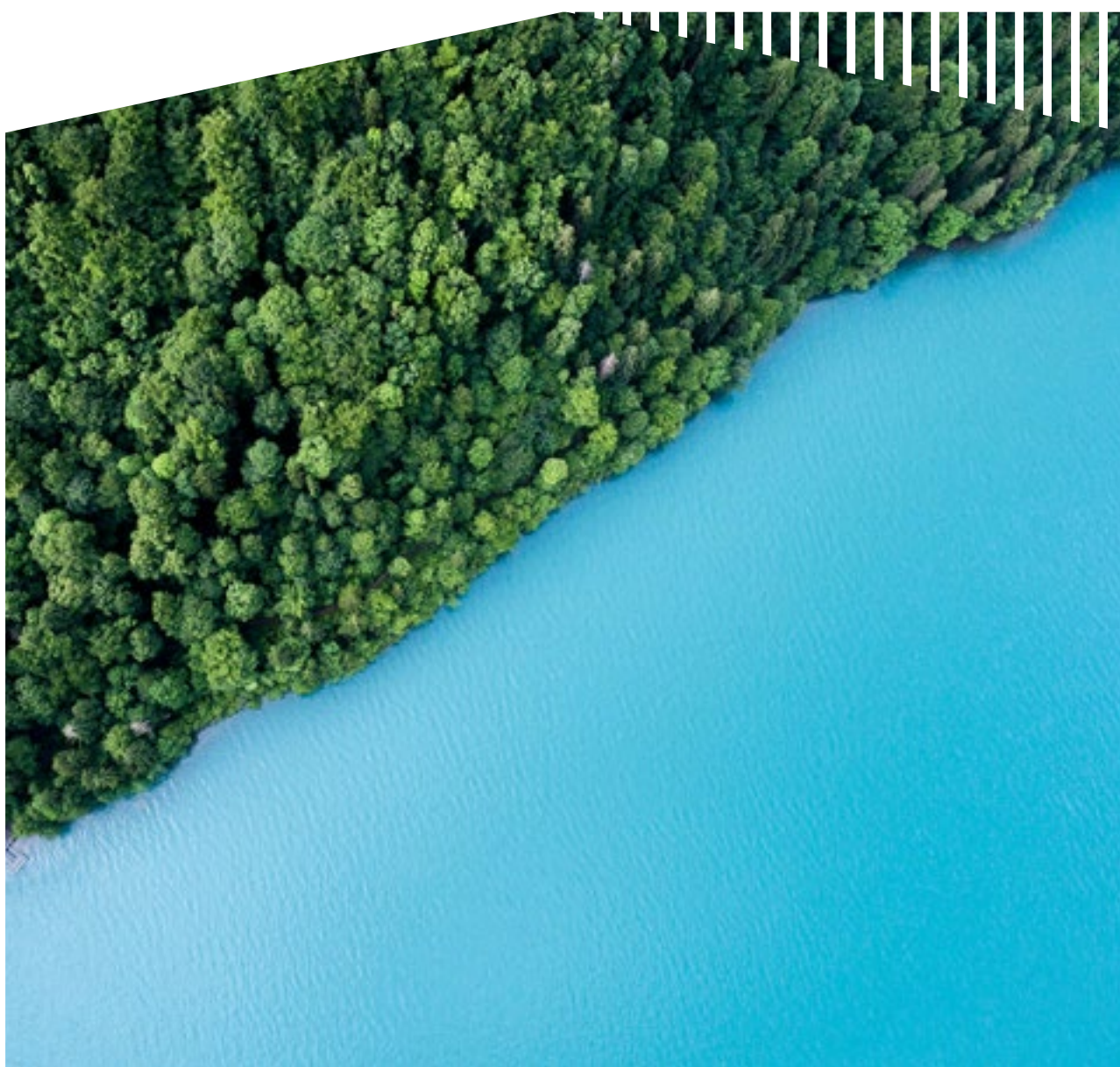


CLIMATE RESILIENCE

2018 HANDBOOK



CLIMATE RESILIENCE

2018 HANDBOOK

FOREWORD

2017 sparked new momentum towards building organizational climate resilience. Milestones included many influential public and private organization initiatives and a renewed commitment to limit global warming to two degrees Celsius and new opportunities in the low-carbon economy. Costly, volatile extreme weather events demonstrated that organizations must prepare for a new normal.

In June, the Financial Stability Board's Task Force on Climate-related Financial Disclosures (TCFD) called on companies to disclose how physical climate-related risks and the transition to a low-carbon economy may affect corporate performance. By December, nearly 250 companies and financial institutions had committed to implementing the recommendations, and 130 investors with over US\$13 trillion in assets encouraged the G20 to include the recommendations in their financial disclosure rules.

The June G20 Summit concluded that green finance is an important solution to a range of complex, interconnected global challenges and the momentum continued with the G20 Green Finance Conference in Singapore in November. Throughout the year, regulators around the world have taken steps to stimulate and support green financing. For example, implementing new disclosure requirements for the issuance and listing of green debt securities from India's Securities and Exchange Board.

In December, two years since the signing of 2015 Paris Accord, France hosted the Climate Finance Day and the One Planet Summit to energize the financial sector to “shift the trillions” to support a low-carbon economy. A growing range of investors also reduced holdings in fossil fuel companies, and many large insurers have stopped covering coal-related projects.

Governments and regulations further drove the shift to a low-carbon economy, aided by new technology developments. The UK and French Governments committed to phasing out petrol and diesel cars by 2040. In June, renewables provided 10% of the US’ electricity; and in November, Australia hit the on switch on the world’s largest battery, strong enough to power 30,000 homes.

Taken together, with the convergence of the low-carbon economy and the fourth industrial revolution, experts predict that US\$1 trillion worth of new markets will develop over the next decade. Incumbents are facing disruptive start-ups in determining who will capture the opportunities.

Climate-related risks dominated the rankings of the top five threats to global prosperity in the World Economic Forum’s Global Risks Report 2018. From hurricanes to wildfires, heatwaves, and droughts to prolonged floods, 2017 was a record year for natural disasters with 31 billion-dollar weather events globally.

We do not yet know what is in store for 2018, but the focus on building climate resilience must continue.

In this context, I am pleased to present the inaugural edition of 2018 MMC Climate Resilience Handbook. Drawing on the expertise and capabilities of our operating companies—Marsh, Guy Carpenter, Mercer and Oliver Wyman—these articles provide our collective insights on three distinct areas of action: strategies for climate resilience, financing for climate resilience, and how to leverage risk management tools to increase climate resilience.

We trust you find these articles informative and stimulating.



David Batchelor

Vice Chairman

Marsh LLC, Chair, MMC Climate Resilience Working Group



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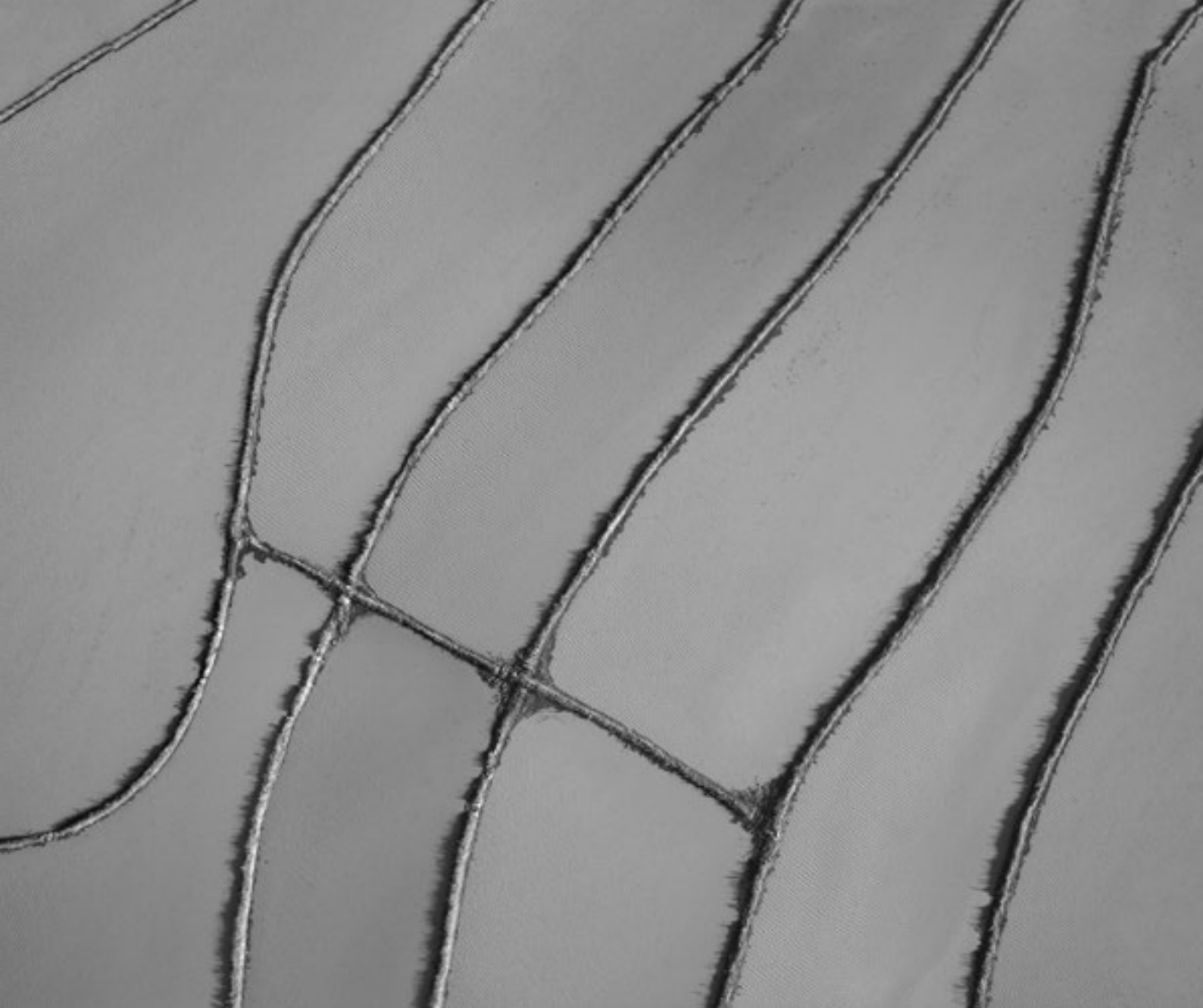
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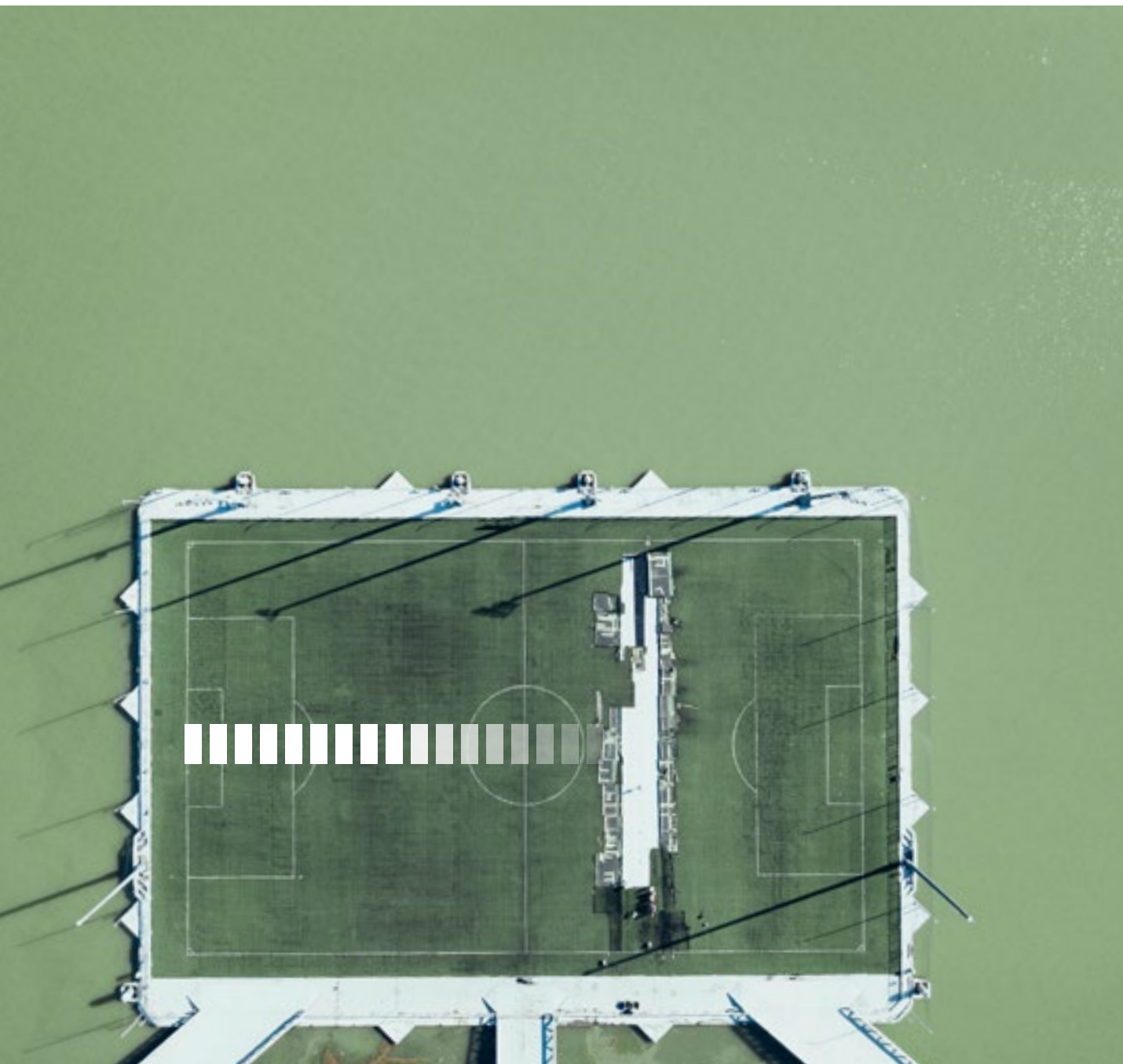
STRATEGIES FOR CLIMATE RESILIENCE

How countries, communities, and companies can thrive as technological innovation and the shift to a low-carbon economy converge.



WHY RESILIENCE IS ESSENTIAL IN A VOLATILE WORLD

JOEL MAKOWER



A NEW FOCUS ON RESILIENCE

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

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

THE WORD: RESILIENCE

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

FOR COMPANIES, COMMUNITIES AND THE PLANET

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

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

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

Also last year, a coalition of 25 military and national security experts, including former advisers to Ronald Reagan and Bush, warned that climate change poses a "significant risk to U.S. national security and international security" that requires more attention from the federal government. The DoD has called climate change a "threat multiplier" that could demand greater humanitarian or military intervention and lead

to more severe storms that threaten cities and military bases and heightened sea levels that could imperil island and coastal infrastructure.

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

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

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

Around the world, Hurricane Katrina in New Orleans in 2005, the Sendai Earthquake and tsunami in 2011 in Japan, the 2012 floods in Thailand, and Typhoon Haiyan in the

Philippines in 2013 all have played critical roles in awakening companies to the risks of a changing climate, for both themselves and their suppliers.

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

LINKING RISK AND RESILIENCE

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

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

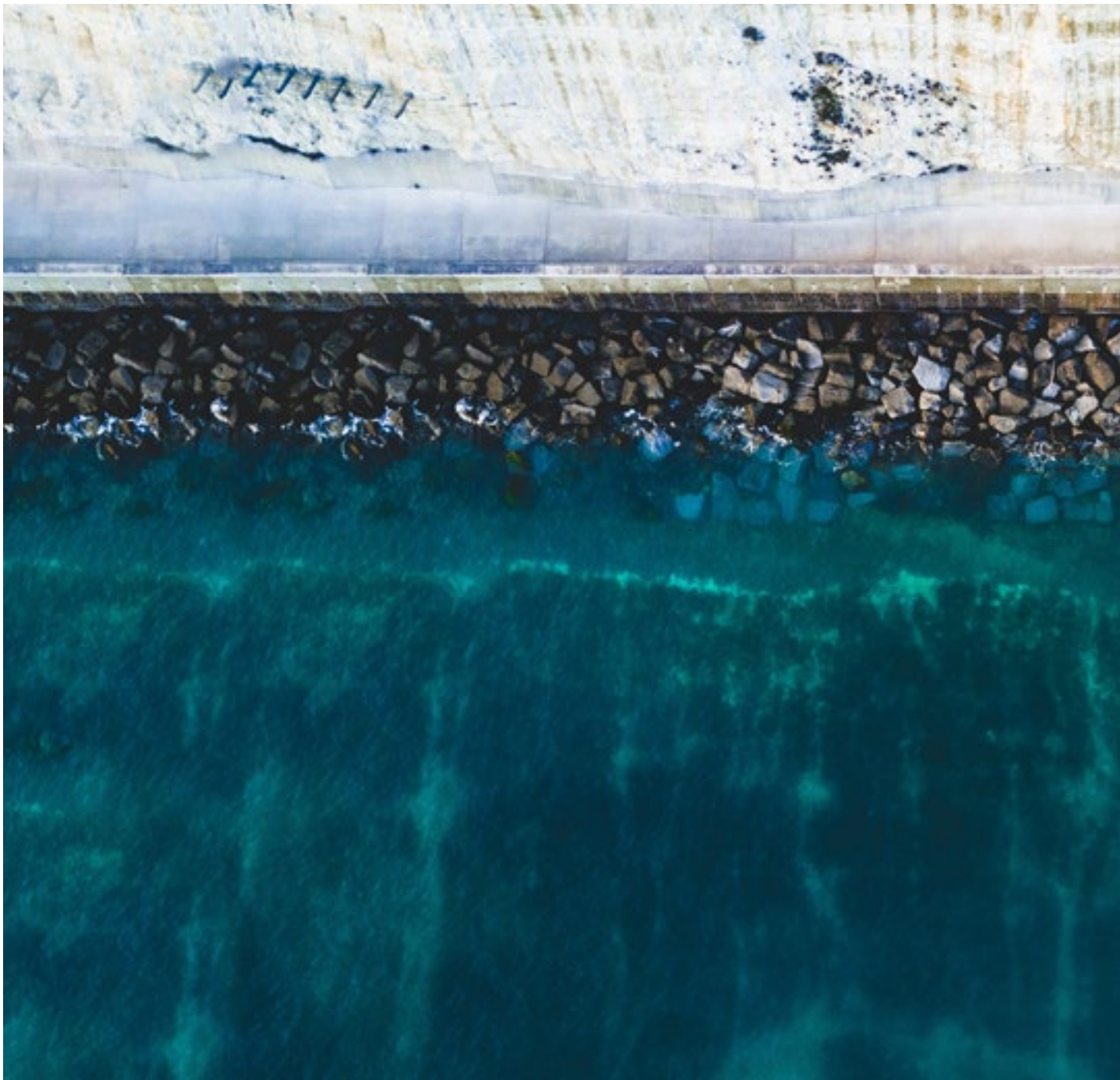
Wittenberg added: “It is important for the sustainability professional to make the effort to actively engage with the risk and finance teams to more effectively integrate their thinking with those of the commercial operations of the organization.”

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

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

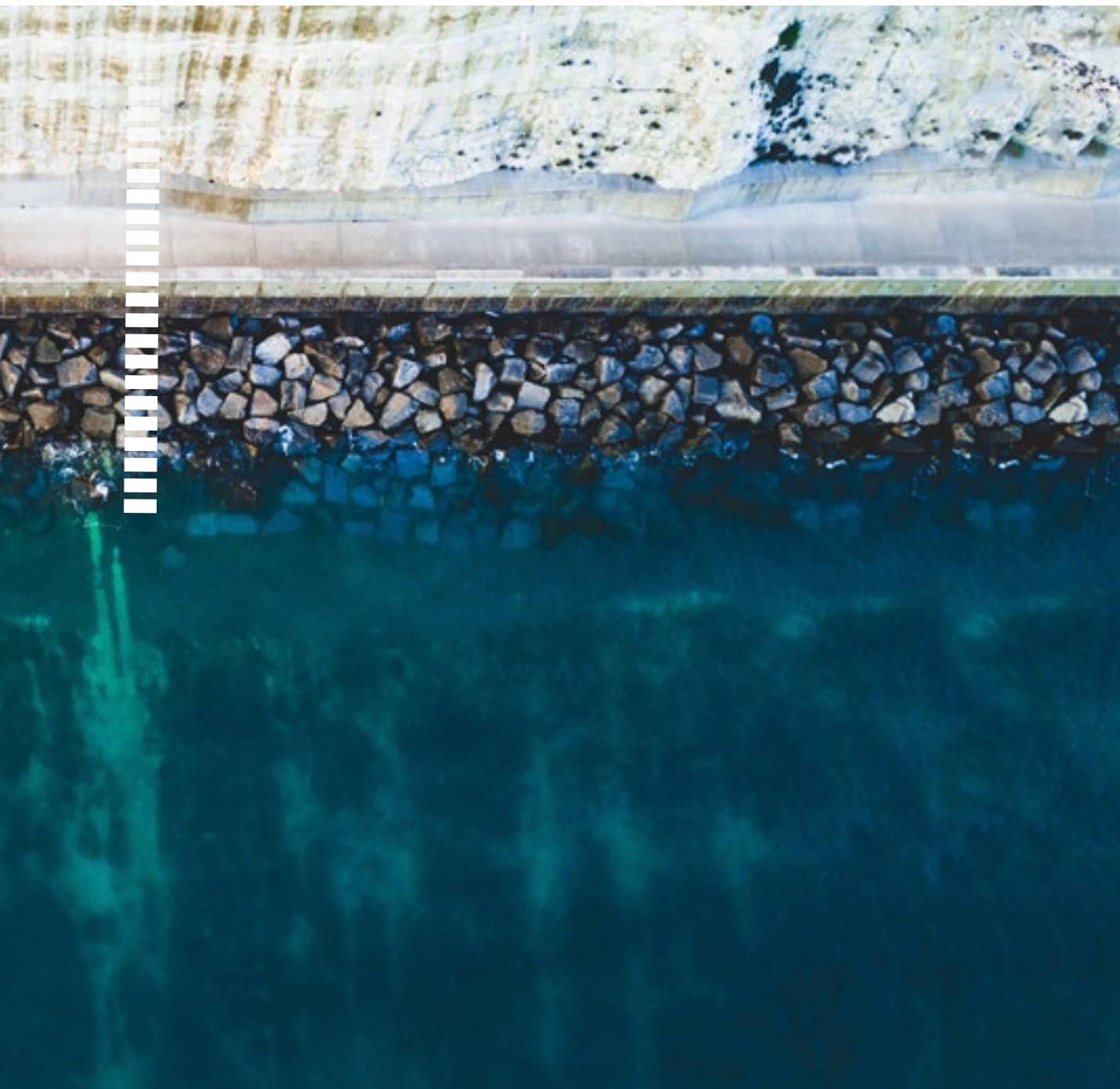
That’s the kind of full-spectrum thinking that in any sector engenders resilience, the mindset that allows companies, communities, and institutions to withstand the test of time with flying colors.

Joel Makower is the Chairman & Executive Editor of GreenBiz Group and is based in Oakland, United States.



HOW CLIMATE RESILIENT IS YOUR COMPANY?

LUCY NOTTINGHAM AND JACLYN YEO



A RISING BUSINESS IMPERATIVE

Companies can have a “blind spot” when it comes to the impact of climate change. Climate risks are frequently seen as an issue too complex and too distant to quantify, rendering the perception that they are too indistinct and abstract to justify a given business decision. Predictions of rising sea levels or other physical impacts by 2050 or 2100 do not align to typical

corporate operational and strategic planning timelines of 12 to 36 months. In other instances, companies also respond to climate risks narrowly via corporate social responsibility (CSR) goals in the area of sustainability reporting. Consequently, they have focused the management of climate risks to being compliant with regulatory or market standards.

However, to consider climate risks simply in terms of mid- to long-term direct physical impacts or as a CSR issue raises the risk of lost opportunities to build climate resilience in the transition to a lower-carbon economy. The low-carbon economic transition will include policy, regulatory, technology, and market changes in response to mitigation and adaptation related to climate change.

CHANGES ARE IN FACT MUCH CLOSER AND EVOLVING MUCH FASTER

Since the 2015 Paris Agreement on climate change, more than 190 nations worldwide have indicated their commitments to the goal of limiting the rise in global average temperatures to less than 2°C. Notwithstanding the announcement that the United States will withdraw from the agreement, global support for the commitments that were made in Paris has remained steadfast. Across every industry, the increased focus on climate change is interacting with and accelerating other major global trends, such as disruptive technologies, digitization, urbanization, and evolving demographics. These rapidly changing economic activities and shifting technologies, combined with new policies and regulations, are racing us towards a lower-carbon economy.

In addition to these global trends, companies are facing pressures from five major forces to better assess, redefine, and enact strategies to increase their climate resilience. (See Exhibit 1.)

Investors, customers, and supply-chain partners are raising issues regarding direct environmental impact and indirect risks associated with climate change with greater frequency and urgency. In addition, policymakers are enacting regulations

in response to climate change, and the shift to de-carbonization will drive dramatic structural changes across the economy.

GOING ON THE OFFENSE TO BUILD CORPORATE RESILIENCE

As businesses around the world prepare to face immediate and rising climate-related pressures, proactive and forward-thinking companies that go on the offensive to build climate resilience will gain a competitive edge. (See Exhibit 2.) A paradigm shift in outlook is necessary. Companies must pivot from a primarily defensive CSR focus to an offense-oriented mindset, which embeds climate-related risks and opportunities in the company's strategy and operations.

GETTING STARTED ON BUILDING CLIMATE RESILIENCE

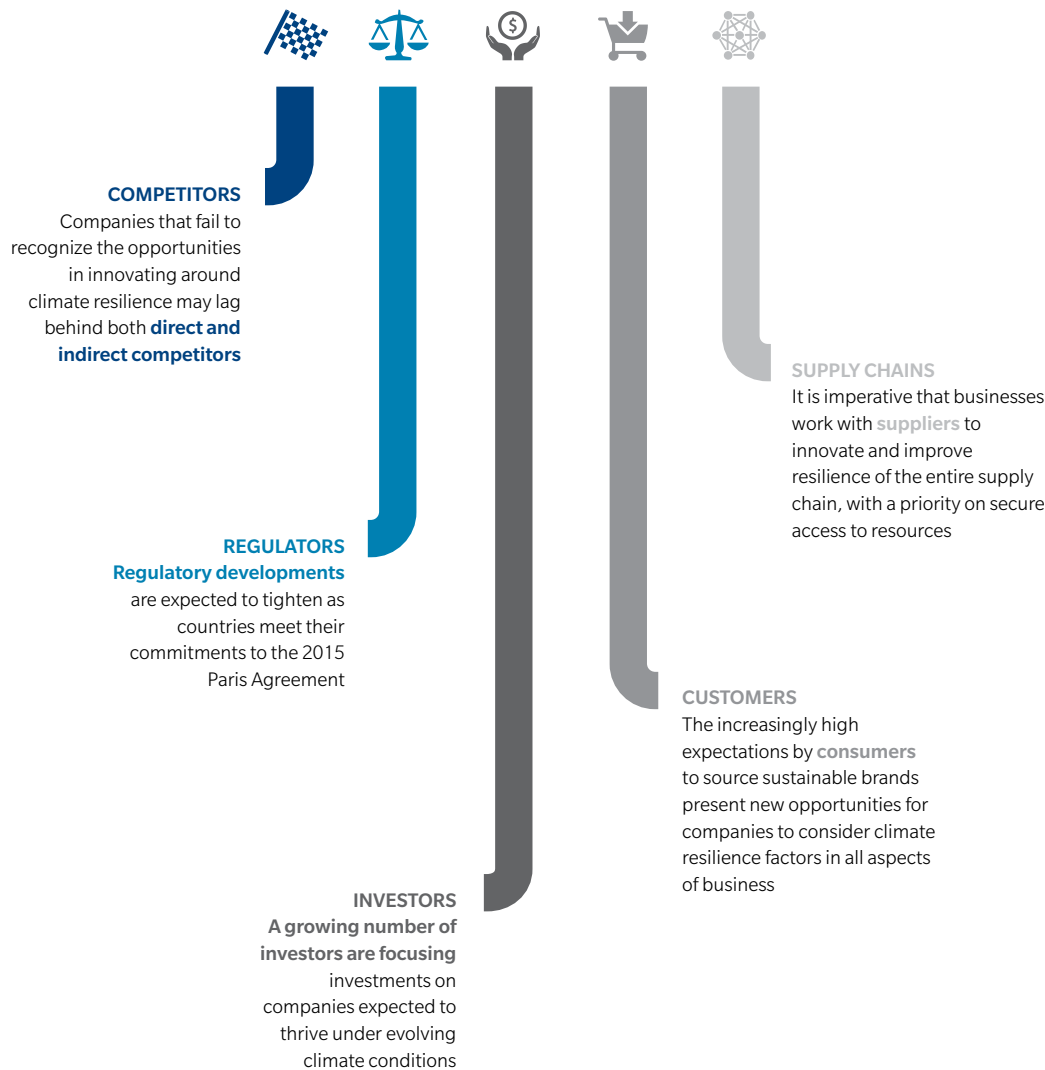
Before taking actions, corporate management and the board must first develop a robust view of how climate change impacts – directly and indirectly – affect the business, company performance, and financial earnings. Or put differently, they need to address the question: “What is our climate resilience?”

Here are three potential actions that companies can take to build an assessment of their current climate resilience. These insights can help support the organizations' decision-making process concerning capital allocations, operation management, and risk mitigation.

ASSESS VULNERABILITY OF OPERATIONS AND FACILITIES TO CLIMATE RISKS

Climate change and the exacerbated extreme weather events can have devastating effects on property and critical information infrastructure with lasting impacts across companies of all sizes. A study conducted by the US National Flood Insurance Program revealed that over 40 percent of US-based small businesses do not recover from weather-related disasters.

THE URGENT NEED TO INCREASE CLIMATE RESILIENCE AS A BUSINESS FUNDAMENTAL IS EVIDENT.

Exhibit 1: Five pressure points driving a growing focus on climate resilience

Source: Marsh & McLennan Companies

The impacts of extreme weather events are also felt throughout local and global supply chains, and can significantly erode an entire sector's profitability. For example, the severe impacts of Hurricane Harvey in August 2017 resulted in significant operational disruptions to ports, airports, railways, roads, and oil refineries. In Texas, both the George Bush Intercontinental Airport and the Port of Houston were completely shut down for up to five days following Harvey's landfall, causing massive backlogs and re-routing throughout the US aviation and maritime systems. With oil refineries and distribution pipelines affected, fuel prices across the nation spiked up to 20 percent

within a week of landfall. Initial economic losses are conservatively estimated between \$70 – 90 billion, with a significant portion of the losses due to uninsured property, although actual losses in the aftermath may affect the GDP growth of the nation's economy.

Companies can undertake a geographic portfolio review, mapping demographic and infrastructure vulnerabilities to natural hazards, and thereby identify the aggregated weather exposure with respect to location, facility, and asset. Companies can then apply a variety of instruments in their risk-mitigation toolkit to enhance their physical, operational, and

Exhibit 2: The evolution of current to target maturity state of building climate resilience



MOST FIRMS ARE HERE

1st Generation

- Predominantly social-responsibility focused with an emphasis on reputation management
- Initiatives linked to employee-engagement programs
- Few efforts to integrate into operational, strategic, or financial planning

2nd Generation

- Recognition that rising environmental risks are impacting corporate performance
- Environmental risk-management programs with limited links to corporate management and strategies

3rd Generation

- Climate risks are embedded in strategic assessment and operational planning
- Climate resilience is leveraged as a competitive advantage

Source: Marsh & McLennan Companies

financial resilience. For example, enhanced business continuity planning – constituting supply-chain analyses and operational recovery strategies – can identify opportunities to maximize operational resilience.

EMBED CLIMATE RISKS INTO ERM PROGRAMS

Companies can also leverage existing enterprise risk management (ERM) and risk assessment processes to increase their awareness of climate risks, better assess resilience across the organization, consider additional areas of analysis and risk mitigation, and develop appropriate management approaches.

Indirect transition risk of climate change, including shifting regulatory and customer demands, is a real and complex component of such assessments and should be embedded in ERM programs. For example, carbon-reduction strategies are often deployed under considerations of resource-constraint risks or regulatory risks.

Drawing on its risk assessment, an organization can identify means of increasing its climate resilience through direct physical risk mitigation (such as infrastructure reinforcement in coastal areas) or by implementing initiatives (such as sustainable supply chains and operational processes).

By ensuring that physical and transition climate risks are incorporated into a company's risk register and management programs, risk managers can identify optimal responses and opportunities to improve corporate performance and financial earnings.

UNDERTAKE SCENARIO ANALYSES TO QUANTIFY RISKS AND REWARDS

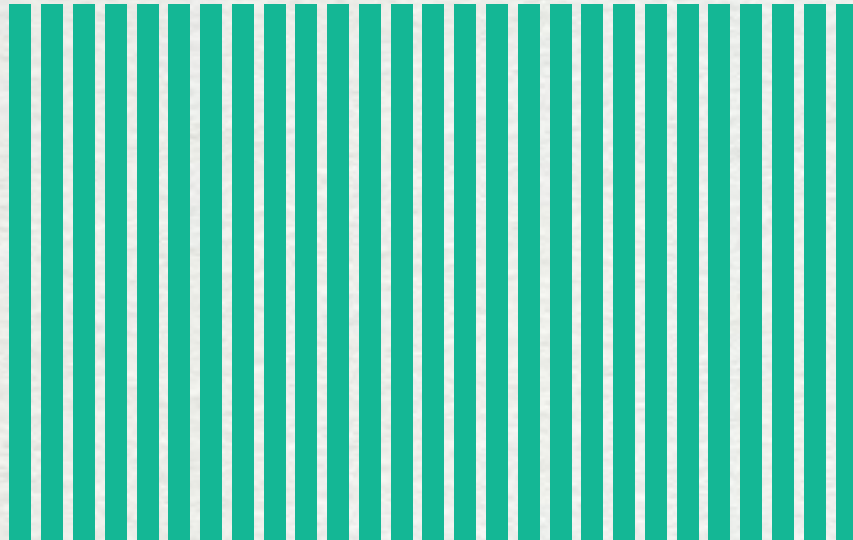
Finally, by explicitly defining and separating external scenarios (such as changing weather patterns and evolving political and regulatory environments) from the internal business plans, scenario analysis ensures that the corporate strategies and plans are robust and viable under different plausible outcomes.

The effects of climate change on specific sectors, industries, and organizations are highly variable. Thus, organization ought to apply scenario analysis in strategic and financial planning, as well as in its risk-management processes. Indeed, the Financial Stability Board's Task Force for Climate-Related Financial Disclosures recommends the use of such techniques, noting: "[Scenario analysis] is an important and useful tool for an organization to use, both for understanding strategic implications of climate-related risks and opportunities and for informing stakeholders about how the organization is positioning itself in light of these risks and opportunities."

BUILDING CLIMATE RESILIENCE IS NOW A FUNDAMENTAL REQUIREMENT

As boardrooms and C-Suites begin to examine how a changing climate is affecting their business, the urgent need to increase climate resilience as a business fundamental is evident. Companies that can successfully identify physical and transitional climate risks, and integrate these risks into strategic and operational planning, can better position their companies to improve climate resilience.

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SUSTAINABLE RETAIL

THE GROCERIES RETAILER GAP

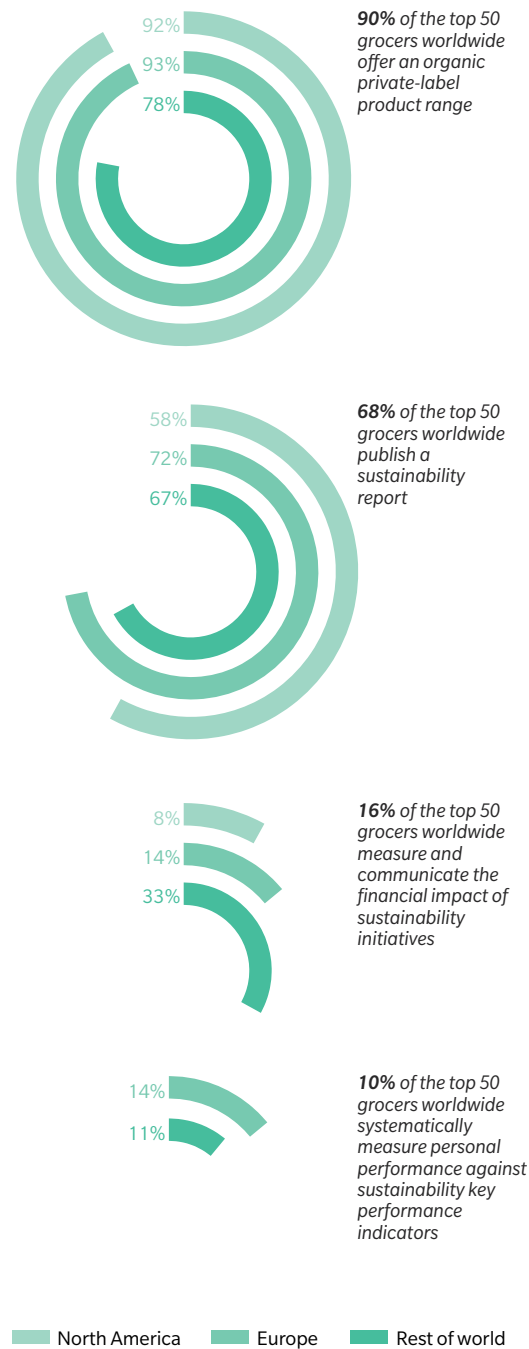
MICHAEL LIEROW AND SIRKO SIEMSSEM

Most retailers agree that sustainability will be a key competitive advantage in the future. Unfortunately, there is a wide gap between their ambitions and reality. A growing mismatch between supply and demand could erode the profits of the entire food industry within four decades. Global demand for agricultural production is expected to grow by 70 percent by mid-century and the global average per capita caloric intake is projected to increase by about 40 percent. The problem is that global food production already utilizes about 50 percent of the arable land surface available and the global agricultural sector already consumes about 70 percent of the freshwater available for human use.

Our research shows there is a broad consensus among retailers that they will almost certainly face wrenching cost and availability problems as a result of the divide that is developing between supply and demand. Most also believe that they will be confronted with very different demand patterns as customer priorities and regulations change. Ninety percent of the top 50 global grocery retailers market their own private-label organic products, and 68 percent publish a sustainability report. (See Exhibit 1.) In their annual reports, 82 percent of groceries retail chief executive officers cite sustainability as a key priority. More than one in three has opened “green” pilot stores.

Nevertheless, the reality behind these flagship initiatives continues to be largely “unsustainable.” While sustainability now routinely figures in evaluating investment decisions and corporate projects, it has had little effect on the key commercial activities of the business – buying, store operations, or supply-chain decisions. In most cases, sustainable product lines account for only a small percentage of sales revenues, and, with new product development and space decisions still dominated by other priorities, change will be slow.

Exhibit 1: Share of top 50 grocers worldwide



Source: Oliver Wyman

Although retailers' advertising campaigns are increasingly built around green messages and products, their in-store price promotions largely ignore them – and these account for a very significant proportion of sales. The vast majority of new stores also have little to do with their “green” concept stores. More than 99 percent of all stores are still “traditional,” “non-green” entities.

WHY SUSTAINABILITY IS NOT “STICKING”

Retail is characterized by low margins, pressing daily challenges, and complex global supply chains. With sustainability commonly associated to climate change, which is considered as a longer time frame challenge, retailers often choose to focus on the near-term urgent matters, leaving sustainability in the backseat. Even deeply committed retailers often struggle to achieve real impact.

In our experience, there are two reasons that this keeps happening. First, retailers fail to incorporate sustainability into their daily decision making. In many, and perhaps even most retailers, decision making is spread out across hundreds of buyers, category managers, procurement managers, store associates, logistics specialists, and ordering managers.

Forty-two percent of the top 50 global grocery retailers have established a sustainability function, and 14 percent now have a “Chief Sustainability Officer.” But only 10 percent of these grocery retailers actually measure and incentivize personal performance against key performance indicators of sustainability. In this context, it is not surprising that sustainability often remains limited to a few corporate “lighthouse projects,” and rarely trickles down into decisions, such as which products to carry or what to promote next month. If sustainability is not an important factor alongside sales, volumes, and margins, decision makers will tend to ignore it.

The other challenge retailers face is that they cannot manage what they do not measure. In order to make their core business model sustainable, retailers must understand the financial impact of sustainability initiatives. But only 16 percent of the top 50 grocers evaluate how sustainability efforts translate into financial outcomes. As a result, it is hard to define realistic targets, shape decision making, and measure progress. Identifying and generating the right key performance indicators can be a difficult undertaking. Often, there is insufficient data. Even when such data exists, disentangling the link, for example, between improving a company's ecological footprint and its economics is far from straightforward.

MAKING SUSTAINABILITY HAPPEN

Nonetheless, leaders in sustainability have shown that it is not only possible to find ways to measure the impact of their efforts, but also to use this knowledge to achieve their ambitions.

Given how decentralized decision making is in a typical retailer, making sustainability a reality requires getting “into the bloodstream” of the whole organization, particularly the decision makers in trading and operations. Our work with clients points to five important success factors:



Clear, strategic intent. Organizations must establish a clear strategic plan that is regularly reinforced over multiple years. Achieving this requires continuous and unambiguous top-level support. A company's management team must acknowledge the organizational and cultural challenges involved in targeting longer-term and more holistic objectives – while not losing focus on short-term sales, costs, and margins.



Greater transparency. Measuring the ecological and social footprint of an organization's products and operations is very difficult, especially on the product side, since most resources are used

earlier on. But the task is not impossible. To date, most retailers have focused on availability, cost, and time-to-market in their attempts to better understand upstream supply chains. In the future, supply-chain management and supply-chain collaboration will need to put as much, if not more, emphasis on resource usage, renewable resources, and social standards.



Defined targets. Realizing a sustainability strategy requires quantified, operationalized objectives for functions and individuals, for both the short and the long term. For sustainability to become a reality, decision makers need to place it on a par with financial performance – and not just a “nice to have.” This requires setting specific goals.



Inclusion of “sustainability” in daily decisions. Sustainability needs to be incorporated into daily decision making in a dispassionate, transparent, and quantitative way. To be effective, there needs to be a detailed understanding of how, when, and by whom decisions are being made, as well as how to influence and change them. Just throwing more data at buyers and at category and operations managers is not enough.



Measuring the impact. Organizations must be vigilant in measuring detailed and quantified results delivered against the targets set. As described earlier, ongoing measurement using key performance indicators is a vital part of embedding sustainability into the organization. Without that, it is very difficult indeed to know how successful the strategy has been, or to ensure that sustainability remains top of mind for those making day-to-day decisions.

CONCLUSION

Building a sustainable retail business model is not easy. It costs money, and is not without risk. The argument for becoming sustainable is fundamentally underpinned by a need: coping in a world of finite resources and increasingly stark trade-offs. The business case for sustainability is fundamentally long term, driven by the need to address emerging but foreseeable realities – ones that only become obvious over time.

However, sustainability offers immediate tangible opportunities to drive growth and reduce costs. In Switzerland, sales of the Coop Group’s private-label sustainability brands and quality labels have reached \$2 billion – more than 18 percent of its food revenues. Coop Group’s market share in Switzerland in organic products exceeds its overall market share by more than 100 percent. In the United States, Walmart’s Project Gigaton aims to remove 1 billion metric tons of GHG emissions from its supply chain by 2030. Initiatives like this are driving changes in all aspects of supply chains, including fleet transportation and operational energy use. Similar to adopting energy efficiency initiatives, Marks & Spencer in the United Kingdom has generated more than \$168 million in net benefits by reducing packaging, decreasing landfill waste, and improving transportation efficiency systems.

These and other pioneers have shown there is a path to profitability in sustainability. Over the next four decades, companies that follow in the footsteps of these early pioneers, as opposed to those that do not, may find the key to prospering in an increasingly harsh landscape lies in doing the “right thing” and building climate resilience.

Michael Lierow is a Partner in the Transport practice and Head of Sustainability Center at Oliver Wyman. **Sirko Siemssem** is a Partner in the Retail & Consumer Products practice, Oliver Wyman. Both are based in Munich.

SETTING STRATEGIES FOR SUSTAINABLE ENERGY

ENERGY TRILEMMA INDEX

2017

Which country leads in providing secure, affordable, and environmentally sustainable energy?

The annual Energy Trilemma Index tracks countries' progress in meeting the energy trilemma – the triple challenge of providing energy that is secure, affordable, and environmentally sustainable.

Three trends of decarbonization, decentralization, and digitization are driving changes in the supply, generation, and use of energy. Governments and regulators that quickly adapt to these trends will have competitive new opportunities to balance the energy trilemma and support their economies and societies.

INSIGHTS FROM THE EVOLVING ENERGY SECTOR¹

The traditional centralized electricity model is breaking open to distributed generation, distributed energy resources (including storage), electronic vehicles (e-vehicles), and two-way energy flows as consumers become “prosumers.” New actors are entering the market, and policymakers need to develop frameworks to accommodate the changes at hand. Here are some of the voices of the global energy sector on the changes in the energy system and market actors.

Alison Andrew, CEO, Transpower

“Consumers have new options for making, storing, and controlling electricity. Looking forward, we expect to see more behind-the-meter technology such as interconnected appliances behind the grid storage and consumers using batteries for their e-vehicles.”

Leo Birnbaum, Chief Operating Officer – Networks & Renewables, EoN

“Future energy investments could be based on long-term arrangements on the customer side, meaning that market design just becomes an optimization signal for whatever asset base utilities have built around the customer business.”

Marty Sedler, Director of Global Utilities and Infrastructure, Intel

“Regulatory structure and utilities are simply not evolving fast enough to meet the needs of the changing power system and customers' changing energy needs. We need greater consistency in regulation around distributive generation.”

Norbert Nuster, President, Power Systems Business, Cummins

“Storage is creating new opportunities to deploy assets as balancing forces in the grid. Currently, due to regulation, there is considerable underutilization of assets, [but] the model will change quickly as a growing number of stakeholders influence the regulatory framework.”

Rob Threlkeld, Global Manager of Renewable Energy, General Motors

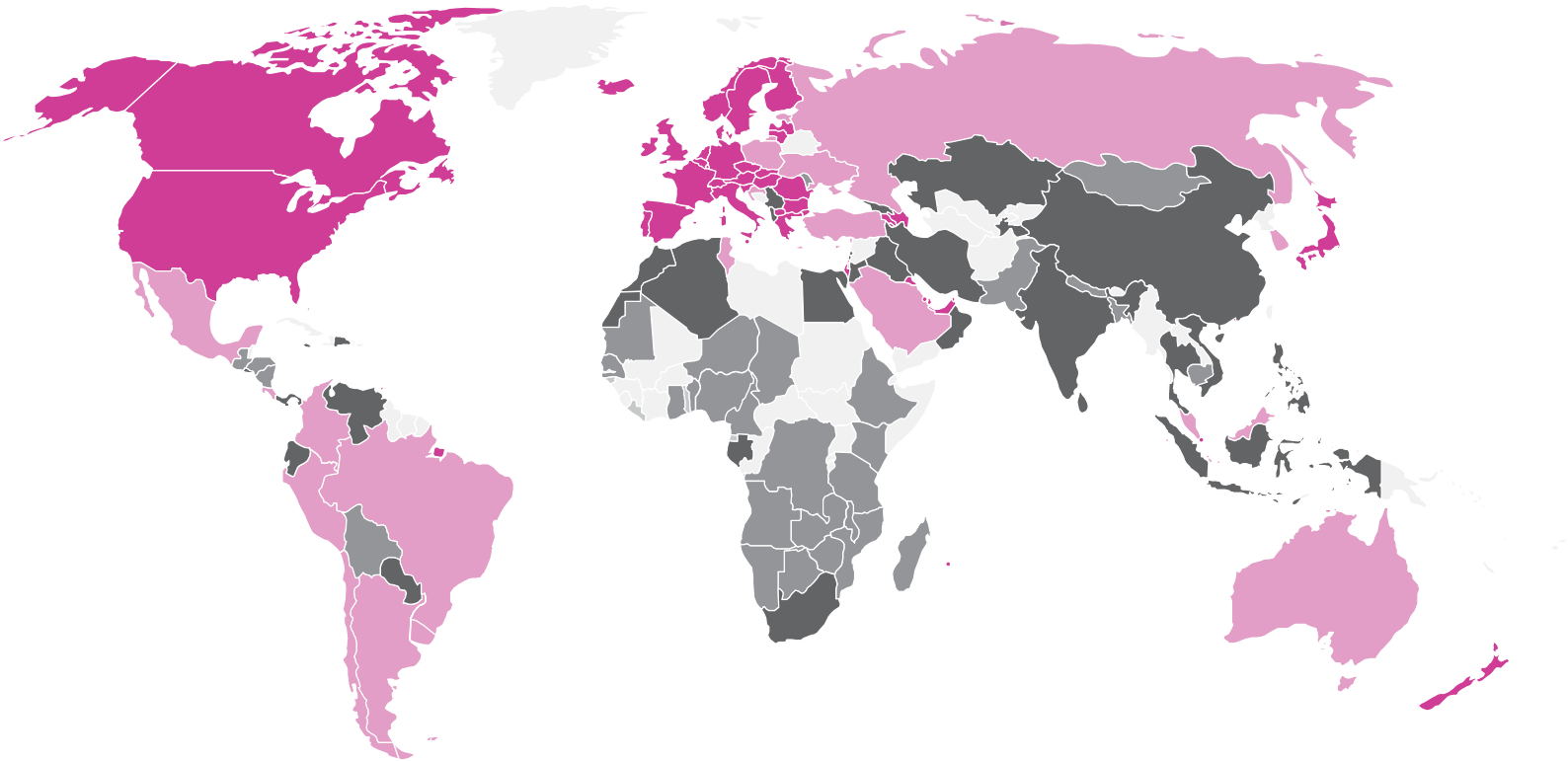
“We need a mind-shift on grid operation. Focusing on the digital transformation of the grid would enable real-time electricity pricing and facilitate collaboration and optimization by all players in the system.”

Andreas Spiess, CEO, Solar Kiosk

“The central grid can be an oversized solution to rural challenges. Entrepreneurial options using new technologies, especially solar, that leverage distributed generation can focus on issuing ‘right-sized’ efficient and cost-effective energy solutions to households and small medium-sized enterprises (SMEs) in rural areas.”

¹ To learn more, please see the World Energy Trilemma 2017, Changing dynamics – Using distributed energy resources to meet the Trilemma challenge, Oliver Wyman and World Energy Council

2017 ENERGY TRILEMMA INDEX



TOP 10 RANKED COUNTRIES

1. Denmark
2. Sweden
3. Switzerland
4. Netherlands
5. United Kingdom
6. Germany
7. Norway
8. France
9. New Zealand
10. Slovenia

ENERGY PERFORMANCE



Source: <https://trilemma.worldenergy.org/>; World Energy Trilemma Index 2017, Oliver Wyman / World Energy Council



SUPPORTING THE CIRCULAR ECONOMY TRANSITION

CORNELIA NEUMANN AND ANDREEA ACHIMESCU

PROLOGUE

THE CIRCULAR CRISIS OF 2040



UTRECHT, 5 JULY 2040 Daan van der Linden put the bags into the back of his old Volvo as his wife Julia bundled their kids into the back seat. He emptied the last of his diesel canisters into the fuel tank and got into the driver's seat. He could sense Julia's anxiety. "It's okay," he said quietly.

"But what if we're caught?" she said. "The fine for driving a diesel car is €20,000. We should have handed it in."

"It doesn't matter. We're leaving. We'll dump it at the airport."

It was astonishing how quickly things had fallen apart. With so much government spending going into lifting the dykes against rising sea levels, everything else was neglected. And it was not only the roads and public buildings. The private homes they drove by were also dilapidated.

As the cost of oil and, hence, of international trade had begun to escalate dramatically in the late 2020s, small trading nations such as the Netherlands had been particularly hard hit. The derelict tankers, now makeshift flood defenses outside Rotterdam harbor, were a stark visual reminder of the "end of trade." The emergency 300 percent tax on electricity introduced in 2035 had been the final straw. Wages had fallen 50 percent in the past five years.

Five kilometers from Schiphol, they drove past Trashboarding World. Snow skiing had ended in 2031 with the final melting of Europe's snow caps. But the 2028 international treaty banning the export of waste meant that great mountains of it were building up in the Netherlands, mainly on what were once dairy farms.

It was dark by the time they arrived at Schiphol. Daan turned off the headlights and drove slowly down a slip road that ran behind a large windowless refugee processing center.

"Where are you travelling to this evening?" asked the automated check-in kiosk.

"Stuart Island, New Zealand," Julia replied. They had been accepted under New Zealand's immigration points system, which favors young families with highly educated parents. As required, they had arrived eight hours before their flight. The physical examinations and security interviews went quickly, leaving them with three hours in the departure lounge. They sat in a row of chairs near to the Green Bank bureau de change. Its shutters were down because the bank had gone into receivership in May, another victim of the widespread business loan defaults.

Daan could not help but feel some satisfaction from the bank closure. After finishing his PhD in chemical engineering in 2023, he had started a business making small power generators for homes. He had used a loan from his parents to get started. But when he needed funding to begin manufacturing on a commercial scale, he couldn't find it. With energy prices still low, no one had seen the value in businesses based on efficient resource use. Green Bank had been the last to reject him.

The sun was rising, which meant it was time to board. Huge zeppelins hovered over what was previously a runway, 200-meter-long cigar-shaped balloons with 50-meter passenger cabins hanging below. Fuel costs and CO2 emission charges had bankrupted the last European airline in 2030, and two years later, the Dutch electorate had voted to ban all airplane travel.

"How long will the trip take, Mummy?"

"It all depends on the winds, darling. A week or two, probably."

When they began to float away, he started imagining how it all could have turned out so very differently...

FROM LINEAR TO CIRCULAR: FINANCING THE TRANSITION

What will the world look like in 2040 if vital natural resources become scarce? What would stimulate a shift from the current linear “Take-Make-Dispose” consumption model that relies on the availability of abundant natural resources, to a circular economy based on the principle of “Reduce-Reuse-Recycle”? (See Exhibit 1.)

Recent research examined this question within the context of the Netherlands which consumes more than three times what the Dutch ecosystem can produce (globally, consumption is 1.7 times what the Earth can produce). The research identified a range of solutions, which the Dutch financial sector can use to accelerate the circular transition. To make this happen, it will be essential to see close cooperation between businesses, banks, institutional investors, and the government.

The opportunities are significant. Circular businesses focus on “closing the loop” in supply chains by reusing end-of-lifecycle products as raw materials, sharing idle resources, using renewable resources, or extending the product lifecycle. Estimates of economic contributions of the circular economy vary, but all point to substantial change by 2030: a contribution of €6 billion to €30 billion to Dutch GDP, and the creation of 15,000 to 80,000 new jobs¹. Changes

on this scale will create many winners and losers in established industries.

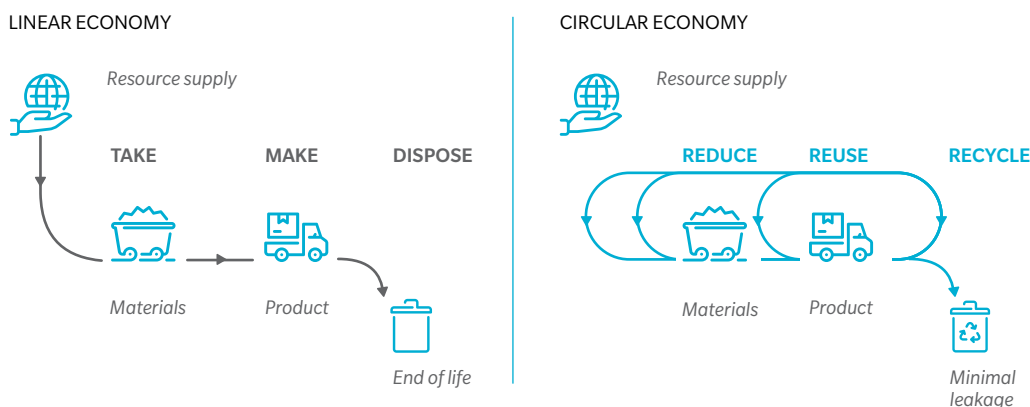
At the moment there are a few hundred circular Dutch businesses, most of which are in the pioneering phase. Startups in particular are hindered by a lack of reasonably priced risk capital (such as equity). Circular startups will require roughly €500 million in risk capital over the next five years. Only a part of this demand is expected to be covered by traditional risk-capital providers.

Improving the circular funding climate in the Netherlands – as well as other countries – without creating any market distortions requires a concerted public-private response whereby financial institutions, the government, and corporates reinforce each other’s efforts. The most significant obstacle regarding financing is a lack of knowledge of circular business models. Research identified a set of actions for different stakeholders.

Corporates: drive circular innovation, partly by supporting small innovative companies

As key raw materials grow scarce, traditional supply chains will begin to destabilize. While this may not happen for several years, building a stable circular supply chains takes time. It requires coordination among many

Exhibit 1: From a Linear Economy to a Circular Economy



Source: Oliver Wyman

¹ Rabobank. The potential of the circular economy. August 2015. Web. Accessed June 2017

different parties, changes to core operational processes, and sometimes even the creation of new markets. Given this lead time, circularity needs to become part of the CEO story in the short to medium term as companies begin to consider the right mix between building and buying circular capabilities. To expedite circular innovation, corporates can consider a spectrum of buy options – indirectly, via incubators and accelerators, or directly, through partnering with circular startups as a customer, acquirer, investor, or strategic partner.

Institutional investors: leverage position as responsible shareholder to make circular strategy a priority

Institutional investors, such as pension funds, insurers, and asset managers, can use their role to put the circular economy transition higher on the list of priorities for portfolio companies. To do so, they will need to invest in building knowledge and expertise on the topic themselves. As a second priority, institutional investors could consider increasing their portfolio allocation to venture-capital or private-equity funds with a sustainability mandate. Institutional investors could also create or invest in a (cross-industry) venture-capital fund with a circular mandate.

Banks: engage with SMEs to overcome the knowledge gap on circular business models and risks

The high uncertainty around the viability and risks of circular SMEs means bank lending can be challenging to obtain. However, banks can reduce the downside risk of these businesses by drawing in other economic actors that can contribute to stabilizing cash flows or guaranteeing loans. For example, banks can involve insurers who can provide products protecting banks from high-risk segments of the supply chain; or banks can develop facilities to support large companies' use of supply-chain financing for circular companies. For businesses that are not bankable currently, banks can provide advice on alternative sources of funding (for example, high-net-worth

individuals) and support in challenging business models and assessing technological risks. Finally, banks may need to reconsider their definition of eligible collateral to consider technology-driven intellectual property (IP) or consumer products rented as services.

Government: stimulate an innovation-friendly and transparent financing landscape for young businesses

The role of the government in improving the funding landscape for circular businesses should center on correcting market failures either directly or by incentivizing private actors. In the context of the circular economy funding, the government should intervene with two main goals: to improve market transparency regarding the availability of funding, and to increase the supply of funding. With regards to transparency, the government can support an aggregator website, where all sources of funding available to circular startups and SMEs are listed and categorized in terms of suitability; this would provide young businesses with a one-stop shop for understanding their funding options. And to support investors, a third-party technology assessor can provide assurance to investors. To increase funding, governments can consider creating incentives for private investors to fund circular initiatives – for example, by offering tax breaks on shares bought through crowdfunding platforms.

THE MOST SIGNIFICANT OBSTACLE REGARDING FINANCING IS A LACK OF KNOWLEDGE OF CIRCULAR BUSINESS MODELS.

EPILOGUE

CIRCULAR VICTORIOUS



UTRECHT, 5 JULY 2040 Daan was waiting outside when the driverless electric van arrived.

“Can I help?” Daan asked.

“We’re here for an Airbnb,” the woman said.
“But the sign on the door says Tulip Enterprises. Are we in the wrong place?”

“No, no, that’s just the first two floors,” Daan explained. “All the rest have switched into apartments.”

Since the late-2020s, most commercial property developers had followed Google’s lead and designed their buildings so that they needed little more than the insertion of a kitchen to be turned into residential apartments. With so many people now working from home and cafes, office occupancy had halved since 2020 and new construction had all but ended.

“Sorry we’re late leaving,” Julia panted. “I couldn’t find my cup.”

“Never leave home without your cup!” declared Mr. Maes, quoting the old anti-disposable cup campaign. It had been part of movement triggered by a 2023 BBC documentary series hammering home the damage being done by solid waste and, especially, by plastic. Public sentiment had turned violently against plastic, and many governments imposed taxes on goods made of plastic. By 2030, alternatives to plastic and to throwing it away had proliferated to the point where plastic waste had reduced by 80 percent.

Once the rest of the family had stepped into the van, Julia told the vehicle to take them to Return and Repair. The eight kilometer trip took only six minutes. Driverless technology had reduced the number of cars by 70 percent. With cars no longer parking except overnight, most roads were effectively two meters wider. And traffic lights had been eliminated by the “hive” technology that coordinated the movements of cars coming into each other’s proximity. The van had not stopped once on the way to Return and Repair.

Julia placed her mobile phone on the counter and said, “This one’s a return, if you know what I mean.”

“You want the latest one?” the reception asked. When Julia nodded, he dropped her phone into the slot on the countertop box labelled “phone upgrade” and tapped the Q-fone 17 icon on its display screen. The machine extracted the €50 upgrade fee from Julia’s phone wallet as it loaded the latest software.

Julia had gone from the Q-fone 8 to the 17 without buying a new device since 2031. The skyrocketing price of the gold, copper, and platinum that went into making them had made new phones prohibitively expensive. With people wanting to hang on to phones for as long as possible, the phone companies had devised this new way of selling upgrades.

Daan and Julia returned to the van and told it to go to Schiphol Airport. Though it was a Monday morning, the terminal was not busy.

As the plane took off and looped around to head south, Daan got a clear view of Rotterdam harbor. Half the ships were being loaded or unloaded with cargo. The rest were being dismantled by gigantic machines. As a result of product and resource innovations, 80 percent of production was now local-for-local and global trade had halved.

The flight to Bamako was surprisingly pleasant and they were excited on arrival at Bamako-Senou airport. They walked out of the air-conditioned terminal into the 30-degree heat of Mali in July.

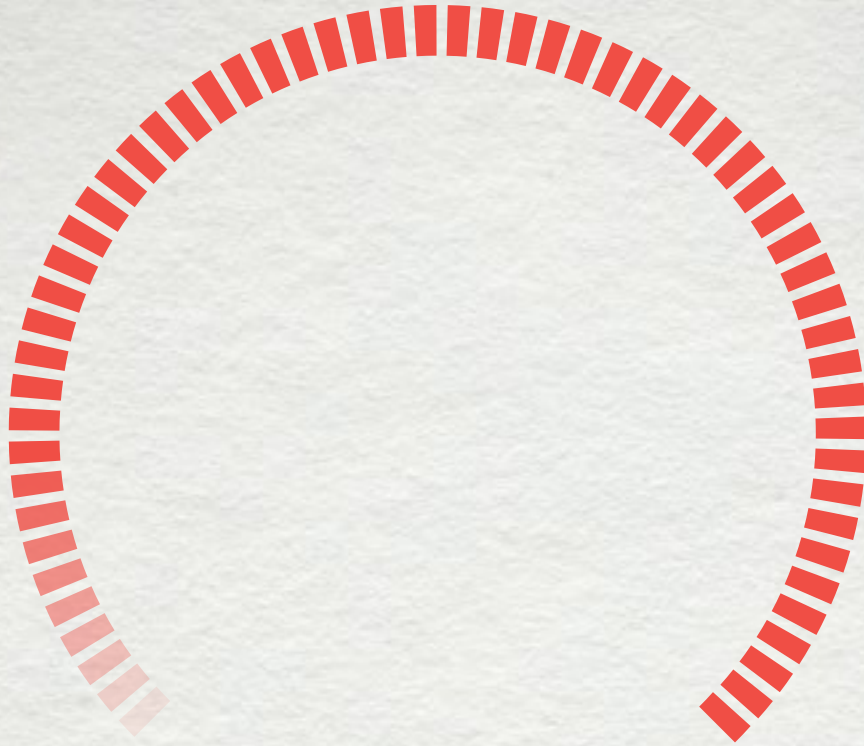
Once the luggage was packed into the taxi, the children were astonished to see a person driving a car.

The highway into the city took them past great fields of solar panels, elevated two meters above the ground, with each panel tilted to face the sun. In the shade beneath the panels, the normal sundried earth of Mali was replaced by a verdant green, on which a scattering of goats grazed.

This is an extract from Supporting the Circular Economy Transition: The Role of the Financial Sector in the Netherlands, Oliver Wyman, 2017.

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AVIATION FUELS, STAGE TWO

RENEWABLE JET FUELS ARE THE NEXT
STEP IN THE INDUSTRY'S EVOLUTION

BOB ORR, ERIC NELSEN, GEOFF MURRAY, AND BJOERN MAUL

The aviation industry is one of the most advanced in terms of exploring options for reducing greenhouse gas emissions. Aviation contributes only about 2 percent of all human-produced carbon dioxide emissions – but that figure is set to rise, given that demand for air transport is expected to double by 2035. (See Exhibit 1.) To date, the industry has focused mainly on reducing overall fuel usage and improving fuel efficiency, such as through new plane technology and operational

improvements. But further reducing greenhouse gas emissions – particularly in the face of new regulations set to come online in the next few years – may require the industry to take the next step: embracing renewable jet fuels.

Since 2009, five renewable jet fuels have been approved for use in aircraft. These are known as “drop-in” fuels: Much like the ethanol gasoline mix used by cars, they are blended into conventional fuels for use in today’s aircraft

engines. A number of major airlines have tested renewable fuels, but high costs and commercial-scale availability are holding back widespread adoption. It's something of a chicken-and-egg problem: Biorefineries can't reduce costs and increase scale without a commitment from the airlines to buy the fuel.

What may finally get renewable jet fuels over the hump is regulation. In October 2016, the 191 member states of the International Civil Aviation Organization (ICAO) agreed to a new global market-based measure to support the twin goals of near-term carbon-neutral growth and long-term reduced carbon emissions. Sixty-six member states (including the US and China), representing nearly 87 percent of international aviation activity, will participate in the pilot phase of the program, beginning in 2021. Without renewable jet fuels, it is unlikely that airlines will be able to reduce emissions sufficiently to meet the requirements of this and other emissions regulation schemes that are set to go into effect.

Renewable jet fuels represent an opportunity for airlines to invest in their future. There are several ways they can get out ahead as regulation kickstarts demand: First, by starting now and gradually expanding renewable fuel commitments with biorefineries, they can

rapidly drive improvements in fuel cost and availability. Second, they will need to work with airports and with planemakers to develop efficient fuel delivery mechanisms on the one hand and ensure engine requirements are met on the other. And finally, the industry should participate in and strongly encourage government funding of ongoing fuel research and development, with a focus on scalable low-cost feedstocks and increased refinery efficiency.

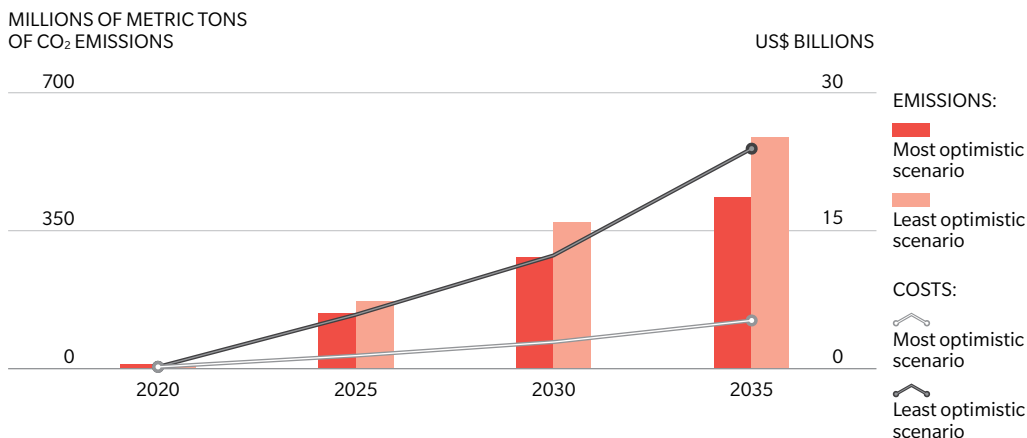
Airports also could realize an opportunity through the early adoption of renewable fuels. Developing airport-wide plans for sustainability that include renewable fuel usage would allow an airport to differentiate itself from others as a "sustainable airport" and further local community sustainability goals.

This article first appeared in Forbes

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Exhibit 1: The greening of aviation

Estimated aviation emissions to be offset, and the cost to achieve carbon-neutral growth from 2020



Note: The impact on aviation of offsetting costs for a global MBM scheme are expected to be much lower than fuel price volatility. The estimated offsetting cost for 2030 equals an extra US\$2.6 in jet fuel price per barrel, versus a standard deviation in jet fuel prices annually of nearly US\$40 per barrel over the past decade

Source: ICAO, Committee on Aviation Environmental Protection (CEAP)



SUSTAINABLE URBAN LOGISTICS

TACKLING THE INTER-SECTION
OF E-COMMERCE, URBANIZATION
AND CONGESTION

JOHN DAVIES

Executing logistics operations can seem boring to those not directly involved: When it works, it is boring. Goods are picked (from fields or warehouse shelves), packaged, shipped and delivered to the loading docks of a business or a person's front door. When clicking the infamous e-commerce "buy" button, most people don't think about what has to happen next.

At least they don't think about it until they're stuck behind a delivery truck on a city street while the driver unloads crates of vegetables for tonight's two-star meal or carries packages into an apartment building. While sitting in a single passenger vehicle and fuming, drivers rarely connect the dots between their expectations and what it takes to meet them.

The challenge is predicted to grow as more of the world's population moves to cities. By 2050, 70 percent or more of the global population will live in cities. This mass migration brings daunting challenges to urban environments and the businesses operating there, including rising concern among environmentalists, city officials and business leaders.

Many cities have developed strategies to move people more efficiently and safely within the urban environment. Much less attention has been paid to the importance of delivering goods to people at work and home. While conducting a recent research project, the GreenBiz Research team learned that city leaders need to broaden their perspective to understand the tradeoffs involved in moving people, as well as the goods and services they require, when planning for a healthy, safe and equitable urban environment.

BATTLING POLLUTION AND CONGESTION

GreenBiz recently partnered with UPS® to conduct research that formed the basis of a new report, "The Road to Sustainable Urban Logistics." To understand the driving forces behind efforts to make urban logistics more sustainable, we interviewed city leaders, academics, fleet operators, nonprofits, retail organizations and other subject matter experts.

When asked to name the top two issues that businesses are concerned about in the urban environment, it wasn't a surprise that 58 percent identified air quality and 53 percent noted traffic congestion. (See Exhibit 1). Many cities have concentrated on personal transportation and the mass transit solutions designed to alleviate these issues, and those efforts are showing some results.

What was surprising is how few cities have developed goods movement plans. During our research, we talked with Anne Goodchild, director of the Urban Freight Lab at the University of Washington. She told us that most cities do not have a freight plan. "They have a transportation plan, a bike master plan, a transit master plan. But freight has not been something cities have been planning for," she said.

Businesses already see this as an issue: 95 percent of those surveyed by GreenBiz recognized the business challenges that freight poses in growing cities. Our survey respondents identified the biggest barriers to more efficient and sustainable urban logistics as insufficient collaboration across sectors (65 percent) and lack of critical infrastructure (64 percent). Our research also shows that there is a way to navigate toward an urban environment with reduced congestion, better air quality, enhanced safety and greater mobility access resulting in a better urban experience and a healthier quality of life.

THE FUTURE IS DATA-DRIVEN AND COLLABORATIVE

Problems can arise for cities that implement initiatives without considering an overall freight and logistics plan. It is imperative that planners capture the data and use tools that can help plan for a more sustainable infrastructure for goods transport and delivery. There are too many examples of initiatives that resulted in greater congestion because they were based on faulty assumptions.

According to Goodchild, "What happens in the absence of data is that cities come up with ideas and then implement them without a lot of

participation from the private sector, or without a lot of insight into what the impact will be.” This points to the important role that businesses, and especially logistics providers, can play in improving the quality of the urban environment.

Logistics companies are staffed with industrial engineers who seek to optimize delivery routes far more granularly than simply applying a “no left turns” strategy. These firms partner with research institutions such as University of Washington’s Urban Freight Lab and MIT’s Megacities Logistics Lab. Along with nonprofits such as the Rocky Mountain Institute and the World Resources Institute (WRI), this collection of organizations can bring on-the-ground experience and global expertise to address a particular city’s unique urban landscape.

The greatest barriers to more efficient and sustainable urban logistics are insufficient collaboration across sectors and lack of critical infrastructure.

When asked which stakeholders should be engaged to address congestion and other mobility-related issues in urban environments, our survey respondents answered that, in essence, everyone should have a seat at the table.

When we talked with Ani Dasgupta, global director of the Ross Center for Sustainable Cities at WRI, he shared how his organization “often finds that even inside a city administration, different departments are not talking to each other as much as they should. This is why it is important to bring cities and businesses and communities and civil society together.”

By partnering with natural conveners such as academic labs and NGOs, becoming more data-driven in analyzing the unique constraints in their city and the impact of new technologies and solutions, and engaging and educating a wide range of stakeholders, urban leaders can help make goods delivery boring once again.

This article is adapted from an article originally published on GreenBiz.com

John Davies is Vice President and Senior Analyst at GreenBiz Group based in Oakland, United States.

THE ROAD TO SUSTAINABLE URBAN LOGISTICS

BUSINESS IN THE URBAN ENVIRONMENT



95%
Of companies surveyed recognize their business challenges in growing cities

45% Very aware

31% Aware

19% Somewhat aware

4% Not at all aware

TOP CONCERNS

58%
Air quality

53%
Traffic congestion

34%
Convenience of public transportation

31%
Other

18%
Safety

8%
Noise

A PROBLEM OF INCREASED E-COMMERCE, URBANIZATION AND CONGESTION

TOP BUSINESS CHALLENGES



Meeting e-commerce customer expectations

33%

Deliveries to retail locations

32%

Meeting city requirements for emission levels

31%

Deliveries affected by city transportation regulations

30%

Deliveries to residential customers

29%

COLLABORATION IS KEY

THE BIGGEST BARRIERS TO MORE EFFICIENT AND SUSTAINABLE URBAN LOGISTICS.



65%
Insufficient collaboration across sectors



64%
Lack of critical infrastructure

56% Lack of investment in innovative solutions

49% Lack of leadership and accountability

36% Governance

25% Demand superseding capability

13% Other

THE SOLUTION LIES IN CONVENING A DIVERSE SET OF STAKEHOLDERS. "Which stakeholders should be engaged to address congestion and other mobility-related issues in urban environments?"

98% Public transit officials

78% City Chief Resilience Officers

93% Business owners operating in the city

76% Personal mobility providers (e.g., taxis, Uber/Lyft, etc.)

86% Logistic delivery services (UPS, etc.)

73% Citizen advocates

81% Residents

16% Other

THE WAY FORWARD



Businesses' role will be key to creating a more sustainable urban environment.

72%

Businesses should work closely with city officials in identifying and addressing urban environmental and social challenges

63%

Businesses should take a proactive role in identifying and addressing urban environmental and social challenges

7%

Businesses should be responsible for their own operations and impact, but have no responsibility beyond that



FINANCING FOR CLIMATE RESILIENCE

How to stimulate private capital investment for the trillions needed to finance climate-resilient economies and societies.



A STRESSING CLIMATE?

KEY CHALLENGES FOR BANKS
IN ASSESSING AND DISCLOSING
CLIMATE CHANGE RISK

JANE AMBACHTSHEER, JOHN COLAS, ILYA KHAYKIN AND ALBAN PYANET

NEW RECOMMENDATIONS FOR FINANCIAL DISCLOSURE

Companies in all sectors, including those in the financial-services industry, are being asked the same question: What are the implications of climate change risks and opportunities for your organization's financial performance? Investors, regulators, consumers, suppliers, and employees are looking for greater clarity and transparency on this issue. At this stage, however, there's no established best practice for assessing the impact of climate change on bank performance. This topic has not escaped the focus of central bankers, specifically Financial Stability Board (FSB) Chair and Bank of England Governor Mark Carney, who has written and spoken extensively on climate change risk. The recent release of a disclosure framework aims to facilitate the process; yet companies—particularly financial institutions—face a number of challenges in implementing the recommendations.

The FSB Task Force on Climate-related Financial Disclosures (TCFD), issued a set of recommendations in June 2017, providing a framework and approach for all companies to report on climate impacts in their mainstream financial filings.¹ The disclosures, which are meant to be voluntary, consistent, comparable, reliable, and clear, should aim to provide material information to lenders, insurers, investors, and other stakeholders. This disclosure of the financial impact of climate-related risks will push institutions to enhance how these risks are assessed, priced, and managed. To that end, banks and financial institutions are particularly encouraged to adopt the recommendations.

SCENARIO ANALYSIS TO ASSESS CLIMATE RISKS AND OPPORTUNITIES

In adopting the TCFD recommendations, financial institutions will need to embed the impact of climate change into their strategy, risk, and opportunity analyses. These analyses should consider the physical risks stemming from climate change in the physical environment, the transition risks associated with the economic costs of moving to a lower-carbon economy, and the opportunities for developing new products and services in response to climate change. The TCFD recommends using scenario analysis to support this exercise – including the consideration of a 2-degree Celsius (or lower) global temperature-warming scenario aligned with the 2015 Paris Climate Agreement.

Scenario analysis is a well-established method to inform strategic plans and ensure resiliency to a range of future states. The use of scenario analysis to assess the implications of climate-related risks and opportunities for companies, however, is recent.²

Organizations need to consider a range of scenarios relevant to their businesses. Alongside the Paris Agreement scenario (where a rise in global temperatures is limited to 2-degree Celsius by 2100 but significant transition risks arise from the economic adjustment needed to limit the temperature increase), scenarios with higher degrees of warming are typically considered to further stress the physical risks of climate change (such as a 3-degree Celsius scenario, which is broadly aligned with the current Paris commitments, and a 4-degree Celsius or warmer scenario that reflects the current temperature pathway if countries do not follow through on their commitments).

1 In late 2015, at the request of G20 leaders, finance ministers, and central bank governors, the Financial Stability Board (FSB) established an industry-led task force under the leadership of Michael Bloomberg. The task force was charged with developing voluntary, consistent climate-related financial risk disclosures for use by companies in providing information to investors, lenders, insurers, and other stakeholders. To learn more, see: <https://www.fsb-tcfd.org>.

2 Mercer first introduced this approach with its 2011 report, *Climate Change Scenarios – Implications and Strategic Asset Allocation*, followed by its 2015 study, *Investing in a Time of Climate Change*.

Each scenario must include a set of coherent variables and a narrative explaining the underlying rationale for the values and trends of the variables, as well as the interdependency between them. These variables can include assumptions on policies and regulatory developments (regionally, domestically, and internationally), the pace of technological change, the sea-level rise, and how these disruptions may positively or negatively impact industry sectors and supply chains. Along with this, organizations need to develop a methodology capable of translating scenario variables into a financial impact. A fine balance is needed to thread the complexity of the processes and analyses so as to ensure realistic implementations and executions of scenario planning and assessment.

CHALLENGES IN DEVELOPING EFFECTIVE CLIMATE SCENARIOS

There are a number of challenges in developing effective climate scenario analyses to support management in reaching actionable decisions. For example, the banking sector faces four key challenges in developing climate scenario analyses for their wholesale exposures.

1. **Time horizon** – The disconnect between the typical time horizon of risk analyses and the longer-term climate forecast horizon.

Time horizon is a key challenge when modeling the impact of climate change on bank performance, as the impacts will materialize over a longer time frame than banks typically consider in their processes and tools:

If retaining a short-term view of the climate scenario (such as three-to-five years, which is similar to stress-testing or planning horizons), there will be a limited impact, as the biggest impacts are expected in the medium to long term (15 years). Importantly, this information set will not help banks drive strategic changes until conditions materially worsen.

If retaining a longer-term view (roughly 25 years), forecasting income statement and balance-sheet views requires modeling anticipated changes in the portfolio

composition, business models, and financial structure of the institutions. Results will be subject to multiple assumptions (scenario, portfolio evolution, and sector evolution), complicating their interpretation, significantly increasing uncertainty, and decreasing comparability between banks.

There are two main implications:

1. Comprehensive sensitivity testing of potential credit losses is more relevant and appropriate at this stage than a full-blown, firm-wide, holistic stress-testing exercise that would cover losses, revenues, and capital. Such sensitivity testing can help banks assess the exposure under alternative portfolio constructs and business strategies and therefore drive decision making. While holistic stress testing may someday be useful, at the moment, it introduces greater uncertainty into forecasts and complicates an interpretation of the results.

2. Existing models will require adjustment and/or new models will be necessary to accommodate the longer-term time horizon.

2. **Data availability** – Data gaps for assessing climate impacts on credit risk.

Banks currently do not have comprehensive, deal-by-deal climate-risk assessments across the portfolio and often have only very limited relevant climate attributes of their borrowers. Moreover, in contrast to traditional macroeconomic stress testing where a model can be calibrated and back-tested against previous crises or economic environments, climate modeling lacks the necessary historical empirical data since the most critical and material effects of climate change have yet to be observed (although this is changing, with the increase in extreme weather events, as well as a series of bankruptcies in the coal sector).

There are two main consequences:

1. Given the limited availability of borrower-level climate attributes, a sector-level analysis is – at this early stage – a more efficient way to capture the main sensitivities of the organizations to transitional risks. Supplementing the sector-level

methodology with select borrower-level analyses helps to calibrate the approach and increase conceptual soundness.

2. Given the lack of empirical loss data related to climate change, banks must make use of expert judgments, which are subjective.

3. Coordination and organization – Integrating cross-functional capabilities and expertise across the bank.

Climate-related analysis and disclosure calls for integrating expertise and capabilities from various departments within a bank, such as:

1. Sustainability leaders, who are often subject-matter experts on climate change and understand the potential impact and nuances of different scenarios.
2. Credit-risk experts with an understanding of the drivers of borrower credit losses and the bank's credit portfolio.
3. Stress-testing teams, who understand different approaches to sensitivity analysis and stress testing and can build and/or run the stress-testing machinery.
4. Strategic planning units, which can incorporate information on climate risks, sensitivities, and opportunities into planning processes and strategic decision making (this may include decisions that limit the financing of certain types of activity, such as coal-fired power generation and the launch of "green" products and services).
5. Finance and/or investor communication leaders who can frame and detail disclosures, with support from management and the board.

Achieving the coordination needed across these teams to create a collective output will challenge the existing organization, governance, and processes but is necessary for delivering a robust climate strategy for the years ahead.

4. Modeling uncertainty – Implications of significant uncertainty in modeling on scope of climate disclosure.

As the challenges highlight, there are significant limits to anticipating the financial impact of climate change accurately. Given those bounds, companies and financial institutions will need to carefully determine the extent of their disclosures. Insufficient information may not provide investors with a transparent view of the risks and could fail to meet expectations of the TCFD, as well as regulators. However, disclosure of uncertain information may also mislead stakeholders and be inconsistent with the TCFD's articulated principle of reliable disclosure.

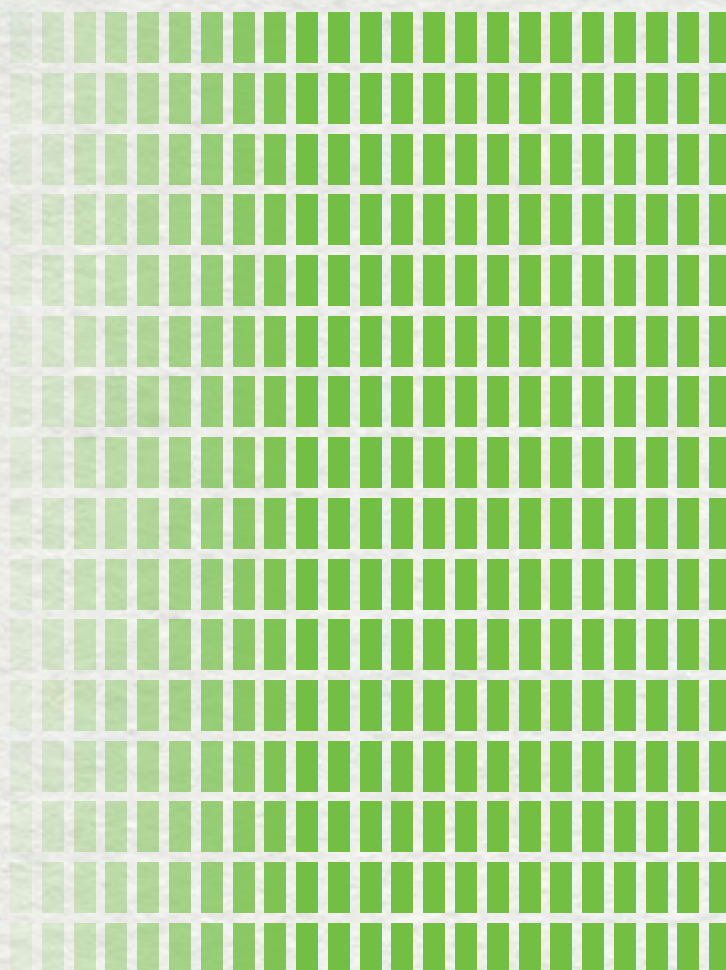
MOVING AHEAD WITH MANAGED EXPECTATIONS

Organizations are expected to show prudence in framing and detailing disclosures to ensure the information provided is properly understood by the market. Initial discussions with leading banks suggest that the robustness of disclosures will evolve over time as financial institutions refine their climate-related underwriting and risk-assessment practices while corporates, in parallel, enhance their disclosures to reflect climate risks and resiliency strategies.

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<http://www.brinknews.com>

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FINANCING CLIMATE RESILIENCE

PRACTICAL CONSIDERATIONS TO ENHANCE
STRUCTURES IN PLACE TODAY

PETER REYNOLDS AND GAURAV KWATRA

MARKET NEEDS FIXING

Research suggests there is a material gap between the demand for, and supply of, funding for green investment. For example, the Development Bank of Singapore (DBS) estimates that annual demand of US\$200 billion in Southeast Asia over the next 30 years will massively outstrip annual supply of US\$40 billion.

However, polling at the November 2017 G20 Green Finance Conference¹ in Singapore indicated otherwise. During the conference, the audience – composed of finance professionals in the green space – responded to a live polling question: “What is the biggest challenge to scaling up financing for green projects?”

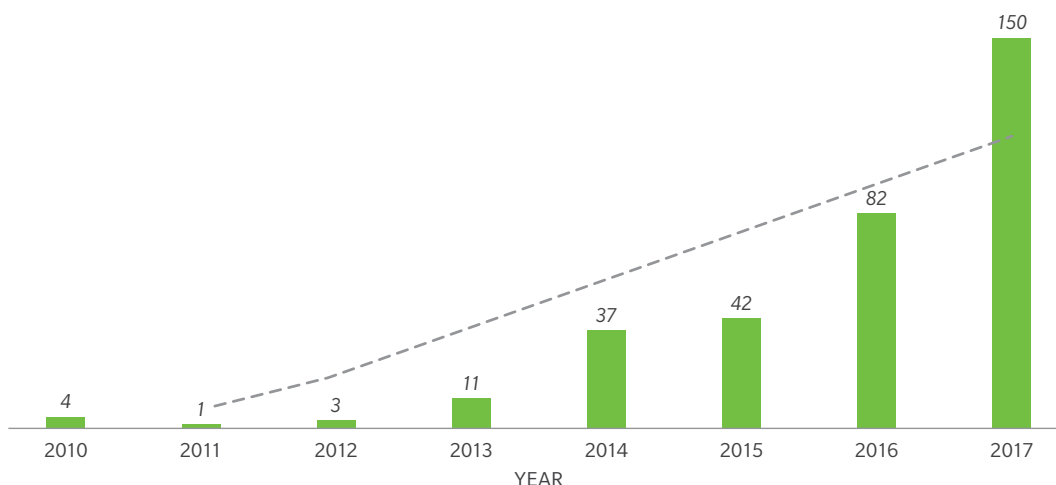
Almost half (44 percent) answered “lack of environmental data,” while 39 percent selected “lack of investible projects”, and the remaining 17 percent chose “inconsistent standards.” Neither “investor demand” nor “maturity mismatch” were picked. This phenomenon points to a paradox at the core of green finance: Top-down estimates suggest a huge need without being matched by sufficient bottom-up funding. Yet when investors were asked the same question, they focused on matters of data, project invisibility, or standards – clearly indicating that the issue for investors is a shortage of demand, rather than supply!

Simply put, the market at present isn’t working, and needs fixing.

¹ In collaboration with the Monetary Authority of Singapore and the United Nations Environment Program, the G20 Green Finance Conference was jointly organized by the Asia Securities Industry and Financial Markets Association (ASIFMA) and the Global Financial Markets Association (GFMA), and was held in Singapore on 15 Nov 2017.

Exhibit 1: Volume of green bonds issued since 2010

USD BILLIONS

**Source:** Climate Bond Initiative

BOND MARKET AT PRESENT

With the significant mismatch between the top-down growing demand for the green finance and the insufficient bottom-up funding of green projects, a transformational shift is required to address the challenge of climate change. Green bonds are currently the most mature form of debt instruments dedicated to financing eco-friendly projects, and there has been a sharp growth in issuance in recent years. (See Exhibit 1).

However, green bonds are not appropriate for all climate change financing. There are other pools of funding available to finance green projects from various sources, including:

- **Government and State grants** – directly designed to encourage development in green investments, including subsidies, tax relief, and other benefits.
- **Multilateral Development Banks (MDBs)** – either specifically designed to operate in this field (for example, Global Environmental Facility and Green Climate Fund) or those increasing their “green” mandate (such as the World Bank, AIIB, among others).
- **Private-sector quasi-MDBs** – such as large foundations and other charitable funds.

- **Private-sector funding providers** – including those looking to diversify their investment portfolios (for example insurance companies looking to match long-dated liabilities), as well as more traditional financing mechanisms (such as banks, green private equity, and venture-capital funds).

Such funds are designed to specifically address green projects that would not receive stand-alone private sector funding. Each participant in these funding pools has different modalities (broadly, a mix of grants, debt, equity, and guarantees) available to finance such projects.

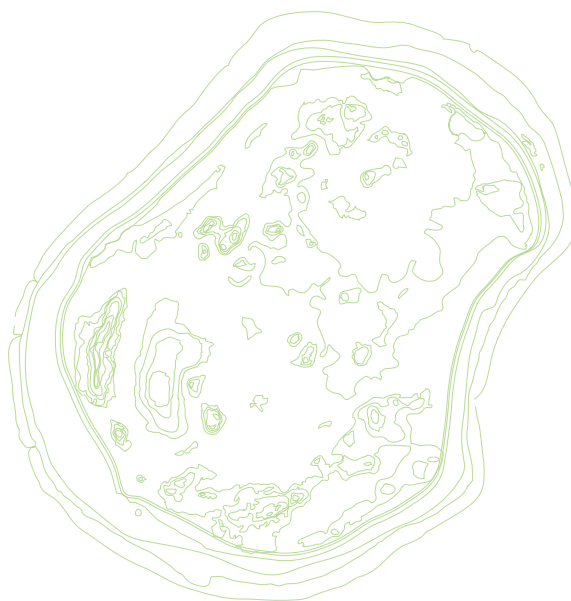
MATCHING AVAILABLE RESOURCES EFFECTIVELY

In our experience, access to and use of these funding pools has been relatively slow. Furthermore, the process to gain access to such funds is often frustrating for those looking to finance and develop climate resilience. Often, funding comes with onerous ongoing monitoring and reporting requirements that represent a hidden cost to the recipients.

While much of the discussion had been focused on the mismatch between the supply of funds and the global need, even where potential

| C A S E S T U D Y |

FUNDING A CLIMATE-RESILIENT PORT IN NAURU



The Pacific island state of Nauru approached the Green Climate Fund (GCF) for funding assistance with the development of a climate resilient port, a project that was discussed at the 18th meeting of the GCF Board. The GCF agreed to grant financing of \$26.9 million, with the project co-financed by the Asian Development Bank, and the Governments of Australia and Nauru. Though successfully funded, the project highlights key challenges faced in green financing:

- Identifying the green portion of the project: Like most infrastructure, the port requires regular redevelopment. However the frequency of such redevelopment needs has increased due to more adverse weather, caused by climate change. Clearly identifying how much of this change is caused by climate impact is subjective.
- Parsing between the development and climate portions of the cost: The proposal as presented in the public discussion at the GCF outlined the incremental cost of building a “climate resilient” port over a more standard port. Again, the precise calculation of the incremental costs is clearly somewhat subjective, and open to interpretation.
- Quantifying the benefits: The benefit stream outlined in the proposal is estimated to extend for 50 years. While the port is a critical infrastructure requirement for the 11,300 inhabitants of Nauru, placing a precise value on the benefits is clearly impossible.
- Accessing multiple funding sources: The project is funded by four different parties, all of whom have different processes and requirements to access the funds.
- Determining appropriate funding concessionality: The port is a commercial venture, and hence will be able to repay some of the funding cost over time from future revenue streams. As such, funders needed to determine the correct level of concessionality in funding so as to not distort the private market – and ideally “crowd-in” the availability of such funding.

supply of funding exists to meet the demand, the mechanism for matching projects with funds is not working efficiently. We believe the resolution of this issue – enabling efficient transmission of funds to the appropriate green projects – is key to meeting the challenges of climate change.

To ensure transformative and efficient change, the various pools of funding will need to be combined in more creative ways. This will require the effective functioning of a complete “ecosystem” of participants in the market, ranging from public to private and often crossing international boundaries.

BREAKING DOWN THE BARRIERS

First and foremost, to strengthen green policies and catalyze green projects, the various challenges and barriers to entry must be recognized. (See Exhibit 2).

Many green finance recipients find it difficult to articulate their needs and the green benefits of their projects, as they are not familiar with the highly specific financial terminology and/or may come from an engineering or infrastructure background.

The relatively early stage of green finance is also challenging for recipients as they lack the historical track records to quantify positive outcomes for potentially transformative ideas, often resulting in higher risks. Moreover, because the investments are often in unproven early-stage startups, R&D funding carries a much higher risk premium, given the higher degree of uncertainty and longer-term potential payout, hampering the initial catalysis phase.

On the other hand, funding providers also face a number of additional challenges besides the shortcomings in language, operations, and processes. There is no efficient secondary market for green investments, leading to longer-term exposure required to be held on the balance sheet (both national and private), making the need for careful consideration of such investments all the more important.

Plus, the global benefits for the public sector and MDBs are hard to align with potentially high local costs. Given the wide breadth of potential projects, there is no “common currency” used to compare across the various projects.

WHAT CAN BE DONE?

There are tangible ideas that should be considered now to improve the functioning of the market today. These can be categorized broadly into three types of initiatives, with examples of each included below:

1. Make funding recipients better counterparties.

Develop a set of detailed online education resources designed to equip those seeking funding with the skills needed to communicate with potential funding providers, and carefully assess funding offers once those are made.

Market participants come together to develop more standardized funding mechanisms, in addition to green bonds, that can then be traded. Such approaches may include newer digital funding tools, such as “initial coin offerings” or crowd-funding.

2. Make funding providers better partners for those requiring funds.

Develop a common application process and an online platform for projects to be presented. This will allow the interested parties to view the range of possible projects without needing to complete multiple applications.

Wherever possible digitize the application process and consider using the newer tools of 21st-century finance such as blockchain, initial coin offerings, and digital contracts.

Produce a set of operational target standards for each of the funding providers, and track and compare each to the benchmarks to allow for learning.

Exhibit 2: Illustration of root challenges to financing climate resilience today

| | RECIPIENTS | FUNDING PROVIDERS |
|----------------------------|---|---|
| 1 LANGUAGE | <ul style="list-style-type: none"> • Lack financial jargon and terminologies to clearly articulate their needs • Lack financial understanding to assess the different options available in the market | <ul style="list-style-type: none"> • Lack investment strategy to clearly articulate their risk appetite, especially how to balance financial returns with a “second bottom line” • Lack of common definition of “green” (for example, carbon storage and capture is both seen as good and damaging to different groups) |
| 2 OPERATIONS | <ul style="list-style-type: none"> • Dealing with many options and multiple funding providers, all with: <ul style="list-style-type: none"> – Different recipient assessment criteria (often manual and slow) – Inefficiency in managing funding platforms • No ex-ante view on whom to approach first | <ul style="list-style-type: none"> • Processes not adapted to financing green projects; often a very formulaic financing perspective on a relatively subjective topic • Scarce resources available that combine climate science and financial expertise |
| 3 PROCESSES | <ul style="list-style-type: none"> • Material – and costly – ongoing reporting requirements on climate impact, with different requirements for each funding source | <ul style="list-style-type: none"> • Slow and bureaucratic processing of funding requests (for example, board-level approval with little standardization) • Unclear regulatory framework and volatile inter-governmental support |

Source: Marsh & McLennan Companies

3. Improve the information flow between the two sides.

Set up a platform for sharing market data on green projects, on which external ratings can be developed. This would need to include an agreed-upon approach to quantification of second bottom-line risk – that is, the volatility in potential project success – to carefully manage this new form of risk.

Build new digital solutions to simplify and track project impact efficiently, so as to provide the data in a timely fashion for the performance-monitoring needs of providers, while not over-burdening recipients.

Addressing climate change is clearly an era-defining global challenge. Effective financing of such projects by multiple parties is essential to overcoming the challenge. As such, careful development and growth of effective transfer mechanisms is critical.

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HOW BONDS CAN CLOSE THE CLIMATE ADAPTATION FINANCING DEFICIT

ALEX BERNHARDT

A GROWING NEED FOR ADAPTATION

To date, green bonds have dominated the conversation among debt investors as the primary means of achieving environmental or social impact in fixed-income mandates. Green bond issuance has grown significantly since the market was initiated in 2007 with offerings by the European Investment Bank (EIB) and the World Bank. In 2017, total labeled green-bond issuances – those explicitly marketed by issuers as green and many receiving third-party verification of their “greenness” – amount to \$221 billion in debt outstanding. An additional \$674 billion has been identified as “climate-aligned” by the Climate Bonds Initiative, bringing the total market for such debt to nearly \$900 billion.¹

The vast majority of the projects financed by green bonds have been focused on achieving climate change mitigation goals via low carbon-energy installations or public-transport initiatives to reduce greenhouse gas emissions. While investment in such green projects faces challenges in reaching the necessary scale,

a less often considered (but arguably just as critical) element of the climate change investing equation is the need for climate adaptation. That is to say, initiatives that anticipate, plan for, and adapt to the changing climate and its impacts. Examples include altering coastal infrastructure for anticipated sea level rise or implementing green roofs and permeable pavements to reduce heat island effects in cities.

Even if temperature warming is limited to 2° Celcius by the end of this century, some significant level of change to historical weather patterns and sea levels is expected over this time frame. Indeed, leading research – and recent events in California and the Caribbean/ US Gulf Coast – indicates that these impacts are already materializing. Though such impacts are notoriously difficult to quantify, the United Nations Environment Program (UNEP) pegs the annual requirement for investments in climate adaptation at \$56 to \$76 billion per annum in 2015, increasing to anywhere from \$140 to \$300 billion per annum in 2030.² This equates roughly to an aggregate requirement of between \$1.5 to \$3 trillion over the 15-year time period.³

¹ https://www.climatebonds.net/files/files/CBI-SotM_2017-Bonds&ClimateChange.pdf

² UNEP Adaptation Gap Report, 2016 <http://drustage.unep.org/adaptationgapreport/sites/unep.org/adaptationgapreport/files/documents/agr2016.pdf>

³ Author calculations.

THE NEED TO MOVE MORE DOLLARS
RAPIDLY INTO CLIMATE FINANCE TO
SUPPORT ADAPTATION IS CLEAR.

LEVERAGING BONDS TO CLOSE THE GAP

To date, actual and future committed public finance for climate adaptation has fallen woefully short of the estimated need. Though data is limited, it appears as though private finance is not being mobilized adequately to fill the remaining gap. Evidence of such limited commitment to adaptation can be found in the green bond universe where only 3 percent to 5 percent of issuances have been tied to an adaptation-related project, all in the water sector.⁴ This despite the fact that the Green Bond Principles acknowledge the application of bond proceeds to support “climate change adaptation (including information support systems, such as climate observation and early-warning systems)”⁵ and the Climate Bonds Initiative includes in its taxonomy an adaptation section (albeit unfinished).⁶

The reasons for the adaptation-financing deficit are manifold, and the solutions will not come easily. In the meantime, there exist a number of promising sub-segments in the global bond market for investors looking to diversify their sustainable investment portfolios with climate change adaptation solutions:

- **Catastrophe Bonds:** Insurance-linked securities (ILS), in particular publicly-traded catastrophe bonds, represent a compelling opportunity for investors to support financial resilience in the face of the multiplying physical impacts of climate change. While most issuers of ILS today are commercial insurers, a growing number of such transactions are originating from public-sector insurers, non-financial corporations, and public entities, many of which have at their core a social mission.⁷ The ILS market today is small – 30 times smaller than the climate-aligned bond market at just \$30 billion in debt outstanding⁸ – but the capacity of the global capital markets to assume more weather and catastrophe risk is immense. This capacity could be put to use plugging the widening catastrophe insurance gap,⁹ though a broader array of corporate and public-sector issuers will first need to recognize the merits of ILS in helping them manage their contingent weather/catastrophe liabilities.
- **Environmental Impact Bonds:** Social impact bonds are not all structured as bonds per se, and so defy simple aggregation, but by most estimates they represent a very small investable market (less than \$1 billion in total issuance outstanding). These bonds follow a “pay for success” model whereby investors receive a higher rate of return if a certain predetermined social objective is met. Recently, the DC Water and Sewer Authority issued what is believed to be the first Environmental Impact Bond globally, the proceeds of which will be used to support green infrastructure improvements (such as permeable pavement). If storm water runoff reduces by a certain amount in the years post-issuance, then investors will receive a onetime additional payout when the bond reaches maturity.¹⁰

4 https://www.climatebonds.net/files/files/CBI-SotM_2017-Bonds&ClimateChange.pdf – Page 18

5 <https://www.icmagroup.org/assets/documents/Regulatory/Green-Bonds/GreenBondsBrochure-JUNE2017.pdf>

6 <https://www.climatebonds.net/standards/taxonomy>

7 <https://insurancelinked.com/insurance-linked-securities-and-responsible-investment/>

8 As at 2017: http://www.artemis.bm/deal_directory/cat_bonds_ils_issued_outstanding.html accessed November, 2017.

9 http://www.swissre.com/media/news_releases/The_USD_13_trillion_disaster_protection_gap.html

10 <http://www.goldmansachs.com/media-relations/press-releases/current/dc-water-environmental-impact-bond-fact-sheet.pdf>

- **Resilience Bonds:** While resilience bonds are still just a concept, the elegance of the solution has distinct appeal, and several pilot programs are rumored to be in the works.¹¹ In short, a resilience bond would act like a catastrophe bond for a municipality but with a built-in contingent premium discount for the issuer based on the completion of an infrastructure improvement which would make the covered location(s) less susceptible to damage from the covered peril(s).¹² Using premium discounts to incentivize long-term decision making for individual policyholders is a time-worn concept in the personal insurance industry, though it has yet to be applied effectively in the catastrophe bond market.¹³

CONCLUSION

While the above investment categories are all currently small in size (or as yet non-existent), the building blocks for global investing in climate change adaptation are in place. Scaling these opportunity sets will be essential, as the need to move more dollars rapidly into climate finance to support adaptation is clear. This need will only increase as global temperatures continue to rise.

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¹¹ <http://www.bbc.com/future/story/20170515-resilience-bonds-a-secret-weapon-against-catastrophe>

¹² <http://www.refocuspartners.com/wp-content/uploads/pdf/RE.bound-Program-Report-September-2017.pdf>

¹³ <https://hbr.org/2017/08/how-the-insurance-industry-can-push-us-to-prepare-for-climate-change>

FINANCING FLOOD PROTECTION

CLOSING THE GAP

CHARLES WHITMORE

A GROWING PROTECTION GAP

On a global scale, approximately 70 percent of economic losses due to natural catastrophe events are not covered by insurance. This protection gap – the cost of uninsured events – frequently falls on governments in the form of disaster relief, welfare payments, and infrastructure repair and rebuilding. The ultimate cost of these responses places a strain on public balance sheets and increases public debt, hurting taxpayers.

Globally, economic losses from natural catastrophes such as floods and hurricanes have increased dramatically. This is no different in Europe, where weather-related uninsured losses have remained high since 2010. The trend may be attributed to the steady increase in urbanization and projected increases in rainfall. Along with this, Europe has experienced a corresponding increase in the concentration of both insured and uninsured flood risks.

Geographically, the European continent is made up of countries with small land masses and comparatively large rivers. A single flood event can affect more than one country and produce damages that overwhelm the public funds available to address them. Severe and prolonged flood disasters may yield insurance claims that far exceed the funds available to pay for even insured losses.

Organizations throughout Europe have thus significantly promoted public sector initiatives to close this gap and improve their societies' ability to respond to the impacts of natural catastrophes. For example, in the United Kingdom, the British Insurance Brokers' Association flood scheme provides flood cover for businesses and many commercial premises located in flood risk areas. As part of the Italian Catastrophe scheme, risks from all natural perils to which the country is exposed – earthquakes, floods, flash floods, landslides, mudslides, and tsunamis – have been modelled and quantified so as to enhance the private-public partnership (PPP) between the country's insurance industry and its governmental bodies.

FOUR WAYS TO CLOSE THE PROTECTION GAP

To supplement such initiatives, there exist additional actions the private sector can take to support broader product offerings, ensure greater market stability, and close the protection gap.

1. **Harness the global insurance industry's capability to implement risk transfer solutions and promote risk mitigation measures**

A successful public/private approach to managing disaster risk and the potential impact of climate change requires meaningful engagement among a wide spectrum of stakeholders to ensure a focused and sustainable solution over the medium term. The insurance industry has a critical role to play given its data capabilities in quantifying, pricing, and underwriting risk using cutting-edge modeling software – providing the mechanism to effectively spread and diversify risk worldwide.

The United Nations has recognized the importance of the insurance industry's role in educating and incentivizing its policyholder base on climate-related risk. In April 2016, the United Nations Secretary General hosted a high-level meeting to address the topic of resilience. Subsequently, the Insurance Development Forum (IDF) was formed.¹ The IDF is an industry-wide body that will engage international entities to work together to achieve a "better understanding and utilization of risk information that could help governments in better deployment of their resources to build resilience to protect people and their property."

2. **Enhance Public/Private Partnerships**

A coordinated approach between the insurance industry and governments is increasingly being recognized as the most effective means of creating sustainable and effective risk transfer mechanisms. Greater strategic dialogue is needed between governmental departments,

¹ Dan Glaser, President & CEO of Marsh & McLennan Companies sits on this Forum.

non-governmental organizations, the scientific and academic communities and, of course, the insurance industries. It will promote the development of multifaceted approaches to disaster risk management and the implementation of insurance solutions. A joint collaboration should involve sharing complimentary expertise that enables communities to: better assess and understand risk; put in place ex-ante prevention and resilience measures; combine resources to create effective risk transfer solutions; and enable societies and communities to dramatically speed their recovery, post-loss (See Case study: Flood Re – A Public Sector Initiative).

3. Improve data collection for modeling efforts

One of the main challenges in modeling evolving flood risks is the requirement for high quality data. The computational demands for hydraulic modeling is high, especially as the size of modeled areas expands with increasing urbanization, and given that preventative measures can directly influence flood threats through the construction of defense structures.

Unfortunately, detailed data on the presence, construction standards, and operational regimes of flood defenses is not universally available. Modelers will thus have to expend considerable effort to quantify this aspect. Finally, as flood damage occurs in a fairly binary manner – property being either submerged in water or not – highly accurate information on the location of risks is essential, especially in changing urban environments.

Despite such challenges, the first flood risk models for Europe began appearing in 2004. While commercial vendors have been slow to address the gap so far, others, including brokers, have been steadily producing models. At Guy Carpenter, we have produced a range of flood models for key countries and a pan-European hailstorm model based on detailed claims data. Such efforts are part of the push to broadly quantify risk so as to enable insurers to price and assume previously uninsured risks – risks that, in the event of natural

disaster, ultimately burdened public-sector balance sheets.

4. Product transparency and innovation

The factors that contribute most to the protection gap – low insurance penetration and lack of insurability – must be addressed at their source. Some insurance products may be too complex for promotion of increased uptake, with confusing language or myriad clauses and exclusions making them difficult to understand. As a result, there exists significant room for policyholder misinterpretation, potentially leading to voided and non-responding policies. The distribution of insurance products also needs to become more streamlined, more cost-effective, and more user friendly from the customer's perspective. The use of emerging technology will be critical in creating a cheaper and more customer-friendly insurance purchase experience.

CONCLUSION

The protection gap is widening in both emerging and advanced economies where investment in critical infrastructure does not always keep pace with asset growth and accumulation. As such, the (re)insurance industry will play a crucial role in establishing efficient risk transfer strategies on behalf of public sector entities as part of their plans to manage rising flood risks.

The financial management of flood risks continues to present significant policy challenges in Europe, as well as in many other parts of the world. Careful consideration of the relative effectiveness of various risk management strategies will be necessary – from prevention investments to the use of risk transfer schemes against significant post-disaster costs. Equally important will be private-public collaboration to create a public private partnership (PPP) that unites the efficiency of private organizations with the effectiveness of state guarantees.

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| C A S E S T U D Y |

UK'S FLOOD RE A PUBLIC SECTOR INITIATIVE

Following years of planning by the insurance industry and negotiations with a wide group of stakeholders including the United Kingdom government, the Prudential Regulatory Authority, the Financial Conduct Authority, and others, Flood Re was launched in April 2016. The overarching aim of this market-based scheme is to ensure better access to more affordable household insurance for people in high flood risk areas.

Flood Re brings long-sought stability to a marketplace that has been beset by major flood events in recent years. This 25-year initiative possesses value beyond simply providing a framework for the provision of insurance. All stakeholders are committed to working in unison with the government to deliver on its objective of boosting public confidence and understanding; re-establishing a functioning flood insurance market that supports the customer; and strengthening the overall national understanding of the peril to ensure that robust risk management strategies exist at all levels.

Here's how it works: the household customer continues to purchase home insurance from an insurer in the usual way. Flood Re enables the insurers to reinsure (transfer) the flood risk element of a household policy to Flood Re at a pre-set (fixed) more affordable reinsurance premium based on the property's local tax rates, with no variation for hazard level. The premium base has been fixed

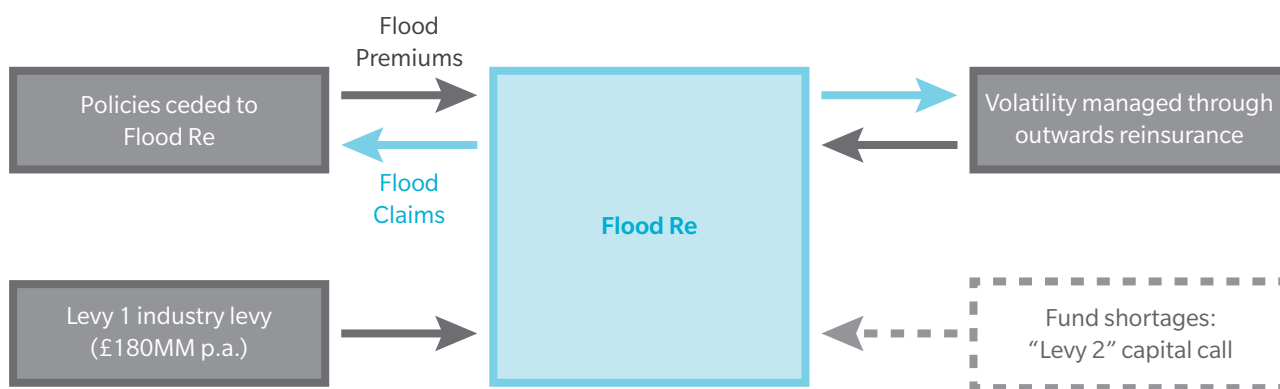
sufficiently low to be affordable for high-risk homeowners and therefore, the income for Flood Re is bolstered by "Levy 1;" a GBP 180 million annual levy on all UK household insurers calculated according to market share. In extreme circumstances, Flood Re can also call upon "Levy 2" from household insurers to bolster the position of the company (Exhibit 1).

Benefits to UK Homeowners: An estimated 350,000 homeowners in the UK are expected to benefit from Flood Re and stimulate a more competitive insurance market. Early figures for Flood Re take-up and "on-boarding" by insurers and customers are very positive, with all major insurers participating. At this early stage, customers are seeing direct benefits from the scheme with flood-exposed households experiencing reductions in premiums that can be measured in the thousands of pounds.

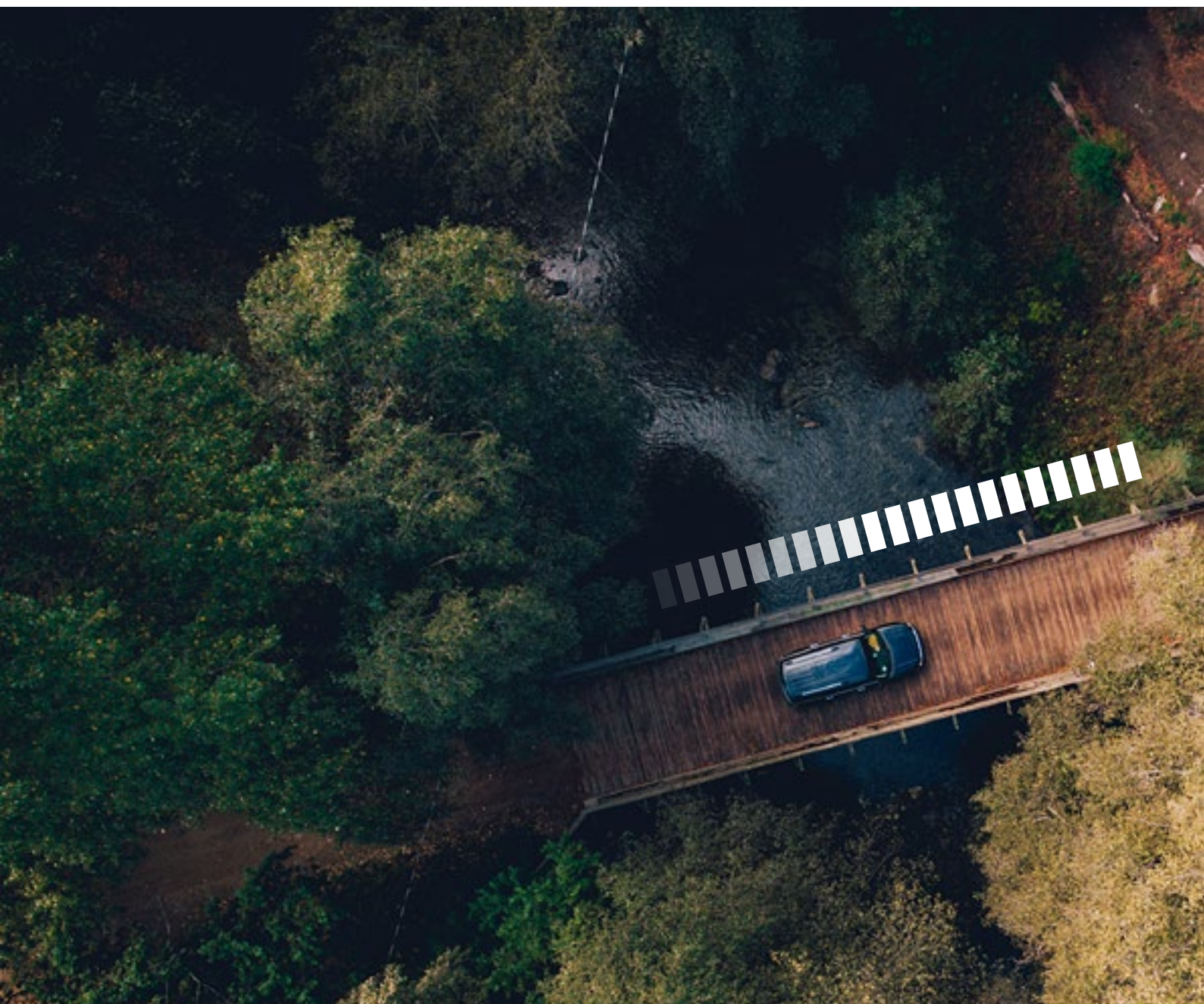
Guy Carpenter collaborated extensively on the launch of Flood Re. Working together, the two teams developed key parts of the business plan submission to the PRA; the expected portfolio composition and build-up analysis; catastrophe modeling and realistic disaster scenario testing; and the design and testing of operational systems.

A GBP 2.1 billion multi-year reinsurance program was placed to ensure that the scheme could be operationalized. Flood Re also broke new ground in that the placement was the first known reinsurance program procured under the European Union (EU) and UK public procurement regulation, requiring the design of a bespoke reinsurance strategy to meet the regulatory requirements.

Exhibit 1: The construct of Flood Re



Source: Guy Carpenter



FINANCING A GREEN FUTURE

WHO IS DRIVING IT PAST THE
TIPPING POINT?

JACLYN YEO



GOING MAINSTREAM

The transition to a lower-carbon economy has already begun and will require a great deal of financing. Collectively known as green finance, these efforts are understood to be instrumental in carbon-reduction strategies, achieving sustainable development goals, and building a climate-resilient future.

The question is: Who will drive green investment into the financial mainstream – investors or regulators?

Because the transition to a lower-carbon economy will involve various, far-reaching changes, no one single definition for green finance holds across all countries and regions. Nonetheless, the common theme of green finance is investment that promotes a sustainable, lower-carbon, and climate-resilient economy.

WIDE-RANGING SPECTRUM OF GREEN FINANCING TOOLS

More measures related to green finance were introduced between June 2016 and June 2017 than in any one-year period since 2000. These included implementing strategic policy signals and frameworks, supporting the development of local green-bond markets, and promoting international collaboration to facilitate cross-border green bonds investments. The result has been increased flows of green finance, most notably in the issuance of green bonds, which doubled to US\$81 billion in 2016.

Though green bonds are the most common instruments, green financing principals can be applied across various financing and de-risking instruments. This includes traditional debt and equity and other tools along that continuum, such as credit enhancements. (See Exhibit 1.)

While green bonds are most commonly associated with green infrastructure financing, they may appear unattractive due to the common misconception that green infrastructure projects are less “bankable.” This is one of the factors

leading to the so-called “green financing gap,” estimated to range from a minimum \$2.5 trillion, to as high as \$4.8 trillion. The gap is largely attributable to inadequate risk-adjusted returns, one of the key barriers facing private-sector financing of sustainable infrastructure, described in recent reports by Mercer and the Inter-American Development Bank.¹

This gap can be bridged via credit enhancements from de-risking instruments such as insurance and derivatives, which remove some of the inherent risks that otherwise make an investment unbankable. With adequate credit wraps, green investments can be treated as de-risked products with higher returns and longer-term financial stability, with the eligibility for longer tenure.

As such, green financing instruments should be sufficiently broad so as to capture all the objectives of the respective green finance provisions. At the same time, however, the designation of green finance needs to be defined more narrowly so as to make the emerging discipline credible and actionable. Unifying criteria and standards will be required to specify the scope and degree of “green” for investors and regulators, given the various initiatives across regions and countries to define environmentally-friendly financial instruments and investment principles.

GREEN FINANCE AND INVESTORS: WHO’S DRIVING WHOM?

As it concerns both the direct and indirect risks of the transition to a lower-carbon economy – as well as the various opportunities associated therewith – green finance has lately become the talk of the town. Investors are recognizing the increasing number of green investment opportunities, along with new markets to penetrate and consumer bases to attract. Indeed, global sustainable investment stood at \$23 trillion in 2016, a 25 percent increase from 2014 with a compounded annualized growth rate of 12 percent.

¹ Mercer and IDB, *Building a Bridge to Sustainable Infrastructure* (2016) and *Crossing the Bridge to Sustainable Infrastructure*. 2017. Both reports can be accessed at Mercer.com

Some argue that investors are spearheading green finance. Mandated climate disclosures – compulsory reporting of how companies manage climate-related risks – represent a major step toward mainstreaming green finance. This will promote transparency and help investors identify climate-related risks and opportunities.

For example, in March 2017, global investment institution BlackRock listed climate risk disclosure as one of their key engagement themes in their investment priorities.² Specifically, the firm will be asking companies to demonstrate how climate risks might affect their business and what their managements' approach will be to adapting and mitigating these risks.

Shareholders increasingly want to know what companies are doing to transform their operations and products and remain competitive during the transition to a lower-carbon economy. In 2017, a leading energy company was

pressured by investors to report climate-related impacts on its business under a two-degree scenario. The move was a strong signal to the market that climate change is now counted as a significant financial risk.

GETTING PAST THE TIPPING POINT

Investors may be driving the green finance initiative, but they cannot succeed without the support of other key stakeholders. Besides institutional investors, there are markets where regulators and policy makers appear to be more aggressive in leading the transition:

- **Regulators**
To better facilitate the development of green finance, the Luxembourg Green Exchange in September 2016 opened a segment dedicated to Sustainable and Social (S&S) projects bonds, a sector valued at over US\$23 trillion. It had increased the visibility of S&S projects and expedited their financing.

Exhibit 1: Spectrum of selected green financing products available

| FINANCING INSTRUMENTS | | DE-RISKING INSTRUMENTS | |
|--|--|--|--|
| Asset Category | Definitions | Credit Enhancement | Definitions |
| Fixed Income (Debt) <ul style="list-style-type: none"> • Bonds • Loans | Lending or debt instruments provide borrowers with upfront funding in exchange for repayment of funding Example: Green bonds | Third-party guarantee <ul style="list-style-type: none"> • Credit-rating agencies | Provides overall credit rating to help investors manage investment risks and offers visibility into the perceived risk-reward profile of an investment Example: Moody's and S&P started to assess climate change impacts on credit ratings in 2016 |
| Equity <ul style="list-style-type: none"> • Listed • Unlisted | Equity investments provide critical capital base for company or project to grow its operations, access other sources of finance, and reduce investment risks faced by other investors Example: PPP, REITs, direct corporate stocks | Insurance <ul style="list-style-type: none"> • Political risk • Credit risk | Insurance protects investors from a borrower's failure to repay as a result of pre-specified events, such as political situations that include governmental expropriation of assets Example: Political Risk Insurance |
| Funds and structured products <ul style="list-style-type: none"> • Debt/Equity funds • Securitized products | These instruments allow investors to diversify investments and reduce investment transaction costs, and improve borrowers' access to finance smaller "green" projects Examples: Sustainable Global Equity Funds | Derivatives <ul style="list-style-type: none"> • Weather-indexed | Financial agreements to manage various risks faced by investors/ borrowers, such as risks associated with adverse weather conditions Examples: Weather parametric |

Source: Marsh & McLennan Companies

² BlackRock, 2017. BlackRock Investment Stewardship Engagement Priorities for 2017-2018.

Meanwhile, the Securities and Exchange Board of India in June 2017 finalized the disclosure requirements for the issuance and listing of green debt securities, which will raise funds from capital markets for green investments in climate change adaptation, and more specifically, renewables and clean transportation.

- **Legislations**

The French Energy Transition for Green Growth Act was enacted in January 2016, mandating that institutional investors and fund managers disclose in their annual reports how climate change considerations have been incorporated into their investment and risk management policies.

China has also been ambitious in launching pilot zones to focus on different aspects of green financing in the provinces of Guangdong, Guizhou, Jiangxi, Zhejiang, and Xinjiang. In the program, banks are encouraged to explore new financing mechanisms; the program also incentivises the financial sector to accelerate the advancements of green insurance and credit-enhancement instruments in these regions.

Undoubtedly, *investors are the key driving forces*, but to drive further demand at this nascent stage, *government intervention may be necessary*. Regulators and/or policy makers might need to step in with subsidies, risk-mitigation mechanisms, and guarantee mechanisms for green investments.

WHERE NEXT?

This year's G20 Summit in Germany concluded that green finance will be key in addressing a host of global challenges. This echoes the call at the previous year's Summit to scale-up green financing for driving environmentally sustainable growth.

2017 has since seen significant progress by world leaders, national initiatives, and investors alike in fostering sustainable global growth through green finance. The G20, the UN Environment Programme, and the Monetary Authority of Singapore has continued to maintain this momentum when the G20 Green Finance Conference was held in Singapore in November 2017.

Such conferences promote the development of a green financial system, workable from a capital markets perspective and aligned with the national and international commitments of the Paris Agreement.

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<http://www.brinknews.com/asia>

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INCREASING CLIMATE RESILIENCE THROUGH RISK FINANCING

CASE STUDY MOZAMBIQUE

THOMAS LONDON AND ROBERT WYKOFF



INCREASING IMPACTS

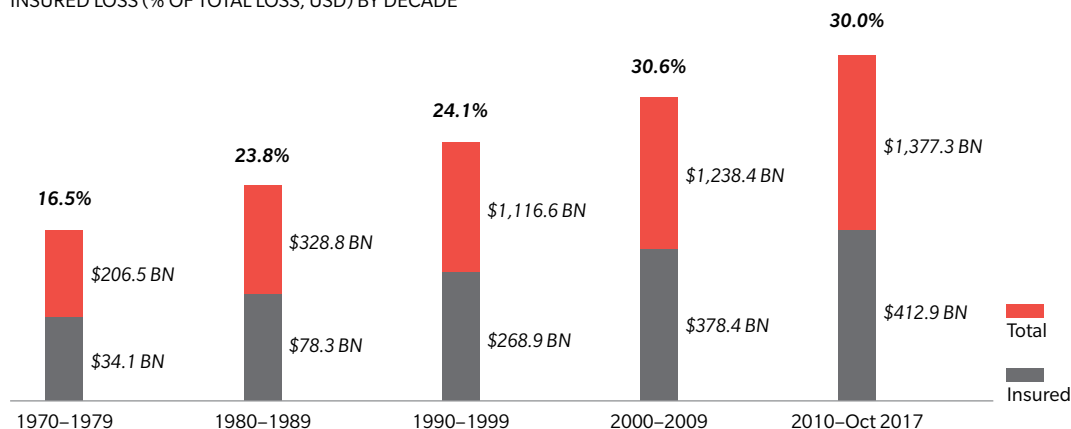
2017 marks one of the worst years in recent history for global natural catastrophes. Staggering losses stemming from a series of devastating floods, hurricanes, and earthquakes have brought the topic of disaster risk financing back to center stage as governments, the public, and insurance companies work to recover and rebuild. By October 2017, global insured

catastrophe losses for the year were in excess of US\$100 billion, only the third time such a threshold was breached.¹ Extreme weather events that destroy homes, businesses, infrastructure, and agricultural assets have high opportunity costs, particularly in emerging economies, where scarce resources must be reallocated to reconstruction efforts.

¹ <http://www.gccapitalideas.com/2017/10/31/asia-pacific-catastrophe-report-2017-executive-summary/>

Exhibit 1: Rising economic impacts of natural catastrophes

INSURED LOSS (% OF TOTAL LOSS, USD) BY DECADE



Source: Swiss Re, Sigma

Scientific consensus suggests that climate change will exacerbate the intensity of tropical cyclones, severe storms, and droughts. While many of these losses are privately insurable, governments are often responsible for filling the gap when the private sector is unable or unwilling to. Although insurance is currently providing a greater portion of relief from natural catastrophe losses, the industry's growth is being eclipsed as trends such as urbanization drive total dollar losses higher. (See Exhibit 1.)

Private insurance can be quite important in supporting economies in resilience and disaster recovery. For example, research indicates that a one percent rise in insurance penetration translates to a 13 percent reduction in total uninsured losses and a 22 percent reduction in taxpayers' contribution following a disaster. Further, insurance improves the sustainability of an economy and leads to greater rates of growth – a one percent rise in insurance penetration leads to increased investment equivalent to one percent of national GDP.²

With insurance covering an estimated 40 percent of catastrophic losses, developed countries generally have the fiscal resources and political stability to address catastrophe

risk. However, in developing countries it is estimated that only five percent of catastrophe losses are insured.³ Those assets with insurance are often foreign investments, such as oil and gas exploration efforts, located far from urban centers, built to international construction standards, and insured with large international insurers. These facilities suffer relatively little losses during catastrophes and offer few premium benefits to local insurers.

DEVELOPING A MARKET

Mozambique offers a case study of the challenges developing economies face as limited resources hamstring competing efforts to grow the economy, build resilient infrastructure, and prepare for disasters.⁴ The country is Africa's third most susceptible to weather-related perils, the result of its proximity to the Indian Ocean, 2,400 km of coastline, and downstream location on numerous major African rivers. Approximately 41 percent of Mozambique's coastal areas are exposed to catastrophe events, while economic activity in these areas constitutes 52 percent of the country's gross domestic product.⁵ Weather-related events account for 94 percent of the country's economic losses, and climate change

2 Lloyd's City Risk Index 2015-2015 – <https://www.lloyds.com/cityriskindex/>

3 Cummins, Mahul. Catastrophe Risk Financing in Developing Countries: Principles for Public Intervention. The World Bank.

4 Cummins, J. David., and Olivier Mahul. Catastrophe Risk Financing in Developing Countries: Principles for Public Intervention. Washington, D.C.: World Bank, 2009. Print.

5 "Risk calculators and dashboards". Verisk Maplecroft.
https://maplecroft.com/about/news/economic_losses.html. Accessed: February 2017.

is expected to increase both the frequency and severity of weather events.⁶ When disasters occur in Mozambique, vital resources must be redirected to relief efforts.

To help the country tackle these challenges, international donor agencies are exploring ways to build capacity and proactively finance catastrophe losses by tapping into local and international insurance markets. USAID's Coastal City Adaptation Project aims to enhance Mozambique's capacity to respond to climate change by decreasing the country's exposure to rising sea levels and weather events. The Project involves mitigation efforts and training local communities on best practices to prepare for, respond to, and recover from disasters. For the first time, USAID is exploring the viability of engaging the private insurance market to support foreign risk financing initiatives in developing economies.

Effective risk transfer programs spread risk among many parties through a process called layering. For example, insurance can directly cover government assets, reinsurance can provide a backstop for government insurance schemes, and insurance linked securities can fund infrequent but severe events by transferring risks to global financial markets. In the most extreme circumstances, international donor support can serve as a backstop for devastating losses.⁷ (See case study on next page.)

Research and analysis suggest that greater private sector participation will support the development of a national catastrophe insurance program. Should efforts in Mozambique prove successful, programs developed there could serve as a template for ones in other countries. USAID's pilot program simultaneously addresses several critical components to maximize the odds of success: at risk populations are being educated about relevant prevention and response techniques; buy-in is being achieved at all levels of government; appropriate tools, data, and analytics are being explored to identify and

quantify risks; and training and guidance are being tailored to a wide audience ranging from rural populations to the CEOs of large insurance companies.

CHALLENGES REMAIN

While progress is being made in Mozambique, capacity building efforts are not without their challenges. Examples include:

- At-risk populations are often unwilling to relocate given the disruptive effects it has on communities.
- In-country technical ability is scarce, necessitating external resources be brought in.
- Financial tools such as risk financing can be a tough sell in regions where even food is not reliably available.
- Data to support the identification and analysis of at risk regions are often incomplete or non-existent.
- Assessing losses in devastated areas proves difficult when critical infrastructure has been destroyed by disaster.

**INSURANCE IS A VITAL TOOL IN THE
CAPACITY BUILDING ARSENAL.**

⁶ "Basic Country Statistics and Indicators (2014)". *PreventionWeb*. <http://www.preventionweb.net/countries/moz/data>. Accessed: February 2017.

⁷ World Bank; Policy Research Paper Disaster Risk Financing and Contingent Credit: A Dynamic Analysis; Daniel Clarke and Olivier Mahul; June, 2011.

| C A S E S T U D Y |

TRANSFERRING PUBLIC RISK TO THE PRIVATE SECTOR

Privatizing risk typically begins with a low limit pilot program. As data are gathered and familiarity with the process grows, a program's limits, coverages, and geographic territories may be expanded. The following are examples of governments that have successfully transferred public risk to the private sector:



MEXICO

The Mexican government pioneered government risk transfer strategies with the world's first sovereign catastrophe bond in 2005. This provided coverage for US\$160 million across three regions, supplemented by an additional parametric reinsurance program. Four years later, Mexico made history again by issuing the first ever multi-peril catastrophe bond for hurricane and earthquake losses.¹ The coverage continues today, funding the reconstruction of public assets, key infrastructure, and low-income properties damaged by natural disasters.² In 2017, a series of earthquakes triggered coverage, obligating the entire earthquake tranche of the bond.



TURKEY

In one of the most seismically active countries, the government established the Turkish Catastrophe Insurance Pool and issued a US\$400 million catastrophe bond in 2013. The bond covers parametric earthquake risk and is triggered by seismometer measurements taken by the country's Early Warning and Rapid Response System. As of 2015, the pool increased its total coverage to US\$500 million.³



CARIBBEAN CATASTROPHE RISK INSURANCE FACILITY

CCRIF is a regional catastrophe fund for Caribbean governments to limit the financial impact of hurricanes and earthquakes. It is the first multi-country risk pool and represents a cost-effective way to pre-finance short-term liquidity for recovery efforts following a catastrophe, filling the gap between immediate response aid and long-term redevelopment. Parametric triggers enable rapid payouts by eliminating delays due to loss adjustment processes and providing an objective basis for payouts and pricing. Since its inception, over US\$100 million in payouts have been issued, all within 14 days of the given disaster event.⁴ In 2017, Hurricane Irma resulted in US\$31.2 million in payouts and Hurricane Maria triggered a US\$19.3 million payout to Dominica, marking over US\$50 million in payouts for 2017.

1. Dana Julie and Sebastian von Dahlen. *An Overview of Potential Pathways to Appraising Impact of Sovereign DRFI: Where Should We be Looking to Assess Benefits?*. WBG, DFID, GFDRR, March 2014.

2. Bussolera, Paolo. "Indemnity based Nat Cat insurance covers for sovereign risks – Example: FONDEN, Mexico". *Munich Re*. Presentation, April 23, 2013.

3. "GC Securities* Completes Catastrophe Bond Bosphorus Ltd. Series 2015-1 Notes Benefiting the Turkish Catastrophe Insurance Pool". GC Capital Ideas. August 26 2015. http://www.guycarp.com/content/dam/guycarp/en/documents/PressRelease/2015/GC%20Securities_%20Completes%20Catastrophe%20Bond%20Bosphorus%20Ltd.%20Series%202015-1%20Notes%20Benefiting%20the%20Turkish%20Catastrophe%20Insurance%20Pool.pdf. Accessed: February 2017.

4. *Informe Anual del CCRIF SPC 2015 – 2016*. The Caribbean Catastrophe Risk Insurance Facility, 2016.

Exhibit 2: Layering in action

The matrix is a 5x5 grid. The vertical axis is labeled 'LOSS SEVERITY' and the horizontal axis is labeled 'LOSS FREQUENCY'. The grid is divided into four colored regions: light orange (top-left), medium orange (top-right), dark orange (bottom-left), and red (bottom-right). The regions are labeled 'RISK TRANSFER' and 'RISK RETENTION'. Various risk management strategies are plotted as red dots with labels.

| LOSS SEVERITY \ LOSS FREQUENCY | Low | Medium | High | Very High |
|--------------------------------|--------------------------------|-----------------------------|---------------------------|-------------------|
| Very High | International donor assistance | | | |
| High | | Insurance linked securities | | |
| Medium | | | Insurance and reinsurance | |
| Low | | | | Contingent credit |
| Very Low | | RISK TRANSFER | RISK RETENTION | Reserves |

Source: World Bank



PATH TO SUSTAINABLE INFRASTRUCTURE

AMAL-LEE AMIN AND JANE AMBACHTSHEER

The world needs more infrastructure, particularly in developing countries. But not just any infrastructure. To achieve the economic, social, and environmental objectives embodied by the Paris Agreement and the Sustainable Development Goals (SDGs), this infrastructure must be sustainable, low-carbon and climate-resilient. The New Climate Economy's 2014 report, *Better Growth Better Climate*, estimates that from 2015 to 2030, the global requirement for new infrastructure assets will be \$90 trillion, more than the value of the world's existing infrastructure stock.

To meet these needs, annual investment in infrastructure will need to increase from current levels, about \$3 trillion, to \$6 trillion. At the same time, data from the Organisation for Economic Co-operation and Development and alternative assets researcher Preqin shows investors' allocations to infrastructure are gradually increasing, driven by a combination of factors (such as low yields in traditional asset classes and inflation protection).

Together, these should be positively reinforcing developments. But are they? The Inter-American Development Bank (IDB) commissioned Mercer to assess the extent to which infrastructure investors – and other stakeholders, including governments, multilateral development banks (MDBs) and infrastructure industry initiatives – are focusing and collaborating on sustainable infrastructure. Our findings are somewhat mixed: the positive momentum of new initiatives focused on sustainable infrastructure is countered by the fact that sustainability concerns struggle to enter the core allocation strategies of mainstream investors.

Our initial report, published in November 2016, *Building a Bridge to Sustainable Infrastructure*, outlined the effort underway to raise awareness of sustainable infrastructure investment opportunities and develop tools to foster related investment analysis and monitoring. However, as outlined in the companion paper, *Crossing the Bridge to Sustainable Infrastructure*, we find that the level of investor awareness and engagement with these developments seems relatively limited. In addition, current allocations

**ULTIMATELY, SUSTAINABLE
INFRASTRUCTURE IS THAT WHICH WILL
ENABLE THE WORLD COLLECTIVELY
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PARIS AGREEMENT.**

to infrastructure fall short of the levels required to support economic development, The New Climate Economy found in 2016. To overcome these barriers, we set out a call to action for investors, governments, MDBs and industry initiatives (see infographic on next page).

WHAT IS SUSTAINABLE INFRASTRUCTURE?

In a broad sense, sustainable infrastructure is socially, economically and environmentally sustainable. The specific application of this concept will depend on the relevant geographical and sector contexts. But ultimately, sustainable infrastructure is that which will enable the world collectively to meet the SDGs and the Paris Agreement.

Some investors have the misconception that sustainable infrastructure simply means more renewable energy infrastructure. Indeed, investment flows into renewable energy have been increasing; for example, in 2016, more than 40 percent of new infrastructure investment went into renewables, data from Preqin shows. Although this is positive, sustainable infrastructure needs are broader. The New Climate Economy's *Better Growth Better Climate* outlines in detail the change that is required across three critical economic systems: cities, land use and energy.

In addition, infrastructure needs to be resilient in the face of a changing climate. A 2016 study of public-private partnerships (PPPs) by Acclimatise found that “among the sample of 16 national PPP policy frameworks examined, not a single one was found to mention a changing climate, climate resilience, or adaptation.”

BRIDGING THE DIVIDE

A CALL TO ACTION

Three sets of complementary actions are outlined below. The first relates to industry initiatives focused on infrastructure investment. The second two address multilateral development banks (MDBs), governments, investors and industry initiatives.

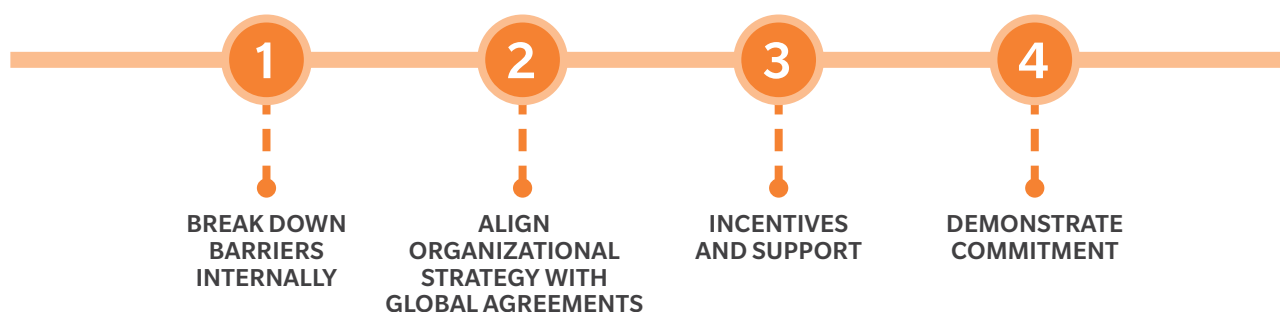
ACTION ONE: CONVENE THE CONVENORS

Investors identified a number of opportunities for industry initiatives to influence the investor mindset on sustainable infrastructure (SI), and to accelerate the development and standardization of frameworks and tools. Action one is about delivering on the five “C”s outlined in this illustration.



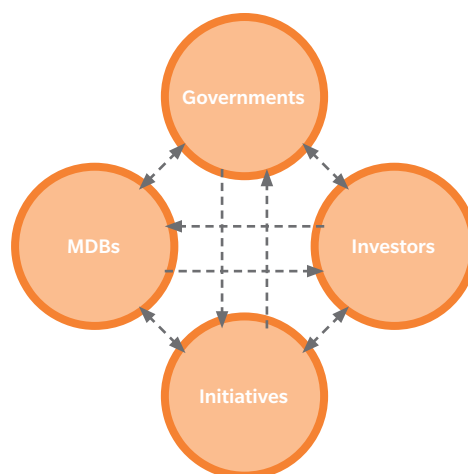
ACTION TWO: INTERNAL ALIGNMENT

Key steps for success: addressing internal barriers to prioritizing SI and implementing required changes; aligning organizational strategies with international agreements and commitments; and structuring of incentives to deliver on those commitments.



ACTION THREE: EXTERNAL COLLABORATION

There are collaborations that must take place between stakeholder groups to cross the bridge towards sustainable infrastructure. These leverage key links across the development and financing process, from project planning, to investment due diligence and reporting. To advance the ecosystem towards effective sustainable infrastructure, each group must play a role. A key focus is on building new relationships and shifting the discussion so that infrastructure investment and development naturally consider alignment with commitments aimed at achieving the 2nd degree, or lower, target.



Source: Crossing the Bridge to Sustainable Infrastructure, Mercer and Inter-American Development Bank (IDB), 2017

INVESTOR INTERVIEWS SHOW LACK OF PROGRESS

As part of our research, we spoke with a number of infrastructure investors about the extent to which they consider sustainability in their decision-making. Despite growing attention to environmental, social, and governance considerations within investment organisations, we found that many infrastructure teams are just now developing a formal approach to sustainability in investment and, further, that such considerations are generally applied at the deal level. There is little top-down thinking about the transformational change and investment pathways that must accompany successful implementation of the Paris Agreement and the SDGs, and the opportunities that they offer to investors. We identified the following factors contributing to this lack of progress:

- Lack of familiarity with the sustainable infrastructure business case and a related lack of experience in considering what might qualify;
- Limited standardization of tools and approaches, with barriers to entry for investors;
- Lack of coordinated policy commitments across regions and sectors consistent with the Paris Agreement and the SDGs, which dampens investors' focus on energy transition risk (that is, the risk associated with swift action to mitigate climate change);
- Lack of tools and focus on climate resilience (that is, adaptation), which has seen little prioritization to date.

Investors noted an interest in learning more about the merits of a sustainable infrastructure approach and in gaining the know-how to achieve it. To date, industry initiatives have not been successful in providing such knowledge and would benefit from greater clarity about what constitutes sustainable infrastructure and its business case.

CALL TO ACTION

Despite some high-level commitments to sustainable development by policymakers, and the significant efforts underway to leverage private-sector finance, there is still a lack of engagement from many infrastructure investors. Thus, a call to action is essential. We highlight three key initiatives, as outlined in Exhibit 1.

If you invest in infrastructure, we encourage you to review Crossing the Bridge to Sustainable Infrastructure and develop an approach that enables your organization to optimize risk and return considerations for the long term, while being cognizant of the role your investments play in the transition to a low-carbon and sustainable economy.

This article was first published on www.Top1000Funds.com on June 2, 2017.

Amal-Lee Amin is Chief of the Climate Change and Sustainability Division at the Inter-American Development Bank. **Jane Ambachtsheer** is a Paris-based partner at Mercer Investments and a member of the Financial Stability Board Task Force on Climate-related Financial Disclosures.



SOLD! USING AUCTIONS TO UNLOCK CAPITAL MARKETS FOR CLIMATE ACTION

BENJAMIN CHEE AND CHANTALE LACASSE



THE CHALLENGE: HOW TO REDUCE GHG EMISSIONS AT THE LOWEST COST

With the Paris Climate Accord in 2015, the global community committed itself to limiting average global temperatures to 2°C above pre-industrial levels. Reducing Greenhouse Gas (GHG) emissions and transitioning to low-carbon economies will be crucial to meeting this goal. The costs, however, are high and public funds are limited.

One way to drive GHG emission reductions is through a “carbon market,” which provides a market-based financial incentive for private-sector entities to reduce carbon emissions. The collapse of carbon prices has removed the incentive for private-sector investment in clean technology projects, however, as a consequence, many GHG emissions abatement projects, such as emission-reduction projects at landfills and agricultural, and wastewater treatment sites, are at risk of being decommissioned. This is true even though many of these projects would require little additional funding to continue operating.

The World Bank’s Pilot Auction Facility for Methane and Climate Change Mitigation (“PAF”) was established to test an innovative financing approach and the use of auctions for GHG abatement. The PAF offers a price guarantee to projects that reduce GHG emissions. The public funds used for this guarantee are allocated through an auction that selects entities that require the least additional funding per ton of carbon dioxide equivalent (tCO₂e).

Three auctions were held under the PAF, and over \$50 million was committed to support these price guarantees. NERA Economic Consulting (NERA) developed the detailed auction rules and managed the auctions held under the PAF¹.

INNOVATIVE USE OF AUCTIONS

The PAF features a pay-for-performance mechanism that takes advantage of existing infrastructure to deliver a price guarantee to entities that have the potential to deliver future emissions reductions. The mechanism is supported by donor funding from the governments of Germany, Sweden, Switzerland, and the United States.

The PAF consists of two key elements. The first is a tradable put option for emission reductions. The option is structured as a zero-coupon puttable bond issued by the World Bank Group through the International Bank for Reconstruction and Development. Upon maturity, the put options give the holder the right, but not the obligation, to deliver qualifying Emission Reductions (ERs) to the PAF in return for receiving a payment. An ER is a type of carbon credit that represents the successful emissions reduction equivalent to one tCO₂e. The payment received is the strike price of the option and the premium is the price paid for the option. The payment less the price paid locks in an effective guaranteed floor value for ERs.

The holder of the option may still sell its ERs in the open market if a better price is available. Optionality is crucial as it allows the

¹ To learn more, visit <http://www.pilotauctionfacility.org/>

holder of the put option to benefit if carbon prices in international markets rise above the strike price. Here, the PAF will have achieved its objective – stimulating private-sector investment – at no cost, given that payment will not be made if the holder does not exercise its put option. If carbon prices in international markets fall, the holder of the put option has the right to sell its ERs to the PAF at the strike price. Either way, the price guarantee will have incentivized private investors to fund abatement projects.

The PAF's second key element is the use of an auction to effectively allocate put options to entities that would require the least additional funding to deliver ERs. Bidders compete in the auction to purchase these put options, and the auction sets a uniform guaranteed floor value for each ER. The floor value can be determined either by fixing the option's premium and allowing bidders to bid down the option's strike price, or alternatively by fixing the option's strike price and allowing bidders to bid up the option's premium. Either way, the auction transparently determines the value of the put option and selects the entities willing to pay the most for the option (or, equivalently, to receive the least in terms of price guarantee to deliver the ERs). Thus, the competitive nature of the auction maximizes the impact of public funds and achieves the greatest climate benefits per dollar.

*THE COMPETITIVE NATURE OF THE AUCTION MAXIMIZES THE IMPACT OF PUBLIC FUNDS AND ACHIEVES THE **GREATEST CLIMATE BENEFITS PER DOLLAR.***

CRITICAL SUCCESS ELEMENTS

Bidders around the world participated in the PAF auctions, and 24 firms were selected as winners. More than \$50 million was allocated, with potential reductions of over 20 million tCO₂e by 2020. A number of best practices are responsible for the program's success.

FOCUS ON WHERE IMPACT IS GREATEST

The PAF focused on reducing methane emissions at the program's inception and has expanded to target nitrous oxide emission reductions in its third auction. Both methane and nitrous oxide are highly potent greenhouse gases with a global warming potential of 25 and 300 times that of carbon dioxide, respectively. Thus, the reduction of one ton of methane is equivalent to 25 tons of carbon dioxide and the reduction of one ton of nitrous oxide is equivalent to 300 tons of carbon dioxide.

Due to the low price of carbon credits, 1,200 methane projects in developing countries were identified as being at risk of decommission. The Methane Finance Study Group estimated that, across all developing countries, methane projects could reduce as much as 8,200 million tCO₂e at less than \$10 per ton in incremental cost financing.

PAY FOR PERFORMANCE

The PAF pay-for-performance mechanism delivers funding only upon achievement of pre-defined and verified emission reductions. This program does not pay for the installation of the underlying abatement projects, but pays for the performance of such projects. The PAF thus does not assume the risk of project implementation, which remains with the developer.

LEVERAGE EXISTING INFRASTRUCTURE

The program leverages existing infrastructure in two main ways. Firstly, the World Bank uses its established infrastructure to issue zero-coupon puttable bonds that are equivalent to put options. These bonds are tradable, and parties may buy and sell the bonds on the same markets as traditional World Bank bonds. This reduces implementation costs and enables winning bidders to transfer ownership, which maximizes the likelihood of achieving emission reductions. Second, the holder of the put option surrenders its ERs before payment is made by the PAF. The PAF leverages the Clean Development Mechanism (or CDM), the Verified Carbon Standard (or VCS) and the Gold Standard infrastructures in place to implement this.

MAXIMIZE IMPACT OF PUBLIC FUNDS

The PAF makes use of a clock auction format, a novel approach in international climate and development finance. A clock auction proceeds in a series of rounds. In a round, bidders state how many put options they are willing to buy, given the option's premium and strike price. If bidders in aggregate are willing to purchase more than the number of options available, the economic proposition of the options is made less attractive in the next round (by increasing the option's premium or reducing the option's strike price), and bidders have another opportunity to state how many options they are willing to buy. This process continues until there are just enough options available to satisfy demand.

This competition drives down the effective guaranteed floor value (the strike price less the premium) for ERs to ensure that public funds achieve the maximum impact by selecting winners with the lowest expected costs per tCO₂e. The two auctions that targeted methane emissions, which employed different auction formats held nearly a year apart, delivered virtually the same net value (\$2.10 per ER in the first auction and \$2.09 per ER in the second). This suggests the reliability of the price signal delivered by the auctions, and that the auctions were effective in encouraging straightforward bidding and in achieving a market-reflective price.²

SUMMARY

The auctions under the PAF were successfully held in specific sectors, but could also be used in others. On a country level, the model could be used by governments that need to meet commitments under the Paris Climate Accord. On the global level, the auction format could be scaled with increased funding for larger multi-country climate auctions.

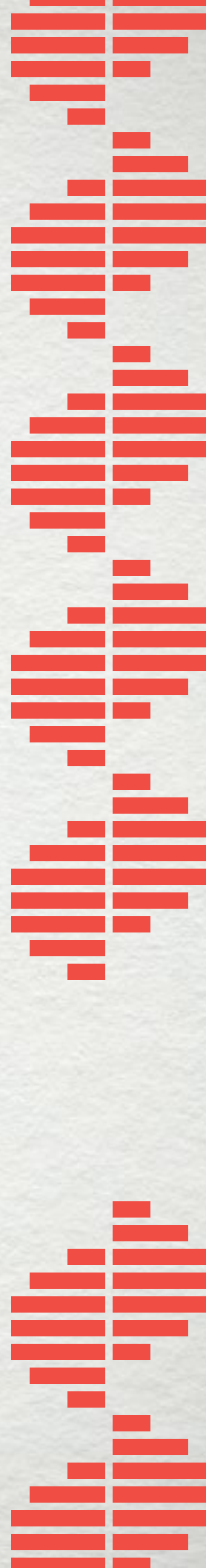
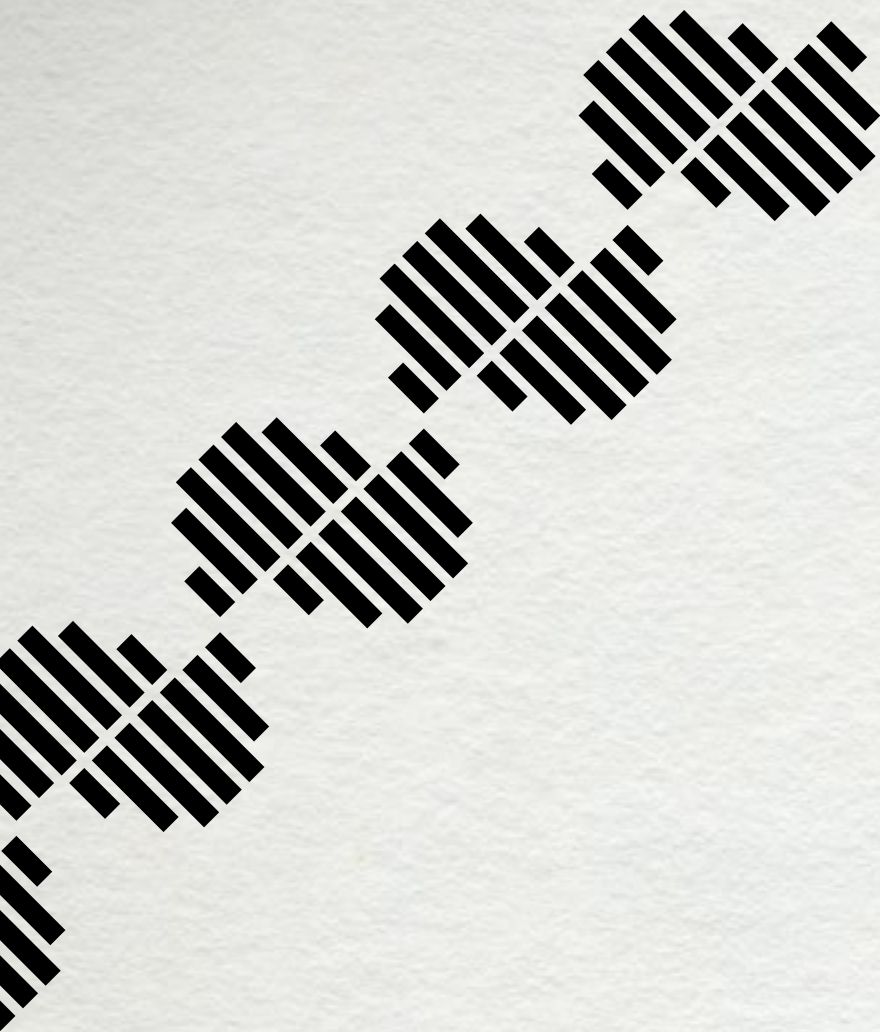
Benjamin Chee is a New York-based director, and **Chantale LaCasse** is a Washington, D.C.-based Managing Director, both at NERA Economic Consulting. They led the team that implemented the PAF auctions. The NERA team has been involved in the successful design and implementation of over 200 auctions.

² The third auction's net value was \$1.80 per ER. Details of the first two auctions are available here: <https://www.pilotauctionfacility.org/content/report-lessons-learned-auctions-1-2>



RISK MANAGEMENT FOR CLIMATE RESILIENCE

How risk management processes and insights
can be applied to enhance organizations'
climate resilience.



UNLOCK GROWTH BY INTEGRATING SUSTAINABILITY

LUCY NOTTINGHAM

EVOLVING RISK CONTEXT

The COP21 climate summit in December 2015 was all about unifying around pledges to limit global temperature rise. Since then, the focus has been on putting those goals into action.

Government policies and actions will have a large role to play in steering the shift to a lower-carbon economy. However, market forces are also driving businesses to respond to the risks and opportunities presented by this transition.

The World Economic Forum's *Global Risks Report 2018* highlights the environmental threats that present the most likely and most damaging risks. The report also shows how other dangers, such as social instability, involuntary migration, and unemployment, can be exacerbated by environmental or natural catastrophes. Together, the forces of a changing physical environment present businesses with a wide array of strategic and operational risks, including supply-chain disruptions caused by decreased availability of key resources, the loss of customers or vendors, and changing policy and regulatory regimes aimed at reducing the risk of climate change.

Corporate risk profiles are changing as a result of these environmentally-driven pressures and three associated trends: The growth of responsible investing has led investors and credit-rating agencies to focus on companies' exposure to climate change impacts, growing requirements

for disclosure on sustainable practices, and shifting customer preferences cascading through B2B and B2C supply chains. Across a wide range of industry sectors, sustainability and transparency around a product are no longer simply tiebreakers after cost, quality, and delivery—they have become table stakes. As the CFO of a food product supplier observed, "If it is important to the customer, then it is important throughout the supply chain."

Despite the significant implications and measureable financial impacts of sustainability-related risks and opportunities, sustainability often has weak links to the financial, risk, and strategy agendas at many companies. Firms must identify, assess, and respond to the strategic and operational risks and opportunities presented by this changing business environment. Those that do not may find themselves losing ground in an increasingly competitive global marketplace (See Exhibit 1).

Research into the risk and sustainability gap identified three key actions for both sustainability leaders and risk and finance executives to help companies make progress: integrate sustainability into strategic planning and enterprise risk management (ERM) planning processes; embed sustainability into financial modeling and risk assessment processes; and create a common set of terminology.¹

Exhibit 1: Benefits of embedding sustainability within ERM programs



Increases visibility for broader set for key performance drivers



Aligns risk taking with profit, growth, and sustainability targets



Generates higher future returns through disciplined allocation of capital aligned to investor expectations



Stabilizes performance by protecting against downside scenarios



Increase awareness of emerging risks within key decision making processes



Achieves risk governance and compliance as a by-product of value creation

Source: Marsh & McLennan Companies' Global Risk Center

¹ Unlock Growth by Integrating Sustainability: How to Overcome the Barriers, Marsh & McLennan Companies, the Association for Financial Professional, and GreenBiz Group, 2016

EMBED INTO EXISTING OPERATIONAL AND STRATEGIC PLANNING

To support growth and achieve a competitive advantage, sustainability must be integrated into the strategic and financial planning process.

Sustainability executives should secure leadership support and become allies with those who have a seat at the strategy and executive table. In addition, sustainability leaders should participate in cross-functional bodies that cut across silos, such as a loan committee that includes marketing, finance, and product-development representatives.

Building relationships with the strategic planning team or internal audit can also help drive ownership of the concept through the organization. At one organization, the internal audit group has helped align sustainability and enterprise risk management (ERM) processes and support external reporting. Perhaps more importantly, the group has guided the sustainability team in shaping conversations across the business and executive team.

At many companies, integration of sustainability and planning is already taking place to manage strategic and operational risk. For example, one company chose to ensure a high level of LEED certification in constructing a new plant in China. This created a “sustainability win” and provided a competitive advantage, as customers approved of this approach. It also ensured greater operational resiliency by reducing energy costs, reducing wastewater, and generating other operational efficiencies that position the company for success in the face of fluctuating water costs or the future introduction of a carbon price. As the CFO said, “We are investing \$90 million, and we don’t want to do this twice.”

Leading companies are also factoring externalities into corporate scenario planning or three-year strategic planning processes. A global clothing manufacturer incorporated information on water stress and scarcity into strategic planning and had discussions about emerging market growth plans and factory

leasing and siting. Discussions on a 10-year lease for a factory were enriched by questions of whether there would be sufficient water to support operations, and the analysis helped the company identify potential issues in business continuity.

Finance and enterprise-risk leaders are also recognizing that sustainability-related initiatives offer opportunities to secure new or expanded conversations with capital markets. For example, one manufacturer’s \$60 million expansion of a facility was financed by a new market tax credit program that attracted four different impact investors focused on community development. The organization’s finance team worked closely with the sustainability group to promote the project, including working on a video segment on the green impact of the expansion.

EMBED RISKS INTO RISK ASSESSMENT PROCESSES AND FINANCIAL MODELING

Many companies have not effectively integrated sustainability risks into ongoing risk assessment processes. One barrier is that the horizons for many sustainability risks far exceed those used in most corporate risk assessments. That creates challenges in quantifying sustainability risks in meaningful financial terms for the company.

Yet companies are making progress. For example, many now apply an internal carbon price to project evaluations as part of the risk assessment and capital allocation process. One organization categorizes and embeds sustainability risks (such as climate change impacts or transitions in energy supply) into its risk taxonomy and ERM categories (financial, strategy, or reputation) as an accelerant and driver of other key risks. This approach enables the ERM and sustainability teams to identify overlaps between many corporate-identified exogenous risks and so-called “sustainability risks.” In this way, a sustainability focus has become an element of risk mitigation and contributes to achieving organizational strategies.

At another company, the sustainability executive became part of the ERM committee. In that role, the individual has been able to integrate sustainability discussions into an ERM process that is strongly focused on the economic and financial risks to the company by working closely with the treasury, finance, and legal leaders of the annual ERM review.

CREATE A COMMON LANGUAGE RELATING TO RISK AND RESILIENCE

The framing and communication of sustainability risks has a huge impact on bridging the gap to the finance and ERM programs. Corporate sustainability goals and programs need to be communicated in the language of the business and, in terms of the core corporate metrics, consistent with those required from any strategic or operational business plans. Those might include a risk-adjusted return number, a range of the potential cost savings, or revenue or earnings increase, with a clear identification of the assumptions and a clear understanding of the risks that create uncertainty in outcomes.

Establishing a common core language relating to risk and resilience clarifies the issues that are deeply tied to business operations. For example, a conversation about issues such as “how to increase the resilience of the supply chain” is more likely to gain traction in a company than a discussion about “a sustainable agriculture strategy.”

CONCLUSION

It is clear that sustainability issues will continue to affect businesses as extreme weather events, resource depletion, and other related impacts present financial risks. Shareholders, investors, regulators and customers are demanding greater disclosure on the risks to a corporation's long-term sustainability.

Finance and enterprise risk leaders must help their corporations financially assess and integrate sustainability-related initiatives to enable enterprise risk mitigation and capture competitive advantages. For their part, sustainability leaders must look to better integrate their efforts into corporate strategic and operational planning, financial modeling, and enterprise risk management to help the corporation respond to evolving risks.

Those companies that can effectively identify, assess, respond to, and manage the strategic and operational risks and opportunities presented by the changing business environment will be best positioned for long-term growth.

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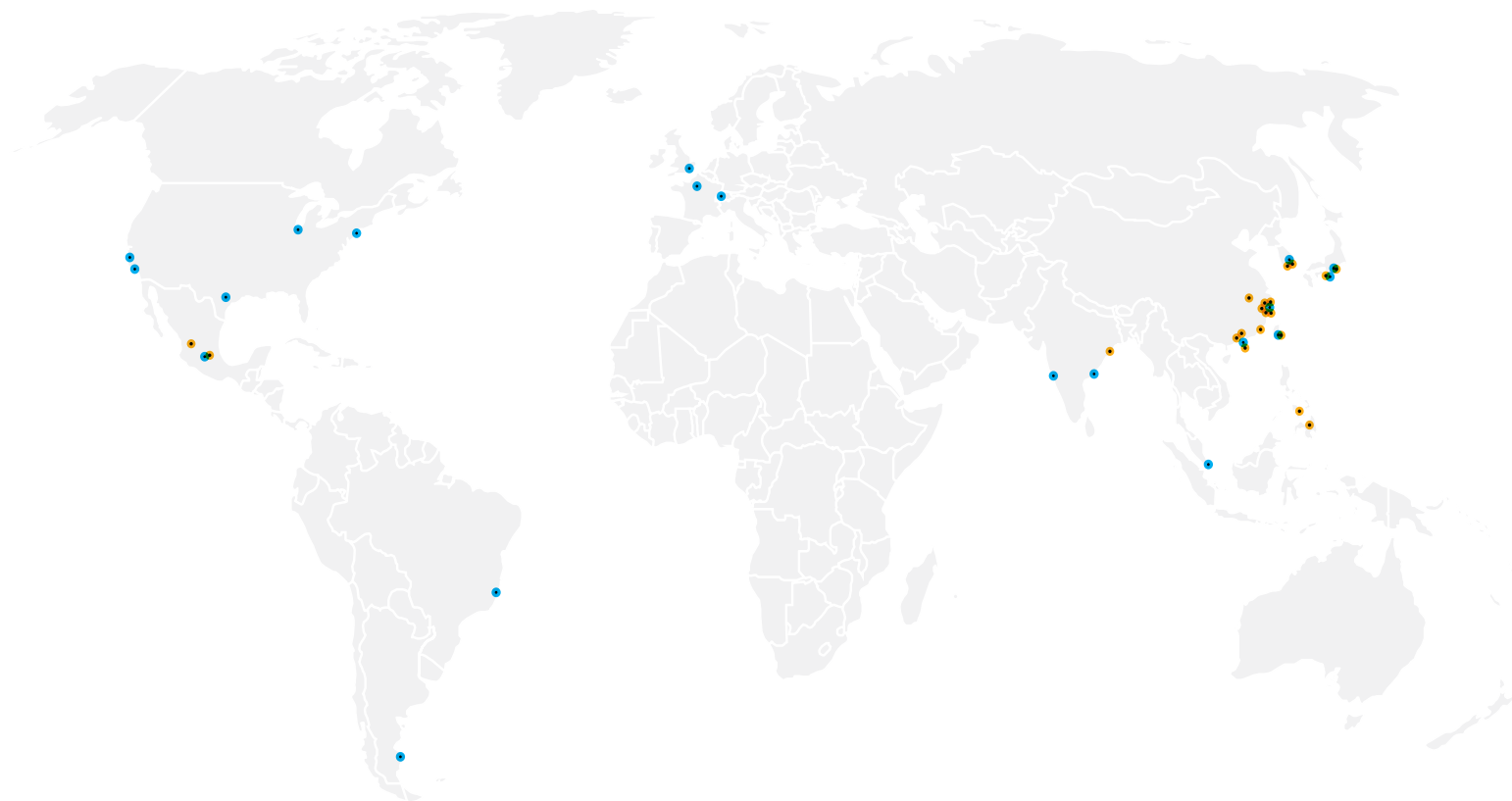
**IF IT IS IMPORTANT TO THE CUSTOMER,
THEN IT IS IMPORTANT THROUGHOUT
THE SUPPLY CHAIN.**

EXTREME WEATHER THREATENS GLOBAL SUPPLY CHAINS

Cities facing greatest economic exposure from flood events

GDP at Risk, US \$BN

| | | | | | | | | | | | |
|---|-------------|-------|----|----------|-------|----|--------------|------|----|---------------|------|
| 1 | Tokyo | 17.65 | 6 | Delhi | 11.28 | 11 | Paris | 8.29 | 16 | Chicago | 6.23 |
| 2 | Osaka | 13.83 | 7 | Taipei | 10.75 | 12 | Houston | 7.83 | 17 | Mumbai | 6.11 |
| 3 | Los Angeles | 13.29 | 8 | Shanghai | 9.85 | 13 | Buenos Aires | 7.34 | 18 | Singapore | 5.88 |
| 4 | New York | 13.07 | 9 | Seoul | 9.83 | 14 | Bern | 6.72 | 19 | Mexico City | 5.60 |
| 5 | Sao Paulo | 11.63 | 10 | London | 9.71 | 15 | Hong Kong | 6.56 | 20 | San Francisco | 5.48 |



Cities facing greatest economic exposure from wind events

GDP at Risk, US \$BN

| | | | | | | | | | | | |
|---|----------|-------|----|----------|-------|----|-------------|-------|----|-------------|-------|
| 1 | Taipei | 81.14 | 6 | Shanghai | 26.81 | 11 | Mexico City | 16.34 | 16 | Kolkata | 11.06 |
| 2 | Manila | 60.66 | 7 | Dongguan | 26.35 | 12 | Guangzhou | 15.81 | 17 | Suzhou | 10.27 |
| 3 | Seoul | 44.68 | 8 | Xiamen | 18.67 | 13 | Hong Kong | 15.57 | 18 | Wuxi | 9.17 |
| 4 | Tokyo | 29.06 | 9 | Ningbo | 18.55 | 14 | Shenzhen | 14.81 | 19 | Guadalajara | 8.52 |
| 5 | Hangzhou | 28.93 | 10 | Osaka | 18.45 | 15 | Busan | 11.46 | 20 | Hefei | 7.94 |

Source: City Risk Index 2015-2025, Lloyds, https://www.lloyds.com/cityriskindex/threats/wind_storm

2017: EXTREME WEATHER EVENTS AROUND THE WORLD

| | | | |
|---|---|--|---|
| Hurricane Maria Northern Caribbean 2017 | Maria struck the northern Caribbean as a Category 4-5 storm just weeks after Hurricane Irma had devastated the region. Puerto Rico was left without power, and energy infrastructure repairs will take months. Hurricane Maria could cost Puerto Rico between \$45 billion to \$95 billion in damages and 50%-90% of annual GDP. | Flooding Sri Lanka 2017 | Sri Lanka saw its worst flooding since 2003, displacing over a half million people. Deforestation magnified the scope of the event, increasing the likelihood of mudslides. |
| Hurricane Harvey US Gulf Coast 2017 | Breaking the record for most rainfall from a tropical cyclone in the continental US, Harvey caused unprecedented flooding in Houston and the surrounding region. The main airport and port were closed for five days, causing backlogs throughout the US transportation system. Damage estimates are in excess of \$180 billion, making Harvey the most costly storm in US history. | Heat wave Australia 2017 | South Australia and New South Wales faced widespread blackouts as grid and power generators were unable to meet high power demands to serve cooling needs. As a result, a AU\$550 million energy plan is being enacted to meet future demand related to expected increased temperatures. |
| Hurricane Irma Northern Caribbean/ US 2017 | Irma ranks as one of the four most powerful storms ever to occur in the Atlantic Basin, impacting the northern Caribbean and Florida. Insured losses are estimated to be between \$20 billion and \$40 billion. | Drought Montana (USA) 2017 | Crops across the Northern US were heavily damaged as an exceptional drought kept the region in a dangerously dry state. Wildfires raged during the "driest period on record" for Montana, destroying over 270,000 acres. The combined effect of drought and fire may exceed \$1 billion. |
| Heat wave Southern Europe 2017 | The strongest heat wave in years (nicknamed "Lucifer") impacted southern Europe. Portugal experienced more than three times the average number of wildfires in 2017, and farmers across southern Europe saw crops wither and the drought cause more than \$1 billion in lost revenue. | Typhoon Southeast Asia 2017 | Typhoon Doksuri caused extensive damage in Southeast Asia, especially in Vietnam, where it was the most powerful storm to hit the country in a decade. Loss estimates are at a \$500 million across the region with widespread damage to farmland, roads, and water and electricity infrastructure, along with an estimated 250,000 homes. |
| Monsoon South Asia 2017 | The worst monsoon in 15 years struck India, Bangladesh, and Nepal. In India's financial capital, Mumbai, over 150 milliliters of rain fell in one hour, collapsing buildings, washing away roads, and shutting down the city. In Bangladesh, more than 6,000 sq. km. of crops were damaged. | Typhoon Southeast Asia 2017 | Hong Kong raised its highest alert as Typhoon Hato struck the city in August, causing and estimated \$1.42 billion in economic losses. |
| Colombia rains 2017 | Torrential rains led to a tragic mudslide in the southern city of Mocoa, where three rivers overflowed their banks and coursed through the city. Deforestation and high population density were identified as contributing factors to the event. | Wildfires California (USA) 2017 | Fueled by significant growth in vegetation due to record winter rains following a five-year drought, wildfires spread across California in the last months of 2017. The damage resulted in at least \$9.4 billion in insurance claims and the total cost of the fires, from fire suppression to insurance and recovery expenditures, is estimated to be as high as \$180 billion. |



EXTREME WEATHER

MAKING LANDFALL
ON BUSINESS

TOM MARKOVIC



The Atlantic hurricanes of 2017 were timely reminders that extreme weather events and changing weather patterns often present acute, rising, and immediate threats to businesses. Prior to 2017, there had never been a year in which more than one Atlantic Category 4 hurricane landed in the United States in the previous 166 years of recorded weather patterns. In 2017, there were three such landfalls – Harvey in Texas, Irma in Florida, and Maria in Puerto Rico.

Hurricanes Irma and Jose also mark the only time in recorded history that two hurricanes reached 150 mph wind speed levels in the Atlantic at the same time. Irma remained a Category 5 hurricane for more than three days, longer than any hurricane in the satellite era (which began in 1966), while Hurricane Harvey set a US rainfall record for a tropical storm that delivered financial and material devastation through both flooding and wind damage.

THE DESTRUCTION OF PRODUCTIVE ASSETS OR INFRASTRUCTURE IN AN EXTREME WEATHER EVENT CAN ENTAIL A HIGHER OVERALL FINANCIAL LOSS.

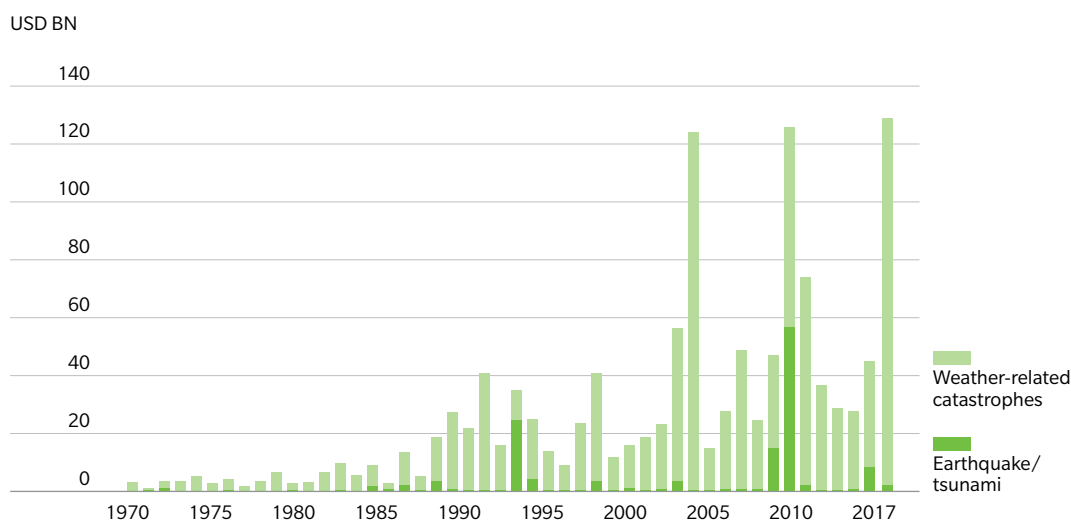
The list of extreme weather events is not confined to the United States; the number of extreme weather events globally increased more than five times, from 38 in 1980, to 191 events in 2016.¹ In 2017, the total economic losses from natural catastrophes globally were estimated at US\$300 billion — of these losses, however, only about US\$133 billion were insured. (See Exhibit 1.)

One does not need to look at just the events labeled as “natural catastrophes” to realize the impact that extreme weather events and climate change can have on businesses. Chile has been in a nearly decade-long drought that started in 2007, which has severely impacted power, water, agriculture, and many other vital industries. The drought prompted the Chilean government to

lay out a water plan in 2015, and has led private mining companies to invest in desalination plants. The only breaks from the dry spell have come in the form of downpours, such as when the equivalent of seven years of typical rainfall fell in about 24 hours in the Atacama Desert region in 2015. The rainstorms have also resulted in destructive mudslides, which left 5 million residents in Santiago and the surrounding areas without water when their chief water source was contaminated by flooding and mudslides in February 2017.

Changing weather patterns are impacting all major industries, including agriculture, infrastructure, transportation, energy, manufacturing, public sector, and real estate. Agricultural companies must plant new crops on existing farmland, or relocate planting operations to higher/lower elevations, or more northern/southern latitudes. In the energy sector, water shortages can affect the cooling systems of thermal and nuclear power plants, such as in 2009 when one-third of France’s nuclear power capacity had to be shut down as river temperatures were too warm to perform necessary cooling.

Exhibit 1: Historical records of total insured catastrophe losses from 1970 to 2017



Source: SwissRe and Marsh analysis

¹ Swiss Re Institute, Feb 2017. Natural Catastrophes and manmade disasters in 2016: A year of widespread damages (last accessed 5 October 2017) http://media.swissre.com/documents/sigma2_2017_en.pdf

Economic production today is more complex, interconnected, and involves assets and inputs with higher economic value than in the past. This means that the destruction of productive assets or infrastructure in an extreme weather event can entail a higher overall financial loss than was previously the case. Business interruption can be severe due to the reliance on infrastructure and the overall supply chain impacts.

CHALLENGES OF TRADITIONAL INSURANCE COVERAGE

The financial impact of such events frequently cannot be managed through insurance coverages that are currently offered under traditional insurance policies, which can lead to the following three key challenges:

- 1. A mismatch in event measurement and recognition.** For example, roads leading to open-pit mines in Australia's Bowen Basin get washed away when a cyclone inundates the region, leading to an operational disruption seldom covered under traditional business interruption (BI) policies, as the financial impact is not a result of first-party physical damage.
- 2. Coverage may not be available for the threat presented.** For example, losses due to interruption to power supply caused by transmission line damage are extremely difficult to insure in the commercial market, and the impacts of the 2017 hurricanes will be felt in the power and the utility sector in Florida, Texas, and the Caribbean. Looking elsewhere, crop insurance in many developing regions is not readily available and comes with limitations.
- 3. Slow settlement processes.** Even in scenarios where coverage does apply in the examples mentioned above, the claims settlement process is often arduous, lengthy, and payout rarely comes close to the full extent of losses. This is the basis risk that is seldom talked about – the difference between actual losses and payouts under traditional insurance policies. Last but not least, having quick and easy access to funds is vital to human and business survival when catastrophic events strike.

| C A S E S T U D Y |

PARAMETRIC TO MANAGE GAPS IN RISK MANAGEMENT FOR CROPS

A private crop grower in South America felt the impact of drought on crop yields in 2016. With limited applicable crop insurance from the commercial market, the grower has turned to parametric solutions. As part of the structuring process, an in-depth analysis was performed on historical rainfall data and crop yields. The analysis identified a strong correlation between (i) the duration of the drought during the growing season and (ii) the grower's crop yields – the longer the drought, the larger the adverse financial impact to the grower. Furthermore, historical rainfall data has shown that significantly worse weather conditions have taken place historically than experienced in 2016, emphasizing the need to protect revenue. Based on this information, the grower has elected to purchase parametric coverage based on a drought duration index. The risk period covers the growing season, and the payout is greater for longer-lasting droughts. Payout formulas are predefined, and depend solely on the rainfall measurements provided by a third party, thus facilitating expedient settlement.

Exhibit 2: Comparison of traditional and parametric cover

| | TRADITIONAL INSURANCE | PARAMETRIC/INDEX-BASED COVER |
|------------------------------------|---|--|
| Trigger | Loss or damage to physical asset | Event occurrence exceeding parametric threshold |
| Recovery | Reimbursement of actual loss sustained | Pre-agreed payment structure based on event parameter or index value |
| Basis Risk | Policy conditions, deductibles and exclusions | Correlation of chosen index and structure with actual exposure |
| Loss assessment and payment | Months to several years – depending of complexity of loss | Transparent and rapid settlement |
| Term | Usually annual, multi-year difficult | Single or multi-year – up to 3 years |
| Structure | Standard products and contract wordings | Customized product with high structuring flexibility |
| Form | Insurance contract | Insurance or Derivative |

Source: SwissRe and Marsh analysis

To increase resiliency to climate change and mitigate the impact of un/under-insurable climate events, both public and private entities are adding parametric solutions to their toolbox of risk-mitigation products. This applies equally to long-term planning and management of midterm revenue volatility reduction, as well as to the short-term ability to secure quick access to funds in a time of need.

Parametric solutions revolve around a measurable index, and are based on predefined formulas and payout mechanisms with quick claims settlement and without physical damage requirements. Indexes can range from one as simple as the amount of rainfall impacting the St. Andrews golf course during the final day of the British Open golf tournament, to multi-

trigger concoctions of typhoon wind speed and storm rainfall measurements that may impact a single power distribution network of a utility based in the Pacific Ring of Fire.

One of the key notions is that the underlying data used to calculate the index have to be reliable and verifiable through a trusted third party with an extended history, and the expectation that data will be available in the future – this is essential for historical analysis, structuring, premium calculations, and settlement. An even more important premise is the ability to design the index such that the basis risk is minimized between (i) actual losses and (ii) the formulaic payout offered by the parametric policy or contract. If data is not available or correlations are poor, meaningful coverage will not be viable.

PARAMETRIC SOLUTIONS ARE LIKELY TO BE USED AS A RISK MITIGATION TOOL BY A GROWING LIST OF COMPANIES.

ADVANTAGES OF PARAMETRIC SOLUTIONS

Although the parametric-coverage design process may be complex – and it may take several months to develop an optimal solution and place it with either the insurance markets or the capital markets – the settlement process is typically straightforward. Once an event has occurred, such as a hurricane crossing a predefined geographical area in the Pacific, or the risk period has reached expiration date and total rainfall is now known at the weather station tracking a series of farms, measured data is compared to coverage triggers. If, for example, hurricane winds in the geographical box reached a certain speed that is above coverage triggers, payout would be calculated based on pre-agreed formulas. Likewise for rainfall, the longer the drought, the higher the payout to the farmer; with the modeled expectation that longer dry spells lead to higher losses. Payment could be issued within days of the measurable event, and funds can be deployed immediately to repair roads, make loan payments, and so on. Noting that if coverage is placed as insurance, attestation may be required confirming that actual losses are at least equal to the payout received. Thus, the coverage offers improved event recognition, increased availability of coverage, and speedy settlement. (See Exhibit 2.)

There are other benefits to using parametric coverage. For example, parametric solutions can free up funds for investing in new industries (sovereign tax revenue considerations), relocating operations to better-yielding farmlands, providing assistance in the case of catastrophic events, investing in vital power and food supply-chain infrastructures, and so on.

CONCLUSION

In recent years, there has been a significant increase in the use of parametric solutions. Placements include drought index-based solutions for agriculture operations in Brazil, multi-trigger storm protection for power sector in Southeast Asia, and storm-surge protection in the transportation sector in the United States. Climate change is driving unpredictable weather patterns, and as the need for parametric solutions continues to grow, the available market capacity is expected to continue to increase. Going forward, parametric solutions are likely to be used as a risk mitigation tool by a growing list of companies.

Tom Markovic, PhD is a Senior Vice President, Weather & Energy Specialty Products, Marsh USA Inc. based in New York, United States.



USING CAPTIVES TO MITIGATE CLIMATE CHANGE RELATED RISKS

ELLEN CHARNLEY

Climate change, whether anthropogenic or a natural phenomenon, has resulted in irreversible consequences. It has affected weather patterns, strengthened storms, and increased the probability of extreme weather events, such as hurricanes, earthquakes, and wildfires, among many others. In view of the growing frequency and severity of these extreme weather events, captive insurers are strategically funding risk exposures to mitigate the impact of climate change on their parent companies.

ESCALATING CLIMATE CHANGE AND ENVIRONMENTAL RISKS

The effects of climate change are increasingly exposing businesses to new and unpredictable risks; often times they can be catastrophic in nature or interfere with an organization's ability to do business, which inherently drives up the associated operational costs. Since 2014, each successive year has been recorded as the hottest year on Earth.¹ There has been an undeniable increase in the frequency and intensity of water shortages — to the extent that by 2050, the Organisation for Economic Co-operation and Development's (OECD) Environmental Outlook estimates that four billion people (40 percent of the global population) will be living in water-scarce areas.² This has led to an international food crisis as countries struggle to adapt their agricultural

industry. It has become increasingly difficult for organizations to retain climate resilience, which is significantly raising the cost of business operations.

Not surprisingly, the *Global Risks Report 2018* revealed that over the past decade extreme weather events and failure of climate change mitigation and adaption, as well as water crises, have consistently emerged as key risk concerns to business leaders in the global risk landscape. These risks are interconnected and can exacerbate many other risks, such as domestic and regional conflict, as well as involuntary migration. According to the report, every environmental risk that was assessed has become more prominent: each rising above the average on both scales of likelihood and impact. Additionally, manmade environmental catastrophes caused by pollution, oil spills, fracking, radioactive contamination, and greenhouse gas emissions have permanent effects on the global economy. Demand for raw commodities continues to increase as a result of resource depletion, and traditional businesses in these industries may fail to properly function should businesses not substitute them with more sustainable alternatives. Organizations can capture major strategic advantages by starting to address and quantify these risk factors and considering traditional risk transfer and captive use along with reinsurance, where appropriate. (See Exhibit 1).

Exhibit 1: Captive solutions can improve climate resilience

Global Uncertainties

- Floods
- Earthquakes
- Hurricanes
- Droughts
- Increased frequency of natural catastrophies
- New exposures due to climate change
- Pandemics



Gaps in traditional coverage

- Growing exposure due to climate change
- More frequent natural catastrophies



Captive solutions

- As natural catastrophies become more frequent and spread to unprepared locations, the environmental insurance market may begin to harden. Having a captive allows access to less expensive coverage and prepares for real a "worst-case-scenario"
- Formal funding
- CAT bond access
- Flood, earthquake, and wind
- Insurance linked securities (ILS)

Source: Marsh

¹ <https://www.nasa.gov/feature/goddard/2016/climate-trends-continue-to-break-records>

² <http://www.oecd.org/env/indicators-modelling-outlooks/oecdenvironmentaloutlookto2050theconsequencesofinaction-keyfactsandfigures.htm>

Despite the impacts of the United Nations Climate Change Conference, and an array of new regulations controlling oil, pollution, and other elements, in many instances, the environmental concerns and damages currently facing international businesses have not been immediately addressed.

Some businesses are already feeling the impacts of climate change “drivers” such as pollution. A prime example is the hazardous smog blanketing several of China’s larger cities. This issue has caused metropolitan areas like Beijing to shut down businesses for days until the pollution and haze dissipates. These events may lead to contingent business interruption (CBI) losses, which may be insurable. However, such events may be difficult to insure on the commercial markets, unlike other climate-related risks that result in physical property damage. With very limited options, companies are creating their own insurance solutions in captive insurance companies.

Captives may offer security for an extremely uncertain environmental landscape by offering customizable coverage, such as the example illustrated in Exhibit 1, and providing a vehicle to access reinsurance for otherwise difficult to insure losses. For example, wind-related losses and impacts on transmission and distribution (T&D) lines for power and utility companies. Captives recently have shown a large uptake rate for supply-chain risk (which increased 133 percent from 2014 to 2015 for Marsh-managed captives); considered non-property-damage business interruption, such risks could result from global weather events and could ultimately affect a business halfway around the world. Examples include the Thailand floods in 2011, the Japan earthquakes and tsunami of 2011, and Hurricane Harvey in 2017.

PROTECTING YOUR BUSINESS FROM RISING SUPPLY-CHAIN RISK

The combination of climate change, global financial pressures, and political protectionism emphasizes the critical importance of global supply chains and the potential impact of their failure.

Given today’s highly uncertain business environment, companies may look to captives to provide more comprehensive supply-chain coverage. Traditional business interruption insurance provides only limited protection, as it is restricted to the impact of physical loss or damage at (primarily) first-tier suppliers. The development of an all-risks supply-chain cover, supported by captive-funded pre-placement risk assessments, can provide additional comfort for an organization in a challenging risk environment.

It is important that risk managers work closely with their own supply-chain managers and external advisers where appropriate in order to:

- Identify/validate business-critical suppliers of goods and services and the suppliers on which they rely.
- Assess and quantify the impact of the loss of that supply and its inherent resilience.
- Obtain indicative costs for all-risks supply-chain cover for key elements.
- Consider preliminary assessment funding and risk transfer through captive vehicles.

The assessment of supply-chain risk is not, however, a stand-alone exercise but one that should form part of an integrated approach to the identification, mitigation, and transfer of risk.

Climate change has an immediate effect on global business operations by causing massive property loss and business interruption risks. Many captive parents and prospective captive owners should consider the benefits of writing property, wind, flood, business interruption, and supply-chain coverage into their captives in order to protect against these growing environmental threats.

Ellen Charnley is President, Marsh Captive Solutions, based in Nevada, United States.

| C A S E S T U D Y |

WHAT IS A CAPTIVE AND HOW DOES IT ADDRESS CLIMATE CHANGE RISKS?

A captive insurance company is a bona fide licensed insurance or reinsurance company owned by a non-insurance company, which insures or reinsures the risks of its parent or affiliated companies. Simply put, it is a formalized mechanism to finance self-insured risks or access the reinsurance market.

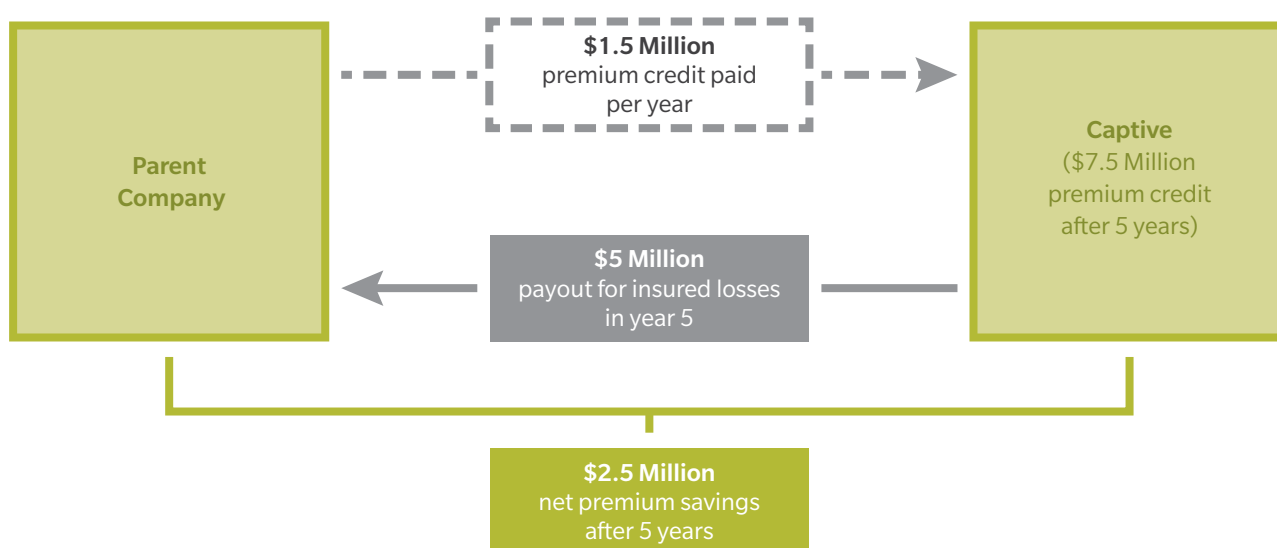
Historically, most captives were formed by parent companies from North America and Europe, but a new trend is starting to emerge. Over the past three years, Marsh has seen growing interest from emerging geographies driven by captive owners who are becoming more creative in the construction of their captives, taking advantage of geography-specific opportunities (such as direct writing ability across the European Union), regulatory flexibility, and international tax efficiencies. Captives formed by parent companies in Latin America increased by 11 percent in 2016, compared to the previous year, making it the fastest growing region for captives. Many assume captives only write traditional or predictable risks; however, this is not true. Captives can write high-severity, low-frequency risks as well. As an insurance

company, they are able to access reinsurance markets and alternative capital markets to fund less predictable retained risks that are uninsurable or difficult to insure on the commercial market. Furthermore, a captive can act as a risk-financing vehicle that, over time, builds up surplus to pay for more catastrophic risks such as hurricanes and earthquakes. This helps organizations reduce cash flow volatility and decrease budget uncertainty.

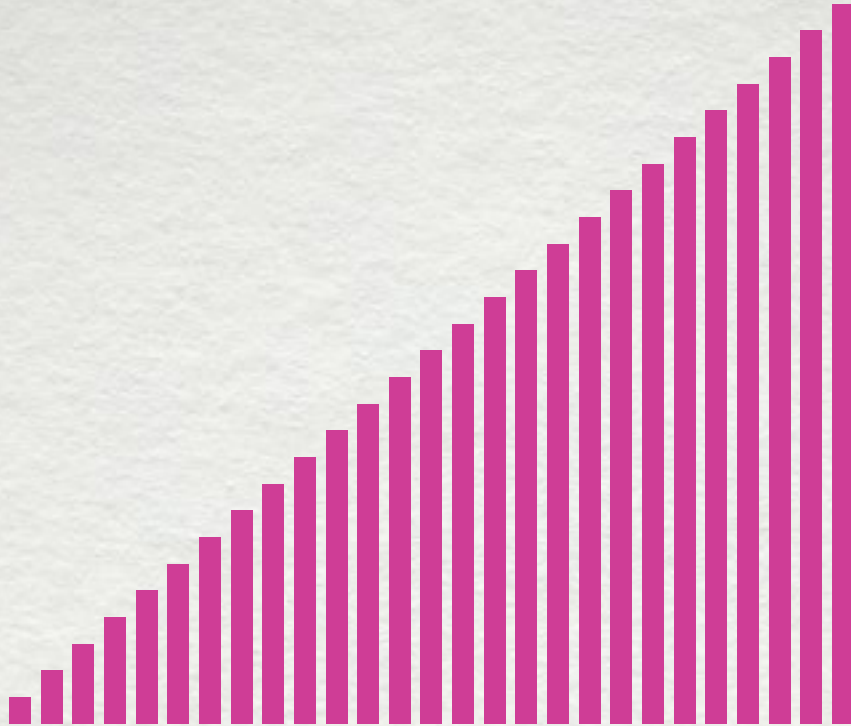
For example, consider an organization that has a large property exposure with an existing US\$1 million deductible. They determine that they can raise their deductible to \$2 million and receive a \$1.5 million premium credit. (See Exhibit 1.) The company has not had any product liability losses in excess of \$1 million in the past 10 years, so they decide to assume the higher deductible of \$2 million. They then decide to remit the \$1.5 million premium savings into a captive, which will insure the \$1 million excess /\$1 million layer.

As illustrated in Exhibit 2, the company recouped \$2.5 million in net premium savings over five years by obtaining capacity from the captive instead of the commercial insurance market. In addition, by formally putting aside premiums into the captive each year, the parent had proper reserves accrued, which ultimately stabilizes earnings for the consolidated organization.

Exhibit 2: Creating financial stability through a captive program



Source: Marsh



CLIMATE CHANGE AND THE EVOLVING CORPORATE GOVERNANCE LANDSCAPE

MELITA SIMIC

Climate change is no longer an ethical environmental issue. It has become a matter of corporate governance, with regulators and shareholders globally increasing oversight and pressure on greater corporate disclosure of climate change risks.¹

In fact, the first climate change-related securities class action was filed in late 2016 in the United States, and in August 2017, an Australian bank was sued by shareholders for what is viewed as a failure to properly disclose the risks to the business posed by climate change. More such cases are expected to follow globally. Shareholders and regulators will be examining companies and directors for purported failures to accurately disclose climate change-related risks to investors.

The increasing focus on climate change exposures presents new and different challenges for directors and their companies, with the threats of class action lawsuits, significant remediation costs and irreversible damage to the corporate and personal brand growing ever more likely.

Against this changing landscape, directors should consider what protection for climate change exposure can be offered under Director and Officer (D&O) insurance policies and where potential gaps in cover exist.

IDENTIFYING THE GAPS IN D&O COVER

A typical D&O policy covers directors and officers for all acts, errors or omissions arising from their conduct as directors, which could therefore include matters relating to climate change risks. Some of the allegations that may trigger a D&O policy include breaching their fiduciary duties in not considering the financial risks associated with climate change or failing to comply with legislative reporting requirements. Furthermore, if the D&O policy contains Company Securities Cover, coverage may also be available for the company in the event of

shareholder litigation – a key issue as share prices have been known to plummet following adverse news on climate risk exposures.

However, D&O liability insurance policies might not always respond to a climate-related risk in the manner expected. In part, the issue stems from the fact that D&O insurance was established long before climate change emerged on the world's political agenda. Consequently, climate-related risks do not fit neatly within existing definitions and exclusions of traditional insurance policies, leading to potential gaps in cover.

Most D&O policies contain a pollution exclusion. Some exclusions read in absolute terms excluding claims, for example, “arising out of, based upon or attributable to or in any way involving directly or indirectly pollutants.” Others use narrower language to exclude claims “for” pollution. The reason for the exclusion is that pollution-related claims are addressed by a raft of other insurance policies. When applying this exclusion to climate change risks, the issue becomes about determining whether greenhouse gases are considered “pollutants.” This is defined in most D&O policies as any solids, liquids, gaseous, or thermal irritant or contaminant.

In the United States, the conclusion appears to have been drawn that carbon dioxide (along with other greenhouse emissions) falls under the classification of “pollutant.” This finding has been recognised in various jurisdictions, including in Australia.

Some D&O policies remove the ambiguity by expressly defining carbon dioxide or other greenhouse gases as a pollutant. Those D&O policies that feature a pollution exclusion typically contain write backs to the exclusion or provide extensions for shareholder pollution claims (some are limited to derivative claims only) and defense costs, the latter being typically sub-limited.



¹ Summary version of paper delivered by Melita Simic, Senior Vice President, Marsh Property Ltd. at the International Legal Symposium: Climate Change Risk and Corporate Governance Directors' Duties and Liability Exposures in a post-Paris World. 29-30 August, 2016, University of Melbourne

| C A S E S T U D Y |

D&O POLICY TERMS AND CONDITIONS FIRST- AND THIRD-PARTY COVER

D&O policies principally cover ‘third party losses’ which relate to losses sustained by a third party (such as customer, client or supplier) as a result of a director’s wrongful acts, errors or omissions. (See Exhibit 1.) Loss is typically defined to include damages, judgments, settlements, and other associated expenses such as defence costs, claimant’s costs, and crisis costs. However, climate-related direct and indirect risks result in a number of “first party losses” being direct losses sustained by the company. Damage to property, business interruption, lost market value, and remediation and clean-up expenses are some of the losses sustained directly by a company as a consequence of a climate-related risk, and these items are not typically covered by a D&O policy.

Exhibit 1: First- and third-party D&O cover of climate risks

| | D&O POLICY COVERAGE PARTS | |
|---|---|--|
| | First party costs and expenses Reimburses an organization for the costs it incurs | Third party costs and defense costs Covers an organization's liability to third parties |
| Climate-related risks (physical and transition) | <ul style="list-style-type: none"> • Business interruption • Property damage • Market value loss • Remediation and clean up costs | <ul style="list-style-type: none"> • Regulatory investigations • Litigation and defense costs • Compensation and claimant's costs |
| D&O policy coverage |  |  |
| Source: Marsh | | |

Other exclusions found in a D&O policy may also restrict cover for climate-risk exposures. For example, D&O policies can contain a bodily injury and property damage exclusion on the basis that such claims are covered under public and products insurance policies or workers compensation insurance. If couched in broad terms (“arising out of,” “based upon,” etc.), the exclusion will likely capture any climate change event that leads to property damage, along with mental and emotional distress caused by associated pollution.

Some D&O policies specifically exclude cover for fines and penalties, which will then limit any cover that a D&O policy may provide following an adverse regulatory finding into a breach concerning climate change.

There are other exclusions which can also affect policy coverage. For example, many fraud and dishonesty exclusions deny claims for loss resulting from the willful violation or breach of any law, regulation or bylaw anywhere in the world, as well as the breach of duty imposed by any such law, regulation or bylaw.

Further, it is possible that climate change exclusions may be introduced in future D&O policies should boards fail to demonstrate a prudent and diligent approach to climate-risk governance in their proposals for insurance.

RESPONDING TO REGULATORY INVESTIGATIONS

Globally, there is increasing regulatory pressure on companies to meet their duties and obligations associated with climate-related risks in line with the growing body of climate science. Fortunately, most D&O policies today include some form of cover for legal costs incurred by directors or officers in responding to and attending an investigation. The better D&O policies provide this cover to the full policy limit, contain an advance payment promise, and apply even before the allegation of a wrongful act, error, or omission.

In a worst-case scenario, the consequences of any type of regulatory breach for directors and officers or the company can be severe, including criminal prosecutions, fines and penalties, disqualification or imprisonment, follow-on civil proceedings, significant legal costs and expenses, damage to reputation, and brand and disruption to business.

If a prosecution commences with the regulator following an investigation, a claim is likely to trigger under the typical D&O policy, as criminal proceedings are typically covered. Similarly, cover should also be available for any civil penalty proceedings that may be instigated by a regulator against a director for statutory breaches following an investigation. However, cover for prosecutions against the company itself is not expressly covered. As such, most D&O policies will provide some cover for costs incurred by directors in defending disqualification orders.

CONCLUSION

In the face of larger stakes around climate change risks, directors must have a thorough understanding of the risks involved and how they can be best managed. The better D&O policies will cover: (1) reasonable legal costs incurred to bring legal proceedings to overturn orders disqualifying a director from managing a corporation; (2) reasonable costs and charges in hiring a public relations firm to mitigate the effects of any published negative statements; (3) fines and penalties to the extent insurable by law; (4) preparing formal notifications to regulatory bodies in the event of an actual or suspected material breach of a company's legal duty; and (5) internal investigations requested by a regulator following a company's formal notification.

While the better D&O policy can provide some coverage for climate-related risk exposures, it does not necessarily mean that companies need to respond to all related losses and liabilities. Instead, directors and officers should carefully analyze their own risk profile to ensure a D&O program is structured to meet their needs.

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"EYES IN THE SKY" NOW ROUTINE FOR DISASTER ASSESSMENT AND RECOVERY

BEV ADAMS AND DUNCAN ELLIS

In the wake of flood, surge, and wind damage from Hurricanes Harvey and Irma, access to numerous residential, commercial, and industrial properties was limited for days, even weeks. Many property owners struggled to safely assess the physical and economic losses. Such access issues and the number of claims have also limited insurance adjusters' ability to assess damage as resources are stretched.

Given the billions of dollars in losses from these and other storms this year, the ability to gather information under trying conditions at an early stage is vital to recovery.

A range of rapidly evolving technologies, known collectively as "visual intelligence," is being developed and making a difference in managing catastrophic disaster response and claims assessment for insureds and insurers. Drones, fixed-wing aircraft, helicopters, satellites, and open-source intelligence—such as traffic cameras, YouTube, Facebook, and Twitter—combined with expert analysis, are providing real-time insights for initial loss projections (See exhibit 1.) These technologies and analyses provide many layers of data, allowing claims processes to move more swiftly and effectively. In turn, this enables communities and businesses to more quickly access financing to get back on their feet after a natural disaster.

DRONE TECHNOLOGY AND CATASTROPHIC EVENT COVERAGE

Much media attention has been focused on drone use by the insurance industry during recent disasters. Drones have been used commercially since 2003, but under tight regulatory restrictions. In the United States, increased use has been propelled by changes in Federal Aviation Administration (FAA) regulations.

While commercial use of drones less than 55 pounds is now more common, there are still many operational restrictions and the risk of being denied permission to fly if outside regulatory parameters. For example, drones could not be flown in Houston when flight conditions improved in the wake of Harvey

because the FAA enacted a temporary flight restriction given the immense search and rescue and humanitarian relief efforts required.

Factors beyond regulations may also inhibit drone integration in post-disaster scenarios. Weather is one concern, as standard drones cannot be deployed in the rain, making storm and flood coverage difficult unless higher-cost specialist units are available. Additionally, the pilot must be within eyesight of the drone, which can be impossible if there are road accessibility issues. However, law enforcement and other agencies are increasingly provided with special exemptions. For instance, the UK Fire and Rescue service can now deploy drones three miles beyond line of sight. Whether or not such exemptions will be extended to commercial operators remains to be seen.

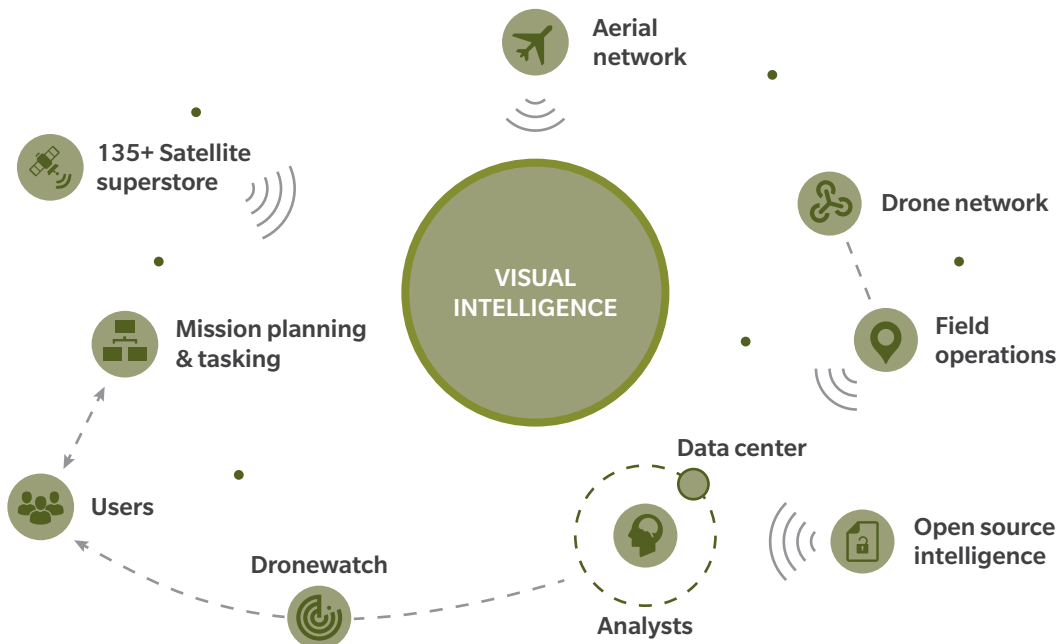
OTHER VISUAL INTELLIGENCE OPTIONS

Since drones may not be the best or most practical option in every situation, visual intelligence incorporates satellites and fixed-wing aerial technology for photo and video imagery following a catastrophic event. The variety of imagery generated by these technologies includes vertical, oblique, thermal, infrared, lidar, radar, mapped video, and immersive 3D visualization and measurement. They also can provide distinct levels of detail, from wide-area mapping to a narrowly focused, two-centimeter view.

Information about losses is also available from imagery gathered by U.S. government agencies, such as the National Oceanic and Atmospheric Administration (NOAA) and Civil Air Patrol. These government programs help prioritize current emergency response needs and build on experience from previous disasters. The imagery collected by NOAA and other agencies is typically available to all within four to six hours of their flight. While these government programs can be helpful, they cannot be wholly relied on as flight plans may not cover all impacted areas.

As with drones, a variety of conditions may impact the commercial use of satellites and fixed-wing aircraft for visual intelligence purposes. For example, the Caribbean is

Exhibit 1: Visual Intelligence is more than drones and satellites



extremely difficult to access by fixed-wing aircraft, and deployment can be cost prohibitive.

Additionally, a fixed-wing aircraft must launch close enough to the disaster and have refueling options and power and telecommunications capabilities that allow data to be downloaded and uploaded. Ongoing cloud coverage also presents challenges as it will block a satellite's view. Fixed-wing aircraft cannot necessarily fly below the cloud level and will produce blurry images if it is raining below the cloud ceiling.

Neither technology offers the level of imagery detail a drone can, but they can provide valuable information when there is severe and widespread damage. The fixed-wing aircraft images can offer more dynamic imaging options than satellite alone by capturing both a vertical and oblique "birds-eye" perspective. In the case of flood or storm surge analysis, this sideways view offers a better sense of the water levels and overall damage, especially of wash-through. Such logistical difficulties can delay image gathering, which is a challenge because flood waters often recede quite rapidly. However, images can still capture the overall extent of the damage and assist in triaging an organization's initial response.

APPLYING VISUAL INTELLIGENCE TO RISK MANAGEMENT AND CLAIMS

Much attention has been focused on the post-event uses of drones and satellites, but these visual intelligence analytic tools can be applied to the full cycle of extreme weather-event risk management and business decision making.

ASSESSING PROPERTIES PRE- AND POST-EVENT

Combinations of visual intelligence technologies can establish what a property looks like both under normal circumstances and following a disaster. These point-in-time images may be of critical importance if an area faces back-to-back disasters, in order to document what damage occurred in the first storm versus the second.

This technique was used to assess the damage from Canadian wildfires, UK floods, and now Harvey and Irma. Not only did the data gathered from non-human sources come in faster, it reduced safety exposures in hazardous areas and accelerated claims handling. Consider assessing roof damage. Rather than pay costly fees and

risk potential injuries from a contractor climbing up on the roof, a drone can quickly gather this basic data to determine next steps.

When applied to an organization's losses and insurance processes associated with those, there are four main uses for visual intelligence:

Triage for impact assessment and inspection. For organizations with possible damage to multiple sites, visual intelligence can assist leadership to triage which areas have the greatest damage and accessibility issues, and which require immediate attention (such as mitigating further damage by applying a temporary roof covering). Although an onsite investigator may be able to drive out to make these assessments, it can take more time, be hazardous, and be more expensive.

Organizations can then leverage the visual intelligence data to effectively direct resources. Additionally, the images can help access supply chains. Knowing where suppliers' facilities are located can help to quickly assess the damage they endured and the potential follow-on impact.

Accelerate insurance claims settlement. For properties that were destroyed, images can serve as proof to accelerate the claims settlement with insurers, although these decisions cannot be fully based on images. For example, in the recent wildfires in Fort McMurray, Canada, visual intelligence allowed insurers to establish initial loss estimates and make claims payments weeks before direct access to the affected area was possible.

Provide justification for advanced aid. Insurers will not settle claims based on imagery alone in most cases, but they may provide advance payments or other benefits if visual intelligence helps prove damage and access issues. Additionally, if the site experiences a complete loss, the insurer may choose to settle the claim based on the visual intelligence. This was the case for some total losses in the Japanese tsunami and the Fort McMurray catastrophes. In other cases, some companies have begun to automatically settle auto claims based on flood footage.

Financial management and loss estimation for insurers. For insurers, visual intelligence can assist in estimating the cost of an event in order to ensure that they have the proper financial protections in place to meet their obligations. Depending on the scope of the natural disaster, insurers may require a top-up cover. CAT modeling will typically provide the industry with sufficient insight into loss potential, which is used prior to the event. However, visual intelligence is the best option in areas to view actual impact and start to make some assessments, as was the case with the Japanese tsunami.

FUTURE USE

For the broader insurance industry, there are currently limiting factors to the technology. For example, a drone is not capable of learning the algorithms necessary to make the assessments that a loss adjuster can about whether the damage to a building is significant, partial, or complete. But there may soon come a time when considerations for advanced payments are possible based on the images.

The use of visual intelligence by insurers is at an early stage. But its use during events such as Harvey and Irma will add to its growing capabilities. Visual intelligence can add a new dimension to recovering from a catastrophic event by enabling the gathering of real-time, actionable information to advance insurance claims while preserving life, safety, and business operations.

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