cases, offering [financial incentives](#) or perks to encourage employees to act on them.

In reality, the sum total of businesses taking things this far is still pretty small. Just a quarter of the 613 companies tracked by nonprofit group Ceres link some portion of executive compensation to progress on sustainability strategy, although far fewer tie it to specific goals such as cutting greenhouse gas emissions. Still, that's substantially higher than the number of organizations that did so back in 2012.

Moreover, a higher percentage of the organizations surveyed by Ceres — approximately 40 percent — are building sustainable business principles into corporate training programs, or [engaging employees](#) across a variety of roles, from the front office to the manufacturing floor.

“Sustainability-focused employee engagement sometimes emanates from a highly engaged CEO or other senior management, and sometimes from employee-led ‘green teams,’” according to a 2014 Ceres report. “No matter how they begin, it is necessary to embed sustainability within the culture of the organization and across all functions of the business to ensure they last.”

Facebook's unusual commuting perk is just one small example of how green behavior pervades the tech company's workplace. Another reminder can be found right in the company's parking lot. The social media giant is one of more than 250 active participants in the [Workplace Charging Challenge](#), a Department of Energy program meant to encourage adoption of electric vehicles. The program's goal is 500 participating companies by 2018.



The initiative helps fund the installation of plug-in charging stations. Among the big businesses that have signed up: 3M, Baxter International, Capital One, Cigna, Cisco Systems, Coca-Cola, Dell, Eli Lilly, Ford, General Motors, Google, Intel, Kaiser Permanente and MetLife. Over the past three years, the program has encouraged the installation of more than 5,500 charging stations that are available to more than 1 million workers at more than 600 workplaces. Over that time, the system's fleet has grown to more than 9,000 vehicles.

Logistics company Deutsche Post DHL isn't a Workplace Charging partner, but it's also encouraging EV adoption through [GoGreen](#), the umbrella program for all of its sustainability initiatives. For example, the company teamed up with Nissan to create an EV test-drive program at its headquarters in Plantation, Florida, and at airports in New York and Los Angeles. Employees can sign up to borrow the cars on specific days of the month. “Our hope is that employees and customers will get as accustomed to the idea of an [EV] as they are with their smartphones, helping the companywide GoGreen initiative to gain even more traction,” Deutsche Post said.

Some businesses, including financial services giants Bank of America and Swiss Re, support even bolder efforts to help employees embrace or reinforce sustainable behaviors at home. During 2015, BofA supported a \$500 discount for employees investing in a solar rooftop installation from SolarCity. It also offered a \$3,000 reimbursement incentive to workers buying a hybrid, compressed natural gas or



“highway-capable” EV. As of the last update, more than 7,200 BofA employees had taken advantage of that benefit.

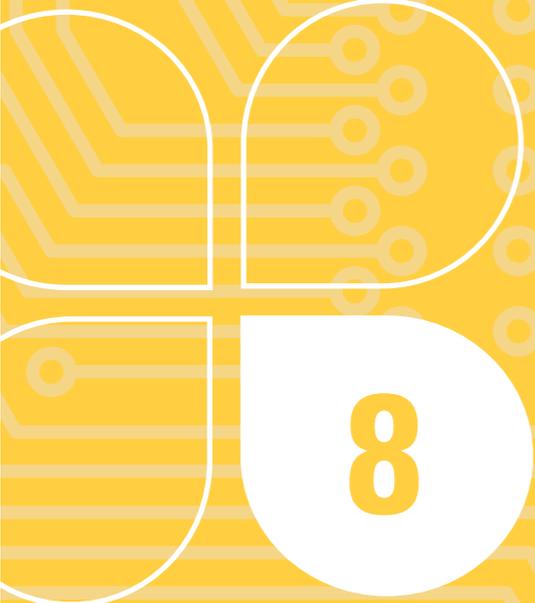
You can credit Swiss Re for being among the first multinational organizations to create a program of this nature — and for standing behind the effort over the long term. Its [COyou2](#) grant initiative was first established in 2007 and is scheduled to run at least through 2020.

Employees must apply for the funds, but anyone is eligible after working at Swiss Re for three months. The payout comes in the form of a grant for up to 50 percent of the overall investment for a project that helps shrink an employee’s carbon footprint. Over the first seven years of the program, the insurance company granted more than 9,000 subsidies. Last year, there were more than 2,268 approved worldwide — ranging from home appliance replacements to home insulation replacements and other energy-efficiency upgrades to more environmentally friendly forms of transportation.

Given the scale of this employee incentive program, it’s not surprising to learn that sustainability looms large in the core values and mission of companies like Swiss Re. To be successful in that mission, companies must embed sustainability into the cultural norm. That includes providing employee incentives that encourage the right behavior — not just in the workplace, but at home. ❀

Bank of America offers employees a \$3,000 incentive to buy a hybrid, natural gas or electric vehicle.





8

THE POWER OF MICROGRIDS GETS UNLEASHED

Barbara Grady, Senior Writer, GreenBiz

A few solar panels connected to inverter, plus a battery no bigger than those found inside an electric vehicle. That's all it takes for a village in Kenya that never before had electricity to not only light up homes but also enable some businesses to power refrigerators and computers.

The collection of electrical parts providing the new source of power is called a [microgrid](#). And because of them, rural communities across Kenya — as well as companies and cities around the world — are becoming more self-sufficient and resilient while polluting less. It's nothing short of an energy revolution.

Microgrids are localized systems that generate and deliver electricity to a defined geographic area, such as a building, campus or neighborhood. They are transforming remote economies in the developing world, as well as businesses, universities and municipalities in the industrialized world. Microgrids can serve as backup power sources to entities

The so-called Internet of Things, in which devices are connected and able to communicate in real time, is another technology driver. IoT software means that exactly the right amount of energy from the cheapest source can be delivered via microgrids or shifted in split-second response to changes in weather or demand, reacting just like the bigger grid does.

As these technologies have advanced, the costs of solar and wind power have plummeted, making renewables a compelling prospect for electricity buyers. The price of solar has fallen 82 percent per watt in the past six years, while wind power has dropped 61 percent during that time, according to Lazard's Levelized Cost of Energy Analysis. That makes them price-competitive with — or in some markets cheaper than — fossil-fuel power.

And then there's resilience. The perceived vulnerability of centralized electrical grids to extreme weather and other disruptive events are making microgrids an attractive option. As hurricanes, floods and other weather calamities become more frequent due to climate change — not to mention the actions of hackers or terrorists — utility power grids appear increasingly susceptible to cascading outages.

After Hurricane Sandy in 2012 knocked out power to much of the northeastern United States, New York, New Jersey and Connecticut began offering multimillion-dollar financing to cities interested in building microgrids as insurance against future power disruptions. Municipalities across the region took the offer, including Hoboken, New Jersey, and Fairfield, Connecticut.

Meanwhile, Tesla's hometown of Fremont, California, is [building a microgrid](#) in part to keep things powered if and when the nearby Hayward Fault erupts. So, too, is the [City of San Francisco](#), which hopes a microgrid can provide backup power when the next big earthquake hits. [Even in tiny Potsdam](#), New York, the local utility National Grid is partnering with GE, Clarkson University and the National Renewable Energy Lab to build what could be the nation's largest municipal microgrid, buffering the town against ice storms and other disruptive weather.

Security is yet another factor. In April 2013, individuals carrying assault rifles broke into a utility substation in San Jose, California, and began shooting at 17 giant transformers that send power to the heart of Silicon Valley. A police response sent the criminals scurrying, and the utility, Pacific Gas & Electric, rerouted power from



also connected to the grid or can be operated independently, allowing homes or businesses to operate off the grid.

Microgrid deployment is a "global phenomenon," according to a 2015 Navigant Research report. It identified 1,437 microgrid projects worldwide representing 13 gigawatts of capacity either operating, proposed or under development. The market for microgrids will soar to \$40 billion by 2020, a fivefold increase over seven years, Navigant predicted.

A convergence of technological, economic and environmental forces, each coming to a head over the past year, are pushing microgrid development forward rapidly, as if by gale-force winds.

The rise of battery storage is one of them. Storage effectively eliminates a key barrier to renewable power generation: the intermittent nature of sunshine and wind. Batteries enable a microgrid to store energy tapped during sunny or windy times of the day and save it for use during times when those weather conditions don't exist.



neighboring substations to prevent a serious outage. But the event was a huge reminder that energy grids can be taken out by troublemakers, or even terrorists.

The event spurred Jon Wellinghoff, then chairman of the Federal Energy Regulatory Commission, to become an advocate of decentralized grids. “The vulnerabilities are extreme, to the extent that we are in a situation where it would not take much to take down our entire grid,” Wellinghoff said [in an interview](#) at VERGE 2014.

The answer, he said, is dispersing the electricity nodes — and thus the targets — “by having many, many targets ultimately through microgrids.”

The U.S. military gets this. It is deploying microgrids at key installations around the world. Defense Department literature describes microgrids as a way to assure uninterrupted power amid extreme weather and security threats. Microgrids are [particularly well-suited for military operations](#) because they can operate independently from a central grid, thereby engendering self-sufficiency. And they can vary in size, providing power to an entire military base or an individual camp.

Joining the military is a growing corps of companies, cities and institutions tapping into microgrids to meet economic, environmental and resilience goals. For example, the University of California at San Diego relies on a microgrid to power its 13-acre campus of research labs, hospitals, classrooms, living spaces and a fleet of

electric vehicles. Software manages electrical loads, responding in real time to changes in demand or supply.

But microgrid deployment faces challenges, especially in industrialized regions with existing grids. Local utilities sometimes create barriers to microgrids, both for safety reasons and to protect existing monopolies. But even entrenched utilities are seeing the benefits, and many are working with microgrid developers and regulatory bodies to [overcome the challenges](#).

The technology still has a way to go before it is truly plug-and-play, though interoperability is progressing quickly. When GreenBiz first built a microgrid to [power the VERGE conference and expo](#) in 2013, getting the various components to “talk” to one another was a formidable challenge. Just two years later, at VERGE 2015, those challenges were far fewer.

The U.S. microgrid market will benefit from legislation passed in 2015 that extended an investment tax credit for renewable and distributed energy resources. The tax credit’s extension suggests 2016 will be a banner year for solar, wind and microgrid installations, which often happen together.

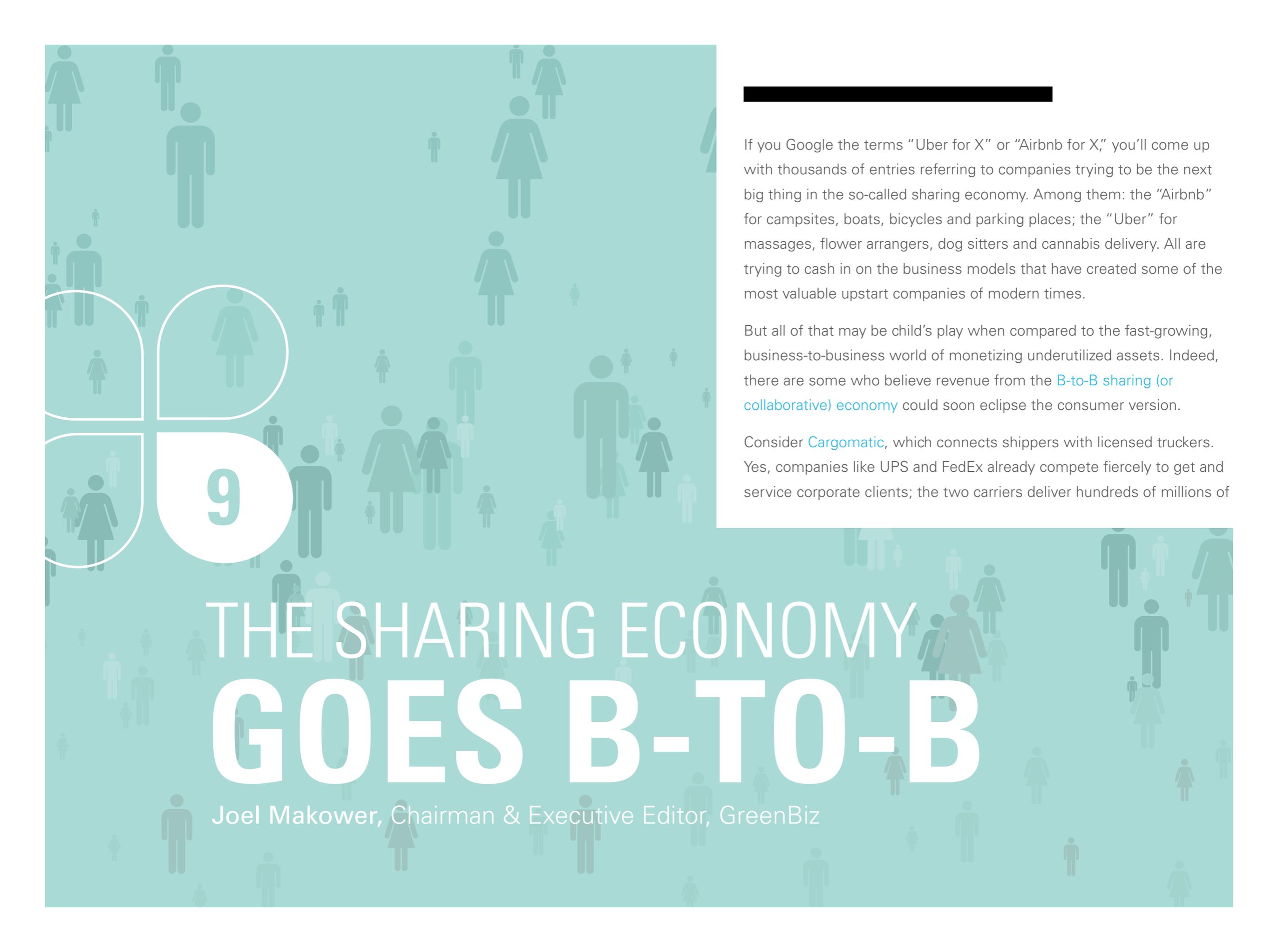
Meanwhile, in Kenya and the rest of the developing world, the opportunity is massive.

“What’s maybe most exciting about microgrids is that they could bring energy to 1.3 billion people around the world who don’t currently have electricity. India alone has

as many as 400 million people without electricity, partly because of the dysfunction surrounding the design of its electric grid,” says the Motley Fool’s Travis Holum.

That’s a \$2 trillion electricity market — a power-packed opportunity. 🍀





9

THE SHARING ECONOMY GOES B-TO-B

Joel Makower, Chairman & Executive Editor, GreenBiz

If you Google the terms “Uber for X” or “Airbnb for X,” you’ll come up with thousands of entries referring to companies trying to be the next big thing in the so-called sharing economy. Among them: the “Airbnb” for campsites, boats, bicycles and parking places; the “Uber” for massages, flower arrangers, dog sitters and cannabis delivery. All are trying to cash in on the business models that have created some of the most valuable upstart companies of modern times.

But all of that may be child’s play when compared to the fast-growing, business-to-business world of monetizing underutilized assets. Indeed, there are some who believe revenue from the [B-to-B sharing \(or collaborative\) economy](#) could soon eclipse the consumer version.

Consider [Cargomatic](#), which connects shippers with licensed truckers. Yes, companies like UPS and FedEx already compete fiercely to get and service corporate clients; the two carriers deliver hundreds of millions of

“The collaborative economy is fundamentally the most revolutionary change in the economy in a long, long time,” says author and entrepreneur Paul Hawken.

packages for retailers like Amazon. But if your shipment is bigger than a few boxes — say, 150 pounds or more — you’ll likely need another carrier.

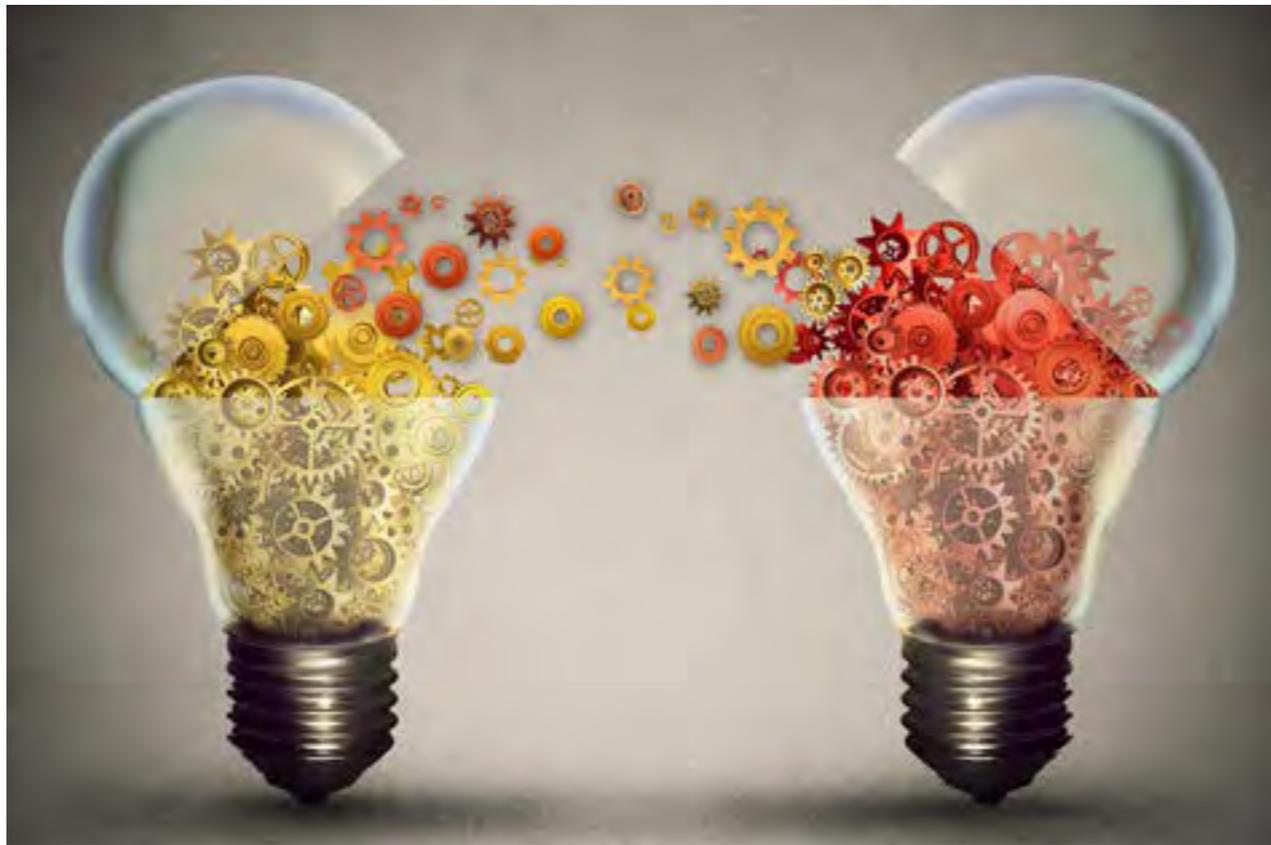
That’s where Cargomatic comes in. It uses smartphone technology to [connect truck drivers to freight](#) that needs to be moved. For truck drivers, who often haul empty trucks for hundreds of miles en route to their next pickup, it creates new revenue opportunities. For shippers, it can mean lower rates on big shipments, particularly at the last minute. And then there are the environmental benefits of fewer empty trucks on the road. All through an app.

The world of shipping and cargo is ripe with opportunities for B-to-B sharing. [Convoy](#), [ShipHawk](#) and [uShip](#), all service customers with less-than-truckload-sized hauling needs. [Lugg](#) and [Fleetzen](#) focus on moving and furniture shipping. [DashHaul](#) and [Transfix](#) are similar to Cargomatic.

And, it turns out that the “Uber for shipping” just might be ... Uber. Its [UberCARGO](#) service leverages its drivers to haul packages around town, helping to meet demand in a same-day-delivery world.

Beyond shipping are seemingly endless opportunities in other facets of business operations. Companies are providing services to share unused office space ([LiquidSpace](#), [WeWork](#), [PivotDesk](#)), farm machinery ([FarmLink](#)), warehouse space ([Flexe](#)), business equipment and services ([Flow2](#), in the Netherlands),





retail spaces available for pop-up shops ([Storefront](#)) and idle heavy equipment ([Yardclub](#)). There's even a sharing platform for cities and other public agencies ([MuniRent](#)) to share heavy-duty equipment. All told, these companies and many others stand to disrupt how companies think about sales channels, supply chains, where to make things, how to make them — and whether to make them at all.

True, much of this isn't really sharing. That is unless, for example, you believe that your favorite hotel chain "shares" its rooms. It's good, old-fashioned asset maximization, no different from what airlines and restaurants do every day. What makes them au courant are their digital platforms — the ability to use mobile apps (or web browsers) to order up exactly what you need quickly, affordably and with minimal effort — frictionless commerce, in the argot of digital commerce. Eliminating human intermediaries — salespeople, brokers and others — also makes such transactions simple, compelling and less expensive.

"The collaborative economy is fundamentally the most revolutionary change in the economy in a long, long time," said author and entrepreneur Paul Hawken [in an interview](#) at VERGE 2013. "It changes all the relationships between the players in the economy. It changes the incentives to scale. It then starts to go back to the village in a sense — your reputation, your character, whether you are or aren't trustworthy. It creates socialization. It's the opposite of the Internet, where you're online alone. It also has a huge impact on how much material we use. It shifts from the economy of stuff to the economy of information, transported and interchanged by people."

The B-to-B sharing economy, said Hawken, will be "[bigger than the Internet](#)" in terms of transforming how commerce gets done.

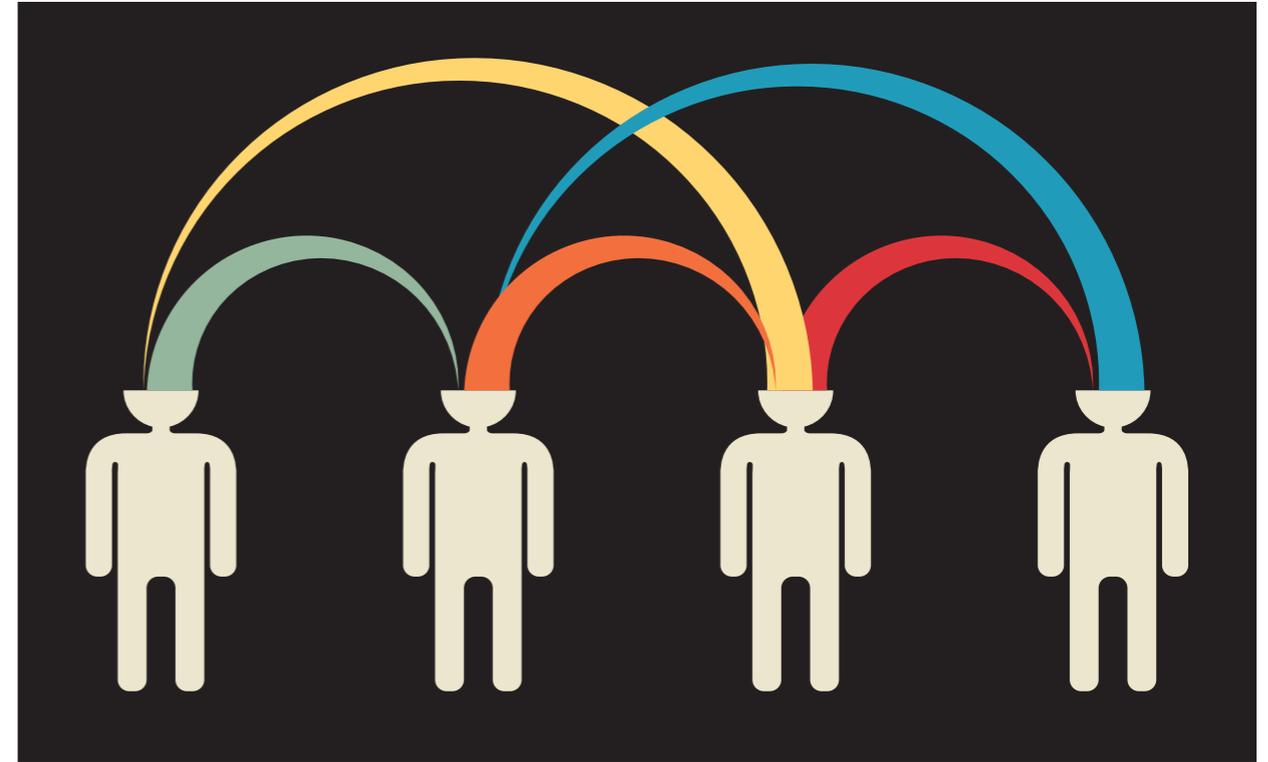
There are differences between the consumer and B-to-B sharing economies. The former is based on trust and experience, the latter more on quality and efficiency. While consumer sharing services don't necessarily replace conventional ones — you can still find a taxi or pet sitter even without an app — B-to-B firms often bring services not otherwise available, especially to smaller firms and entrepreneurs. But the end result is the same: higher asset utilization, improved efficiency and, probably, less stuff.

"Probably?" The environmental impacts of all this sharing and collaboration have yet to be measured, though they could be significant. It stands to reason that using stuff more efficiently minimizes manufacturing costs, waste and emissions, as well as overall consumption. But so far, evidence is anecdotal. For example, according to Joe Gebbia, chief product officer and co-founder of Airbnb, "In North America alone, Airbnb guests use 63 percent less energy than hotel guests." That's enough energy to power 19,000 homes for one year, he says.

Clearly, there's a great deal more research needed to understand the sharing economy's full implications. One small example: Will a service that makes it easier to find parking spaces mean more people will be inclined to drive? We don't know.

As its evangelists are quick to point out, the sharing economy is not just about sharing. It also stands to transform relationships and business ecosystems, fostering communities where collaboration can lead to innovation.





“In the collaborative economy, sharing and networking assets ... will always deliver more value faster,” says Zipcar co-founder Robin Chase.

“In the new collaborative economy, sharing and networking assets, like platforms, car seats and bedrooms, will always deliver more value faster,” says Robin Chase, co-founder of Zipcar and author of [“Peers Inc: How People & Platforms are Inventing the Collaborative Economy & Reinventing Capitalism.”](#)

She continues: “Think of the enormous loss of human potential bound up in patents, copyrights, trade secrets, certifications and credentials. These hallmarks of the old capitalist economy harbor excess capacity just yearning to find the light of day. In the new collaborative economy, innovation is limitless. More minds working together will always be exponentially smarter, more experienced and more well-equipped than fewer ones who work inside a single company or government.”

In these big and well-organized networks, she says, “We can count on the right person — with the necessary skills, networks, insights, and location — to appear.” 

10

THE BLUE ECONOMY CATCHES A WAVE

Elsa Wenzel, Managing Editor, GreenBiz

Seventy percent of the earth's surface is made of oceans, yet only 5 percent of this vast expanse has been explored — and far less than that protected. Businesses are waking up to untapped economic opportunities within these watery regions, which absorb 30 percent of the planet's carbon emissions.

But as warming, acidification, chemical pollution, waste flows, overfishing and rising sea levels [imperil marine systems, species and habitats](#), industrializing the oceans further brings new risks. The recognition of oceans' economic potential is crashing up against the movement to [place an economic value on its natural capital](#).

The emerging "[blue economy](#)" movement applies sustainability to the vast marine environment, which encompasses shipping; transportation; tourism; recreation; and the harvesting of fish, seafood, oil, gas, minerals, energy and even water itself.

If oceans were a national economy, they would be the world's seventh largest — an estimated \$24 trillion in value, or \$2.5 trillion a year in GDP, [according to a 2015 report](#) from WWF. In the United States alone, the blue economy was estimated at \$258 billion, or 1.8 percent of GDP in 2010, according to the Economist Intelligence Unit. China credited oceans with 10 percent of its GDP and even uses a [Gross Maritime Output](#) metric — about \$921 billion in 2014. Valuing the wealth of the oceans is hard to quantify because accounting methods vary and the space is expansive. (Beach sunsets: Priceless.)

Business leaders are recognizing that better data on the blue economy could enhance stewardship, reduce business costs, increase efficiency, spur innovation and open access to new markets and capital flows.

A truly blue economy should do more than prevent or diminish ecosystem harm. As visualization and protection efforts swell, so do new economic opportunities to monitor ocean health, store carbon, promote eco-tourism, prevent waste and protect marine habitats.

Contending that the surface of Mars is better explored, the [Shell Ocean Discovery XPRIZE](#) is offering \$7 million to teams that innovate “deep-sea technologies for autonomous, fast and high-resolution” mapping of the ocean floor. [Google Ocean](#) — which is similarly mapping the world's oceans with National Geographic, government agencies and thousands of volunteers — recently launched 40 underwater “street views” of marine sanctuaries, fishing sites and coral reefs, but that's a mere drop in the bucket.

Other efforts to better understand and protect the big, blue sea: Global leaders are elevating talk of protecting the oceans while nations build blue-economy plans (though many favor development over conservation). The Group of Seven nations in 2015 for the first time put oceans on its agenda. The U.N. is completing its first [World Ocean Assessment](#) and set ocean protection as one of the [17 Sustainable Development Goals](#).

Even so, oceans largely came up dry in the Paris Agreement forged at COP21; the UN climate summit held an Oceans Day, though [on the sidelines](#). The shipping industry, which has cumulative greenhouse gas emissions [equal those of Germany](#), was left untouched by the pact, even with trade by sea set to quadruple by mid-century. The Paris Agreement's text at least noted the importance of “ensuring the integrity of all ecosystems, including oceans” — as well as conserving carbon sinks, a less direct nod to oceans.

Still, a sea change is taking place in some parts of the business world. A growing number of cargo companies are working to improve efficiency and reduce the emissions of their oceangoing fleets. The Maersk Group has a “smart sailing” container shipping effort, and is seeking to decouple growth from carbon emissions. Giant cargo shippers like [Cargill are favoring](#) shipping companies with high efficiency ratings from the Carbon War Room. [Norsepower is among those](#) engineering shipping efficiency through a range of innovations.

Nearly 50 companies as varied as BMW, Electrolux, IKEA, Kohl's, Marks & Spencer and Ralph Lauren are involved



in the [Clean Cargo Working Group](#), a BSR initiative to reduce greenhouse gas emissions from oceangoing shipping. In 2015, its members reported an average 29 percent drop in emissions since 2009, with measurable improvements in 21 of 25 major trade routes. Shipping hulks including Interferry and the Abu Dhabi National Tanker Company signed on [to support a strong COP21 climate pact](#) and to reduce emissions in line with International Maritime Organization goals.

To protect the oceans, the ocean economy requires [NGOs, business and government working together](#).

One example is the Trash-Free Seas Alliance's attack on the trillions of particles of plastic tainting the oceans. The Ocean Conservancy, partnering [with Dow and Coca-Cola](#), seeks to stanch the flow of plastic into waterways by 45 percent in a decade, from





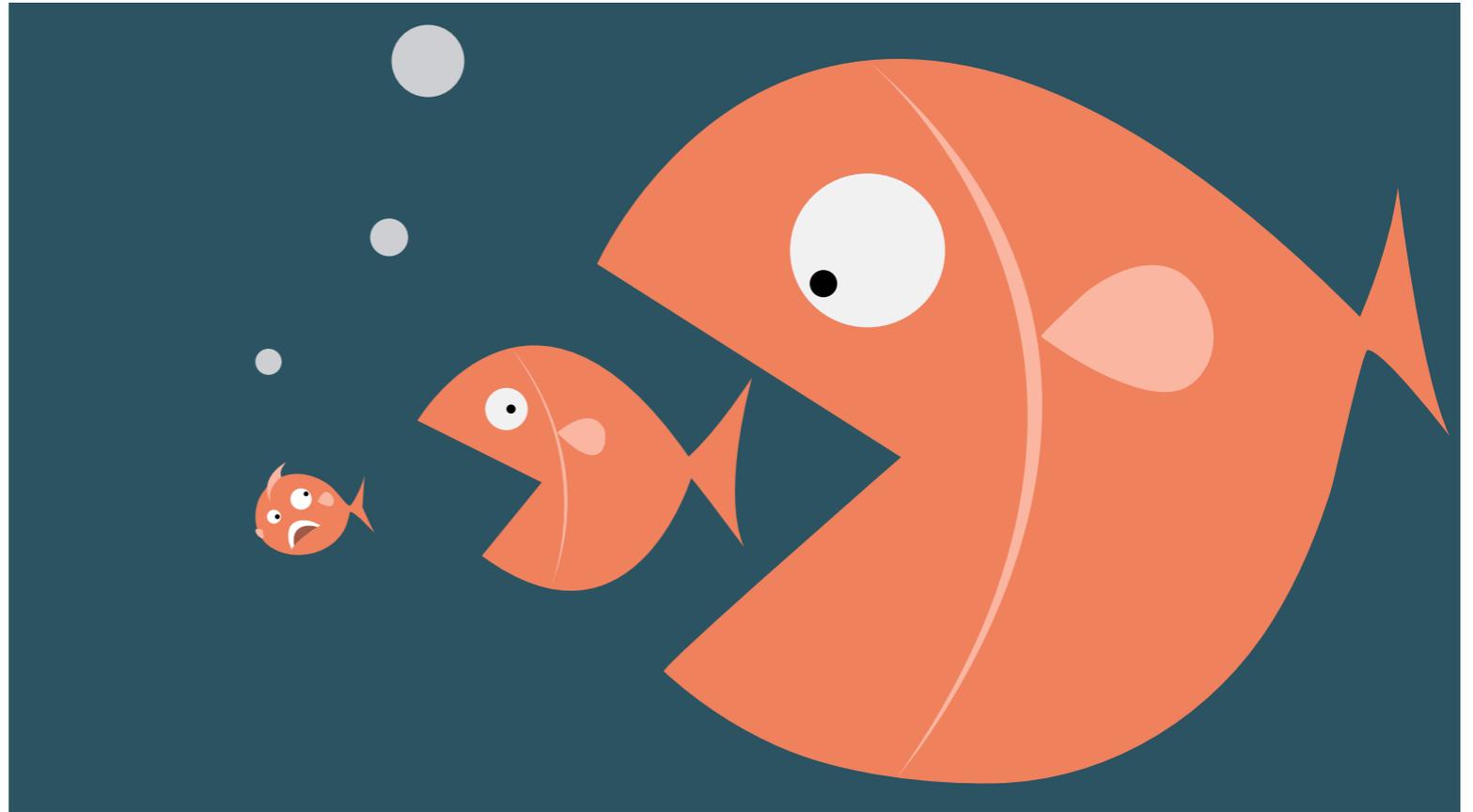
five chokepoints in Asia. The alliance estimates that \$5 billion is needed in public-private investment each year to exploit secondary markets for plastic waste, like fuel or electricity.

A big question is whether plastic waste harvested from oceans can create enough economic value to launch viable business opportunities.

Then there is the concept of “social plastic,” set forth by the [Plastic Bank](#) startup. It treats plastic trash as currency. In Haiti, for example, people can trade plastic litter in exchange for Internet access. The Plastic Bank is experimenting with 3D-printing waste plastic into fresh products, and is working with a growing number of companies to create packaging.

A few companies already upcycle water-bound waste. [Method uses plastic collected](#) from Hawaii beaches for soap bottles. [Interface’s Net Works program makes new carpet tile](#) from fishing nets, which the Patagonia-based startup Bureo also uses to create [skateboards and sunglasses](#). Adidas partnered with Parley for the Oceans to create a new [concept shoe](#) made from recycled 3D-printed ocean plastic waste, including from gillnets used in commercial fishing.

Plastic pollution is just one of many threats to aquatic life and the marine food supply. Although oceans provide only 2 percent of the world’s food, demand could quadruple over the



next decade as the demand for protein grows in lockstep with world population. With 90 percent of fish stocks already overexploited, corporations are seeking sustainable sources for fish and seafood.

Unilever requires fish it buys to be certified by the Marine Stewardship Council. Red Lobster requires suppliers to meet Global Aquaculture Alliance standards. Whole Foods, Wegmans and Hy-Vee recently topped a Greenpeace list of supermarket leaders in sustainable seafood, which includes working to [eliminate slavery](#) from supply chains. A “[blue revolution](#)” in aquaculture could increase yields, much as the agricultural Green Revolution of the late 20th century did. By 2030, two-thirds of fish served could come from farms.

Silicon Valley investors are diving in, too. Tracking seafood supply chains is a theme of the [Fish 2.0 competition](#), which features vessel tracking and DNA testing technologies. Similarly, the [Future of Fish nonprofit incubator](#) fosters traceability, “breakthrough aquaculture,” oyster restoration and more.

One vision, promoted by the [Seasteading Institute](#), (backed by PayPal co-founder Peter Thiel) is of floating cities that farm fish at sea using kelp, a fish feed that also absorbs carbon. Such solutions might even provide a life raft to soon-to-be-underwater island-states like the Maldives.

As sea levels rise, so does the need for [infrastructure to guard cities](#), from New Orleans to





Amsterdam and beyond, yet another opportunity. New financing models are starting to circulate; the Nature Conservancy just supported the first “[blue economy debt swap](#)” with the low-lying Seychelles, a public-private finance model built for endangered island-states to replicate.

There’s more to be harvested from the seas. Biotech firms are concocting new painkillers, antibiotics and cancer treatments from ocean critters. Drugs made from sponges, fish, invertebrates, mollusks and fungi are projected to become an \$8.5 billion market by 2016, according to BCC Research.

Then there are [product designs that mimic ocean life](#), like the lowly Sandcastle worm, [which inspired](#)

[a surgical glue](#). It’s early days for marine biotech and its myriad applications, including safer industrial chemicals, bioremediation products and energy feedstocks. But if a gold rush rises, say, for a miracle sponge, companies will need to collaborate to prevent overharvesting such species.

The same goes for protecting minerals and metals on the seabed floor, where some ores may be 10 times more concentrated than on land. The first deep-seabed mining operation for gold, copper and other things could trawl New Guinea waters in a few years. And as China still controls 95 percent of the market for rare earths — critical ingredients in everything from iPhones to solar panels to wind turbines — yet another opportunity is waiting to surface. ❀

Drugs made from sponges, fish, invertebrates, mollusks and fungi are projected to become a \$8.5 billion market, says BCC Research.



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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 1,600 companies globally. Produced in collaboration with the natural capital research firm Trucost, the 2016 assessment includes more than 30 corporate sustainability performance indicators.

The infographics shown on these pages are backed by detailed data sets and methodology, explained in the Appendix. Readers of the PDF edition will find this supporting data in the back of this report. (Each graphic is linked to its corresponding data set in the Appendix.) Readers of the iPad edition can simply tap each graphic to view its underlying data. 

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THE BIG PICTURE

What are the most important impacts, and where do they arise within the value chain?

Every year, our objective for the State of Green Business Index is to understand whether business is making meaningful progress towards improved environmental sustainability. This year's index is expanded with 10 new metrics, increasing the total to more than 30.

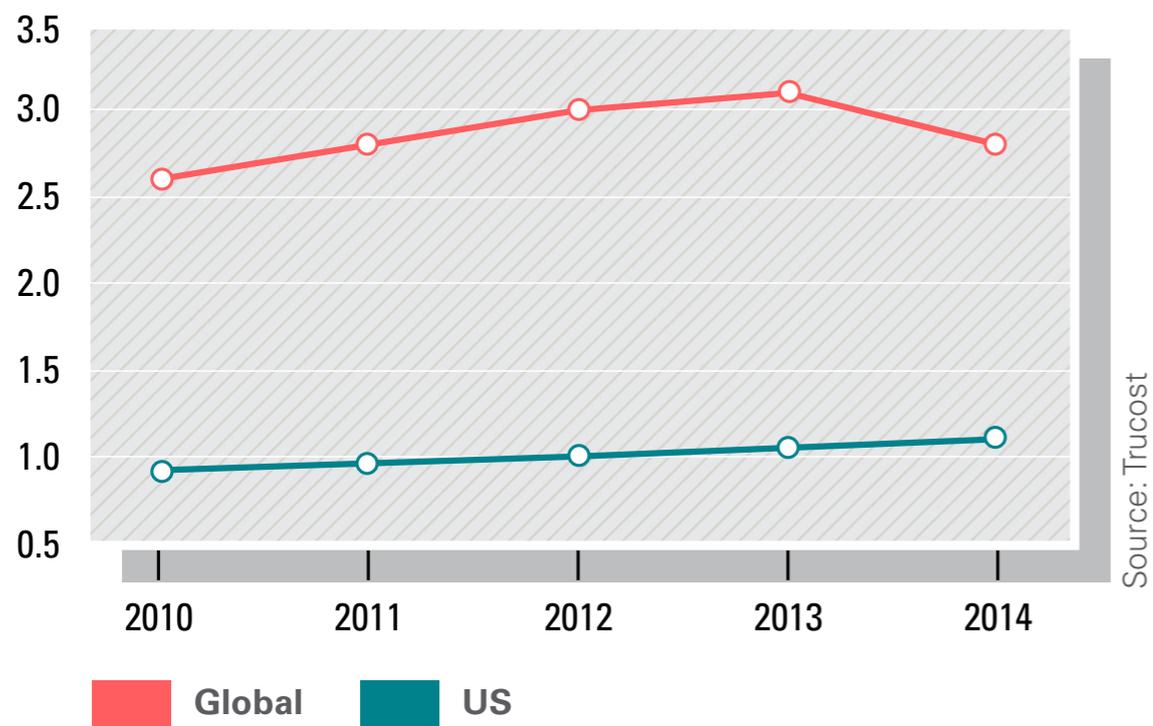
The metrics in the first section of the 2016 index show the macro view on whether businesses have been increasing their environmental sustainability performance, answering such questions as:

- Are companies succeeding in reducing their total cost of corporate natural capital impacts?
- How much corporate profit is at risk from natural capital impacts?
- What are the most important impacts, and where do they arise within the value chain?

“Natural capital” refers to the limited stock of the Earth's natural resources upon which people and businesses depend for prosperity, security and well-being. 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 [UNEP](#).

COST OF CORPORATE NATURAL CAPITAL IMPACTS

Total costs (trillion U.S. dollars)



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.

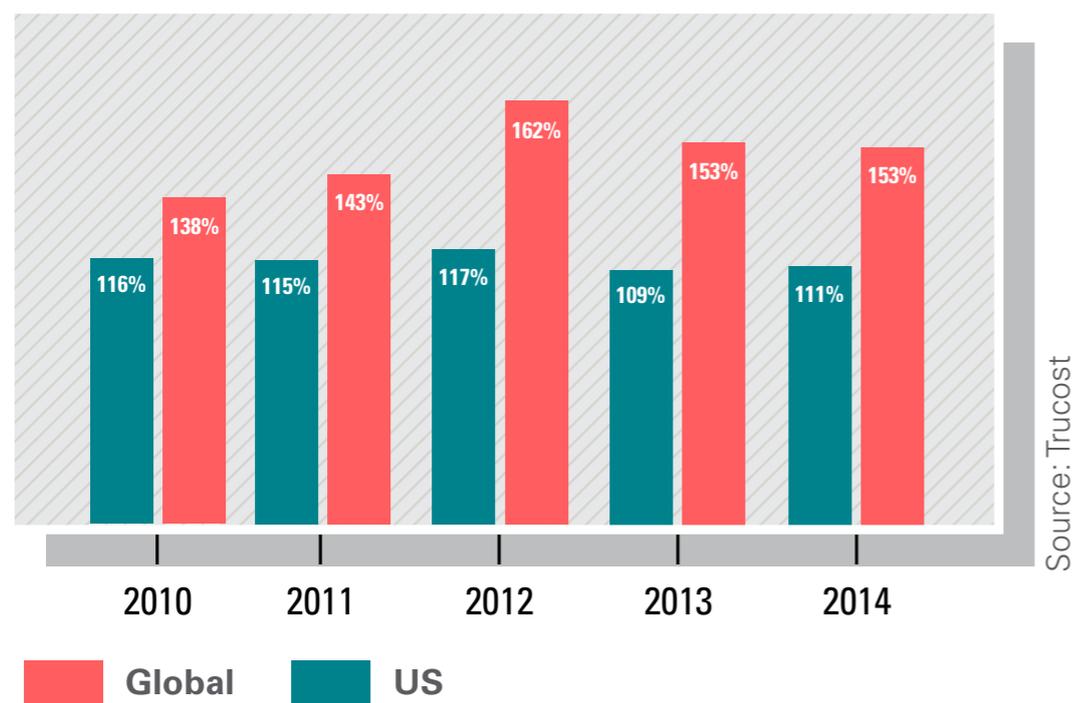
Trucost calculated the value of hundreds of natural-capital inputs consumed (such as water or commodities like fossil fuels) and outputs generated (such as waste or greenhouse gas emissions) by companies' operations and supply chains over the last five years. Trucost calculates these values from a wealth of peer-reviewed academic research and data from a long list of national government sources. The calculation of these natural-capital values is supported by an international [advisory panel](#) of leading academics in economics and the environment.

These natural-capital valuations are applied to environmental impact data for the largest U.S. and global companies. Company data, taken from the Trucost Environmental Register, includes validated disclosure data typically sourced from sustainability reports. Any gaps where companies do not disclose are filled by environmental impact data by applying Trucost's Environmentally Extended Input-Output Life-Cycle Assessment Model. For more information on this assessment process, please visit the Methodology section of this report.

Overall, the indicators show that business risk continues to increase alongside the companies' growing use of natural capital. Corporate use of natural capital has grown over the last five years, although beginning in 2013 there are signs of slowing. In the U.S., the value of natural capital used by business now exceeds \$1 trillion per year, or 6 percent of national GDP, in terms of the environmental and social impacts associated with pollution, ecosystem depletion and related health costs. This number is almost \$3 trillion for global companies. Placing this in context against corporate profits portrays a bleak picture. The profits of over half of all U.S. and global companies would be destroyed if businesses had to internalize and pay for these environmental costs.

PROFIT AT RISK FROM NATURAL CAPITAL IMPACTS

Total environmental costs as percent of net income.





In the last five years, corporate natural-capital impacts have increased by more than 13 percent in the U.S. and 10 percent globally.

ECONOMIC COST OF CORPORATE NATURAL CAPITAL IMPACTS

Nature provides companies with essential inputs like clean water and air, and raw materials required to produce the goods and services that we buy every day. Businesses also create waste and pollution during the manufacture and delivery of products.

In 2014, the largest 500 U.S. companies accounted for a natural capital cost of more than \$1 trillion, or 6 percent of national GDP. That represents the cost to the economy of the environmental and social impacts associated with pollution, ecosystem depletion and related health costs.

The trend is not good. In the last five years, following the global recovery from the subprime mortgage crisis,

corporate natural-capital impacts have increased by more than 13 percent in the U.S. and 10 percent globally. In the U.S., this increase amounts to more than \$123 billion dollars in economic costs.

Have we started to turn the corner towards containing the cost of corporate natural-capital impacts? It's too soon to tell definitively, but the fact that the cost growth is slowing is a positive sign. Prior to 2013, the average annual growth was 5 percent, which slowed to 2 percent in 2013. In 2014, this growth slowed to 1 percent for U.S. companies and decreased by 8 percent for global companies. This trend was first noted in last year's assessment.

PROFIT AT RISK FROM NATURAL CAPITAL IMPACTS

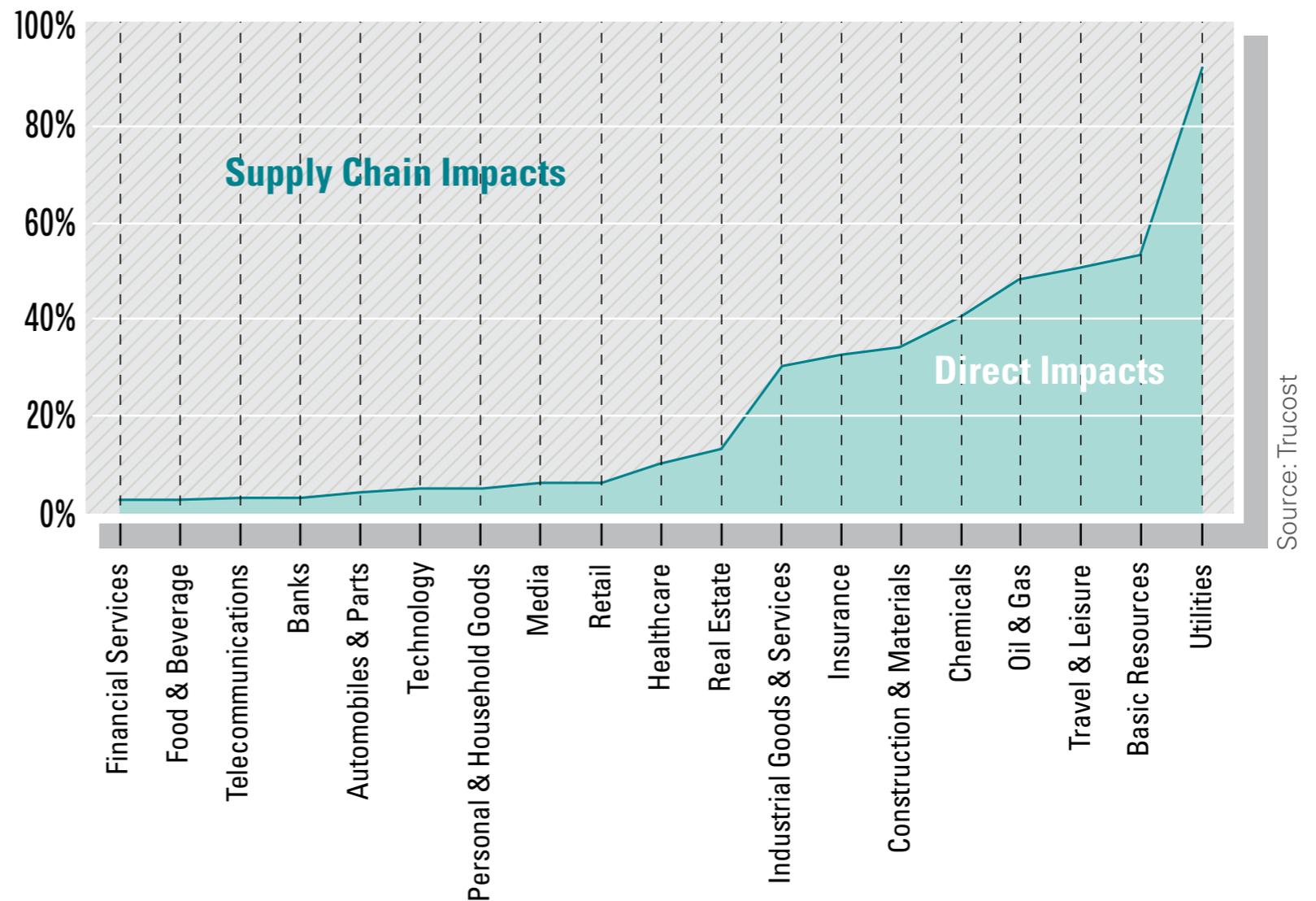
In addition to the economic cost to society from natural-capital impacts, corporate profit can also be at risk.

Many of these costs are not included on company balance sheets. However, they are a real indication of business risk and costs that companies increasingly face due to problems such as droughts or adapting to a changing climate, or from increased energy prices or taxes on pollution.

Very little progress has been made over the last five years. For the U.S., the proportion of company profit at risk consistently exceeds 100 percent. The news

WHERE NATURAL CAPITAL IMPACTS OCCUR IN THE VALUE CHAIN

Average percent of natural capital impacts for U.S. companies in 2014



is worse globally, with the ratio hovering around 150 percent. Such ratios mean that, on average, companies would be unprofitable if they had to pay the actual costs associated with the resources they consume and pollution they generate.

Business risk does not fall evenly across sectors. In 2014, companies in about half of industry sectors would have remained profitable after internalizing the cost of natural capital. Technology, media and healthcare have one-third or less of their profit at risk, whereas sectors like utilities, food and beverage, and basic resources companies operating in mining and forestry face natural-capital costs of 8 to 16 times their annual profits.

The bottom line is that companies' dependence on natural capital is a significant business risk that should be measured and managed to ensure continued profitability.

WHERE NATURAL CAPITAL IMPACTS OCCUR IN THE VALUE CHAIN

Supply chains are increasingly complex, but also recognized by companies as key generators of business value. As more responsibility for creating value occurs in companies' supply chains, the risks associated with potential pass-through costs from environmental impacts also increase. Understanding where environmental impacts are most significant is an important first step to identifying opportunities for environmental improvement, risk reduction and innovation.

This metric shows the average proportion of environmental impacts coming from the supply chains and direct operations of 19 industry sectors across the 500 largest U.S. companies. Within 17 of the 19 sectors, supply chains account for the majority of the environmental impacts. For 10 sectors, supply chains account for more than 90





Source: Trucost

LARGEST NATURAL CAPITAL IMPACTS



percent of the environmental impacts. Only companies that operate in mining, metal production, forestry and electricity generation have greater environmental impacts from their own operations compared to their supply chains.

These sectors with the majority of impacts arising from their direct operations are at the start of the supply chain for many other sectors, as they provide the raw materials for products and packaging, as well as the energy to run factories, buildings and transportation systems.

The findings suggest that, for most sectors, environmental improvement should focus on supply chains to make the biggest difference. Possible initiatives include procurement programs that focus on purchasing greener products from the most environmentally efficient suppliers, designing products with renewable materials and adopting circular economy models to harvest waste products.

LARGEST NATURAL CAPITAL IMPACTS

In order to identify where to best target limited financial resources, business leaders need to understand the most important environmental impacts for their companies.

The top four environmental impacts from companies' direct operations and supply chains account for more than 90 percent of their total environmental footprint, with greenhouse gas emissions and water use accounting for around three-quarters of the environmental impacts for both

U.S. and global companies. Greenhouse gas emissions are the most significant, representing, on average, almost half of total environmental impact exposure.

Water use — taking water from any source for irrigation, energy production, manufacturing, sanitation, drinking water or other uses — is the second most important environmental impact (30 percent U.S. and 27 percent global).

Rounding out the top four biggest natural capital impacts are nutrients and organic pollutants, largely from the runoff of fertilizers used in agriculture (15 percent U.S. and 17 percent global); and acid rain and smog precursors, which include sulfur oxides (SOx), nitrogen oxides (NOx) and ammonia for acid rain, and NOx and carbon monoxide for smog (4 percent U.S. and 4 percent global).



MARKET DRIVERS

Five metrics illustrate how purchasing power and capital are being directed to a low-carbon, more resource-efficient economy.

Five metrics were selected to help illustrate how purchasing power and capital are being directed to a low-carbon, more resource-efficient economy:

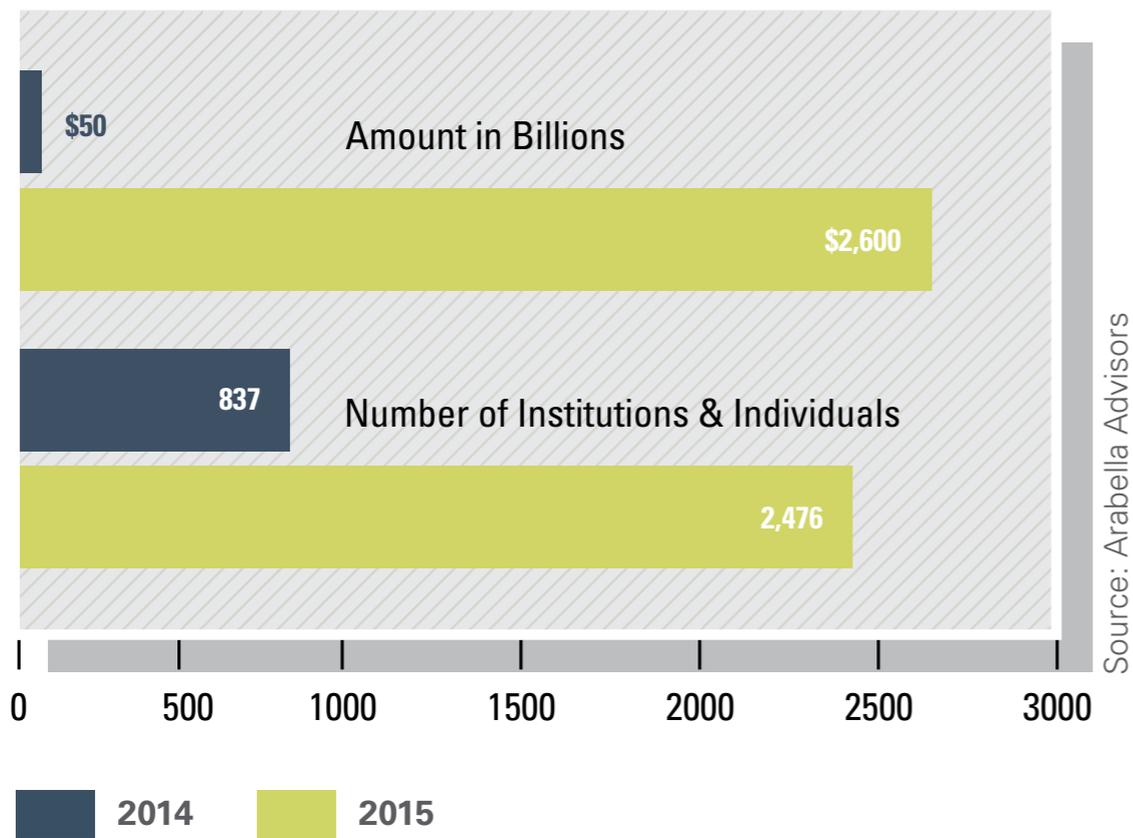
These metrics, new to the 2016 State of Green Business Index, show that companies are operating in an evolving competitive landscape with growing environmental market drivers.

- Divestment from fossil fuels
- Growth in low-carbon investments, specifically renewable energy
- Growth in green bond issuance
- Investors' use of corporate environmental data
- Green purchasing and procurement practices

There is a clear and growing shift toward environmentally conscious investing, with the fossil-fuel divestment movement showing the greatest momentum. The total value of funds involved in divestment of fossil fuels has grown 50 times in the last year alone. Investments in new renewable energy production is the highest it has been since 2011. We also found positive trends in the growth of the green bonds market and the incorporation of environmental principles into investment strategies.

FOSSIL FUEL DIVESTMENT

Assets Under Management of firms committing to divestment



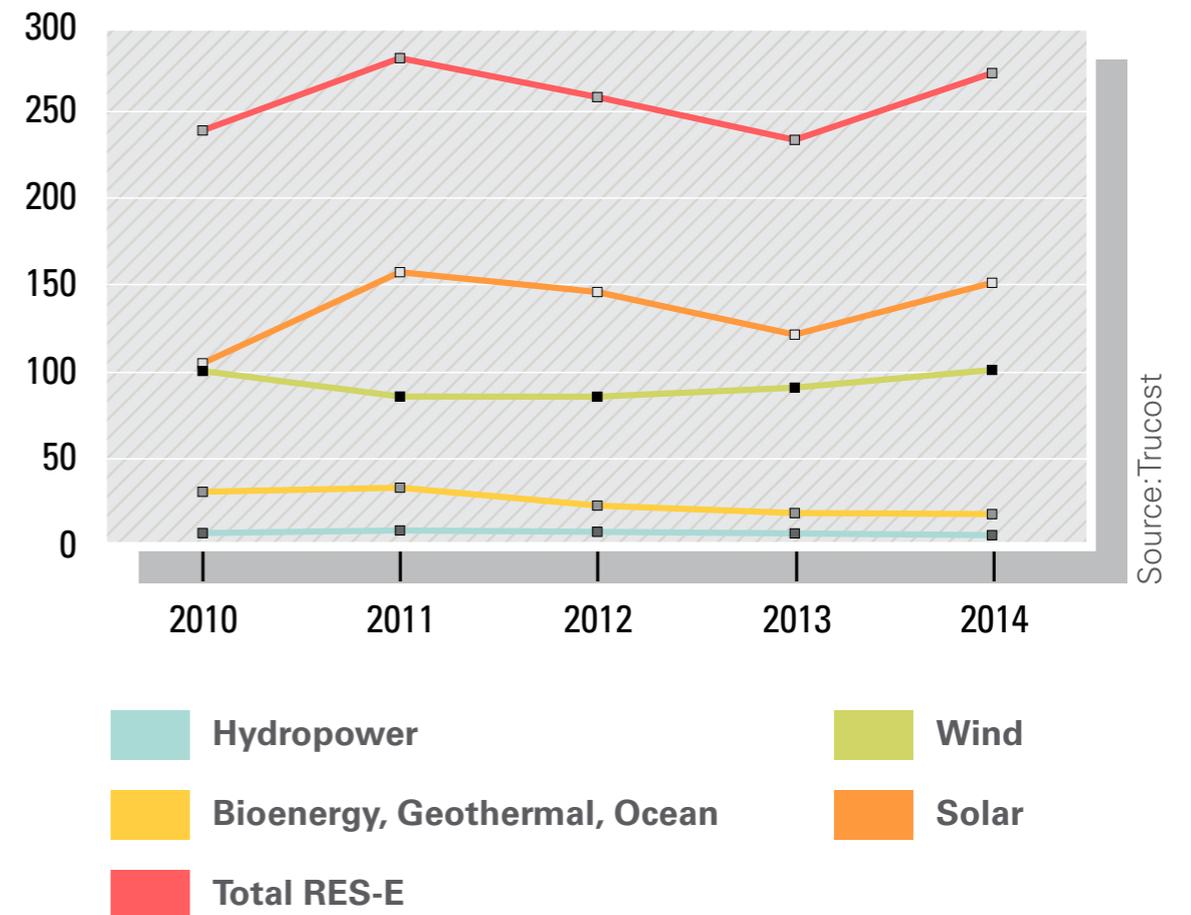
Not surprisingly given the trends uncovered over the last five years, the market for green investing, where environmental concerns are incorporated in investment strategies, is growing. The demand for such capital has increased — quite substantially, in some areas — indicating greater opportunities for companies providing greener products and services.

FOSSIL-FUEL DIVESTMENT

The fossil-fuel divestment movement started in 2011, when students at a handful of colleges and universities began calling for their campus endowments to sell off stock holdings of coal and other fossil-fuel companies. This movement has grown to include other large institutions such as pension funds, private companies and local governments that have pledged to divest from fossil-fuel stocks, bonds and investment funds.

LOW CARBON INVESTMENT

Billions of U.S. dollars



Participation has grown exponentially. In 2014, a total of 837 institutions and individuals representing \$50 billion in assets made commitments to fossil fuel divestment. In 2015, this grew to 2,476 institutions and individuals representing \$2.6 trillion in assets.

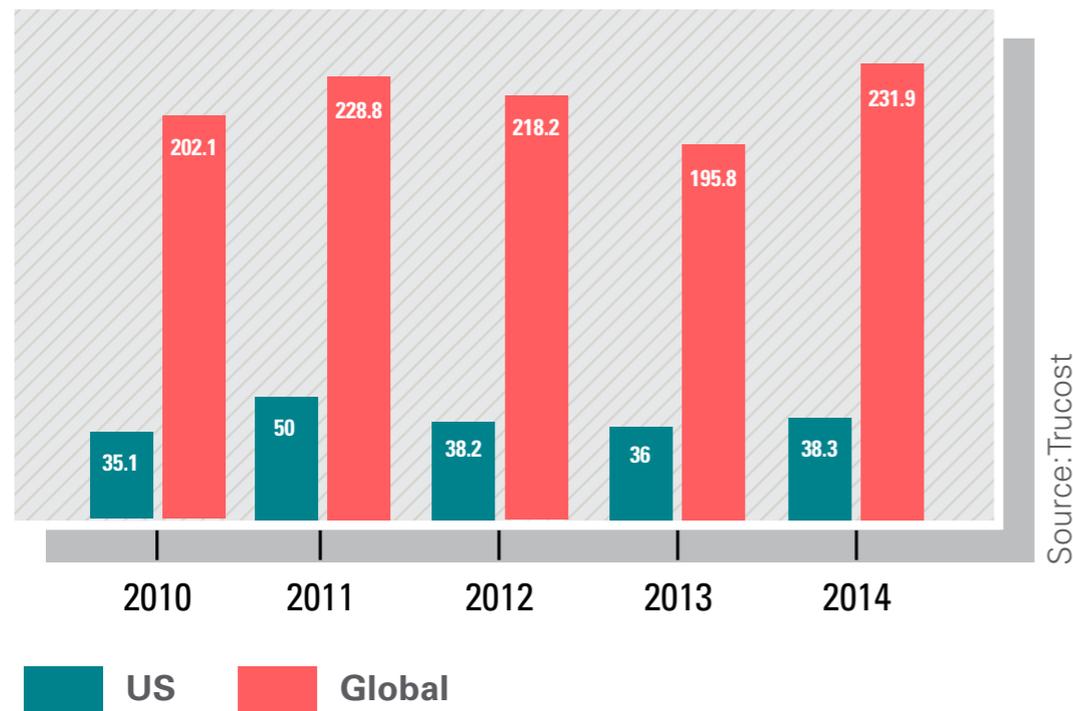
With low oil prices undermining the financial performance of oil and gas companies, and many coal companies nearing bankruptcy, we expect fossil-fuel divestment to become attractive to an increasing number of investors.

LOW-CARBON INVESTMENT

Investment in renewable energy has grown a great deal recently, with new commitments made every year. Renewable investments include a wide range of activities, including technology development, equipment manufacturing and

LOW CARBON INVESTMENT

Billions of U.S. dollars



development of renewable energy projects such as wind or solar power installations. Investment sources include asset-backed financing, public markets, venture capital and private equity, as well as government and corporate research and development.

According to the UNEP, 2014 saw the first increase since 2011 in new investments in renewable energy (excluding large hydroelectricity projects). In 2014, these investments reached \$270 billion, the second-highest amount in five years, behind the all-time

record of \$279 billion in 2011. This increase was driven by a 25 percent increase in solar investments between 2013 and 2014. The amount invested in 2014 may have more benefit than the amount invested in 2011, as the capital costs of renewables such as wind and solar have dropped, meaning each dollar invested brings greater renewable energy capacity than it did previously.

Other than a large increase in investment in 2011, the level of new investments in renewables each year in the United States has

remained relatively steady over the last five years. Global investments declined in 2012 and 2013 compared to 2011; however, in 2014, these investments jumped back and reached \$232 billion — their highest total on record.

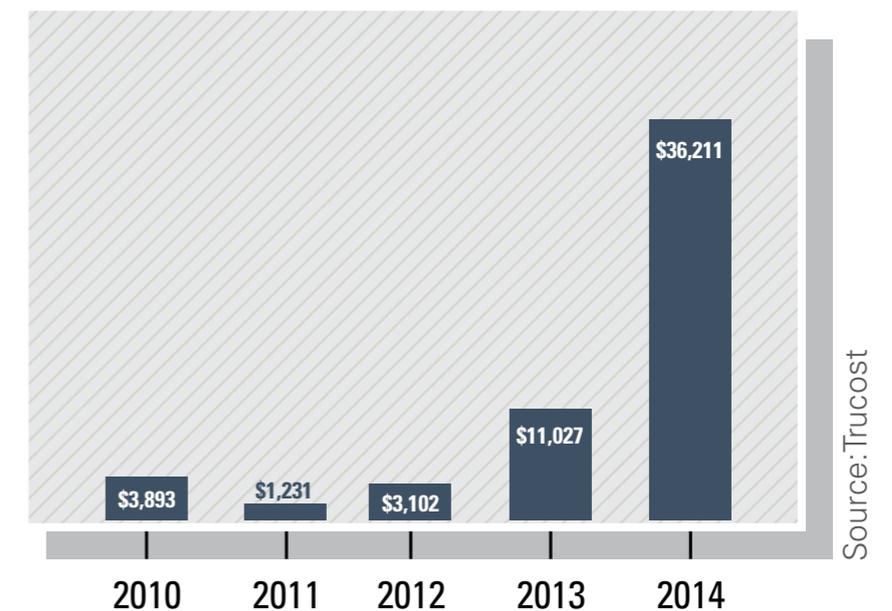
While 2014 was the first year with increased investment since 2011, this is cause for optimism, especially given that the cost of renewables has decreased significantly over this period. This means that new investments can bring about greater capacity than before. However, continued increases in investment are needed to help reduce global GHG emissions to the levels agreed to this fall in Paris at COP21.

GREEN BOND INVESTMENTS

Green bonds provide financing and refinancing for projects that benefit or apply their proceeds to climate or environmental projects, as denoted by the issuer. The Climate Bond Initiative has been tracking the green bond market since 2009. Multilateral financial institutions (for example, development banks like the World Bank) have been responsible for

TOTAL ANNUAL VALUE OFFERED IN GREEN BONDS

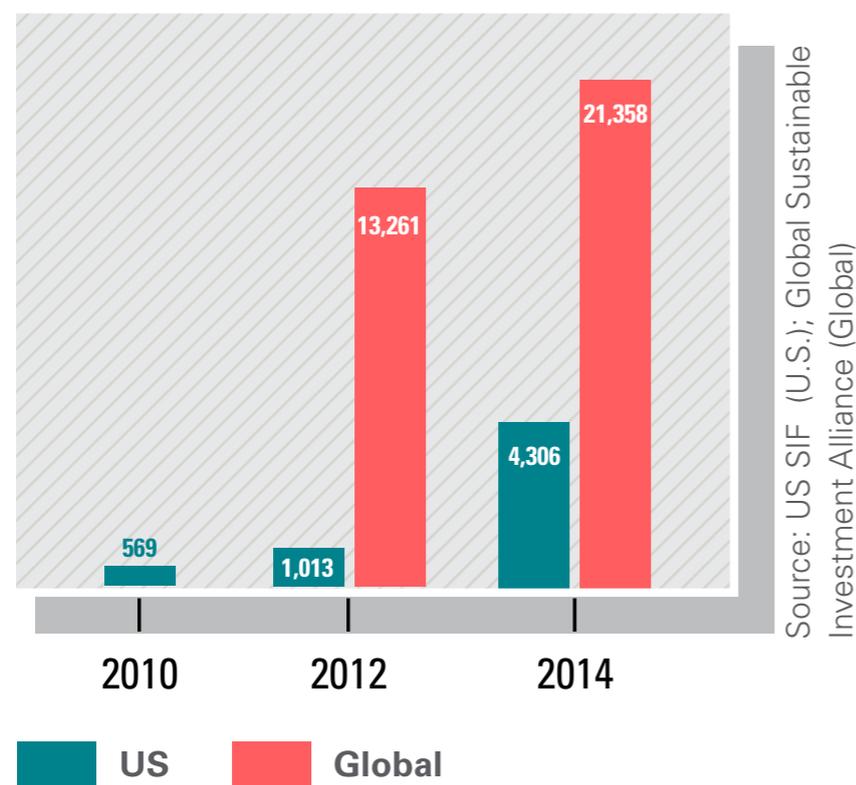
Millions of U.S. dollars





INVESTOR USE OF CORPORATE ENVIRONMENTAL DATA

Total assets under management considering ESG in their investments (\$billions)



issuing the majority of green bonds, with quasi-sovereign and corporate issuers becoming bigger players in the last few years. In fact, the majority of the green bonds issued through 2014 were corporate bonds (\$16 billion). The market tripled in 2013, growing from \$3 billion to \$11 billion, and again in 2014, surging to \$36 billion.

While the market for green bonds is rapidly growing, identifying which bonds are “green” can be a challenge, as there are no well-defined criteria and no penalty if green claims are not met. However, rules and standards are under development through initiatives such as the Green Bond Principles, the Climate Bonds Standard and China’s central bank to help qualify and verify green bonds. Despite the current challenges, the rapid growth and diversification in green bonds are strong indications of investors’ desire to redirect their capital toward greener projects, infrastructure and products.

INVESTOR USE OF CORPORATE ENVIRONMENTAL DATA

Responsible investing has grown dramatically in the U.S. over the last five years. The Forum for Sustainable and Responsible Investment has found that the value of assets under management that integrate environmental, social and corporate governance (ESG) principles into their investments was \$569 billion in 2010, growing to more than \$1 trillion in 2012. By 2014, ESG assets under management quadrupled to more than \$4 trillion, which accounts for 66 percent of total socially responsible invested assets. During this time, the number of funds also grew, from 493 in 2010 to 925 in 2014. Globally, as of 2014, there was more than \$21 trillion in assets invested under ESG principles, up from \$13 trillion in 2012.

These investors aim to achieve competitive financial returns and positive societal impacts. Historically, such investors focused on screening out stocks with negative social impacts, but today the practice has evolved to “screen in,” including more holistic analysis of ESG principles into investment strategies.

The rapid growth in the amount of assets managed with ESG principles shows a shifting mindset among mainstream investors to consider both financial and social returns in their investment decisions. However, institutions typically self-report these numbers and apply varying definitions of ESG principles. Therefore, while the total value of assets under management have increased, it is difficult to quantify the broader benefits.



CORPORATE PERFORMANCE

The research shows that the corporate world, both in the U.S. and globally, is becoming more efficient in using natural capital.

The 2016 State of Green Business Index uses greenhouse gas (GHG) emissions, water use and waste generation as key measures of the outcomes of corporate environmental sustainability initiatives. This year, we have also added the concept of the energy mix, the relative proportions of energy sources that are non-renewable versus renewable. Although the total amounts of emissions and water use have been relatively flat over the last five years, one important sign of improvement is the continued decrease in intensity — that is, reduced GHG emissions, water use and waste generation per dollar of business revenue since 2010.

This research shows that the corporate world, both in the U.S. and globally, is becoming more efficient in using natural capital. However, the absolute impacts continue to be significant and, in some cases, are growing.

We have identified positive trends, but there is a continued need for companies to closely measure, manage and reduce their environmental impact. As society increasingly faces limited stocks of natural resources and damages the natural systems upon which business revenue depends, companies need to help lead the change by providing models of more sustainable commerce.

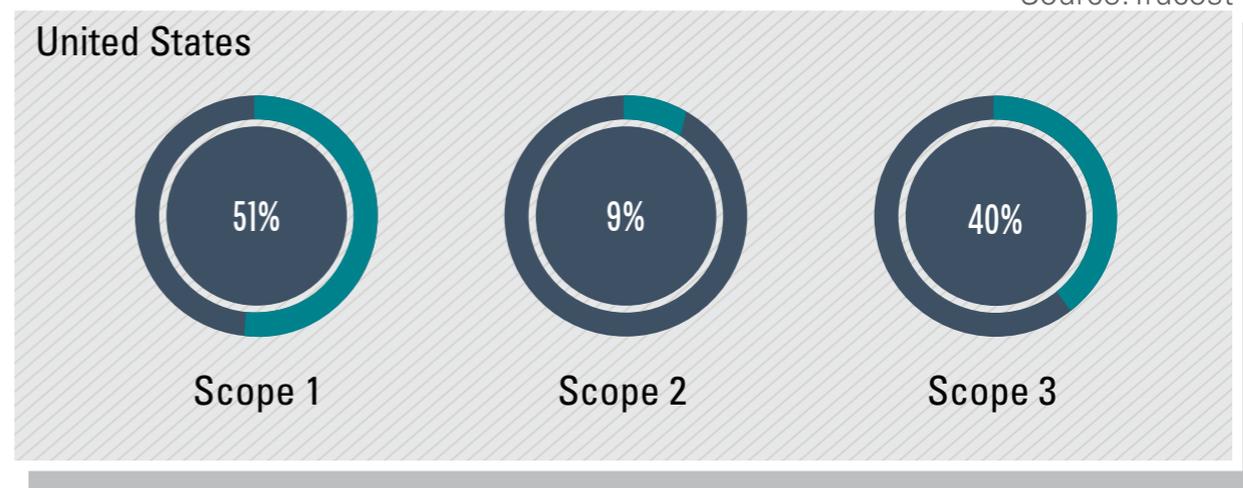
GREENHOUSE GAS EMISSIONS

Between 2010 and 2014, total GHG emissions increased by 5 percent from both U.S. and global firms. Furthermore, the leading source of the increases is the same in the two geographies — namely, Scope 2 sources, or emissions from purchased electricity. U.S. companies saw Scope 2 emissions rise by a substantial 21 percent during the period, whereas global companies saw 15 percent growth in Scope 2 emissions. Scope 1 sources — on-site energy use and other operations — grew by 6 percent for U.S. firms and by 4 percent for global companies. Scope 3 emissions, including those from suppliers, increased by only 1 percent for U.S. businesses and by 4 percent for global businesses.

More encouraging is the trend in GHG emissions intensity, or emissions per unit of revenue. GHG intensity decreased by 9 percent from both U.S. and global companies between 2010 and 2014. Scope 1 and Scope 3 emissions dropped in

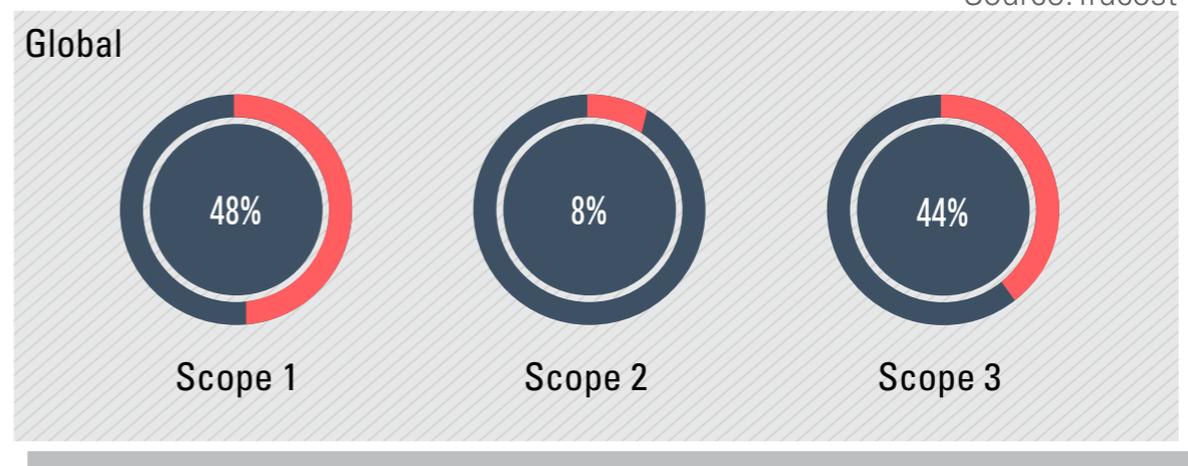
SOURCES OF GREENHOUSE GAS EMISSIONS 2014

Source: Trucost



SOURCES OF GREENHOUSE GAS EMISSIONS 2014

Source: Trucost



US Global

TOTAL ANNUAL GREENHOUSE GAS EMISSIONS

Million metric tons of CO₂e

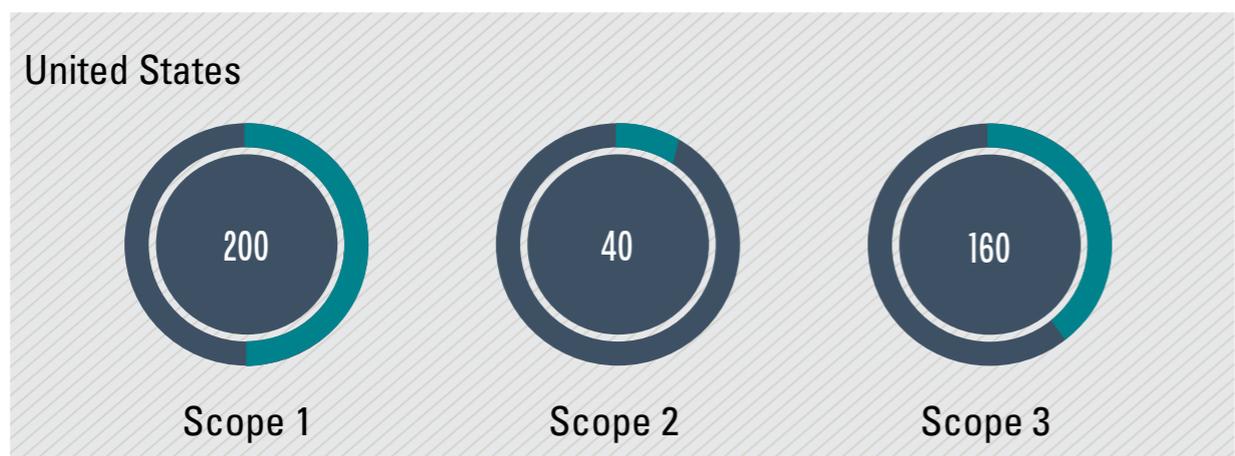


Source: Trucost



GREENHOUSE GAS INTENSITY, 2014

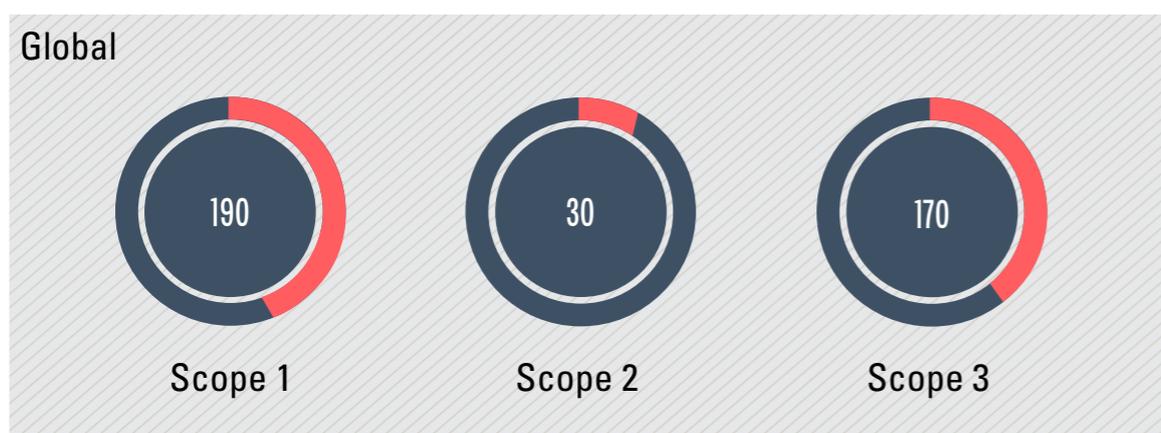
Metric tons CO₂e per million dollars of revenue



Source: Trucost

GREENHOUSE GAS INTENSITY, 2014

Metric tons CO₂e per million dollars of revenue



Source: Trucost

■ US ■ Global

both geographies — Scope 1 decreasing by 9 percent from U.S. businesses and by 10 percent from global businesses, and Scope 3 decreasing by 11 percent from both groups. Scope 2 emissions intensity has remained relatively flat among companies.

If this positive trajectory is maintained, it is a sign that companies are working to decouple revenue growth from environmental impact. Over time, we should see total GHG emissions begin to drop as well. Through collaborative initiatives with suppliers, customers and other stakeholders, businesses are helping reduce the GHG emissions associated with economic activity. Such leadership will continue to be needed and valued into the future.

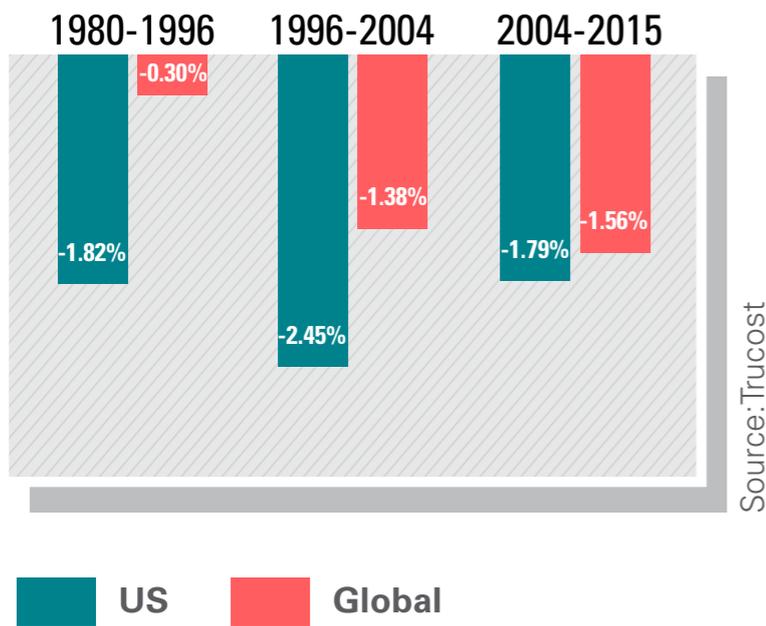
ENERGY EFFICIENCY

Energy efficiency — the amount of energy needed to produce a unit of GDP — continued to be one of the long-term success stories around the world, continuing the modest improvement we've seen nearly every year for decades.

With good reason. Globally, energy efficiency represents about 40 percent of the GHG reduction potential that can be realized cost-effectively. "In many cases, it is an extremely attractive upfront investment that pays for itself over time, while providing the added benefits of reducing the cost of energy and increasing the energy productivity of the economy," according to McKinsey & Co.

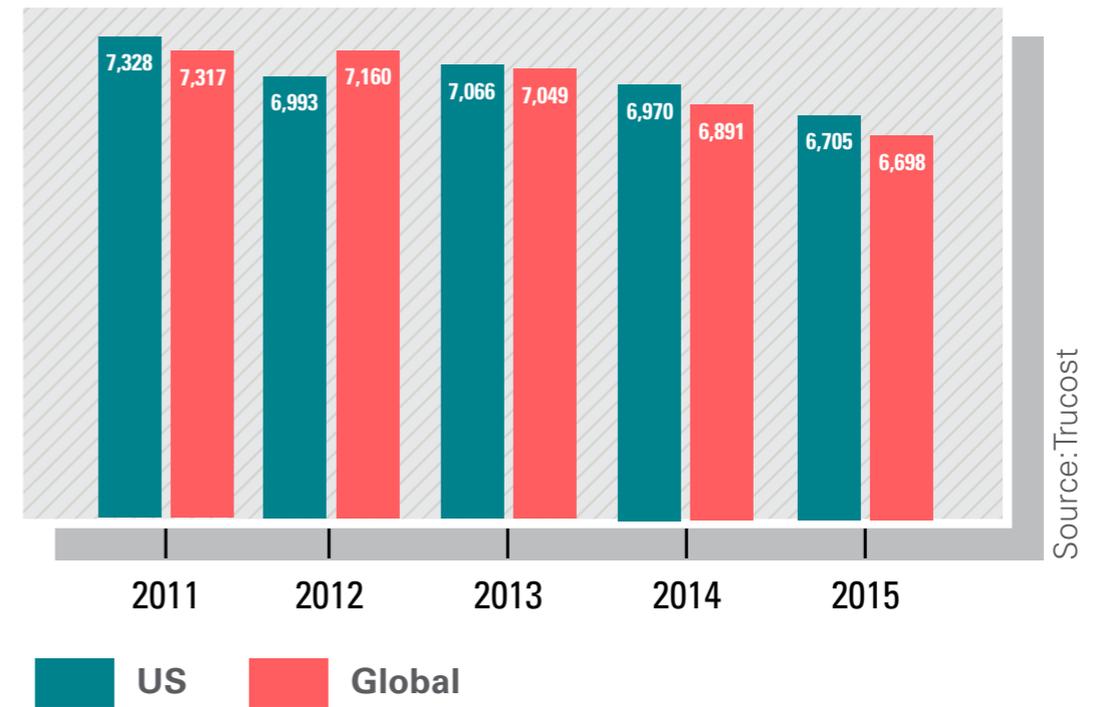
Fortunately, the "toolkit" for energy efficiency is enabling companies, cities and others to seize the opportunities. For example, a wide and growing arsenal of financing mechanisms are enabling building owners, municipalities and others to invest in efficiency technologies with little or no money down, paying for such upgrades over the long term through efficiency savings.

ENERGY EFFICIENCY GROWTH



ENERGY EFFICIENCY

BTUs per million dollars of revenue



Much of this is coming from outside of government programs, at least at the federal level, as financial institutions, utilities and technology providers are finding profitable models to offer residential, commercial and industrial customers. States and provinces are stepping up, too. “Governors, legislators, regulators, and citizens are increasingly recognizing that energy efficiency is a crucially important state resource,” according to the American Council for an Energy-Efficient Economy.

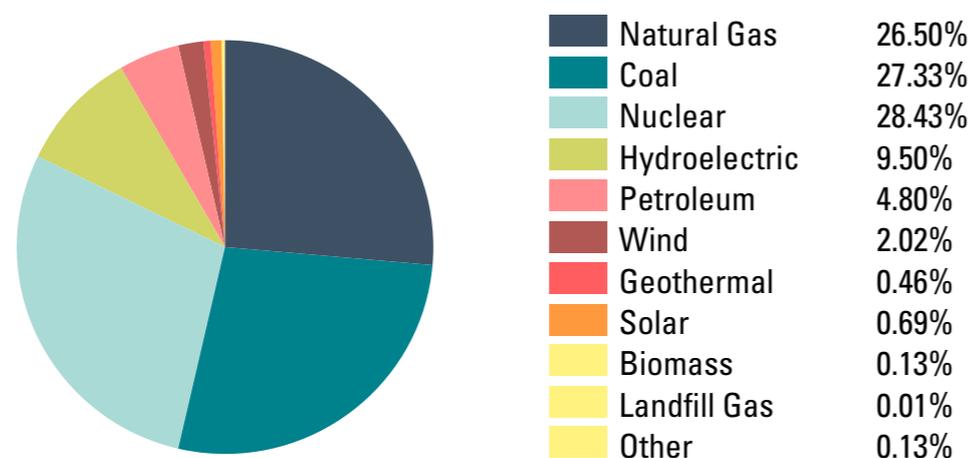
The prospect for low energy prices for the foreseeable future could hamper these efforts, reducing incentives for energy users to upgrade by making the payback periods longer. But this may be countered by two other trends: the decreasing cost and increasing efficiency of the technologies, such as LED lights and smart control systems. The second trend are growing concerns — and mandates — related to climate change, spurring both carrots and sticks to spur further efficiency efforts.

Of course, our metrics track only the intensity, not the overall use, of energy in the global economy. In the coming years, as hundreds of millions of citizens enter the middle class and begin buying more energy-consuming products, overall energy consumption could





ENERGY SOURCE MIX, 2010



Source: Trucost

continue to grow, no matter how efficiently used. For example, according to the Enerdata Global Energy Statistical Yearbook 2015, global energy use between 2000 and 2014 ratcheted up an average 2.2 percent annually, no small sum when compounded. Decoupling energy use from economic growth remains a key lever to a sustainable future.

ENERGY MIX

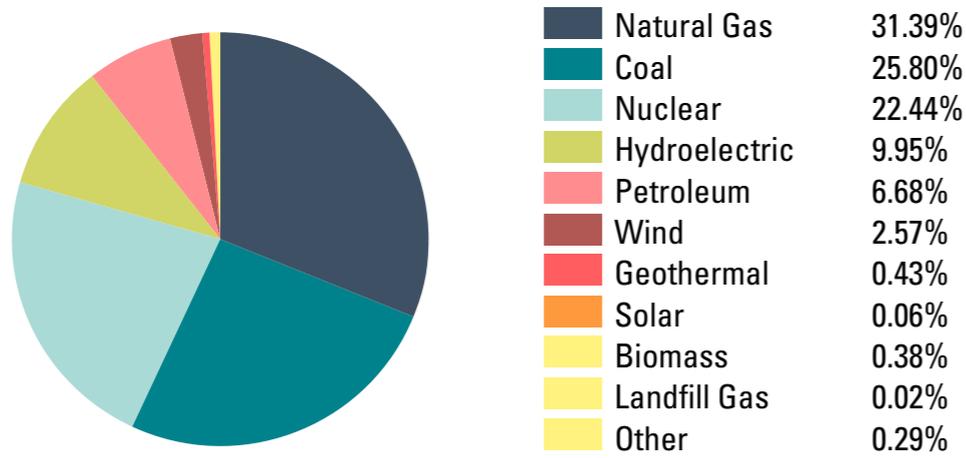
Companies are making the shift to more sustainable energy sources across U.S. and international electricity grids. Growing demand for and generation of renewable energy among firms is clear from the research.

Between 2010 and 2014, renewable electricity sources — including wind, biomass and hydroelectricity — grew 66 percent to 90 percent for both U.S. and global businesses, while fossil fuels and other electricity sources with greater environmental impacts — including natural gas, and petroleum — increased a less robust 24 percent and 30 percent.

Renewable energy sources still make up a very limited amount of the overall electricity mix — most contribute less than 1 percent of total electricity. In addition, several forms of renewable energy declined as a portion of the electricity mix of the studied companies during the 2010-to-2014 period, even as they grew overall, including solar (–53 percent), geothermal (–18 percent) and landfill gas (–12 percent). In the U.S., this is likely due to the increased availability of low-cost domestic natural gas. Both the public and private sectors are investing more in renewable sources of electricity. We anticipate that business will continue to push the energy mix to more sustainable generation and will be reflected in the coming years.

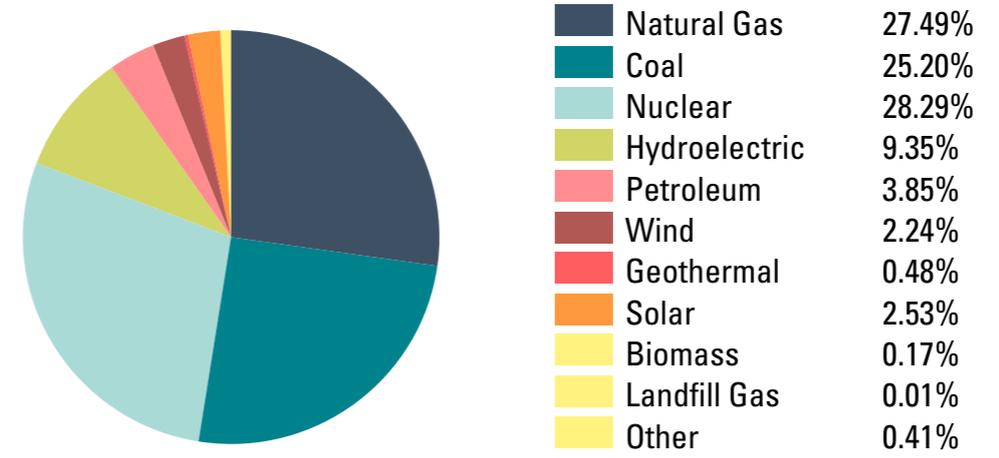


ENERGY SOURCE MIX, 2012



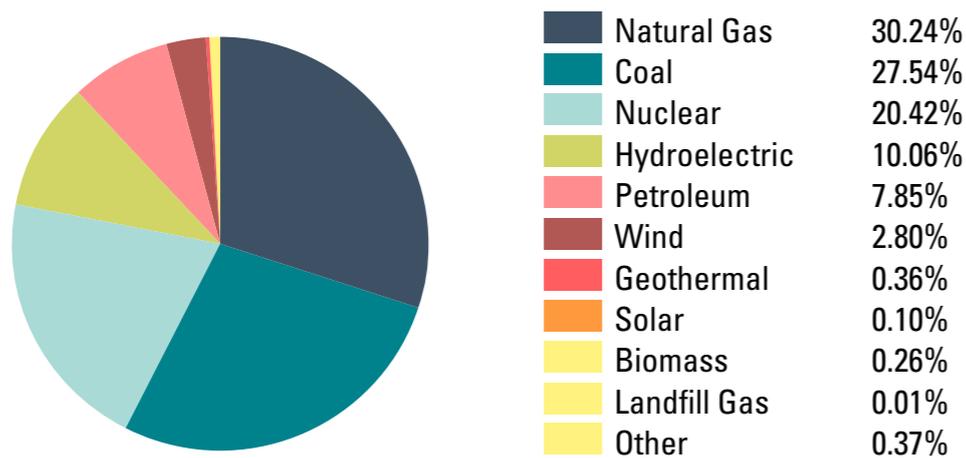
Source:Trucost

ENERGY SOURCE MIX, 2011



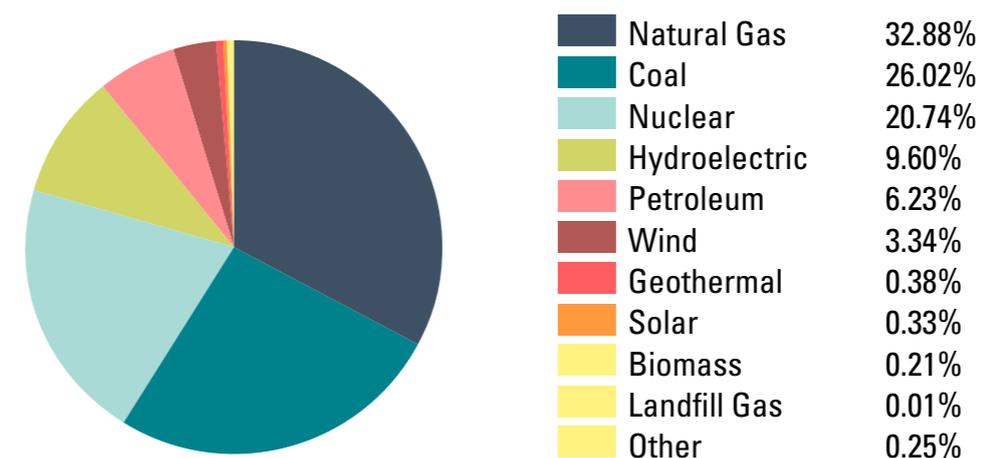
Source:Trucost

ENERGY SOURCE MIX, 2013



Source:Trucost

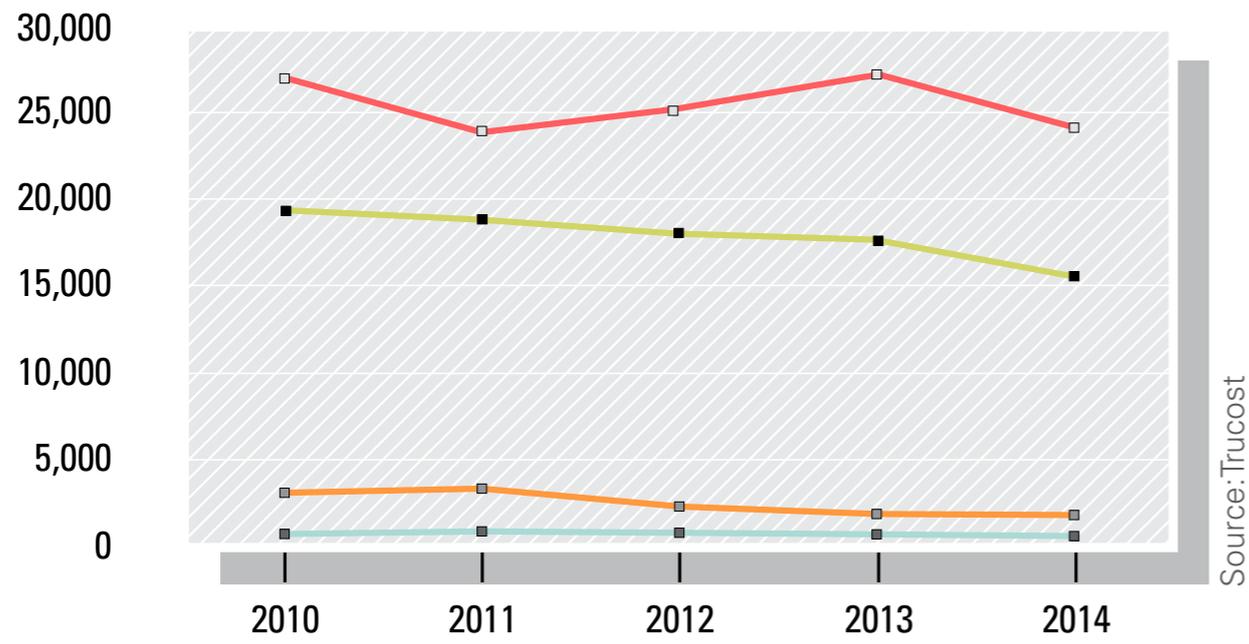
ENERGY SOURCE MIX, 2014



Source:Trucost

INTENSITY OF WATER USE- US

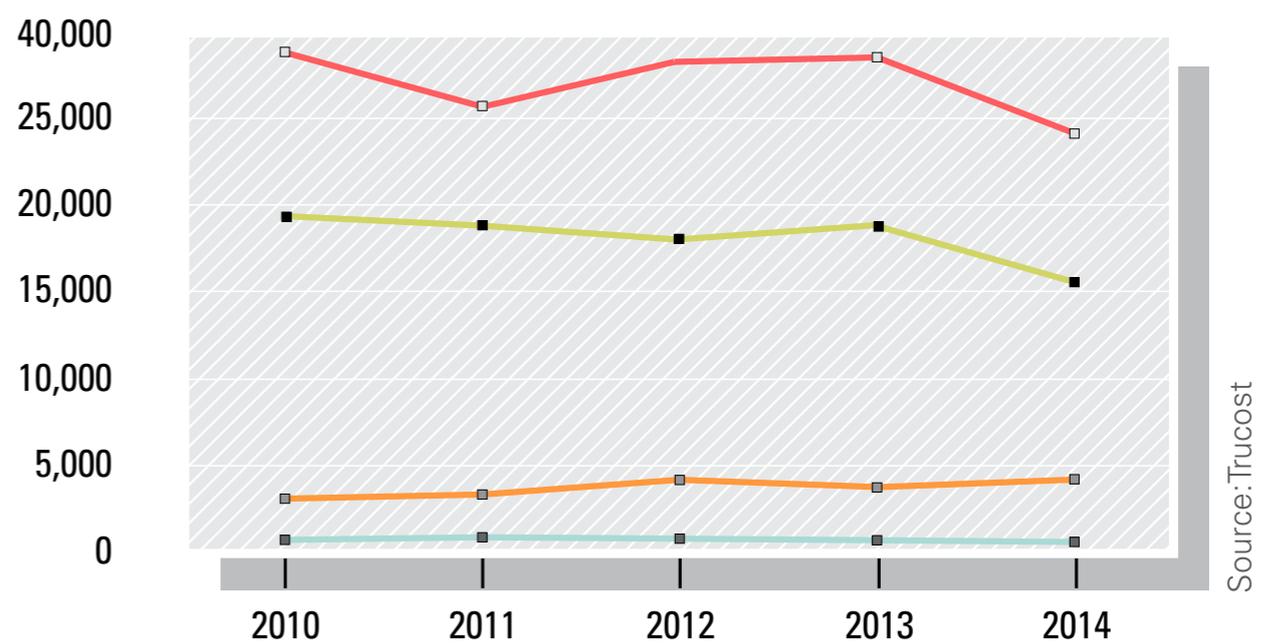
Cubic feet per million dollars of revenue



Source: Trucost

INTENSITY OF WATER USE- GLOBAL

Cubic feet per million dollars of revenue

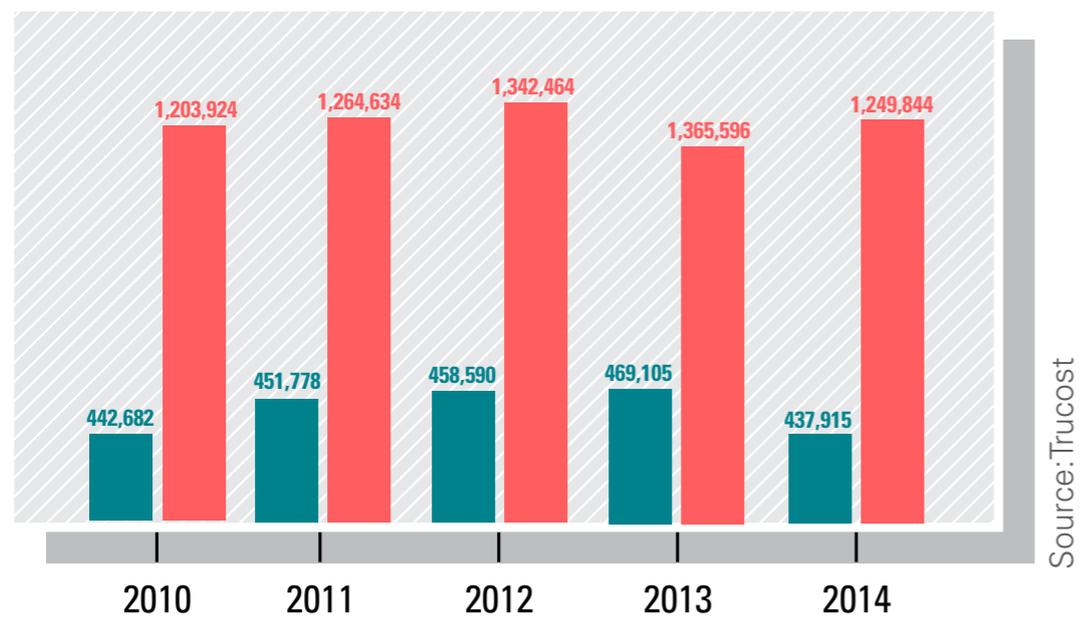


Source: Trucost

■ Direct Withdrawal (Surface/Ground)
 ■ Purchased (Municipality)
 ■ Cooling Water
 ■ Supply Chain

WATER USE, 2014

Million cubic meters



Source: Trucost

■ US
 ■ Global

WATER USE

Water scarcity — due to local and regional droughts, climate change and overuse of limited resources — emerged as a significant news story over the past year. Compounding the effects on human health and ecosystems, water shortages also can interrupt business operations. Realizing this, companies have prioritized water savings within their own activities, as well as among their suppliers.

The overall trend between 2010 and 2014 has been companies using less water: companies using less water (down 1 percent for U.S. firms) and slightly higher water use globally (up 4 percent). They've also used less water per unit of revenue. However, upward spikes in 2012 and 2013 demonstrate the move toward more efficient operations has not been unilateral.

For U.S. companies, the most significant savings have been in purchased water from municipalities (down 13 percent for the five-year period) and cooling water

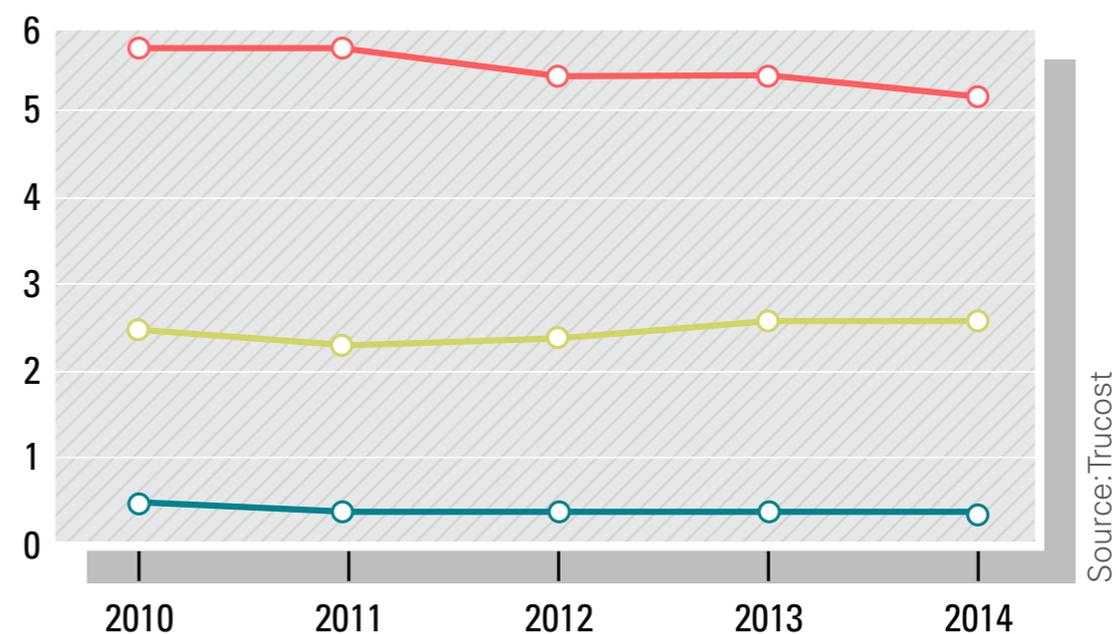
(down 10 percent). Globally, firms purchased less water from municipalities from municipalities by 5 percent and cooling water by 4 percent. However, direct withdrawal of groundwater or surface water has increased among U.S. businesses (up 1 percent) and substantially among global companies (up 32 percent). Similarly, supply-chain water use has increased for the U.S. (up 5 percent) and global firms (up 6 percent).

Relative improvements in water use intensity are more promising. Intensity has decreased for almost every type of water use. The largest decreases have been for purchased water from municipalities (down 25 percent among both U.S. and global firms), cooling water (down 23 percent in the U.S. and 17 percent globally), direct withdrawal of groundwater or surface water (down 12 percent among U.S. companies) and supply-chain water use (down 11 percent in the U.S. and 8 percent globally). The only increased water use intensity was for direct withdrawals of groundwater or surface water for global companies (up 14 percent).

Corporate initiatives to reduce water use will continue to be important for overall environmental sustainability, especially as water scarcity affects more regions and climate change interrupts the natural water cycle. As a positive trend, water

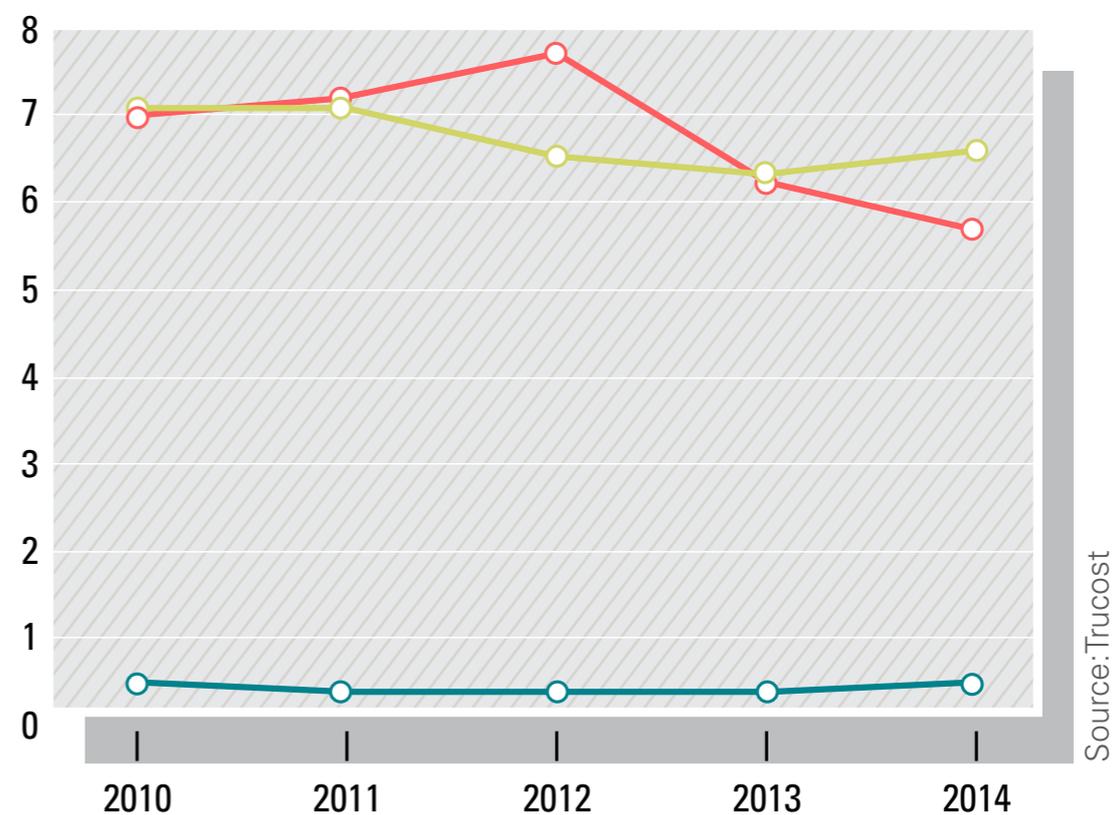
INTENSITY OF WASTE GENERATION- US

Metric tons per million dollars of revenue



INTENSITY OF WASTE GENERATION- GLOBAL

Metric tons per million dollars of revenue



■ Incineration
 ■ Company Reported Recycling
 ■ Landfill

use intensities are decreasing. However, absolute water use continues to increase and is therefore a risk to business as usual. This trend suggests that companies have not yet broadly determined how to grow the bottom line without increasing overall water use. There is a need to change this trajectory and enable ongoing improvements in water efficiency.

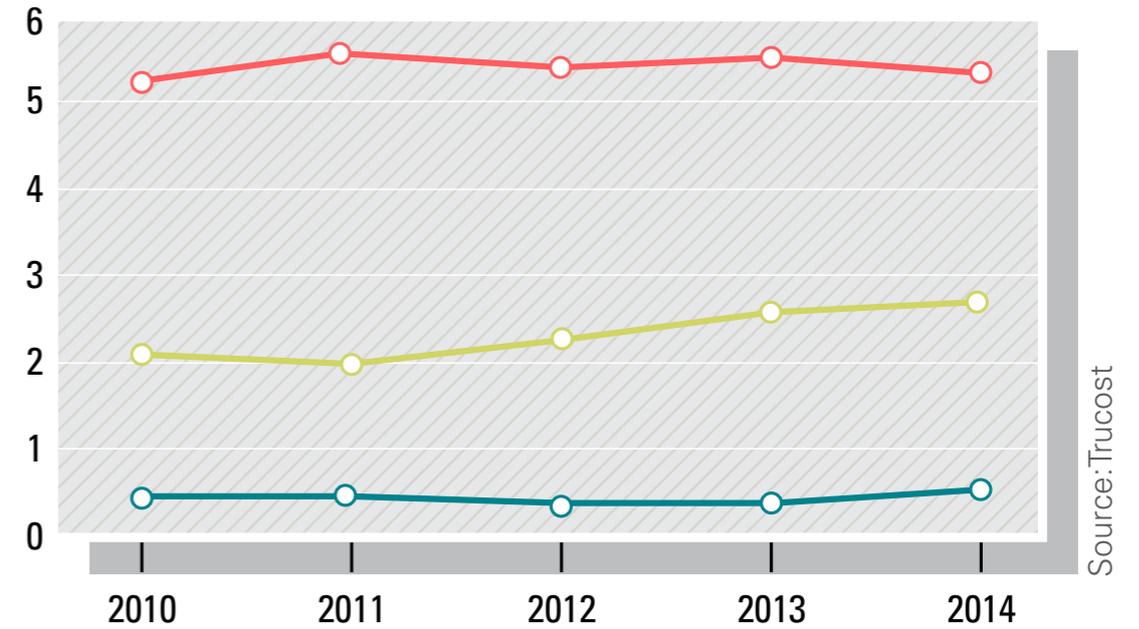
SOLID WASTE

Corporate environmental activities often focus on solid-waste generation, as both a tangible impact recognized by stakeholders and a means to reduce direct costs for disposal. However, the data from 2010 to 2014 shows increases in landfilling and incineration for U.S. companies and increased incineration for global companies. More encouraging, recycling has increased for both groups. The waste-intensity values are mixed, with some measures noting sustainability improvements and others revealing setbacks.

Landfilling and incineration of solid waste are the “end of the road” for materials, as they cannot be reused, thus requiring additional natural resources to be mined or harvested to generate new materials. Solid-waste

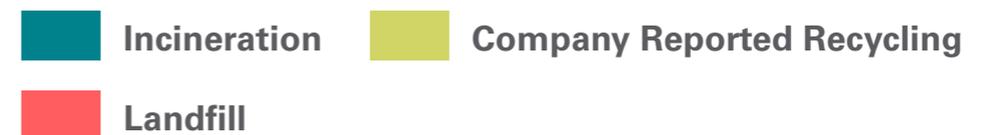
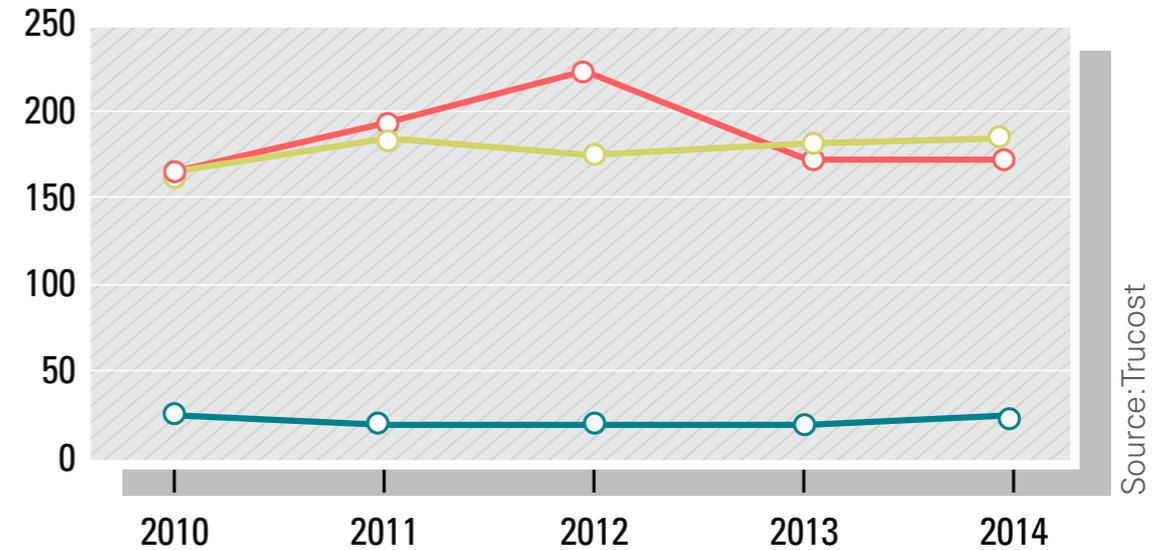
TOTAL WASTE GENERATION- US

Million metric tons



TOTAL WASTE GENERATION- GLOBAL

Million metric tons



incineration increased by 13 percent for U.S. businesses and by 18 percent for global businesses between 2010 and 2014. Landfilling of solid waste also increased for U.S. companies, up 6 percent during the time period. On the global side, the results were more sustainable, with decreased solid-waste landfilling (down 6 percent).

Solid-waste recycling has a more positive trend. Both U.S. and global companies increased their reported recycling during the five-year period, with recycling in the U.S. metric mushrooming by 23 percent and the global metric rising by 7 percent. Recycling materials allows companies to reuse them for other applications and products.

Calculating metrics for the intensity of solid-waste generation, or the treatment of solid waste per unit of revenue, portrays a combination of more sustainable trends and less sustainable ones. On the encouraging side, U.S. companies reported decreased use of landfilling (down 10 percent) and incineration (down 4 percent) per unit of revenue. U.S. business also demonstrated a 5 percent increase in recycling per unit of revenue. For global companies, landfilling of solid waste per unit of revenue decreased by 19 percent from 2010 to 2014. However, more problematic is the increase in incineration intensity (up 3 percent) and decrease in recycling intensity (down 7 percent) among global businesses during that time period.

Overall, the metrics for solid-waste generation demonstrate the increasing amounts of materials being managed by companies through landfilling, incineration and recycling. Although one would hope for increases in recycling relative to disposal, the numbers show that business is not there yet. A transition toward more sustainable waste management appears to be taking place, as the waste intensity metrics mostly move toward positive trends. However, more work is needed to prioritize recovery and reuse rather than disposal and destruction following material use. 🍀

Overall, the metrics for solid-waste generation demonstrate the increasing amounts of materials being managed by companies through landfilling, incineration and recycling.





CORPORATE LEADERSHIP

A growing number of companies are actively measuring, managing and disclosing important information to stakeholders about their sustainability efforts.

In this final section of the 2016 State of Green Business Index, we look at ways that corporations are showing leadership to transition their businesses towards more sustainable operating models.

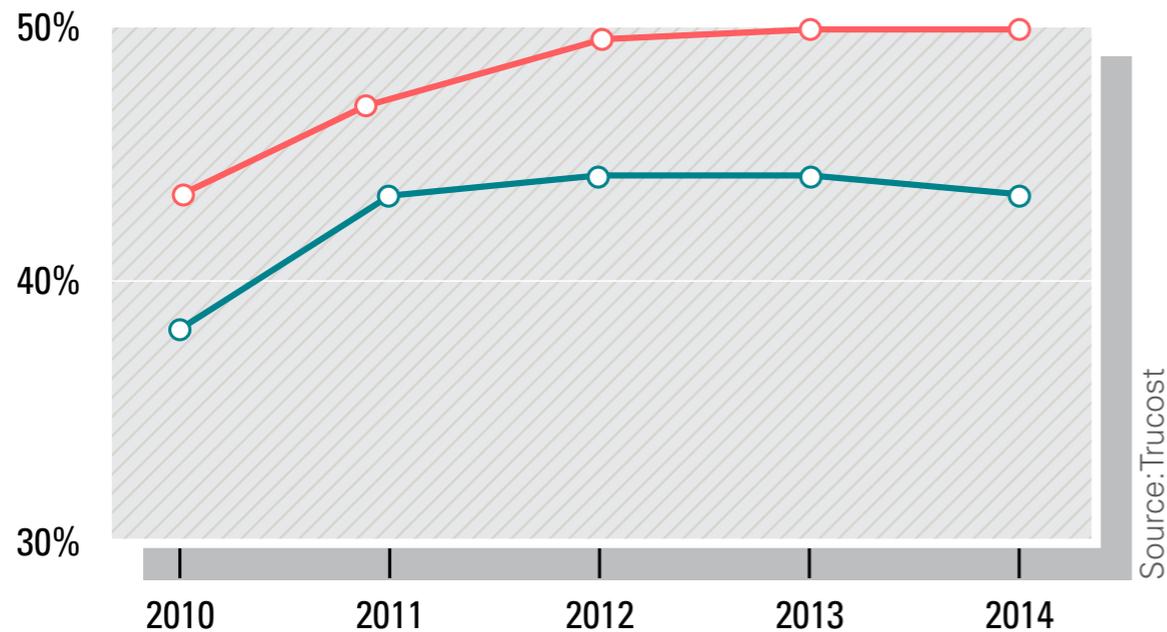
The metrics in this section assess how companies are:

- Measuring, disclosing and assuring their environmental impacts and associated risks
- Participating in initiatives to value their use of natural capital
- Setting targets and implementing projects to achieve environmental savings or profits
- Increasing their investment in R&D to support innovation in environmental solutions and technology

We found that business involvement in these leadership activities is widespread and increasing across all metrics. A growing number of companies are actively measuring, managing and disclosing important information to stakeholders about their environmental sustainability efforts. More companies are measuring the financial costs of their environmental performance by using natural-capital valuations. More companies are assessing their water risk exposure and have reduction targets for water use. An increasing number are reporting greenhouse gas emissions across their

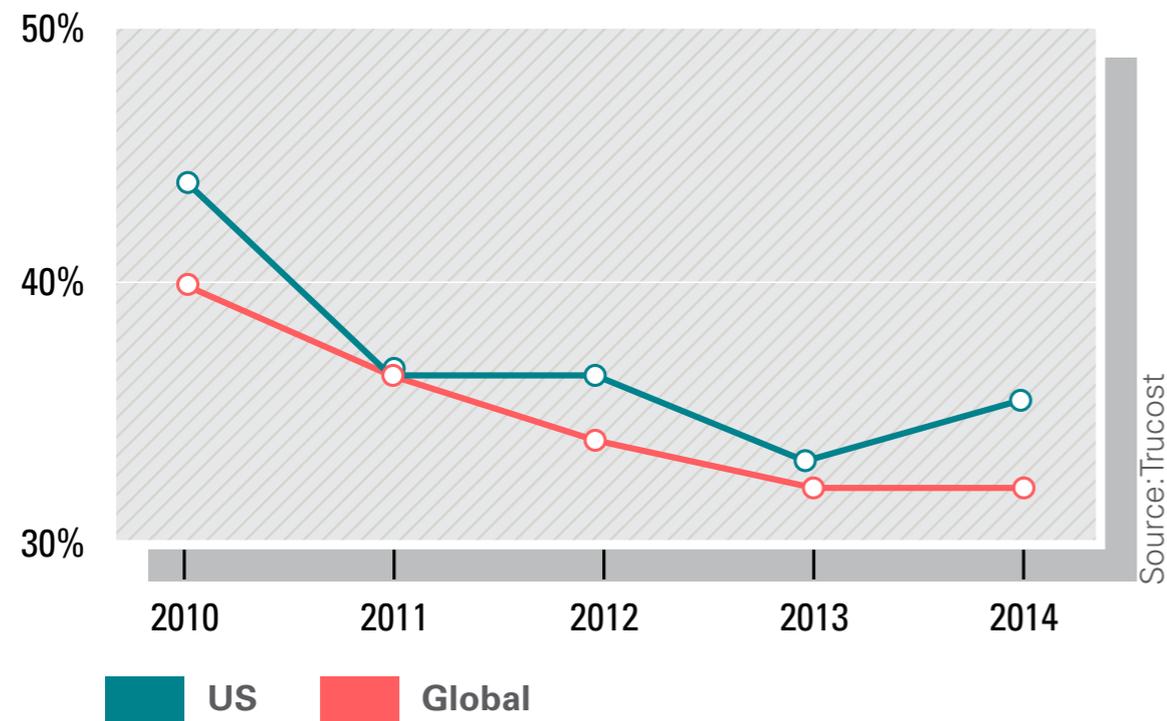
DISCLOSURE OF NATURAL CAPITAL IMPACTS

Disclosed environmental cost as percentage of total environmental cost



NON-DISCLOSURE OF NATURAL CAPITAL IMPACTS

Companies disclosing no environmental impact data



value chains, and a majority now have greenhouse gas reduction targets and projects to help achieve them. Furthermore, many companies are recognizing the opportunity presented by innovative green technologies and are investing in bringing them to market.

While improvements are small for some of the metrics, all the trends are positive. Over time, we expect the increased levels of disclosure, target setting and investment to enhance the environmental efficiency of business. However, as shown by our review of current corporate greenhouse gas reduction targets, more aggressive science-based targets are needed in order to ensure that companies continue to operate and succeed without exceeding planetary limits for greenhouse gas emissions.

DISCLOSURE OF NATURAL CAPITAL IMPACTS

“What gets measured gets managed” is an oft-quoted business axiom. Companies are increasingly measuring, managing and publicly reporting their environmental impacts. This trend has been rapidly growing in response to increased stakeholder requests and competition among industry peers on sustainability leadership.

But one question looms: Are the things companies measure and report focused on their most significant environmental impacts? This metric aims to answer that question.

Trucost annually reviews and measures company environmental performance information, including generation of greenhouse gas emissions, air pollutants and solid waste, as well as water use, water pollution and consumption of other natural resources. Natural-capital valuations are applied to the environmental impact data to calculate each company’s total natural-capital cost. We then identify the percentage of this natural-capital cost reflected in the environmental impact data that each company reports externally.

The good news is that around two-thirds of companies are reporting at least some of their environmental impacts. In 2014, approximately 65 percent of U.S. companies and 68 percent of global companies reported on one or more of their environmental impacts.



The bad news is that even though the number of companies disclosing some environmental impacts has increased over the last five years, companies are still struggling to report on the impacts that represent the majority of their total natural-capital costs. Globally, companies only report on about half of the natural-capital costs associated with their operations. U.S. companies are even further off the mark, reporting on only about 44 percent. The lack of reporting on the majority of companies' environmental footprints suggests that, on average, companies are not fully aware of the business risks to which they could be exposed through increased competition

for natural resources, increased environmental regulation or other limitations that could increase input costs or limit resource availability.

PARTICIPATION IN NATURAL-CAPITAL VALUATION INITIATIVES

Corporate environmental impacts have historically been measured in physical units, such as metric tons of greenhouse gas emissions or cubic meters of water consumption. Different environmental issues cannot be directly compared using these traditional measurements, so how can companies determine which impact is most important to their business?

Increasingly, leadership companies are addressing this problem by placing a financial value (or "environmental shadow cost") on their environmental impacts. This provides business managers with a set of comparable environmental metrics that can be seamlessly integrated into financial decision making and assessed alongside other business priorities.

For this metric, we tallied how many businesses are participating in natural capital valuation initiatives such as the [Natural Capital Business Hub](#), [Natural Capital Coalition](#), [Natural Capital Declaration](#), [Natural Capital Leadership Compact](#) and the World Bank's [WAVES Initiative](#).

The number of companies participating in such initiatives grew to 611 in 2015, up 71 percent from the 357 participating a year earlier and more than triple the 193 companies identified when we began measuring this metric in the 2014 State of Green Business Index.

The sectors most active in natural-capital valuation initiatives include: banks and financial services, representing 16 percent of the participants; industrial goods and services (14 percent); utilities (11 percent) and basic resources (9 percent). These four sectors also have seen the largest increase in the number of participating companies, accounting for 49 percent of the growth over the last three years. Given the significant exposure of these sectors to potential natural resource constraints in their operations and investments, it is logical that companies in these sectors are leading the way in valuing their environmental impacts.

Of the companies participating in these initiatives, many are adopting internal prices for carbon and water. In 2015, more than 435 companies reported to CDP that they use an internal price on carbon to integrate climate change emissions into business planning, create incentives for decreasing emissions or measure the return on investment of carbon footprint reductions. Many companies are also calculating the full value of water using tools like the [Water Risk Monetizer](#) created by Ecolab and Trucost, which accounts for local water scarcity and demand. The tool provides a monetary estimate of revenue at risk from water scarcity, as well as a risk-adjusted (or shadow) price for purchased water.

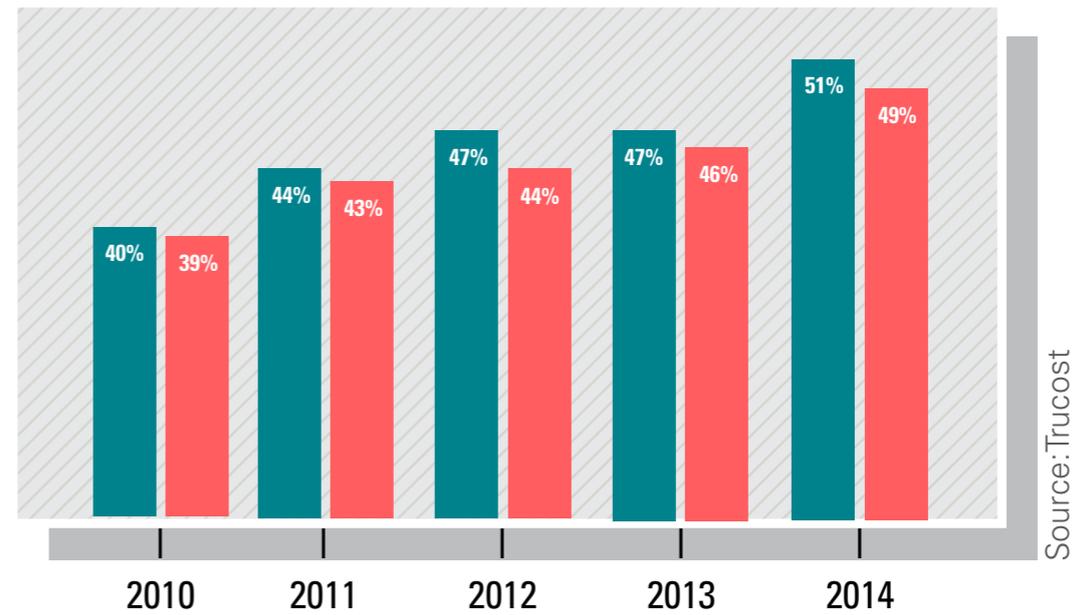
GHG AND WATER TARGETS GHG REDUCTION PROJECTS

In previous sections of this report, we reviewed how environmental impacts have changed over the last five years. Reflecting on this history gives us an idea of how well business has done in addressing those impacts, but it only provides a hint as to where it is heading. In this section, we hope to understand better if companies are undertaking efforts to reduce their impacts by examining how many have publicly set targets for reducing their greenhouse gas emissions and water use, and assessing how many companies have GHG reduction projects underway to help meet those targets. This metric is important, because studies show that companies setting targets are more likely to achieve significant reductions.

The number of companies with water-use reduction targets is small but rapidly increasing. In 2014, more than 20 percent of U.S. companies and 15 percent of global companies had water-use reduction targets. Since 2010, the number of companies with targets has almost doubled in the U.S. and grown nearly as much globally.

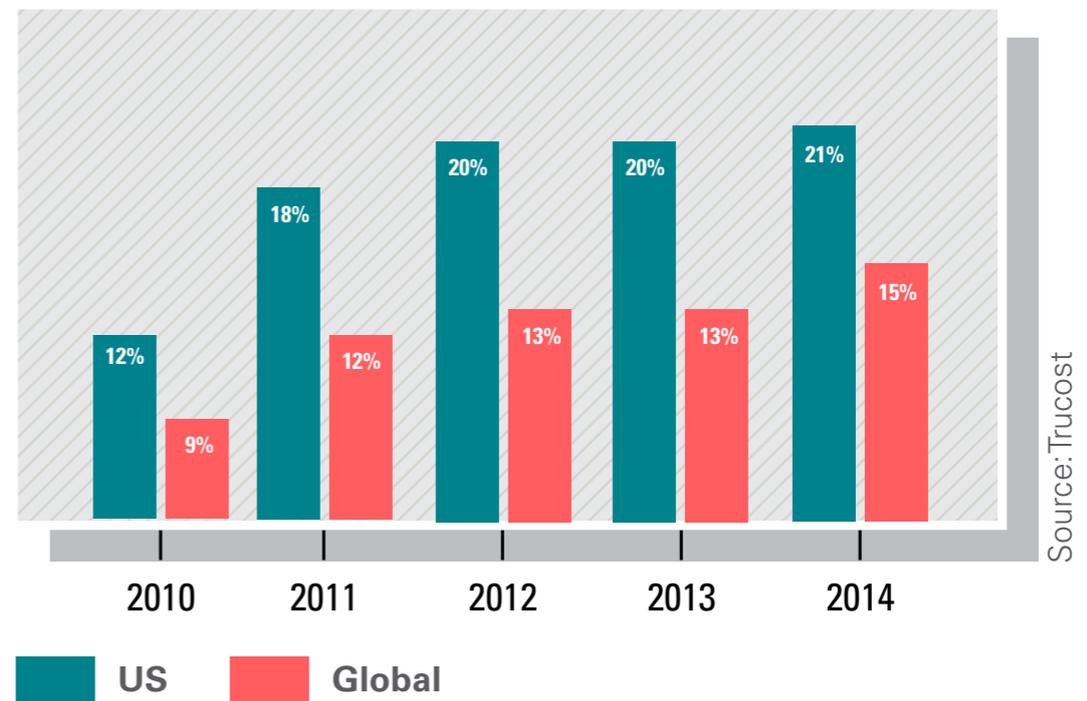
COMPANIES WITH GHG EMISSION REDUCTION TARGETS

Percent of companies disclosing reduction targets



COMPANIES WITH WATER-USE REDUCTION TARGETS

Percent of companies disclosing reduction targets





Even more companies have GHG emissions-reduction targets. Around half of both U.S. and global companies have GHG targets, and even more have GHG emissions-reduction projects already underway. This is a great start, but it also means that the other half haven't set public goals to reduce their energy and fuel use.

The average annual growth rate for reporting on GHG targets or reduction projects is hovering around 2 percent for U.S. and global companies, which shows progress — albeit incrementally. However, as discussed in the following section on GHG targets within science-based limits, this growth needs to increase more rapidly in order to help reduce GHG emissions to a level where we can avoid the most extreme impacts of climate change.

GHG TARGETS WITHIN SCIENCE-BASED LIMITS

The world in which we live contains limited natural resources for us to consume, including limited oil and fresh water. Our world also has a limited capability to

absorb the GHG emissions released into the atmosphere. This limit is sometimes called the “carbon budget,” which is a threshold that we must stay within to avoid the most severe impacts of climate change. Company targets based on such scientific measurements are often referred to as “science-based” goals.

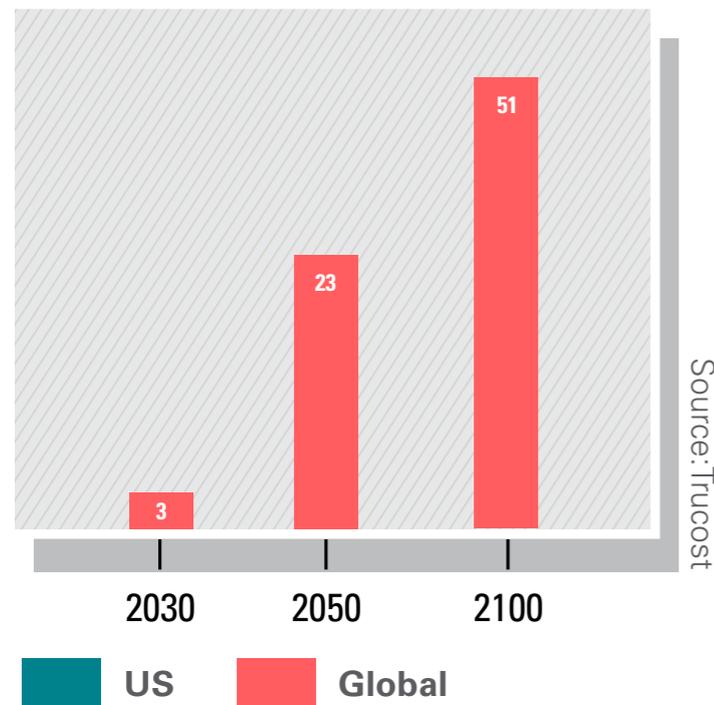
In the previous section of this report, we assessed how many companies publicly report GHG-reduction targets. In this section, we reviewed these commitments to see how close they are to meeting the reductions needed to stay within the world's carbon budget — that is, how many companies have science-based goals.

Staying within the carbon budget will not be an easy task. If business continues as usual, average global temperatures are expected to increase by 3.7 to 4.8 degrees Celsius, which far exceeds the goal to limit global warming to 2 degrees Celsius agreed by leaders of 195 countries at COP21 in Paris. Indeed, the Paris agreement also recognizes that an even lower goal of 1.5 degrees Celsius would have a much greater likelihood of ensuring a stable global climate. This lower limit had support from governments of more than 100 countries, including the United States.

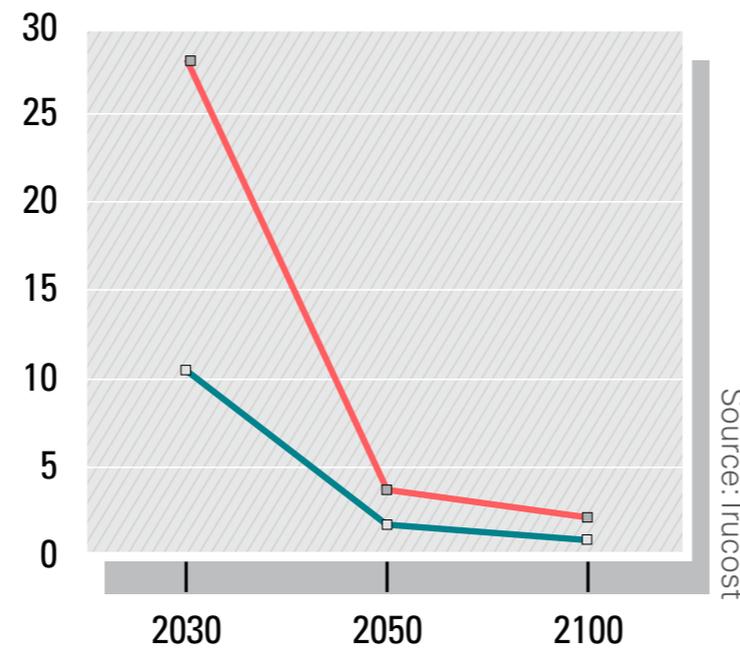


GHG TARGETS WITHIN SCIENCE BASED LIMITS

Reduction in GHG emissions beginning 2015 required to achieve 2° C temperature increase cap (Gtons CO₂e/year)



Percent of total annual reduction required to meet a 2° limit



Globally, a reduction of 3 gigatons of GHG emissions per year is needed by 2030 to keep global temperature increases within 2 degrees Celsius. As we near the planet’s total carbon budget, this annual emissions reduction increases to 51 gigatons per year by 2100.

The current reduction targets that companies have pledged account for nearly 28 percent of the 3 gigaton reduction needed by 2030. However, looking forward towards 2100, more significant reductions are needed. Current emissions-reduction targets account for less than 2 percent of those required for companies to live within their carbon budgets.

THIRD-PARTY ASSURANCE OF SUSTAINABILITY DATA

Many leading companies now have their environmental performance data reviewed and assured by third parties.

Third-party assurance provides company management with increased confidence in the quality of their environmental performance data, making it more likely that it will be used for decision making. Company stakeholders also look to assurance as a sign of high-data quality and a deeper level of commitment by the company to managing its sustainability performance.

For this metric, Trucost assessed how many companies had their data assured by independent third parties to validate their GHG emissions. In 2014, approximately 41 percent of U.S. companies had their Scope 1 emissions assured, 39 percent had their Scope 2 emissions assured and 30 percent had their Scope 3 emissions assured. The proportions for global firms were nearly identical, at 42 percent, 40 percent and 31 percent, respectively.

The percentage of organizations assuring their emissions data has increased consistently over the past five years. In the U.S., the number of companies assuring Scope 1 has grown by 52 percent, Scope 2 by 67 percent and Scope 3 by 143 percent. If the recent trend continues, Scope 3 assurance will be as common as the assurance of Scope 1 GHG emissions in a few years. This is a very positive trend for companies and investors who rely on this information to make informed business decisions.

REPORTING OF WATER RISK

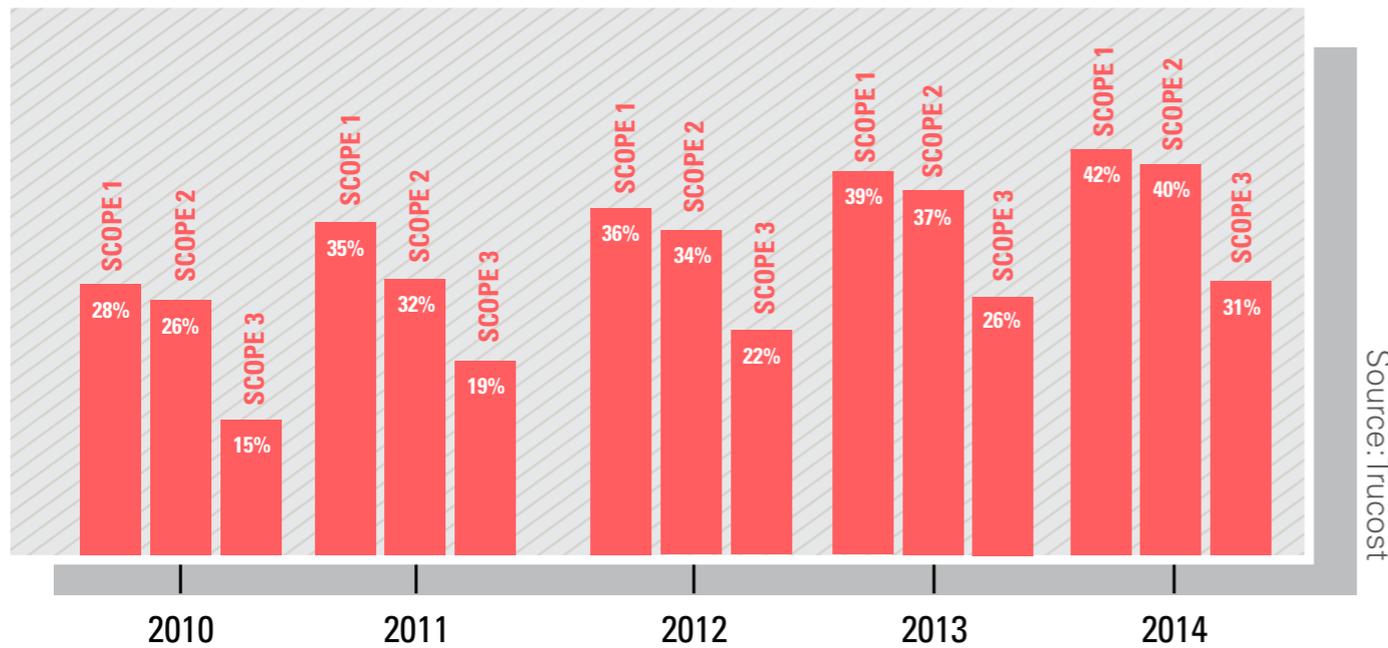
The scarcity of fresh water is increasingly being seen as a major risk for the global economy. This problem is worsening due to growing water demands and a changing climate.

The price that companies currently pay for water does not reflect its real value to the business or the future risk of scarcity. If a company’s management does not have a complete understanding of the value of water to its business and where it is exposed to water scarcity, decision-making could negatively impact the company’s operating cost and revenue generation.

In this metric, we review how many companies are reporting on their exposure to water risk.

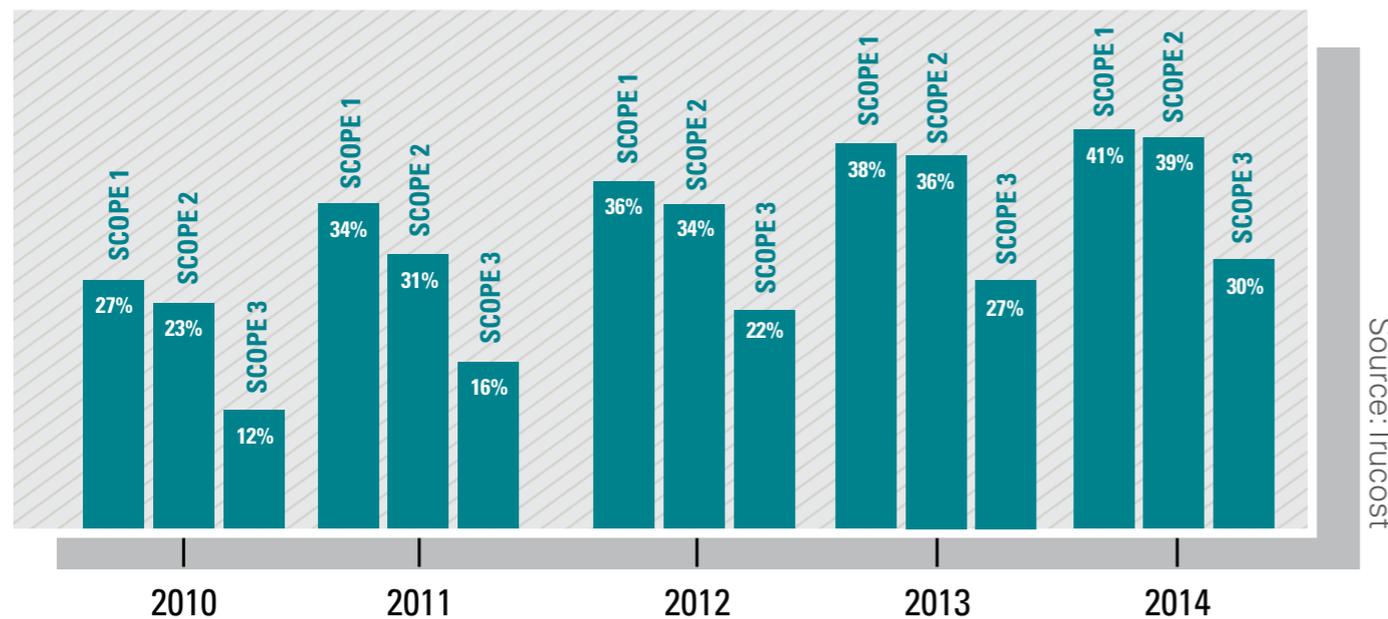
GLOBAL THIRD-PARTY ASSURANCE OF SUSTAINABILITY DATA

Percent of companies assuring GHG emissions data



US THIRD-PARTY ASSURANCE OF SUSTAINABILITY DATA

Percent of companies assuring GHG emissions data



Our findings show that while relatively few companies report on their exposure to water risk, the number that do has been rising at a steady rate. In 2014, 23 percent of U.S. companies reported on water risk, compared with 16 percent globally. These numbers are up from 12 percent and 10 percent in 2010, respectively.

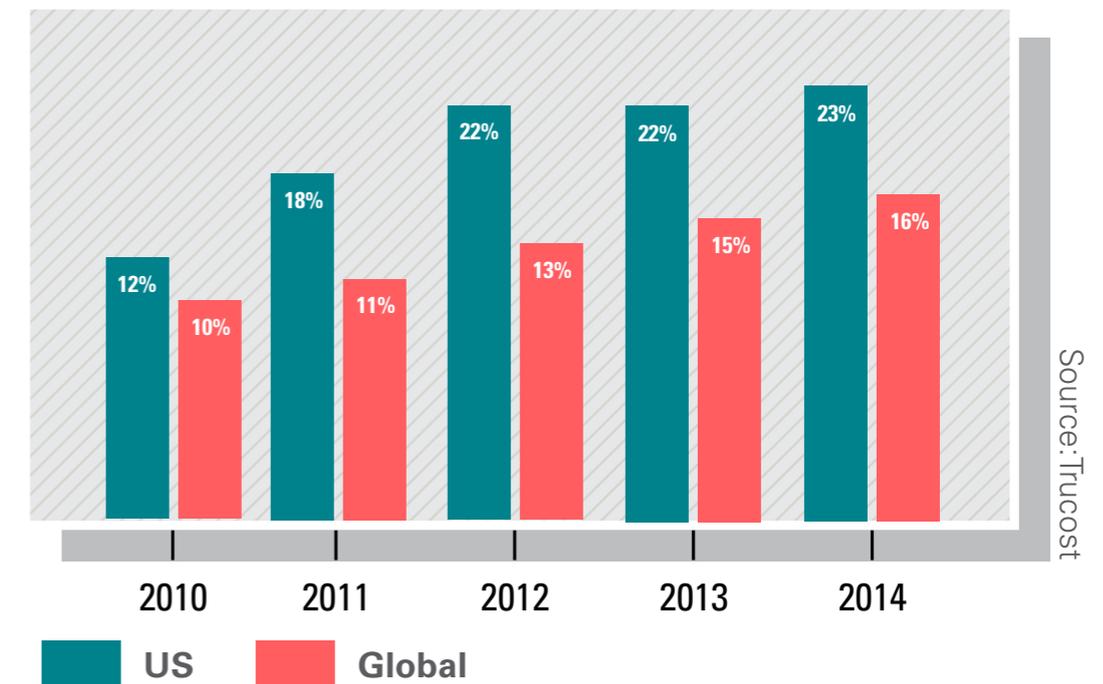
Given the widespread attention to water shortages across the globe and the costs incurred by businesses in drought-stricken areas like California, the Southeastern United States and São Paulo, Brazil, we expect that water-risk reporting will continue to increase.

REPORTING OF UPSTREAM AND DOWNSTREAM GHG EMISSIONS

In 2009, the World Resource Institute (WRI) and World Business Council for Sustainable Development (WBCSD) produced a standard for to help companies account for GHG emissions across their full

REPORTING OF WATER RISK

Percent of companies reporting





value chain. This includes the emissions associated with gathering raw materials needed for a company's products and services, all the way to the emissions resulting from using the product and disposing of it at the end of its useful life. Since the standard's release in 2009, the number of companies reporting has grown significantly.

In this section, we review how many companies are disclosing GHG emissions across all 15 categories defined by the WRI and WBCSD's GHG Protocol accounting standard, and which categories are most commonly disclosed.

The most commonly disclosed GHG emissions category is business travel. For U.S. and global companies, 48 percent and 44 percent of companies, respectively, report this GHG category, which is up from 28 percent in the U.S. and 21 percent globally in 2010. These emissions arise from the burning of fossil fuels during employee business trips via air, rail, road or water.

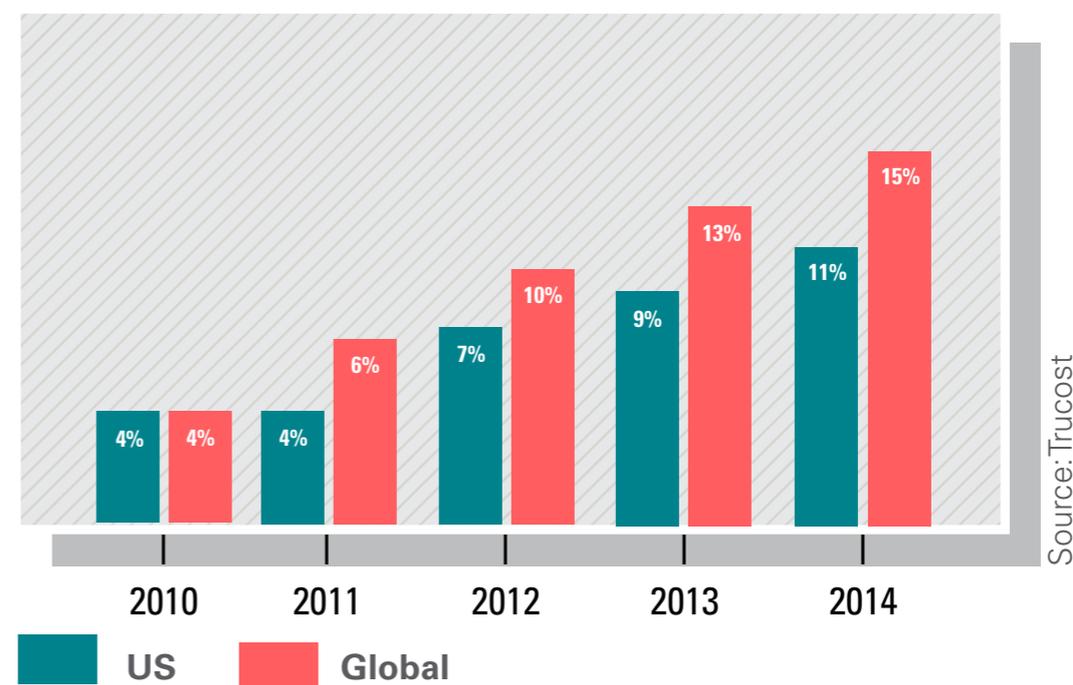
In 2014, the next four most-disclosed GHG categories were reported by more than 20 percent of U.S. and global companies. These four categories are employee commuting, fuel- and energy-related services, purchased goods and services, and waste generated in operations. The number of companies reporting these four categories increased from 17 percent to 23 percent over the last five years at a relatively consistent rate. Purchased goods and services are often the most material supply-chain emission category. As a consequence, an increasing number of companies are taking advantage of rapid input-output life-cycle modeling tools to estimate their suppliers' emissions so they can be better managed.

All five of the most disclosed GHG emissions categories are upstream activities, which means that the emissions are embedded in the companies' supply chains. For many industries, these upstream emissions are likely to be the most material for a company, as detailed earlier in this report.

However, for some firms, the most significant impacts are downstream — that is, after the product is sold and during its use and disposal. For

REPORTING OF GREENHOUSE GAS EMISSIONS FROM PRODUCT USE

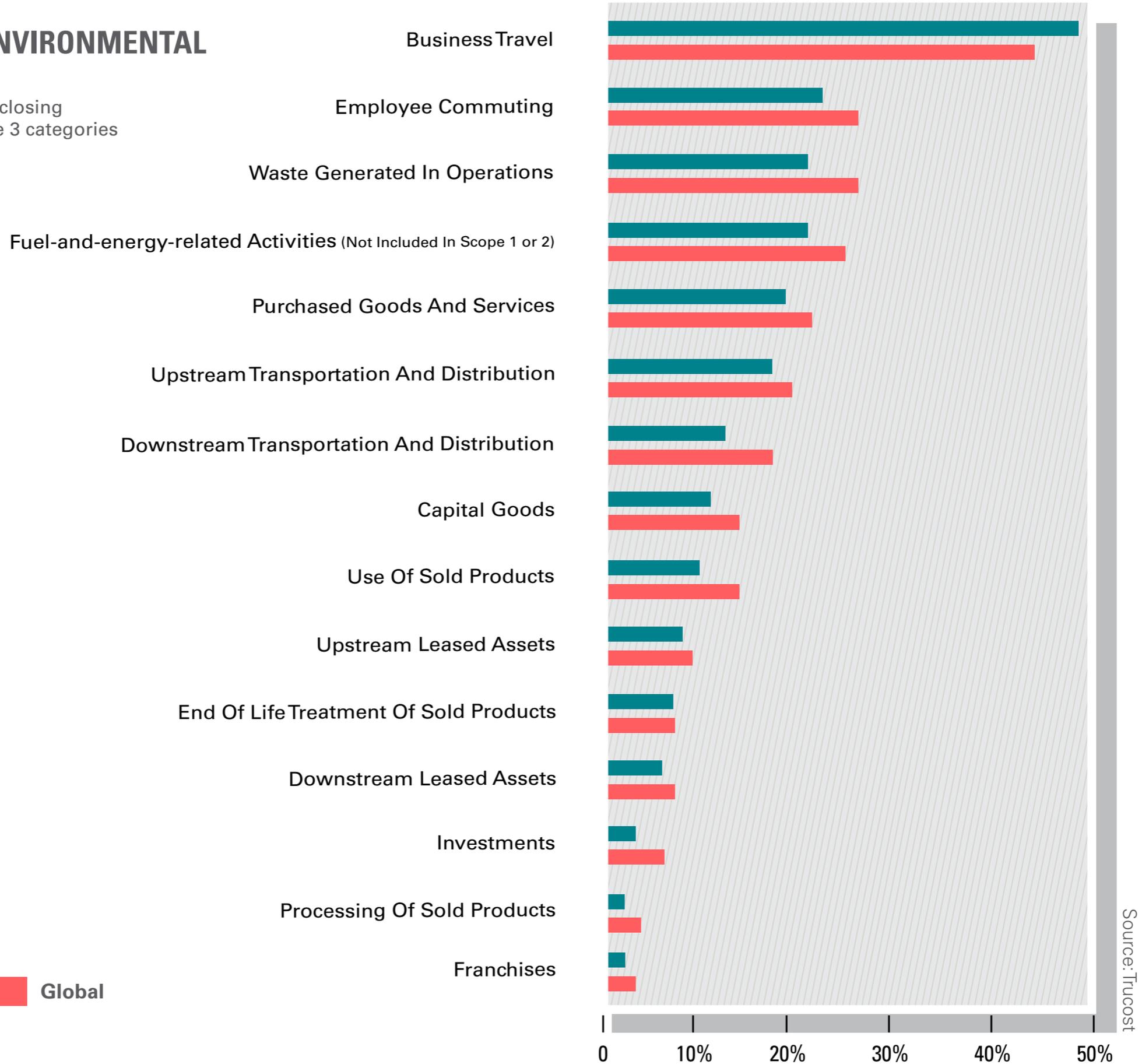
Percent of companies reporting



SUPPLY CHAIN ENVIRONMENTAL PERFORMANCE

Percent of companies disclosing each of the 15 GHG scope 3 categories

■ US ■ Global



Source: Trucost



example, the GHG emissions from cars are also important to consumers concerned about the cost of fuel.

Determining GHG emissions when products are used can be complex, as it requires quantifying direct and indirect emissions. Understanding these emissions demands analyzing variables such as energy consumption and how consumers use products, which can be developed by collecting sales information across business regions. Nevertheless, many companies are tackling this challenge. The number of U.S. companies reporting on the GHG emissions from the use of their products has tripled since 2010 and quadrupled globally. We believe that the number of companies reporting this data will continue to increase as more businesses realize that they can grow revenue with greener product offerings. More investors will also seek to direct capital toward companies that will enable the transition to a low-carbon economy.

We expect continued growth in the number of companies disclosing GHG emissions across their value chains. We also expect growth in the number of companies assessing other environmental issues — including water use, waste generation and land use — across their value chains.

GREEN OFFICE SPACE

Construction of green buildings appears to have plateaued, based on the number that have registered for and been certified by the U.S. Green Building Council's LEED rating system. In the three certification categories measured — for building design and construction, operations and maintenance, and commercial interior design and construction — the past five years has seen relatively consistent levels of activity.

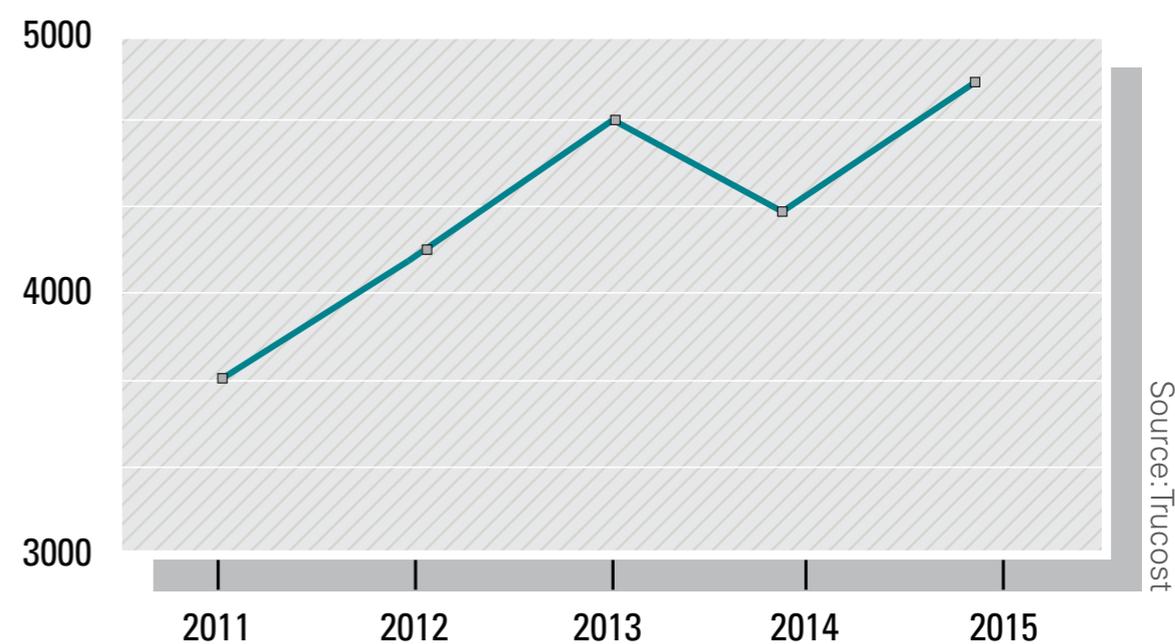
This can be read in two ways: one, that the growth of green buildings seen a few years ago, at least in the United States, has stopped; or that green building has now become so normal that it is predictably boring, as movements inevitably do when they become mainstream.

Still, the prospects for commercial buildings designed and constructed to be environmentally conscious remains positive. Indeed, it is a global phenomenon. “The percentage of firms expecting to have more than 60 percent of their projects certified green is anticipated to nearly double from 17 percent currently to 33 percent by 2018,” according to the World Green Building Trends 2016 study, based on a survey of more than 1,000 professionals from 69 countries.

The study, produced by Dodge Data & Analytics, found that the anticipated growth is largely driven by countries with developing green markets. Mature markets in the United States, Europe and Australia reported moderate levels of growth. Respondents from Asia, the Middle East/North Africa region, Sub-Saharan Africa and South America report much more dramatic growth in the percentage of their projects that they expect to certify as green.

USE OF GREEN OFFICE SPACE

Number of U.S. certified projects



Other studies have found strong growth in developed markets, too. According to McGraw-Hill Construction's latest SmartMarket Report, in partnership with the World Green Building Council, green building was expected to more than triple in South Africa; more than double in Germany, Norway and Brazil; and grow between 33 and 68 percent in the United States, Singapore, the United Kingdom, the United Arab Emirates and Australia.

CLEANTECH PATENTS

The trend lines for cleantech patents are declining — a seemingly negative development — but the numbers don't tell the whole story.

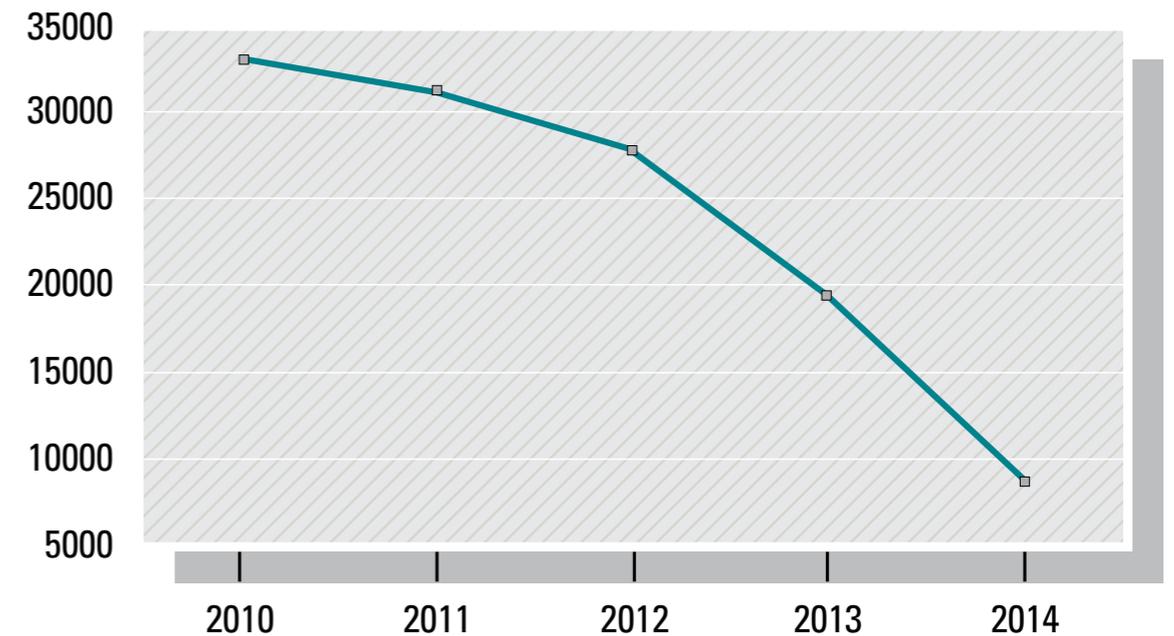
The role of clean technology in the sustainable, low-carbon economy is, perhaps paradoxically, becoming more critical but less measurable. The reason has largely to do with the definition of "cleantech" itself: It is a vague term that has largely become inadequate in describing the wide range of technologies that are reducing environmental impacts and accelerating clean and low-carbon technologies, all while making the world (and, hopefully, its residents) smarter and more connected.

There's no common definition of cleantech, and most are broad. According to Clean Edge, a research firm, the term refers to "a diverse range of products, services, and processes that harness renewable materials and energy sources, dramatically reduce the use of natural resources, and cut or eliminate emissions and wastes."

That's good in theory. In practice, the term has referred largely to clean energy — renewable, efficient, smart, and so on — along with energy-using devices, such as electrified vehicles and LED light bulbs like. But there's a lot more to reducing resource use, emissions and waste than energy. New generations of materials — made from nanomaterials, plants even carbon dioxide — are included. So, too, are software, sensors and analytics that optimize everything from aircraft engines to data centers, vastly reducing energy use while increasing products' life spans. Green chemistry, precision agriculture, water

FILING OF CLEANTECH PATENTS

Number of patents filed



Source: IP Checkups Cleantech PatentEdge Database

TOP CLEANTECH PATENT FILERS, 2010-15

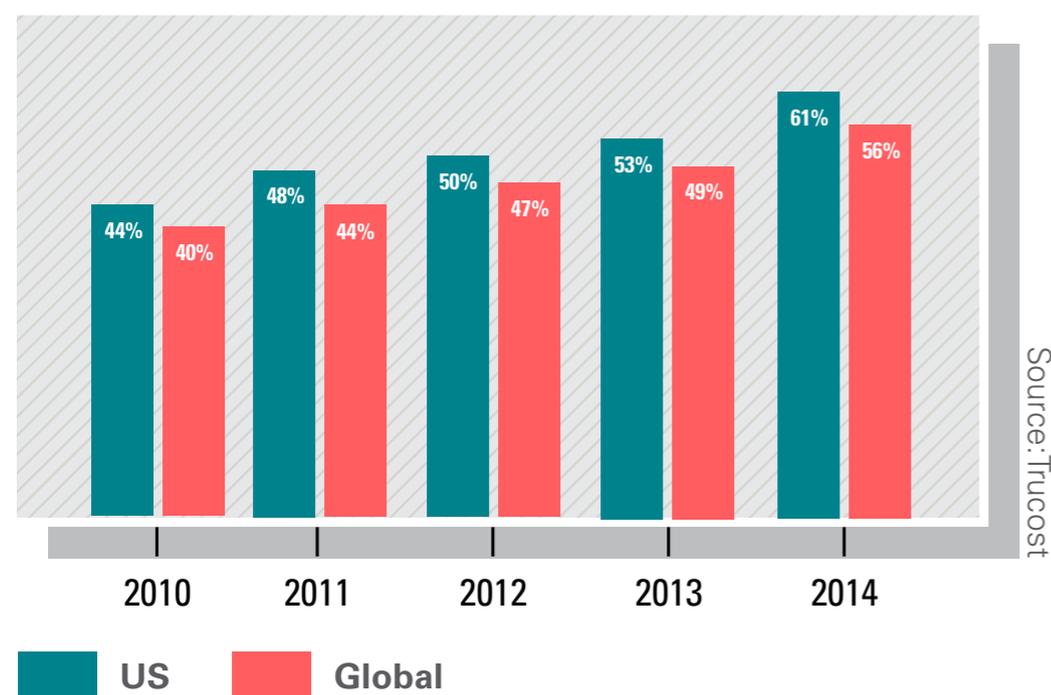
Panasonic.....	7171
Toyota.....	5395
Mitsubishi.....	4018
Siemens.....	3697
BASF.....	3268
LG Chem.....	3089
Hitachi.....	2919
Honda.....	2841
Samsung SDI.....	2598
Semicon Res Lab.....	2498
Philips Electronics.....	2514
Toshiba.....	2348

Source: IP Checkups Cleantech PatentEdge Database

Much like “e-commerce,” which has been so blurred with its traditional counterpart that it’s really just “commerce,” “cleantech” today is really just “tech.”

REPORTING OF NATURAL CAPITAL R&D OR INVESTMENTS

Percent of companies reporting



recycling and desalination, green infrastructure, nontoxic materials — all align with the promise of “cleantech.”

As we’ve said in previous reports: Much like “e-commerce,” which has been so blurred with its traditional counterpart that it’s really just “commerce,” “cleantech” today is really just “tech.”

The data in this metric does not cover the full gamut of technologies, focusing primarily on energy and water technologies — biofuels, solar, wind, hydropower, geothermal energy; advanced batteries and fuel cells; and water filtration and desalination. As such, it covers only a portion of what has been traditionally called cleantech.

REPORTING OF NATURAL CAPITAL R&D AND INVESTMENTS, AND NATURAL-CAPITAL PROFITS OR SAVINGS

Last summer, Lego Group announced it was investing more than \$150 million in research and development (R&D) for sustainable materials for its toys and packaging materials. GE reported that it has invested \$15 billion into products that qualify for its Ecomagination program since 2005, and that it generated more than \$34 billion in revenue from Ecomagination products during 2014 alone.

A growing number of companies are recognizing that the development of environmentally preferable products can generate win-win opportunities, greater economic returns and decrease customer environmental impacts.

Trucost reviewed companies’ public reports to identify how many firms are conducting R&D and making investments to improve the natural capital or environmental performance of their products and operations. Separately, we assessed how many companies are reporting environmental profits and savings from products that they sell or changes they make to their operations.

The number of companies reporting both of these metrics is trending steadily upward.

More companies are identifying and reporting on natural-capital profits or savings, which we expect to create a positive feedback loop.

REPORTING OF NATURAL CAPITAL PROFITS OR SAVINGS

Percent of companies reporting



Companies reporting on green R&D or investments increased in the U.S. from 44 percent in 2010 to 61 percent in 2014. The change also has been significant for global companies, rising from 40 percent in 2010 to 56 percent in 2014. The annual rate of improvement has been relatively steady for both U.S. and global companies (about 2 to 3 percent per year), but it jumped by more than 7 percent for both U.S. and global companies between 2013 and 2014.

The number of companies reporting on natural-capital profits or savings is slightly smaller, but the growth has been faster, increasing 23 percent over five years. Slightly more U.S. companies report on natural-capital profits or savings when compared to global companies. In 2014, 56 percent of U.S. companies and 52 percent of global companies reported, up from 33 percent U.S. and 30 percent globally in 2010.

The growth in the number of companies making these investments is encouraging and demonstrates that companies are placing value on improving the environmental performance of their products and operations. Our findings also show that more companies are identifying and reporting on natural-capital profits or savings, which we expect to create a positive feedback loop of more investment leading to more value creation. 🌱



METHODOLOGY

Trucost maintains a database on the environmental performance of more than 12,000 companies worldwide, representing 93 percent of global markets by market capitalization. The database 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 and verify the research.

In this report, this data has been aggregated for both the S&P 500 index of U.S. companies and the MSCI World Developed Index, covering a total of more than 1,600 companies in 24 developed markets. Trucost also calculated the cost of companies' environmental impacts to provide insight into the economic consequences of those impacts.

MODELING ENVIRONMENTAL IMPACT

To enable comparison of environmental impacts across companies, supply chains, regions, sectors and investment benchmarks, Trucost filled data gaps in company disclosure with data calculated using its environmentally

extended input-output lifecycle analysis model. The model estimates the amount of resources a company uses (the inputs) to produce goods or services (outputs), as well as and the pollution that results.

Trucost's model draws on 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.

Trucost's model analyzes business activities at a global or regional level. Data on emissions from industrial sites 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. Trucost calculates the environmental impacts of 464 business sectors based on the North American Industrial Classification System (NAICS). The model has been enhanced to provide additional detail for environmentally intense



sectors. The environmental impacts modeled for each sector are allocated to a company according to its proportion of total revenue. Trucost primarily uses data from FactSet 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 analysis accounts for impacts from a company's own operations and its supply chain. The input-output methodology models the purchases a company makes and the resultant environmental impacts. This analysis can be extended to include first-tier suppliers that the company buys from, through subsequent tiers of suppliers until the supplier of the raw material is reached. In this way, Trucost can calculate the cost of supply chain impacts. This provides a means to understand business risk, and differentiate between low-impact supplied goods, such as renewable energy, and high-impact supplied goods, such as fossil fuel energy.

VALUING ENVIRONMENTAL IMPACTS

In addition to measuring environmental performance in physical units, such as metric tons of greenhouse gases or cubic meters of water, Trucost is also able to value in monetary terms the costs of these impacts. Once the environmental impact profile of a company has been calculated, an environmental damage cost (natural-capital cost) is applied to each resource and emission to generate an external environmental cost profile. The costs represent the quantities of natural resources used or pollutants emitted multiplied by their environmental damage costs to the economy and society.

External costs are incurred whenever a natural resource is used or pollutants are released to air, land or water. The external cost of using a resource, such as water, or emitting a pollutant, such as carbon dioxide, is the cost that is borne by society through the degradation of the environment but which is external to the books of the firm that uses the resource or emits the pollutant.

Expressing impacts in financial terms enables comparison between a company's external costs and traditional financial performance measures. Damage costs can be measured against revenues to compare the impacts of companies of any size or sector.

The costs provide a good proxy for potential exposure to policy measures that seek to apply the "polluter pays" principle. Companies are increasingly required to contribute to external costs through regulations or economic instruments such as carbon taxes or allowances, which "internalize" costs per unit of resources used and emissions released. The external environmental costs of a company's operations give a good long-term indicator of the environmental sustainability of the company's activities.

Trucost's valuations draw on extensive international academic research into the pricing of environmental externalities and are overseen 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 focusing at the intersection of business, technology and sustainability for professionals from every sector and discipline. Since 1991, it has chronicled how business aligns environmental responsibility with profitable business practices. Through its websites, events, membership network and research, GreenBiz promotes the potential to drive transformation and accelerate progress — within companies, industries and in the very nature of business.

The annual GreenBiz conference, held each February in Scottsdale, Ariz., defines the trends, challenges and opportunities in sustainable business now. GreenBiz's VERGE global event series focuses on the technologies and systems that accelerate sustainability solutions across sectors in a climate-constrained world. The GreenBiz Executive Network is a member-based, peer-to-peer learning forum for sustainability executives from large companies.

GreenBiz also offers companies opportunities to demonstrate thought leadership through webcasts, research reports and focused content on GreenBiz.com. 

www.greenbiz.com

ABOUT TRUCOST^{PLC}

Trucost has been helping companies, investors, governments, academics and thought leaders to understand the economic consequences of natural capital dependency for over 14 years.

Our world-leading data and insight enables our clients to identify natural capital dependency across companies, products, supply chains and investments; manage risk from volatile commodity prices and increasing environmental costs; and ultimately build more sustainable business models and brands.

Key to our approach is that we not only quantify natural capital dependency, we also put a price on it, helping our clients understand environmental risk in business terms.

It isn't "all about carbon"; it's about water, land use, waste and pollutants. It's about which raw materials are used and where they are sourced, from energy and water to metals, minerals and agricultural products. And it's about how those materials are extracted, processed and distributed. 🍀

www.trucost.com



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Cost of corporate natural capital impacts

(Million U.S. dollars)

	2010	2011	2012	2013	2014
U.S.	\$923,000	\$961,000	\$1,009,000	\$1,034,000	\$1,046,000
Global	\$2,601,000	\$2,818,000	\$3,053,000	\$3,114,000	\$2,871,000

Source: Trucost data

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Profit at risk from natural capital impacts

	2010	2011	2012	2013	2014
U.S.	116%	115%	117%	109%	111%
Global	138%	143%	162%	153%	152%

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	3%	97%
Automobiles & Parts	3%	97%
Technology	4%	96%
Personal & Household Goods	5%	95%
Telecommunications	5%	95%
Media	6%	94%
Retail	6%	94%
Healthcare	10%	90%
Real Estate	14%	86%
Industrial Goods & Services	30%	70%
Insurance	33%	67%
Construction & Materials	35%	65%
Chemicals	40%	60%
Oil & Gas	47%	53%
Travel & Leisure	49%	51%
Basic Resources	53%	47%
Utilities	92%	8%

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Source: Trucost data

Largest natural capital impacts								
	Impact 1		Impact 2		Impact 3		Impact 4	
U.S.								
Direct	Greenhouse Gases	60%	Water Abstraction	29%	Acid Rain and Smog Precursors	4%	Dust and Particles	2%
Supply Chain	Greenhouse Gases	37%	Water Abstraction	30%	Nutrients and Organic Pollutants	24%	Acid Rain and Smog Precursors	3%
Total	Greenhouse Gases	45%	Water Abstraction	30%	Nutrients and Organic Pollutants	15%	Acid Rain and Smog Precursors	4%
Global								
Direct	Greenhouse Gases	62%	Water Abstraction	21%	Acid Rain and Smog Precursors	4%	Nutrients and Organic Pollutants	4%
Supply Chain	Greenhouse Gases	37%	Water Abstraction	30%	Nutrients and Organic Pollutants	24%	Acid Rain and Smog Precursors	3%
Total	Greenhouse Gases	46%	Water Abstraction	27%	Nutrients and Organic Pollutants	17%	Acid Rain and Smog Precursors	4%

Source: Trucost data.

Fossil Fuel Divestment

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

	2014	2015
Amount (\$bn)	50	2,600
Number of institutions & individuals	837	2,476

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	2011	2012	2013	2014
Wind	98.9	84.2	84.1	89.3	99.5
Solar	103.3	155.7	144.3	119.8	149.6
Biofuels	10.1	10.4	7	5.5	5.1
Biomass & Waste-To-Energy	16	17.4	12.4	9.3	8.4
Small Hydro	5.7	7.2	6.4	5.5	4.5
Geothermal	3	3.7	1.8	2.2	2.7
Marine	0.3	0.3	0.3	0.2	0.4
Total	237.2	278.8	256.4	231.8	270.2

Low Carbon Investment					
New investment commitments for Renewable Energy (technology development, equipment manufacturing, or projects) by Geography (\$bn)	2010	2011	2012	2013	2014
United States	35.1	50	38.2	36	38.3
Global	202.1	228.8	218.2	195.8	231.9

Source: Global trends in renewable energy investment. United Nations Environment Programme (UNEP). (2015).

Green Bonds- Total value of Green Bonds offered annually					
(Millions of US Dollars)	2010	2011	2012	2013	2014
Corporate	N/A	N/A	481	3,050	16,100
Multilateral	3,534	1,073	1,180	5,717	9,363
Municipal	N/A	N/A	715	179	4,038
Quasi-sovereign	N/A	N/A	651	1,582	6,710
Sovereign	359	159	76	500	N/A
Total	3,893	1,231	3,102	11,027	36,211

Source: Climate Bonds Initiative

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Investor use of corporate environmental data

Total assets under management considering ESG in their investments (\$billions)	2010	2012	2014
US	569	1,013	4,306
Global	N/A	13,261	21,358

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

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GHGs emissions and percentages by scope					
Total emissions (million metric tons)					
	2010	2011	2012	2013	2014
U.S.	3,880	4,045	3,863	3,861	4,091
Global	10,600	11,441	11,309	11,278	11,149
Percent of emissions					
U.S.	2010	2011	2012	2013	2014
Scope 1	50%	49%	48%	48%	51%
Scope 2	8%	8%	8%	8%	9%
Scope 3	42%	43%	44%	43%	40%
Global					
Scope 1	48%	47%	46%	46%	48%
Scope 2	8%	8%	8%	8%	8%
Scope 3	44%	46%	46%	46%	44%

Source: Trucost

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GHGs intensity by scope

Metric tons CO₂e per million dollars of revenue

U.S.	2010	2011	2012	2013	2014
Scope 1	220	210	190	190	200
Scope 2	40	40	30	30	40
Scope 3	180	180	170	170	160
TOTAL	440	420	390	390	400
Global					
Scope 1	210	200	190	180	190
Scope 2	30	30	30	30	30
Scope 3	190	190	190	180	170
TOTAL	440	420	400	400	400

Source: Trucost

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Total primary energy consumption per dollar of GDP					
BTUs per year 2005 U.S. dollars at purchasing power parities					
	2011	2012	2013	2014	2015
U.S.	7,328	6,993	7,066	6,970	6,705
Global	7,317	7,160	7,049	6,891	6,698

Average annual efficiency growth rate			
	1980-1996	1996-2004	2004-15
U.S.	-1.82%	-2.45%	-1.79%
Global	-0.30%	-1.38%	-1.56%

Source: John A. "Skip" Laitner, using Energy Information Administration data

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Global Energy Mix

Electricity mix of large cap Global benchmarks

	2010	2011	2012	2013	2014
Natural Gas	26.50%	27.49%	31.39%	30.24%	32.88%
Coal	27.33%	25.20%	25.80%	27.54%	26.02%
Nuclear	28.43%	28.29%	22.44%	20.42%	20.74%
Hydroelectric	9.50%	9.35%	9.95%	10.06%	9.60%
Petroleum	4.80%	3.85%	6.68%	7.85%	6.23%
Wind	2.02%	2.24%	2.57%	2.80%	3.34%
Geothermal	0.46%	0.48%	0.43%	0.36%	0.38%
Solar	0.69%	2.53%	0.06%	0.10%	0.33%
Biomass	0.13%	0.17%	0.38%	0.26%	0.21%
Landfill Gas	0.01%	0.01%	0.02%	0.01%	0.01%
Other	0.13%	0.41%	0.29%	0.37%	0.25%

Source: Trucost

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Global green power production as percent of total					
	2008	2009	2010	2011	2012
Hydropower	15.9%	16.2%	16.0%	15.8%	16.2%
Solar PV	0.1%	0.1%	0.1%	0.3%	0.4%
Solar CSP	0.0%	0.0%	0.0%	0.0%	0.0%
Wind	1.1%	1.4%	1.6%	2.0%	2.3%
Bioenergy	1.3%	1.4%	1.5%	1.6%	1.7%
Geothermal	0.3%	0.3%	0.3%	0.3%	0.3%
Ocean	0.0%	0.0%	0.0%	0.0%	0.0%
TOTAL	18.6%	19.4%	19.6%	20.0%	20.9%

Source: International Energy Agency

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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					
U.S.	2010	2011	2012	2013	2014
Direct withdrawal (surface/ground)	8%	9%	7%	6%	8%
Purchased (municipality)	1%	1%	1%	1%	1%
Cooling water	39%	39%	37%	37%	35%
Supply chain	52%	52%	55%	57%	55%
Global					
Direct withdrawal (surface/ground)	7%	8%	9%	8%	9%
Purchased (municipality)	1%	1%	1%	1%	1%
Cooling water	37%	37%	35%	36%	34%
Supply chain	55%	54%	56%	55%	56%

Source: Trucost data

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Water intensity					
Cubic meters per million dollars of revenue					
U.S.	2010	2011	2012	2013	2014
Direct withdrawal (surface/ground)	4,100	4,000	3,400	2,800	3,600
Purchased (municipality)	400	300	300	300	300
Cooling water	19,600	18,500	17,200	17,200	15,100
Supply chain	26,400	24,300	25,800	26,700	23,600
Global					
Direct withdrawal (surface/ground)	3,700	3,800	4,100	4,000	4,200
Purchased (municipality)	400	400	300	300	300
Cooling water	18,400	17,100	16,800	17,200	15,300
Supply chain	27,100	25,300	26,700	26,800	24,800

Source: Trucost data

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Waste intensity					
Metric tons per million dollars revenue					
U.S.	2010	2011	2012	2013	2014
Landfill	5.9	5.9	5.5	5.5	5.3
Incineration	0.5	0.4	0.4	0.4	0.4
Company-reported recycling	2.5	2.2	2.4	2.6	2.6
Global					
Landfill	7.0	7.3	7.7	6.2	5.7
Incineration	0.5	0.4	0.4	0.4	0.5
Company-reported recycling	7.1	7.1	6.5	6.3	6.6

Source: Trucost data

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Waste generation					
Million Metric tons					
U.S.	2010	2011	2012	2013	2014
Landfill	51,600	56,300	53,600	55,000	54,500
Incineration	4,000	4,000	3,700	3,700	4,500
Company-reported recycling	21,900	20,800	23,300	26,400	27,000
Global					
Landfill	170,400	197,200	216,700	173,800	159,500
Incineration	11,600	12,200	12,000	12,200	13,700
Company-reported recycling	172,700	191,600	182,400	179,100	184,000

Source: Trucost data

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Disclosure of natural capital impacts

(Disclosed Environmental Cost USD/ Total Environmental Cost USD)

	2010	2011	2012	2013	2014
U.S.	38%	44%	45%	45%	44%
Global	44%	47%	49%	50%	50%
Companies Disclosing No Environmental Impact Data					
U.S.	44%	36%	36%	33%	35%
Global	40%	36%	34%	32%	32%

Source: Trucost data

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Companies With GHG Reduction Targets					
	2010	2011	2012	2013	2014
U.S.	40%	44%	47%	47%	51%
Global	39%	43%	44%	46%	49%
Source: Trucost data					

Companies With Water Use Reduction Targets					
	2010	2011	2012	2013	2014
U.S.	12%	18%	20%	20%	21%
Global	9%	12%	13%	13%	15%
Source: Trucost data					

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GHG Targets Within Science-Based Limits

Percent of total annual reduction required to meet a 2° limit

	2030	2050	2100
Reduction in GHG emissions beginning 2015 required to achieve 2° C temperature increase cap (Gtons CO2e/year)	3	23	51

GHG Targets Within Science-Based Limits

Percent of total annual reduction required to meet a 2° limit

	2030	2050	2100
U.S.	10.3%	1.5%	0.7%
Global	27.7%	3.9%	1.8%

GHG emission scenario assumes a peak in global emissions around 2020, followed by increasing GHG emission reduction through 2100

Source: Trucost

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GHG reduction projects

Number of companies with active emissions reduction projects and initiatives

	2010	2011	2012	2013	2014
U.S.	52%	55%	56%	58%	61%
Global	48%	51%	52%	53%	56%

Source: Trucost data

Companies using third-party assurance for greenhouse gas reporting

Scope 1					
	2010	2011	2012	2013	2014
Global	28%	35%	36%	39%	42%
U.S.	27%	34%	36%	38%	41%
Scope 2					
Global	26%	32%	34%	37%	40%
U.S.	23%	31%	34%	36%	39%
Scope 3					
Global	15%	19%	22%	26%	31%
U.S.	12%	16%	22%	27%	20%

Source: Trucost data

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Reporting of water risk										
Reporting on general water risk										
	2010		2011		2012		2013		2014	
	Number	Percent								
Global	145	10%	167	11%	184	13%	215	15%	238	16%
U.S.	56	12%	86	18%	102	22%	104	22%	107	23%
Reporting on operations in regional water-stressed areas										
	Number	Percent								
Global	145	10%	167	11%	184	13%	215	15%	238	16%
U.S.	56	12%	81	17%	97	21%	104	22%	106	23%
Reporting on key inputs from water-stressed regions										
	Number	Percent								
Global	44	3%	78	5%	101	7%	215	15%	235	16%
U.S.	10	2%	33	7%	42	9%	104	22%	103	22%
Reporting on awareness of supply-chain water risk										
	Number	Percent								
Global	44	3%	65	4%	75	5%	70	5%	94	6%
U.S.	11	2%	23	5%	24	5%	31	7%	43	9%

Source: Trucost data

Supply Chain Environmental Performance

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

	U.S	Global
Business travel	48%	44%
Employee commuting	23%	24%
Waste generated in operations	22%	27%
Fuel-and-energy-related activities (not included in Scope 1 or 2)	22%	26%
Purchased goods and services	20%	27%
Upstream transportation and distribution	18%	21%
Downstream transportation and distribution	14%	17%
Capital goods	12%	15%
Use of sold products	11%	15%
Upstream leased assets	8%	7%
End of life treatment of sold products	7%	10%
Downstream leased assets	6%	6%
Investments	3%	48%
Processing of sold products	2%	4%
Franchises	2%	3%

Source: Trucost data

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Reporting of greenhouse gas emissions from products

Number of Companies					
	2010	2011	2012	2013	2014
U.S.	17	20	34	45	52
Global	55	81	147	191	219
Percent of Companies					
U.S.	4%	4%	7%	9%	11%
Global	4%	6%	10%	13%	15%

Source: Trucost data

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Green Office Space					
	2011	2012	2013	2014	2015
Project Registrations					
Building Design + Construction	4,509	4,194	4,423	3,944	4,322
Building Operations + Maintenance	1,636	971	774	997	954
Interior Design + Construction	1,327	1,354	1,376	1,340	1,573
TOTAL	7,472	6,519	6,573	6,281	6,849
Project Certifications					
Building Design + Construction	2,230	2,656	2,867	2,631	2,930
Building Operations + Maintenance	649	539	607	692	799
Interior Design + Construction	778	1,021	1,203	1,179	1,108
TOTAL	3,657	4,216	4,677	4,502	4,837

Source: U.S. Green Building Council

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Global cleantech patent filings

	2010	2011	2012	2013	2014
TOTALS	33,485	30,850	28,565	19,262	9,141

Source: IP Checkups CleanTech PatentEdge database

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Reporting of natural capital R&D or Investments					
Number of Companies					
	2010	2011	2012	2013	2014
U.S.	206	222	233	246	283
Global	590	635	680	714	811
Percent of Companies					
U.S.	44%	48%	50%	53%	61%
Global	40%	44%	47%	49%	56%

Source: Trucost data

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Reporting of natural capital profits or savings

Number of Companies					
	2010	2011	2012	2013	2014
U.S.	152	173	201	247	259
Global	432	480	570	720	764
Percent of Companies					
U.S.	33%	37%	43%	53%	56%
Global	30%	33%	39%	49%	52%

Source: Trucost data

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