

# Climate risk

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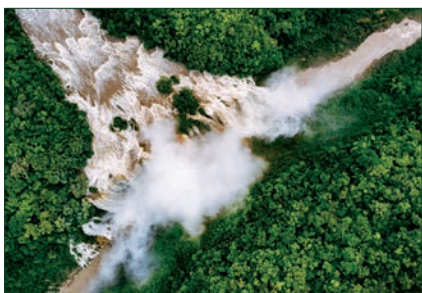
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# Crunch time for climate-related risk exposure

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As governments worldwide focus on the coronavirus (Covid-19) pandemic amid plummeting demand for fossil fuels, it may seem climate change has dropped down the global agenda.

The long-term impact of Covid-19 on green investment and climate movement is unclear, but it is widely thought that low oil prices and economic recession will slow the transition to the low-carbon economy.

However, now is not the time to drop the ball on assessing and addressing climate risk. Once social distancing measures are lifted and the world's thirst for oil resumes, harmful emissions will ramp up again – possibly at even greater levels than before due to the lower cost of fossil fuels. Oil prices could remain in the doldrums for some time, even with higher demand, due to the huge inventories that have built up.

At the same time, severe weather events will continue wreaking havoc more frequently, putting the spotlight once again on climate change and bringing renewed pressure to create a low-carbon economy.

And, still reeling from the economic crisis caused by Covid-19, regulators and central banks will be at pains to avoid another systemic financial meltdown due to the transition to a low-carbon world. The onus will once again be on individual firms to assess and mitigate their own risk exposures.

It's no easy feat. But firms that don't assess the climate risk in their portfolios, or hedge or divest their exposures accordingly, could see some of their assets lose significant value over time. In the meantime, they may fall foul of increasingly stricter regulation.

In April 2019, for example, the Bank of England (BoE) released its supervisory statement for banks and insurers outlining the financial risks from climate change and the strategic approach needed to manage these risks. The guidance has forced institutions to consider their initial plans for putting frameworks in place, as well as nominating senior individuals who will be 'climate-responsible'.

Later, in December last year, the BoE submitted proposals for climate change stress tests, which would require banks and insurers to test the resilience of their portfolios against more frequent severe weather events and transition risk. An article in this report, *Show don't tell – BoE's climate stress test dilemma* (see page 8), discusses the industry's opinions of the proposed stress tests.

The report then turns to the topic of physical climate risk in *Why forecasting climate change is a disaster* (see page 14). This looks at how challenging it is to assess physical climate risk given widely differing long-term forecasts.

We then take a look at the risks that the low-carbon economy poses to certain sectors of industry, in particular fossil fuel producers that could find themselves with stranded assets. In *Calls to hike climate policy raise risk for oil firms* (see page 22), we ask how and when the transition will curb demand for fossil fuels and how firms are estimating and measuring their exposure to this risk.

The report concludes with two interviews addressing different aspects of climate change. In a Q&A, Commissioner Rostin Behnam of the US Commodity Futures Trading Commission (see page 36) talks about ways of tackling market risk caused by climate change. He calls for new derivatives products and other products for risk transfer to be made available to help firms manage their individual exposures to climate risk.

Stella Farrington  
Head of content, Energy Risk



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# Global investing under water?

## Climate change could leave equities exposed

As impending global changes brought about by climate change loom, one issue in particular threatens to cause massive losses to institutional investors – rising sea levels. David Lunsford and Boris Prah, of MSCI, explore where, despite the efforts of initiatives such as the Paris Agreement on climate change, institutional investors must protect their portfolios from physical climate risk, and why, when it comes to facing up to climate risk, inaction could prove catastrophic





Threats to the environment from climate change are many and wide in scope. However, the most potentially devastating and arguably most permanent of these is the threat of rising sea levels. Notwithstanding the Paris Agreement on climate change – in which it was agreed to reduce the temperature rise of greenhouse gas emissions to 1.5° Celsius and which may achieve this goal – the global mean sea level may still rise 29–59 centimetres by the end of the century, and may continue to rise into the next.<sup>1</sup>

Even a modest increase in the global mean sea level of 11cm could result in additional losses of \$1.4 trillion per year – 0.25% of global GDP – according to a recent study.<sup>2</sup> For investors, the question is how coastal flooding may impact global equity portfolios.

### How severe is the problem?

Based on estimates by MSCI Environmental, Social and Governance (ESG) Research, approximately 7% of all facilities covered by MSCI All Country World Index – now known as MSCI ACWI – constituents are under threat from coastal flooding.<sup>3</sup> In addition, nearly 62% of all index constituents had at least one facility in a flood-prone area – highlighting the importance of accounting for these risks and integrating that information into the investment decision-making process. Rising sea levels would likely make these risks more acute.

At a regional level, Asia had the highest exposure to coastal flooding risk by far, both in terms of the number of facilities and the level of potential damage at company sites. MSCI ESG Research's analysis identified 6,257 facilities at risk in Asia, with \$2.25 trillion of revenue at risk between now and 2050.<sup>4</sup> The European Union had the second-highest number of facilities at risk from coastal flooding – 2,270 – while the US had the second-highest amount of revenue at risk, at \$541 billion. Without significant investment in coastal protection

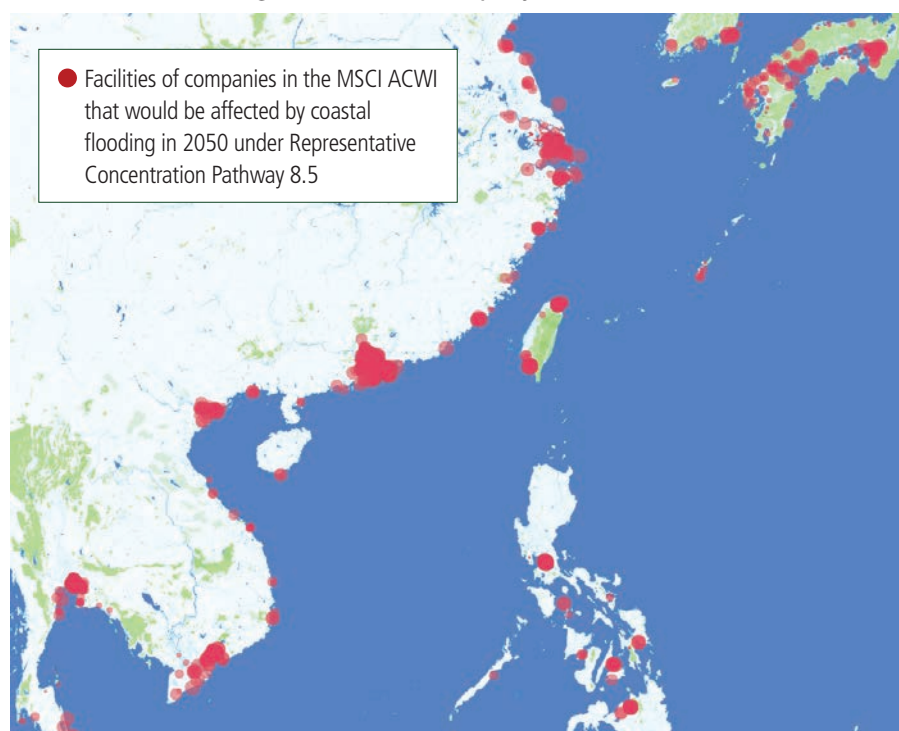
and adaptation, more than half of the global assets at risk could become untenable by 2050, according to MSCI's model (see figure 1).<sup>5</sup>

MSCI ESG Research estimated that nearly 14% of Asian facilities are located in flood-prone areas – nearly double the global average. On closer examination, the Asian risk exposure varies strongly by country.

For instance, Thailand – with 32% exposed

facilities – is strongly affected because of its extensive low-lying areas and widespread land subsidence. In contrast, the relatively low number of affected facilities in South Korea – less than 4% – is outweighed by the high revenue per facility, being estimated at over \$1 billion, on average. Countries with a large share of high-value facilities being exposed may constitute a severe risk in global investment portfolios (see figure 2).

### 1 Relative asset-damage risk to Asian company facilities



This pathway assumes global warming at an average of 8.5 watts per square metre, reaching a warming of 4.1° Celsius by the end of the century, which is close to a business-as-usual scenario. Flood defences are fixed at 2020 levels. Dot size indicates expected relative asset damage per year, using OpenStreetMap data.

Source: MSCI ESG Research, as of January 20, 2020

To estimate and attribute damage costs to company facilities, MSCI ESG Research used probabilistic modelling and geographic information systems technology to project future flood damages under climate change. MSCI ESG Research's physical climate risk analysis comprises approximately 221,000 geo-referenced assets from around 7,200 publicly listed companies. For each of these facilities, MSCI assessed the threat of coastal flooding and the associated financial risks related to asset damage and business interruption. This analysis allows the model to determine cost profiles for each company, and feeds into the calculation of the MSCI ESG Research Climate Value-at-Risk (VaR) metric.

## THE MSCI PRINCIPLES OF SUSTAINABLE INVESTING

MSCI recently published *The MSCI principles of sustainable investing*, a framework designed to illustrate specific, actionable steps that investors can and should undertake to improve practices for environmental, social and governance (ESG) integration across the investment value chain. The framework includes three core pillars to full ESG integration:

**1. Investment strategy** – Asset owners should integrate ESG considerations into their processes for establishing, monitoring and revising their overall investment strategy and asset allocation.

**2. Portfolio management** – Portfolio managers should incorporate ESG considerations throughout the entire portfolio management process, including security selection, portfolio construction, risk management, performance attribution and client reporting.

**3. Investment research** – Research analysts assessing companies and issuing investment recommendations to portfolio managers should integrate ESG considerations – including ESG company ratings – into their fundamental company analysis.

Read the full MSCI principles of sustainable investing at <https://bit.ly/2QHKfUD>

### Navigating all aspects of climate-related risk

For investors looking to identify, understand and manage their long-term financial risks and opportunities, the MSCI ESG Research Climate VaR metric has four main applications:

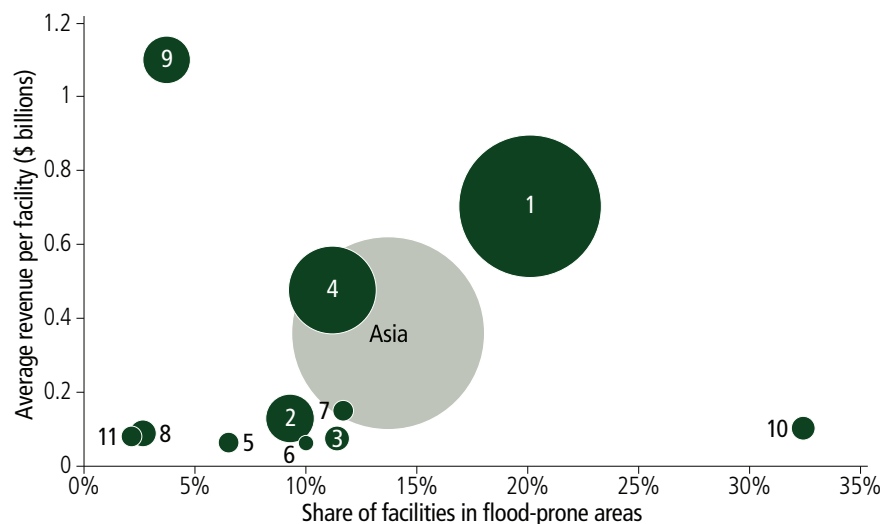
- **Policy transition scenarios** – The policy scenarios aggregate future policy costs based on an end-of-the-century time horizon. By overlaying climate

policy outlooks and future emissions reduction price estimates onto company data, MSCI ESG Research's model provides insights into how current and forthcoming climate policies will affect companies.

- **Innovation transition scenarios** – The low-carbon technology scenario is based on company-specific patent data, providing insight into the strategic investments companies are making to help the transition to a low-carbon economy.

- **Portfolio warming potential** – The warming potential methodology computes the contribution of a company's activities towards climate change, delivering an exact future temperature value a company's activities are currently aligned with.
- **Physical risks and opportunities** – The physical scenarios evaluate the impact and financial risk relating to several extreme weather hazards, such as extreme heat and cold as well as flood risk.

## 2 Share and revenue of facilities in flood-prone areas in Asian countries



- |              |                    |                      |
|--------------|--------------------|----------------------|
| 1. China     | 5. Malaysia        | 9. Republic of Korea |
| 2. India     | 6. The Philippines | 10. Thailand         |
| 3. Indonesia | 7. Saudi Arabia    | 11. Turkey           |
| 4. Japan     | 8. Singapore       |                      |

Circle area indicates the revenue of all facilities per nation.  
Source: MSCI ESG Research, as of January 20, 2020

### No assurance of insurance

Should global action on climate change fail and extreme scenarios of sea-level rise as predicted by the Intergovernmental Panel on Climate Change be realised, companies in the most exposed locations may experience increased difficulty in insuring assets.<sup>1</sup> And, without investment in flood protection measures, some companies could lose their existing coverage.<sup>6</sup> To identify companies that are potentially more resilient to flood risk, investors may scrutinise which have more comprehensive insurance coverage, as well as those that have in place other risk mitigation measures such as improved construction, upgraded floodwater drainage and retention capacity.

Institutional investors may want to review their options on how they work to protect their portfolios from physical climate risks such as exposure to coastal flooding. For example, they may engage with companies on physical climate risk, reduce exposure within a sector and/or a portfolio or create climate-smart benchmarks. ■

## The authors

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Executive director and head of climate policy and strategy, MSCI

At MSCI's Climate Risk Center, David Lunsford designed the transition risk and opportunity assessment methodologies, as well as other aspects of the climate modelling approach. He has worked with governments and corporations on managing climate risk for more than 13 years. He previously co-founded Carbon Delta, an environmental financial technology and data analytics firm, which was acquired by MSCI in 2019. Lunsford has a master's degree in sustainability and international organisations from the University of Geneva.



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<sup>1</sup> The Intergovernmental Panel on Climate Change (September 2019). Special report on the ocean and cryosphere in a changing climate, <https://bit.ly/2ThXd8p>. This range refers to the projection of the global mean sea level under the Representative Concentration Pathway 2.6 scenario at the end of the century

<sup>2</sup> S Jevrejeva, et al. (July 2018), Flood damage costs under the sea level rise with warming of 1.5°C and 2°C, *Environmental Research Letters*, <https://bit.ly/39b7jM3>

<sup>3</sup> The Climate VaR model covers 2,344 out of 2,955 MSCI ACWI constituents (as of December 31, 2019). Of the companies covered by the model, 144,014 locations can be evaluated. Coastal flooding risk can be found at 10,242 of these locations, meaning 7% of the company locations in the ACWI would be exposed to coastal flooding risk under the Representative Concentration Pathway 8.5 business-as-usual scenario, unless further action is taken.

<sup>4</sup> Revenue at risk is defined as the share of current company revenue attributable to facilities affected by specific extreme weather events or gradual climate shifts. To allocate revenue, global breakdown by country and map country revenue is used to asset locations.

<sup>5</sup> Assets deemed untenable will experience, on average, more than 5% of asset damage per year.

<sup>6</sup> G Mollod and W Robson (October 2019), Climate risk in private real estate portfolios – What's the exposure?, *MSCI Research Insight*, <https://bit.ly/39eVXIJ>

# FCA consults on new disclosures

Firms may be required to publish disclosures on risks they face from climate change or explain the reasons why not. Critics believe the new rules should be mandatory. By Rachael King

**L**arge UK companies may be forced to publicly disclose the risks they face from climate change or justify not doing so, under new disclosure rules proposed by the Financial Conduct Authority (FCA).

In a statement on March 6, the regulator announced it wanted to require firms to make climate-related disclosures consistent with the approach set out by the Task Force on Climate-related Financial Disclosures (TCFD) or explain why they have not done so.<sup>1</sup> Firms have until June 5 to provide comments to the regulator.

The TCFD was originally launched by the Financial Stability Board, and published its framework in 2017. Its recommendations are structured around four themes: governance, strategy, risk management, and metrics and targets.<sup>2</sup>

"Climate change presents a serious and wide-ranging threat to global economic prospects, society more broadly, and our natural environment," said FCA chair Andrew Bailey.

Climate disclosures have been touted by many regulators as a good tool to enhance transparency when it comes to monitoring climate risk. However, the FCA noted the current environment is still "evolving", so it will allow firms that are not yet able to make full disclosures to explain why.

The proposals will initially affect 480 large companies with a market capitalisation of £2.3 trillion (\$2.9 trillion). However, the FCA is also considering whether a similar framework can be rolled out to asset managers and life insurers.

"Improved disclosures will support better asset pricing and enable investors to make more informed choices about where to allocate their capital – which will ultimately support the transition to a low-carbon economy," said Bailey.

ClientEarth, a law firm that has led a series of complaints to regulators against firms on climate risk, says the FCA's new proposals allow too much wiggle room for companies to avoid making full climate risk disclosures.

ClientEarth lawyer Daniel Wiseman says the "comply or explain" approach is a "huge missed opportunity". "It would be much simpler, cleaner and more effective for the FCA to just make TCFD disclosures mandatory," he says.

Research conducted by non-profit organisation Ceres claims disclosures have a positive knock-on effect on how businesses operate. "Companies that disclose climate-related financial risks in annual financial disclosures are nearly twice as likely to have time-bound commitments to reduce greenhouse gas emissions, than companies that do not," says Mindy Lubber, chief executive of Ceres.

To help firms bolster their disclosure capabilities, the FCA has teamed up with the Bank of England's (BoE's) Prudential Regulation Authority to form the Climate Financial Risk Forum. The aim of the new forum is to publish industry guidance on climate-related disclosures, risk management, scenario analysis and innovation.



## Regulators told to step up

On March 10, Mel Stride, the chair of the UK Parliament's Treasury Committee, wrote to senior management at both the FCA and BoE to ask them to find ways to help consumers understand the carbon footprint of financial products.

Responding to Stride, Bailey admitted UK consumers did not have clarity regarding the climate-related exposures of their investments. He said the FCA would "support the development of appropriate common approaches".

Then BoE governor Mark Carney said there are "several ways" that asset managers, pensions funds and insurers "could report the level of preparedness for the transition of a given portfolio".

Carney also said the BoE was considering whether there would be a benefit to penalising firms in the form of additional capital charges should they take part in polluting or "climate risky" activities. But he noted there were "some impediments" to implementing such schemes.

Stride also said the Treasury Committee would examine whether firms should be required to hold additional capital on assets exposed to climate risk.

He said the Treasury would be exploring new policy approaches, including an 'EPC-style' carbon footprint rating of financial products. EPCs, or Energy Performance Certificates, are issued to UK households to state how energy-efficient a property is, with a ranking from A to G. ■

*Previously published on CentralBanking.com*

<sup>1</sup> FCA (March 2020), CP20/3: Proposals to enhance climate-related disclosures by listed issuers and clarification of existing disclosure obligations, <https://bit.ly/2TGPn8i>

<sup>2</sup> TCFD (June 2017), Recommendations of the TCFD, <https://bit.ly/2vgmDKn>



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# Show don't tell

## BoE's climate stress-test dilemma

Making the test easier to run could come at the expense of building risk management capacity. By Sharon Thiruchelvam

As Mark Carney prepared to take up new roles at the start of 2020 – advising both the UK government and the United Nations on climate change – he had already moved to secure his legacy at the Bank of England. In December last year, the BoE announced that the topic of climate change will also be included in its 2021 bank and insurance stress tests.

The bank element of the test, to be run as the Prudential Regulation Authority's (PRA) next biennial exploratory scenario (BES), has already attracted plenty of praise for leading the way on assessing the impact of climate change on financial stability. The Dutch National Bank (DNB) undertook such a test in 2018, but experts say the BoE has raised the bar to a new level of sophistication.

"I would say it's state-of-the-art now. It's well explained, prudent; I think most of the components are there," says Pierre Monnin, fellow in monetary policy at the Council for Economic Policy and former economist at the Swiss National Bank.

### Need to know

- The Bank of England is running a 30-year climate change stress test as part of its 2021 exploratory scenario.
- Experts say this is the most sophisticated climate risk exercise to date, but the timeframe for running the test itself is quite short.
- To help banks run the test, the BoE plans relatively prescriptive scenarios with plenty of variables provided by the BoE itself.
- However, that could reduce the scope for banks to build their own data analysis and risk management capabilities.
- There could also be a debate about how granular banks should get with their corporate and retail exposure data.
- It is also unclear what the BoE intends to do with the results, or its expectations for how the banking sector should use them.

The whole process of climate change stress-testing, however, is at a rather early stage of development. The BoE acknowledges there may be trade-offs between robustness and feasibility. It is operating against the backdrop of a lack of proven methodologies and data on the cost of both climate risk and transitioning to a low-carbon economy, meaning to a large extent it is navigating uncharted waters.

"That cost is super-uncertain and there are no functional historical models, so it's really different and it's probably not systemic, because there's some offsetting mechanism. So [for example,] you don't have a large negative drop in GDP, you have a negative shock to oil and gas, and positive to renewables," says Jakob Thoma, head of research at think-tank 2Degrees Investing Initiative.

Hence the whole project is a learning process for banks and supervisors alike, and experts urge an approach designed to allow firms to learn as much as possible. That objective could trigger the main debate among respondents to the BoE's consultation on the test, with responses due by March 18: how prescriptive should it be in setting the stress test scenarios?

"The banks and insurers need to develop scenario expansion capability. You don't want the regulator giving you all the answers because you end up with a single point of failure in the system if the analytics are wrong," says James Belmont, climate risk lead at consultancy Baringa Partners.

The PRA is also running a fairly tight schedule for such an experimental process. It proposes to publish and consult on its scenarios in April, launch the test in the second half of 2020, and publish the results in early 2021 (see box: Risk not capital).

"It's a 2021 exercise in name but not in actuality, because it's going to be running in 2020 for the banks. That's not very long," says Belmont.

### Long-term view

Given the challenges of forecasting and analysing climate risk, the 2021 BES departs from past set-ups by featuring an extended time horizon, multiple scenarios, integration of physical and transition risks, and counterparty-level modelling.



**"You don't want the regulator giving you all the answers because you end up with a single point of failure in the system if the analytics are wrong"**

James Belmont, Baringa Partners

Thoma praises the delayed scenario of the BoE test in particular, which contrasts with the short three-year cycle of a typical stress test. Participants will be required to test a static balance sheet from June 30, 2020 at five-year intervals over a 30-year horizon against three climate scenarios, based on those provided by the official sector's Network for Greening the Financial Sector.

"It has the exact right framing, such as a delayed scenario, which is critical to do meaningful analysis," says Thoma.

The three scenarios are: early policy action, late policy action and no additional policy action. The first assumes an early and orderly transition to a carbon-neutral economy that sees global temperature remain below a 2° Celsius increase.

In the 'late policy action' scenario, the goal is met but the transition is delayed and therefore more severe in order to compensate, and physical effects are felt. Lastly, the 'no additional policy action'





## **“How could a financial institution possibly understand climate risk if they don’t understand their existing level of weather-related risks?”**

Charles Donovan, Imperial College London

scenario assumes business as usual, with global temperature increases exceeding 2°C and severe physical repercussions.

The most severe physical effects of climate change are expected to materialise in the second half of the century if no action is taken. To incorporate them into the timeline for the stress test, the ‘no additional policy’ scenario will calibrate its 30-year horizon to assume the material risks anticipated between 2050 and 2080 will all occur by 2050.

Thoma says the PRA is right not to try fitting the expected temperature rise exactly to the policy delay scenarios. That allows banks to focus on the scale of the risks themselves rather than the exact timing of their emergence.

Banks will also be asked to size their exposure to their top 50 counterparties, submitting detailed breakdowns of their modelling and assumptions.

“Obviously, it’s going to get more and more tenuous the further out you go, because balance sheets will inherently look quite different in 15 years than they look today,” says Jason Eis, executive director at consultancy Vivid Economics.

The static balance sheet assumption will make the test particularly stringent, he adds. “The exposure of banks, particularly those whose asset holdings turn over quickly with the market, will be quite conservative. An upper-end assessment of the risk.”

The second part of the test is more dynamic, and asks participants to assess how they would adapt their business models in response to the risks in each scenario, for example reducing their exposure to at-risk sectors or redirecting capital to capture opportunities.

### **Learning through doing**

In terms of feedback from the banks, sources expect the compressed timeline for the process to be raised, but most experts think banks are up to the task.

“It is going to require significant upskilling; they are going to have to push themselves at a faster pace to respond at the level of analysis required, but it’s well within their capability,” says Eis.

There is, however, an inherent trade-off: to make the process easier for the banks within the timeframe, the PRA has been fairly prescriptive in its approach. In particular, the assumptions for the three scenarios are provided by the regulator.

For each scenario, the BoE will provide temperature and emissions pathways, as well as parameters such as commodity prices and the frequency and severity of perils in specific regions. Macroeconomic and financial variables, including the behaviour of corporate, household and government exposures, will be mapped onto these, before being further expanded by the banks themselves.

The proposal says it will seek “expectations” from the firms about most-likely climate outcomes, but it is unclear whether they will be quantitative or qualitative, or how detailed they should be.

Belmont believes banks will be fairly relieved that the BoE has chosen to provide scenario specifications and data for as many variables as it has.

“That’s the biggest challenge firms have had – understanding the basics of how to construct the scenario specification,” says Belmont. “They should be happy that they’re going to get a bit more detail on the macroeconomic impacts of climate scenario than they might have feared.”

But it’s a mixed blessing, especially in terms of encouraging firms to hone their understanding of the transition to a lower-carbon economy.

“On transition, the proposed level of specification may make it hard for firms to expand the scenarios fully while continuing to ensure that the resulting scenario is internally consistent,” says Belmont. And he adds that this level of specification is not really the regulator’s job.

“The regulator’s job is to set the overall framework within which firms operate. The leading practice and investment in analytics should come from the firms themselves.”

Eis agrees that the BoE has perhaps missed a trick in omitting to ask participants to develop their own scenarios. While fixed standardised scenarios have benefits – primarily, the comparability of impact assessments – Eis says spoon-feeding the banks will discourage them from performing (and building the capacity to perform) scenario construction themselves.

“Much of the uncertainty and risk gets dealt with in the scenario specification itself,” he says.

### **Lost in transition**

In fact, banks may already have more of the data and analytical capacity to run the stress test than they might at first realise. Charles Donovan, director of the Centre for Climate Finance & Investment at Imperial College London, cites the example of a loan to a power plant.

It might be that the risk division has never needed insight into the technical features of the plant – for example, the heat rate, which is how efficiently it burns hydrocarbons to create power. But these are questions that would be very easy to ask at the point of origination.

“Most of this information exists somewhere within the bank; the problem is that it doesn’t typically get passed to the risk management function. So there’s going to be a need to integrate between origination and risk management,” says Donovan.

He adds that the general concept of transition should not be alien to banks at all. For longer-term exposures, risk managers have always needed to consider the likely evolution of business models among their client segments.

“Transition risk assessment is something banks should be quite good at, because they already deal with changes in technology and consumer demand across a range of economic sectors,” says Donovan.

However, even though the test specification is relatively detailed, experts point to transition risks as one of the areas where assumptions may need some improvements. For instance, the starting point for the transition shock is assumed to be the introduction of carbon pricing. But the DNB stress test demonstrated that technology, litigation and consumer behaviour shocks, in isolation or combination, produce differing outcomes.

“When you talk to banks about climate transition, they all have policy shocks in mind,” says the Council for Economic Policy’s Monnin. “I think that’s a weakness – they should also have in mind that a change can come from somewhere else, from consumers’ preferences or from technological progress, for example.”

The consultation does mention that the 2021 exploratory scenario will include litigation risk, but this is not examined in detail in the proposal. Industry thinking on this is already developing, and the 2Degrees Investing Initiative is planning to produce litigation risk modelling guidelines in April.

“The challenge will be to adapt as the market moves, which it continues to do quite fast,” Thoma says.

## Getting physical

There are similar questions around the approach to physical risks. For instance, the degree of granularity assumed for corporate, government and household exposures is already prompting discussion and may well feature in the consultation responses.

The degree of disaggregation assumed for sectors is not specified. Monnin mentions the European Statistical Classification of Economic Activities, which would result in 12 industries at the highest level. But that could then be extended to as many as 200 sub-industries.

"If you take utilities, some sub-sectors are more exposed to fossil fuels than others, even though they are in the same sector," says Monnin.

There are also questions around the granularity of household exposures. For UK household exposures, the test requires modelling to at least a four-digit postcode level. But more detailed analysis on a road-by-road or even house-by-house level is already possible.

"In a flood zone, if one house was 20 centimetres higher than another it would matter. The Bank of England doesn't require it, but the firms might conclude that, actually, it's important to know in much more fine resolution," says Baringa's Belmont.

Donovan believes physical risk is the area where banks will need to up their game the most. He says it is unclear whether most banks even have a sufficient understanding of current weather risks to use as a baseline for future risk.

"How could a financial institution possibly understand climate risk if they don't understand their existing level of weather-related risks?" Donovan asks.



**"It is going to require significant upskilling; they are going to have to push themselves at a faster pace to respond at the level of analysis required"**

Jason Eis, Vivid Economics

He surmises that academia is where the majority of this expertise is housed, and banks will need to combine outsourcing with building expertise internally.

## Using the results

Perhaps the biggest outstanding question is what the BoE plans to do with the results of this 2021 exploratory exercise. It has proposed measuring second-round effects and simulating the systemic risk of climate change, but without specifying how this will take place.

Belmont says the most obvious change to follow the stress test will be to banks' governance and risk management processes, to demonstrate to regulators that they have the capabilities to measure and manage climate risk.

The BoE has also promised to impose on a mandatory basis the recommendations of the Task Force on Climate Financial Disclosure, which was set up by Carney. But there is no start date for mandatory reporting so far. In the meantime, the individual results of the 2021 climate stress test will not be published by the BoE.

That raises the question of whether banks will want to disclose some of the results to their own shareholders, to demonstrate their risk appetite and strategy for financing transition.

"The challenge will be to anticipate both the potential to make [stress test results] actionable after the analysis is done and potential unintended consequences," says Jakob Thoma.

In particular, as banks begin to think through their responses to the stress test results, Thoma says some difficult political choices will emerge. Most attention to date has focused on transition risks related to large corporates, but the stress test could show heavy exposure to climate or transition risks in retail and small business banking.

"The moral hazard questions are limited ... if you're withdrawing capital from companies that aren't adapting, that's desirable. If you are withdrawing capital from a baker in Lancaster, it's politically undesirable and socially problematic," says Thoma. "As we test the boundaries and reach more sophisticated levels, which is essentially what is advocated, these questions will pop up and we will need to manage them." ■

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## RISK NOT CAPITAL

According to the International Energy Agency, to have a two-thirds chance of keeping global temperature below the 2° Celsius increase agreed at the 2015 Paris Climate Conference, some 80% of remaining coal reserves, 50% of oil reserves and 40% of gas reserves would become unburnable, absent advances in technology.

UK banks could be particularly exposed to such transition risks. Loans to fossil fuel producers, energy utilities and emission-intensive sectors amount to around 70% of their common equity Tier 1 capital, the Bank of England (BoE) estimates.

Neither are UK banks immune to physical risks. Some 10% of the value of mortgage exposures in England is on properties in flood-risk areas, and several major banks have significant exposure to at-risk regions, particularly in South Asia.

The 2021 stress test will examine the assets and liabilities and loan and trading books of seven major banks and 37 insurers in what will primarily be a learning exercise.

It will carry no capital thresholds and the results will be published in the aggregate, in order to gain the clearest possible picture of the risks.

The purpose is twofold: individual and systemic. At the level of individual firms, the stress test aims to size their exposure to climate change, understand the risks posed to their business models and how they would respond, and improve their risk management.

The test should also flag up risks at the level of the whole financial system, including second-round effects such as spill-over, increased credit risk, fire sales of stranded high-carbon assets and unintended consequences and material disruption to the provision of financial services in the UK.

The desired outcome, the BoE says, would be to illuminate hidden risks on banks' balance sheets and encourage their engagement with the real economy to reduce carbon output. An undesirable outcome would be to capitalise the system for a 4°C increase or a disorderly transition, rather than providing impetus to avoid these scenarios.





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# The impact of climate change on banks

Over the past few years, concern and public discussion around environmental damage and climate change – and their social impacts – have increased dramatically. Peter Plochan, principal risk management advisor at SAS, discusses some key ideas to allow companies to perform a self-assessment of their maturity in climate risk management

Much is made of the future implications of climate change, but the truth is that it is already costing banks money. Changes to the environment have incurred costs on banks' returns on investment in broad range of scenarios, including:

- Farm loans not being repaid due to poor crop yields caused by extremely dry weather
- Manufacturing debtors shutting down water-heavy productions because of unexpected water shortages, which are becoming increasingly common
- Plastic producers losing significant amounts of business due to new legislation on plastic pollution
- Debtors based in regions that are regularly overwhelmed by extreme weather events
- Debtors receiving huge environmental fines from authorities for unclean production practices and waste pollution.

## The banking regulators' perspective

Banking regulators and central banks are suddenly beginning to pay more attention to the role of climate change as source of financial risk.

The recently established network of more than 60 central banks and regulators – the Network for Greening the Financial System (NGFS) – recognises the need for the banking industry to act and embed the management of climate change risks into its enterprise risk management (ERM) frameworks and processes.

An NGFS report, *A call for action – Climate change as a source of financial risk*,<sup>1</sup> provides the following recommendations, which – although not binding – are aimed at inspiring all central banks, supervisors and relevant stakeholders to take the necessary measures to foster a greener financial system:

1. Integrating climate-related risks into financial stability monitoring and microsupervision. This recommendation covers two main areas:
  - Assessing climate-related financial risks in the financial system by adopting key risk indicators to monitor climate risks; performing quantitative assessments of the financial industry, including climate risk-specific scenario analysis and their integration into macroeconomic forecasting; and financial stability monitoring.
  - Integrating climate risks into prudential supervision by setting supervisory expectations. This provides guidance to financial firms and directly engages with them to ensure climate risks are understood and discussed at the board level, considered in risk management and embedded into firms' strategies and risk management processes.

2. Integrating sustainability factors into own-portfolio management, which is portfolio management performed by central banks themselves on the portfolios under their own management, such as pensions funds and reserves.

3. Bridging data gaps and building on the Group of 20's Green Finance Study Group and UN Environment Programme initiatives. The NGFS recommends the appropriate public authorities share data that is relevant to the assessment of climate risk and, whenever possible, make it publicly available.

4. Focus on building awareness, sharing knowledge, establishing internationally consistent climate and environment-related disclosures, and building a green taxonomy to accommodate this.



Peter Plochan, SAS

While these recommendations are not binding, it is reasonable to expect them to eventually be translated into requirements, and for actions to be undertaken by local regulators and central banks. They will thus trickle down to individual banks in some form. In particular, the first recommendation, alongside any new green disclosures and taxonomy, will have a direct impact on banks.

Examples of regulatory actions include the European Banking Authority's (EBA's) *Action plan on sustainable finance*,<sup>2</sup> which notes:

- As part of the regular risk assessment of European Union banks, a sensitivity analysis for climate risks could be undertaken in the second half of 2020 for a sample of volunteering banks. The exercise would focus on transitional risks and a longer time horizon.
- The EBA aims to develop a dedicated climate change stress test.
- The EBA will provide guidance to banks and supervisors regarding banks' own stress-testing where the qualitative and quantitative criteria to assess the impact of environmental, social and governance risks under scenarios with different severities will be explored.

<sup>1</sup> NGFS (April 2019), *A call for action – Climate change as a source of financial risk*, <https://bit.ly/2xeeNkV>

<sup>2</sup> EBA (December 2019), *EBA Action plan on sustainable finance*, <https://bit.ly/3axsxWj>



### Climate change risk exposure assessment

According to the NGFS framework, climate change may result in physical and transition risks that can have system-wide impacts on financial stability and may adversely affect macroeconomic conditions. In this situation, banks would be exposed to:

- **Physical impacts of climate change.** These include the financial losses that result from increasingly severe and frequent extreme climate change-related weather events – such as heatwaves, landslides, floods, wildfires and storms – and longer-term progressive shifts of the climate, such as changes in precipitation and temperature, extreme weather variability, ocean acidification and rising sea levels.
- **Transition impacts of climate change.** These relate to the process of transitioning to a low-carbon economy. Reducing emissions is likely to have a significant impact on all sectors of the economy that affect the value of financial assets. Potential risks to the financial system from the transition are greatest in scenarios where the redirection of capital and policy measures – such as the introduction of a carbon tax – occur in an unexpected or otherwise disorderly manner.

The magnitude of how physical and transitional risks will manifest will depend on how orderly the transition process and how successful the measures taken to meet climate-related targets will be.

### Incorporating climate change into ERM

It is clear banks must seriously consider how to incorporate climate risk into their ERM frameworks. Banks should assess their:

- **Loan/customer portfolios.** The aforementioned impacts can impair the financial stability of borrowers. In this case, climate risks would manifest as increased credit risk for the banks.
- **Banking operations.** Branches may be more exposed to severe changes in weather (physical impact) or banks can be negatively impacted by changes in regulations, resulting, for example, in penalties for financing heavy polluting projects (transitional impact). In this case, climate risks would manifest as operational, strategic or reputational risks for banks.

In particular, forward-looking ERM must consider the impacts of this new risk on the bank's expected performance over the next three to five years. Rather than adding a new risk category under the strategic risk umbrella, banks must consider how these climate risk drivers impact their credit risk, market risk and operational risk profiles.

The NGFS initiative is planning to provide additional guidance in this area, namely through:

- A handbook on climate and environmental risk management that would set out the steps to be taken by supervisors and financial institutions to better understand, measure and mitigate exposures to climate and environmental risks.
- Voluntary guidelines on scenario-based risk analysis. The NGFS is working to develop data-driven scenarios for use by central banks and supervisors in assessing climate-related risks.



Physical impacts of climate change, such as extreme weather, can have a system-wide impact on financial stability

### Climate change scenario analysis and stress-testing

Forward-looking scenario analysis and stress-testing form the cornerstone of any robust ERM framework. Therefore, to truly understand the potential impact of climate risks on their businesses and borrowers, banks must incorporate climate change into their forward-looking analysis and decisioning.

Regulators are also quickly getting up to speed and are thinking of how to capture the complexity of climate risks in the stress-testing of the financial sector to ensure its stability, and support the transition to a greener economy. In the end, the collaborative effort of regulators, banks and public initiatives such as the Paris Agreement Capital Transition Assessment (Pacta) will be driving the development of respective climate change risk assessment and monitoring methodologies.

A recent example of such co-operation is the *Insurance stress test 2019*, conducted by the Bank of England (BoE) using three climate change scenarios, each with predefined global temperature rise targets and corresponding shocks to equity and bonds portfolios broken down per industry segment.<sup>3</sup> These estimates incorporate co-operation with Pacta and are available for public use through Pacta's assessment tool.<sup>4</sup>

### The way forward

There is urgency for banks to incorporate climate risks into their ERM frameworks and strategic planning. Some banks are already active, but the majority still have a long way to go. Initiatives such as those of NGFS and Pacta help promote a common understanding and will provide a benchmark banks can relate to.

Banks must reflect all of the aforementioned when looking to the future and considering strategy and product mixes to prevent the loss of custom and capital.

What is certain, however, is that there will be a much greater focus on the assessment of environmental and climate risk both on an individual bank level and on a financial system level, considering both the current circumstances and the potential future outlook and impact. Overall, demand for green and more forward-looking ERM processes and systems at banks is likely to significantly increase. ■

<sup>3</sup> BoE (June 2019), *Insurance stress test 2019*, <https://bit.ly/2IskJJn>

<sup>4</sup> Pacta, Bank of England stress test methodology, <https://bit.ly/2TGmR5H>



# Why forecasting climate change is a disaster

Forecasters are poles apart on climate-driven catastrophes, while insurers fear there is worse still to come. By James Ryder

## Need to know

- Anthropogenic climate change is accelerating – its effects on the earth are catastrophic, and the fallout for insurers is proving disastrous.
- Insurers and reinsurers depend on forecasters – and their models – to estimate losses in climate-driven catastrophes.
- Forecasters' cat models have in the past relied on historic data that cannot predict worse scenarios than they contain.
- More dynamic models – GCMs – are on the rise, utilising scenarios that anticipate climate change trajectories.
- So far, their use has not improved loss forecasts enough for insurers' tastes.
- Can forecasters find a sweet spot between cat models and GCMs, or are industry losses set to continue?

**T**he year is 1987. The worst storm in centuries is about to sideswipe the UK with hurricane-strength winds. Notoriously, BBC meteorologist Michael Fish addresses a viewer's concerns: "Earlier on today, apparently, a woman rang the BBC and said she heard there was a hurricane on the way. Well, if you're watching: don't worry, there isn't."

The storm cost the insurance industry an estimated £2 billion (\$2.5 billion). Although Fish claimed his comment was taken out of context, neither the storm itself nor the scale of losses it provoked was forecast by industry models. And the difficulty of modelling catastrophic events – cat risk – is getting more extreme with the march of climate change.

"We can't quantify the impact of glaciers melting. As soon as you start modelling, you make assumptions. And some of those assumptions are fairly heroic," says Swiss Re chief risk officer (CRO) Patrick Raaflaub. "That's what reinsurance companies have to do for a living, but that doesn't

make us necessarily better at predicting outcomes."

To help them with estimating the costs of cat risk to their business, the insurance industry relies on the expertise of cat modelling firms, the two most prominent of which are AIR Worldwide and RMS. They have the unenviable task of quantifying those loss estimates.

"There's so much uncertainty in present-day risk," says a leading climate scientist at one of the largest Lloyd's of London reinsurers, addressing the difficulty of pinpointing those numbers. He points to the initial model-assisted loss estimates for Typhoon Jebi – which struck Japan and Taiwan in 2018 – of just "a few billion". In September, AIR raised its current loss estimate to \$13 billion – but others suggest these figures will continue to rise with time and analysis – a phenomenon insurers call 'loss creep'.

"Every month, they're getting higher and higher," says the climate scientist. "And they're all wrong."

Regularly estimating loss levels significantly



below actual loss values and disparities between the two firms' estimates have worrying implications for insurers: that event impact is changing too rapidly to keep up; that event signals are too open to interpretation; or that the best-in-business firms are seriously diverging on their approaches.

Whatever the reason for the differences, the industry is in search of a solution to deliver more consistent and accurate ways of capturing potential losses arising from cat risk, and may turn to synthesised techniques as a way forward. It implies a lot more work for an insurer that historically consults both – and then decides on a middle way.

### At a loss

2017 and 2018 were the costliest back-to-back years for insurers, with losses totalling \$237 billion, according to data compiled by Aon.<sup>1</sup> Last year, insured catastrophe losses totalled \$90 billion, the fourth-highest on record. Weather disasters, among them hurricanes Michael and Florence and Typhoon Jebi, accounted for \$89 billion of the total. In all cases, model predictions were significantly below actual losses (for more on historic losses in Japan, see box: A (very) brief history of cat modelling).

Looking across five major cat events of 2018, each of the two firms' average estimated loss was well below the actual loss – at \$12.75 billion in the case of RMS and \$15.75 billion for AIR – an average of \$14.25 billion – roughly 65% below the true loss figure of \$40.3 billion.

In the case of Typhoon Jebi, losses estimated by

RMS were between \$3 billion and \$5.5 billion, while AIR's estimate was between \$2.3 billion and \$4.5 billion, which brings an average of AIR and RMS estimates to \$3.825 billion. According to Aon, insured actual losses were \$8.5 billion. So the two firms' average estimates for Jebi were off by over \$4.675 billion – more than 100%.

The least stark differential in the sample was for Hurricane Michael, in which actual loss amounted to \$10 billion versus average estimates of \$8.4 billion and \$8 billion from RMS and AIR respectively. In the Woolsey Fire, they respectively estimated losses of \$2.25 billion and \$2.5 billion on a \$4.5 billion actual loss.

The disparity between the two firms' estimates is also cause for concern – and central to the problem of effectively estimating cat risk. It suggests that the loss estimates being made in this field are in something of a state of disarray.

And as climate change advances, the gap isn't getting any narrower. "Even Hurricane Dorian in the Bahamas this year, there's no overlap in the loss estimates between RMS and AIR," says the climate scientist. "So there's this level of uncertainty." AIR's estimate is between \$1.5 billion and \$3 billion, while RMS puts it between \$3.5 billion and \$6.5 billion. He believes that future incidents are likely to be "an order of magnitude" greater.

Peter Sousounis, a meteorologist and the director of climate change research at AIR, says that modelling firms don't always look at the same criteria. Two significant factors that AIR did not

include in its Dorian estimates, he points out, are damage to infrastructure and 'demand surge' – the latter a phenomenon wherein repair and replacement costs are higher following large-scale disasters than they would be normally. A damaged roof, for example, might cost \$X to replace on a normal day, but when there are 500 roofs with the same sort of damage in one geographic area, prices increase.

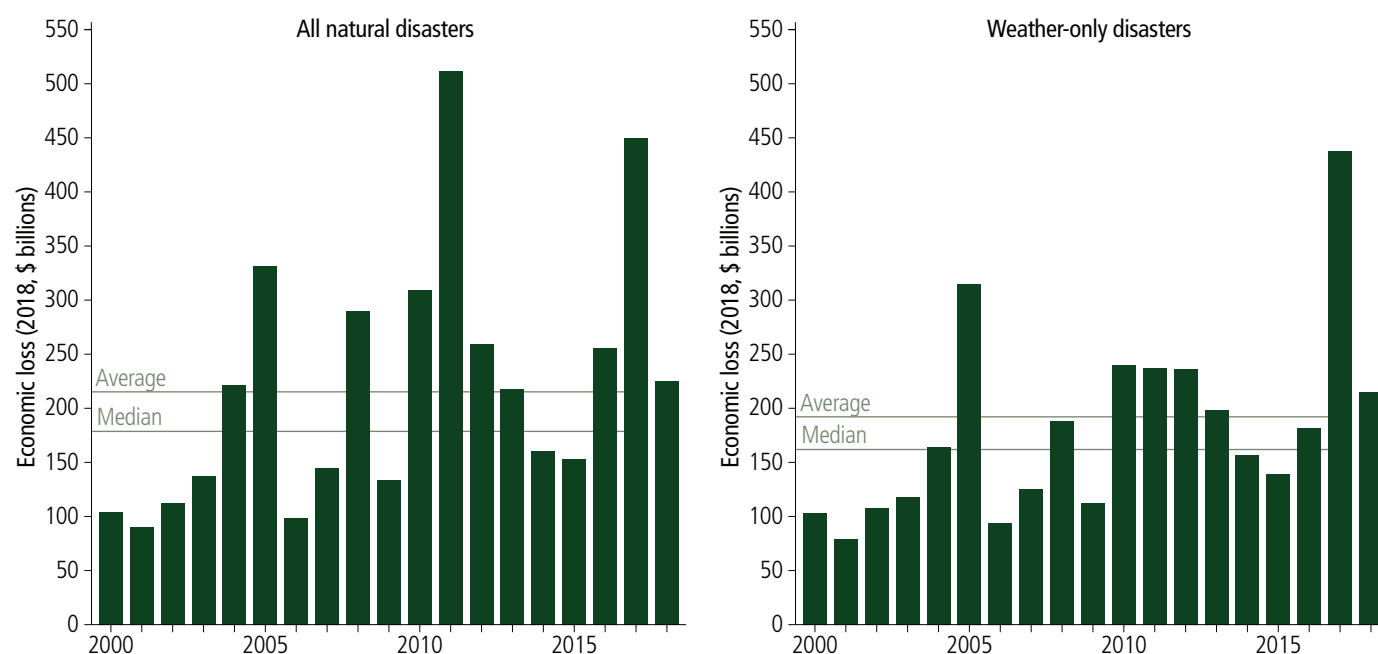
He says: "Given the devastation to Abaco, these factors could amplify losses significantly, and are probably largely responsible for significantly higher loss ranges."

"The research is saying that we might not expect more individual storms – but we may expect, globally, more intense storms," says Pete Dailey, a vice-president at RMS. The atmospheric scientist and meteorologist, who supervises RMS's flood modelling, points out that hurricane-prone regions should begin to expect "fewer category ones and twos, but more threes, fours and fives – and those are the category of storms that produce much more loss".

Asked whether AIR and RMS are responding to climate change differently, Sousounis says: "Our catastrophe models are founded on historical data, like most others. But we do not arbitrarily or indiscriminately incorporate all available data – at least, not with equal weight, and especially if those data show a long-term trend that can be attributed to climate change."

In AIR's view, a 40-year window is the ideal in

## 1 Global economic losses



most circumstances, Sousounis argues, because climate change happens slowly: interannual variability, he says, can “easily” have an impact greater than climate change in “any given year”. As such, 40 years is enough to include variability without capturing “obsolete” climate data from the more distant past. “There are exceptions in either direction, of course,” he adds. “For example, our tropical cyclone models tend to include longer periods of data – but only because analyses have shown there is no detectable long-term trend in landfall activity.”

RMS did not respond directly to questions on the difference between the two firms’ estimates.

Cat model crisis?

There’s no doubt that anthropogenic climate change is making the jobs of the cat modellers significantly harder. Global warming produces a demonstrable increase in the incidence of extreme weather events. In light of such singular ecological disruption, the historical approach to cat modelling can seem dangerously optimistic or narrow. The technique certainly helps insurers evaluate the probability of the reoccurrence of events for which there is some precedent, but isn’t so useful when it comes to predicting the extraordinary.

Insurers use cat models to estimate losses from natural disasters such as hurricanes and earthquakes, and set premiums accordingly. The models are fed with data from historical records, which means they don’t account for the effects of climate change, which is resulting in more severe weather events.

Cat models often use stochastic methods as

“The firm that merges decadal climate models into traditional stochastic natural catastrophe models the most quickly and credibly will be the winner”

Alison Martin, Zurich

a starting point. Before losses can be estimated, stochastic processes are used to generate a large distribution of plausible catastrophe events and associated physical phenomena. These event distributions are based on expertise and whatever historical data is available for a given event type. Next, modellers simulate the impact of these hypothetical disasters on their known exposures. Exposure data might include geographic location, typical repair costs and the reliability of local infrastructure. In the last stage, models produce damage estimates based on the information they have been fed by their operators.

But Greg Shepherd, CRO at Markel, another of the largest underwriters at Lloyd’s of London, points out that cat models are less useful for forecasting severe natural catastrophes that are “far more extreme than we’ve seen before, or in a location where we never expected one to occur” because, at the outer limits of the tail, there’s no historical data to feed the model. A cat model would be unable to spit out an accurate dollar value for a hurricane caused by changing weather patterns striking London, for instance, because not enough losses of a similar type would have been inflicted on insured properties in the past.

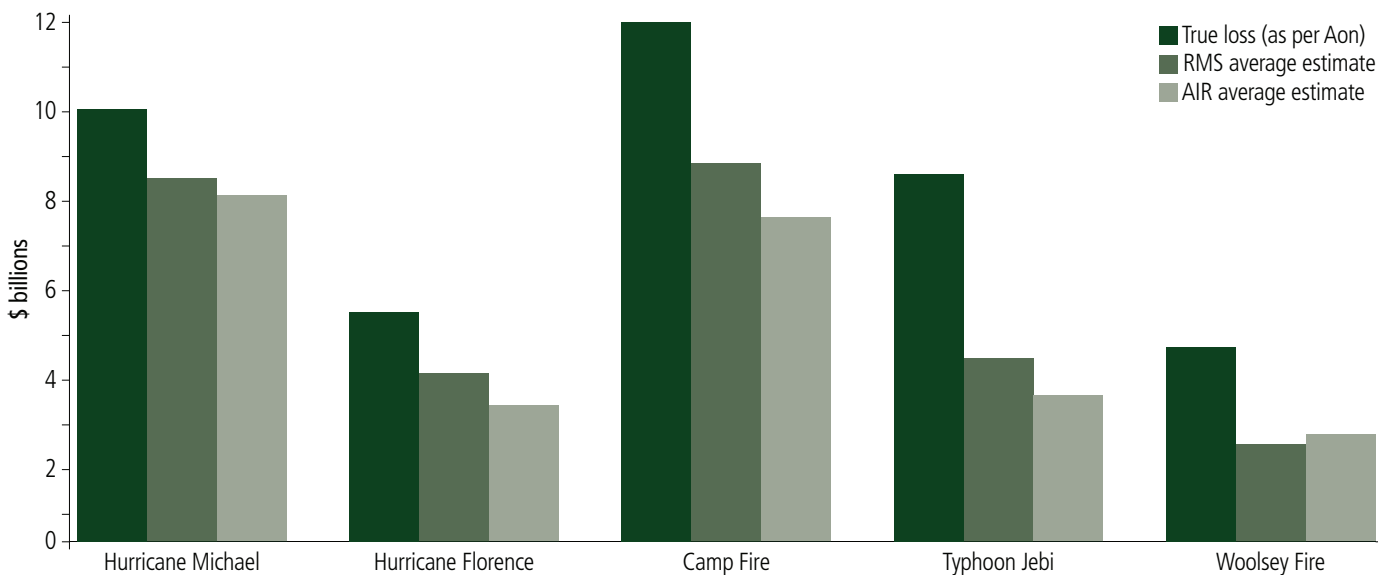
That leaves reinsurers having to price business

whose exposure could alter fundamentally over the coming decades, says Shepherd’s opposite number at a large European reinsurer. Claims could come due in 30 years or more – but in terms of realised losses, says the CRO of a large European reinsurer, “we only know when it happens”.

“Look at wildfires: we can say, with a very high degree of certainty, that climate change is having an impact on the frequency and severity of losses there. But there’s also a suspicion that climate change will have an impact on large hurricanes, for example. That is an area where we know exposures are increasing: there is more being built in exposed areas, and rising ocean levels mean even more areas exposed. But if you look at the actual frequency and severity of losses, so far, it’s a plausible suspicion, but no more than that. Where the risk is materialising very, very slowly and we have very few data points, it’s really hard to track whether your prediction is successful or not. That’s when you need more margin around your predictions: you can’t take aggressive bets.”

Alison Martin, CRO at Zurich, agrees stochastic modelling techniques are limited in usefulness for now. Every firm, she says, is working on merging decadal forecasting – estimating climate variations over a decade – with orthodox stochastic models.

2 Catastrophe modellers’ average insured loss estimate versus actual insured losses (2018)



Source: Actual losses from Aon; average estimates from AIR and RMS



Anthropogenic natural disasters are now more visible than ever, and this burgeoning historical record may soon be more readily operational.

"The firm that merges decadal climate models into traditional stochastic natural catastrophe models the most quickly and credibly will be the winner," she says. "They will be able to say: 'We can attribute X storm, X flood, X wind event to climate change' – and the modelling would support it: 'Here is the economic cost of climate change.' No-one has done that yet, successfully. It's a trillion-dollar question."

### Another world, another planet

New techniques could introduce more accuracy to estimating climate change-related losses.

"Standard actuarial techniques are simply not sufficient for natural hazards," says Tina Thomson, a geomatic engineer and head of catastrophe analytics for Europe, the Middle East and Africa west-south at Willis Re, the specialist reinsurance division of Willis Towers Watson. There are, she says, simply not enough Tōhoku Earthquake or Hurricane Katrina-level events recorded for actuarial techniques alone to be applicable. As such, the insights created by a stochastic catalogue are seen as incredibly valuable.

Insurers are being spurred by regulators and think-tanks to start applying so-called ensemble techniques to their exposures – an umbrella term for model-based quantification methods that employ multiple models at once. The two cornerstones of this approach are the familiar cat models and general circulation models, or GCMs – vast, planet-scale climate simulations that are maintained by academic institutions and governments.

A GCM, also known as an 'earth system

model', is essentially a replica earth with a realistic meteorology of its own that responds to programmable stimuli. By adjusting various parameters, modellers can create any number of 'what-if' planets, each with their own climatic, oceanic and atmospheric conditions. The inherent differences between the fake earths and the original can be as large or small as the modeller wants. A researcher might decide they want to see what would happen to world weather if sea surface temperatures suddenly rose by 3%, for example, or if pressure began changing by tiny increments in the troposphere.

In most circumstances, the simulated disasters occur in step with scenarios set out by the Intergovernmental Panel on Climate Change (IPCC) – a set of potential warming outcomes in which the world has become a degree or two hotter than it is today. Using authentic parameters taken from recorded history, modellers watch to see whether the simulated earth produces consistent and believable outcomes – appropriately sized hurricanes, accurate tidal behaviour, regular temperatures, and so on – that are faithful to those that have been successfully documented on our real planet.

"It's basically a set of synthetic events – events that haven't happened – that we can create over thousands of years," says Thomson. "Tens of thousands, hundreds of thousands [of] simulations of potential events. Then we can quantify the impact."

"The utility is that it allows events that have not occurred in the historical record to actually 'occur'," says AIR's Sousounis. "And that's an important consideration when it comes to climate change."

Even the most sophisticated modelling can't do much to diminish the uncertainty in anthropogenic

climate change. The nature of global warming and the lack of obvious collective action plans mean that financial firms have a near-endless quantity of competing voices to choose from on the topic.

"[The] IPCC has counted four basic scenarios," says Sousounis. "And I'm guessing there are probably 10 times that number of general circulation models, and they do different kinds of experiments." There are even more cat models than that, he continues: "Let's take 40 models and four climate change scenarios – that gives us quite a number of output possibilities."

Maryam Golnaraghi, director of climate change and emerging environmental topics at The Geneva Association, says a GCM generating consistent distributions is not proof alone that the model is feasible for use in constructing projections. A given GCM's behaviour may be regular, but the simple production of a trend does not guarantee its accuracy to the real earth. It has to produce the correct trend. Proving that worthiness, she adds, is no small task: to demonstrate a model's ultimate accuracy, a GCM will be tested against observable data.

"You get your weather distribution. But how do you know it's the right distribution?" asks Golnaraghi. "You run it over and over – maybe 200 or 400 times – and you start to determine whether the model is giving you distributions that fall towards the same pattern."

AIR and RMS both attest to using GCMs in various instances. AIR currently uses GCMs in modelling for hazards including flood and extra-tropical cyclones for the US, Europe and Japan. The firm uses GCM information to guide outputs from high-resolution numerical weather prediction models, which produce realistic simulations of precipitation systems.

RMS uses GCMs extensively in its modelling

## A (VERY) BRIEF HISTORY OF CAT MODELLING

The emergence of catastrophe modelling in the late 1980s was a cause for cheer among insurance companies. Weather-related losses – such as those caused by the storm of '87 – that had plagued businesses, in some cases leading to major insolvencies, seemed as if they would soon become a thing of the past. Through leveraging cutting-edge science and mathematics, the portfolio impact of natural disasters could be simulated, assessed and understood. Premiums could be adjusted accordingly. Physical risk could be given dollar figures with new confidence.

But, given that event catalogues are generally based on the recorded characteristics of pertinent incidents throughout history, the most disastrous event a history-fed cat model can simulate will only be as severe as the severest event in that record.

For this reason, cat models did not prepare insurance companies for the 2011 Tōhoku Earthquake, which produced losses far exceeding the projected probable maximum losses of most of the industry. While Japan is a notoriously earthquake-prone country, experiencing over 1,000 tremors of varying intensity every year, an event such as Tōhoku – a nine on the moment magnitude scale – was wholly

unprecedented. It was the most powerful earthquake ever recorded in that part of the globe and the fourth-largest earthquake in recorded history. Thousands died as resultant tidal waves battered Japan's islands, and aftershocks were felt as far away as Russia.

"Nobody had considered a magnitude nine," says Adam Podlaha, head of impact forecasting at Aon. "By definition, it could not be in the catalogues." Munich Re, a large reinsurance company, estimated the insured losses caused by Tōhoku as \$40 billion, while the World Bank said the total economic cost could reach over \$200 billion. Swiss Re, another global reinsurer, stated that while the tremors themselves were within worst-case-scenario projections, the tidal behaviour and aftershocks following the quake constituted "blind spots" in the existing vendor models.

Tōhoku and events like it were dismissed as black swans – unanticipated super-outliers with extreme results – which, by definition, occur only rarely.

What is certain about climate change, scientists say, is that it will lead to climatic conditions where these black swans cease to look like such outliers.

work, according to a spokesperson. The events in the firm's models for North American winter storms and European windstorms were generated by GCMs run in-house, and some elements in its Japanese typhoon and North Atlantic hurricane models are based on similar in-house simulations. It also uses simulations from the climate science community. Its medium-term hurricane rates are based on sea surface temperature projections created by the Coupled Model Intercomparison Project framework – one family of models used in informing the climate change reports issued by the IPCC.

RMS says that its work on future surge risk is based on sea levels taken from CMIP5, the fifth phase of the CMIP experiments. The firm says it uses hurricane rates from the same source when looking into future hurricane loss. GCM outputs are becoming more realistic, says RMS, and will play a larger role in catastrophe modelling in future.

### The Goldilocks configuration

Outputs from GCMs are not taken at face value, however – before a given GCM's projections can be established as trustworthy, they are subjected to a model validation. "The model is put through an extensive verification process against the past," says Golnaraghi. "They try to replicate the past with the model to make sure that those numerous times they run it are actually going in the right direction. It's extremely time-consuming and resource-intensive."

A combined GCM and cat model approach could prove highly useful. GCMs measuring present-day climate risk can be compared with another set of models running climate change scenarios, and the differences between the outputs of the two groups can be evaluated.

"By comparing a climate change-conditioned model to a baseline model – a model that's measuring the risk of climate change today – you're given the sort of marginal effect of climate change," says RMS's Dailey. "That would be a test of the sensitivity of that risk to climate change, which can be measured for the industry as a whole – let's say, all insured properties across the entire UK – or it could be run for a portfolio."

So, despite the criticisms, the humble cat model is not set to be retired just yet. While it lacks predictive potential of its own, it can be used to make sensible estimates about the unknown with a little help. By using more than one type of model concurrently, insurance firms can plan for a range of potential climate change impacts – that is, plan for the realistic consequences of events that have not yet occurred in recorded history.

Historical catalogues, meanwhile, improve every year as record-keeping becomes more and more sophisticated. Modellers themselves are also largely in agreement with regard to how records-based cat modelling should be practised.

"The sweet spot is to find a period of record where we can capture a good representation of the current climate, as well as having a sufficient amount of historical record to represent the variability," says Sousounis. "[For] most of the models we've built, we use the last 30 to 40 years of record."

For AIR, this is the Goldilocks range, says Sousounis: timescales that are too short risk the misinterpretation of quasi-periodic and naturally existing climate cycles such as the El Niño-Southern Oscillation and the Atlantic Multi-decadal

Oscillation, which are large enough to cause measurable changes in global temperatures and hurricane activity; and selection of timescales that are too long will start to include data that is of relatively poor quality.

Dailey says this topic in particular is extremely hot among RMS clients: "There's absolutely been a pickup in the interest level. In 2017, we saw hurricanes Harvey, Irma and Maria, all in a row. In 2018, hurricanes Florence and Michael, and then just this year, Hurricane Dorian. We've had three years in a row where major hurricanes have produced major losses in highly insured areas. We're engaged with our clients every day on climate perils, but outside of our traditional market – and even beyond capital markets – individual corporates are very much interested."

Corporate interest and action, says The Geneva Association's Golnaraghi, are of crucial importance if the problem is to be tackled in time. She argues that the financial industry at large must engage productively with climate and cat modelling, enhance its understanding of the work being conducted and devote significant resources to upskilling its leaders. Without mobilising in this way, she says, the decisions made will remain based on poor understanding of a complex topic.

But if the industry manages to sufficiently focus on the issue, perhaps it would help modellers find a solution with more precise results. One that is just right. ■

*Previously published on Risk.net*

<sup>1</sup> Aon (January 2019), Weather, climate and catastrophe insight – 2018 annual report, <https://bit.ly/2IDWBDF>

<sup>2</sup> PRA (April 2019), Enhancing banks' and insurers' approaches to managing the financial risks from climate change, <https://bit.ly/2xsxXfb>

## REGULATORY GUIDANCE ON THE WAY?

Although the Bank of England has not yet taken decisive steps to regulate climate-related financial risk, it is encouraging banks to start thinking about the issue. The most significant action to date was the Prudential Regulation Authority's supervisory statement in April – a formal set of rules and policy expectations.<sup>2</sup> But the 16-page document is light on practical detail. It encourages financial firms to "consider" climate risk and "embed" it into existing financial risk management practices without prescribing how. The statement sets out the importance of stress-testing, scenario analysis and disclosure procedures with some clarity, but does not provide a firm set of standards, principles or directions for implementation.

The PRA has also said that firms must assign individual responsibility for climate risk management under its flagship Senior Managers and Certification Regime – but with climate risk management nebulously defined, responsible individuals will have to await further instruction. The same is true for insurers.

"A lot of vendors have responded to the PRA, but where we're going, exactly – the road map – is up to them," says a senior climate scientist with one of the largest Lloyd's of London reinsurers. He goes on to discuss the BoE's stress-test scenarios:

"They described the scenarios they would like submitted. Our understanding is that it's not something that is compulsory ... to be used to measure capital resilience." He confirms that his firm wants to make progress on climate risk, and will be taking part in the tests.

Many insurers that *Risk.net* spoke to for this article echo these sentiments, agreeing that the PRA's attention to climate risk – while positive and a clear signal to other regulators – has not yet resulted in granular requirements. But it's a start, they agree.

"It will drive changes in behaviour," says Tina Thomson, a geomatic engineer and head of catastrophe analytics for Europe, the Middle East and Africa west-south at Willis Re, the specialist reinsurance division of Willis Towers Watson, of the current regulatory stance. "The PRA has collaborated with a number of industry experts to define these initial scenarios, and they're in line with UK climate projections. However, insurers still need to look at how they apply the PRA stress tests to their portfolios, and that is where we have been assisting our clients with the application of the scenarios."





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# Climate risk management

## A self-assessment of progress

Due to a combination of increasing social pressure, demands for better disclosure from investors and emerging regulation, companies are increasingly questioning the extent to which they are incorporating climate change into their global risk management. **Management Solutions** discusses some key ideas that may allow companies to perform a self-assessment of their maturity in climate risk management<sup>1</sup>

As is the case for most emerging risks, a multidimensional approach to self-assessment is advisable. This article analyses climate risk management through six dimensions: strategy, governance, organisation, risk management, methodology, and reporting and disclosure. Table A presents a sample self-assessment model along these dimensions.

### Strategy

Strategy definition requires, as a precondition, both the identification of risks and opportunities in the short, medium and long terms, and the estimation of their financial impact in different temperature scenarios.

The complexity of this process, given the level of uncertainty, is apparent: What extreme physical impacts will take place and when? What political actions and regulations will be adopted? To what extent will technologies that allow a sustainable energy mix or CO<sub>2</sub> capture be developed, and when? Despite these unknowns, senior management teams need to define a climate strategy that might profoundly affect the company's business, which in turns sets off a decisive mobilising effect and crystallises as a tangible masterplan for climate change adaptation.

### Governance

From a governance point of view, the incorporation of the climate dimension in global risk management is not a simple endeavour. The crosscutting nature of this risk, the uncertainty in its measurement and the lengthy time horizon of impacts versus the immediacy of the investments to be made entail important barriers.



To overcome these barriers, three structures are suggested: strong sponsorship from the management body, a robust governance with explicit involvement of the board and a framework that includes all six elements of climate risk management.

### Organisation

Climate change is a common factor that amplifies multiple risks previously managed by companies through already up-and-running risk areas, and thus its organisational component is, to some degree, a transformational one.

On one hand, a clear definition of accountability on climate risk is required in the different risk areas and for all businesses. On the other, the company will need an area with a global vision to take the lead and promote the plan in a co-ordinated manner and according to the enterprise-wide climate strategy.

The profiles involved are also diverse. These include quants (to develop evaluation methodologies and scenario analysis) and technical profiles (to analyse technological alternatives to reduce the carbon footprint and protect assets from physical impacts). Consequently, a non-trivial question is: does the company have sufficient and specialised resources and, if negative, how does it remediate this in a context of scarcity of these profiles in the labour market?

### Risk management

Companies should adapt their risk management practices to the specific ways climate change might affect their business, depending on the industry and geographies in which they operate. In all cases, they

<sup>1</sup> Management Solutions (2020), Managing climate change risks, <https://www.managementsolutions.com/climate-change-risks>



must have mitigation strategies for physical and transition risks – and, in the case of the financial sector, assess how counterparties or insured companies are managing their own climate risks.

Regarding physical risks, the company will need to assess different adaptation strategies, such as asset relocation, investment in resilience, disaster recovery and insurance coverage increase. Concerning transition risks, it will need to activate internal levers to promote its transformation, such as the incorporation of sustainability factors in investment decisions or internal pricing of CO<sub>2</sub>.

### Methodology

One of the main challenges in managing climate risk is implementing a methodology to measure its financial impacts. This step requires a transversal knowledge of the company and its strategy. This includes being able to quantitatively determine the extent to which a specific temperature increase would affect physical risks, and how greenhouse gas emission reduction efforts can affect transition risks. Thus, the estimation of impacts should be a transversal exercise that brings together experts from many areas across the company: strategy, operations, legal, business, technology, and so on.

Additionally, in the case of regulated sectors – for example, financial and insurance – risk assessment methodologies would have regulatory implications mainly focused on capital, such as internal capital adequacy assessment and stress-test exercises.

### Reporting and disclosure

The existence of a solid climate information model is essential to address the multiple internal and external demands: for example, investors, rating agencies, banks and regulators.

The information model faces multiple challenges: from identifying the fine line between providing transparency and breaching confidentiality, to implementing the procedures to capture all relevant information. Additionally, in the case of the financial industry, the different criteria or the poor data quality provided by clients may create additional difficulties.

Initiatives to establish common criteria and regulation disclosure in certain industries may nevertheless improve the quality of information.

In short, the transformation companies should achieve to face climate change will be profound and complex. Nevertheless, this transformation should be considered a priority by management bodies, for a number of reasons – not least the existing evidence that financial markets are already taking into account the impact of climate risk on the valuation of their investments. ■

A. Sample self-assessment model on climate risk management	
Stream	Maturity indicator on climate risk management
Strategy	Physical and transition risks that would affect the company in the short, medium and long terms have been identified
	Physical and transition risks have been assessed in different temperature scenarios
	The opportunities of the new context have been evaluated (for example, diversification, product catalogue and sustainable financing)
	A climate risk strategic road map has been defined
	A masterplan to be implemented in three to five years has been approved
	Budget for the masterplan implementation has been allocated
Governance	The board performs specific oversight functions on climate risk
	The board approves risk appetite for climate risk
	There are specific committees on climate risk
	There is a global climate risk management framework approved by the board
	Climate risk policies include specific commitments, aligned with the strategy
	All risk management policies have been adapted to the climate risk policy
Organisation	Ownership of climate risk is clearly defined
	First, second and third line of defence functions for climate risk are clearly defined
	The organisation has expert profiles on climate risk
	The co-ordination procedures with other risks have been defined
	Sustainability is considered within the remuneration objectives and policies
Risk management	The different risk areas, financial or non-financial, are aware of the impact of climate change within their scope
	Policies, methodologies and management processes in the different risk areas have been adapted to incorporate the climate dimension
	Investment decision-making considers the climate dimension
	The different physical risk mitigation alternatives (adaptation, resilience and risk coverage) have been evaluated
	A price for CO <sub>2</sub> emissions has been incorporated into business decisions
Methodology	A methodological framework for climate risk measurement has been defined
	The most relevant scenarios have been identified for the relevant businesses and geographies
	A group of company experts has evaluated probabilities and severities of physical risks
	A group of company experts has evaluated the impacts on the variables of demand, price, cost and valuation of assets that would be affected by transition risks
	Methodological experts of the company have defined the statistical models that best adapt to the estimation of the potential impacts of risks
	The company is aware and has begun to consider the regulatory implications (if any) of the climate risk quantification
Reporting and disclosure	A climate information model has been defined and implemented
	Climate metrics and measurement criteria have been defined
	The capture processes for feeding these metrics have been defined
	Plans have been defined to cover information gaps
	Control mechanisms on climate risk information (data governance, data quality) have been implemented
	The published information has the required supervisory mechanisms (chief financial officer and internal audit)



# Calls to hike climate policy raise risk for oil firms

Increased climate policy will put more oil and gas assets under threat of stranding. By Pauline McCallion

## Need to know

- A consensus is emerging that more effort is needed to ensure global temperatures don't exceed the critical 2°C above pre-industrial levels.
- Assessing the extent to which increased climate policy will hit demand for oil and gas is an enormous challenge.
- According to various forecasts, a 2°C world would see global oil demand peak in the 2020s and, by 2040, drop to between 8% and 32% lower than today.
- Firms are starting to apply the various climate scenarios to their own assets and portfolios.
- However, according to Carbon Tracker, last year every oil and gas major sanctioned non-2°C compliant projects.
- Shell defends one of its critiqued projects, pointing out that it replaced coal.
- Majors are coming under pressure to be more transparent on their climate progress and many are making huge changes to their portfolios.

**A**s world leaders and government officials gathered in Madrid for December's UN Climate Change Conference, the pre-conference speech by UN secretary-general António Guterres had immediate resonance for oil and gas firms.

"We simply have to stop digging and drilling, and take advantage of the vast possibilities offered by renewable energy and nature-based solutions," he said.

Pressure is undoubtedly building on governments to increase action on climate change and much of it focuses on upholding the 2015 Paris Agreement on climate change under which almost 200 countries pledged to keep global temperatures "well below" 2° Celsius above pre-industrial levels and to "endeavour to limit" them to 1.5°C.

If these targets are to be achieved, it is now clear that global climate policy will need to be ramped up significantly. According to the UN Environment Programme, current policy puts the world on course for global warming of over 3°C. Moreover, there is now widespread agreement, not just among scientists and environmentalists, but from within the financial community, that allowing the world to heat up much beyond the 2°C guardrail would have dire economic as well as social consequences. French

insurance firm Axa famously said in 2017 that a 4°C world would be uninsurable.<sup>1</sup>

This expected increase in climate policy has huge repercussions for fossil-fuel businesses. However, assessing how demand for oil and gas will be impacted in the short to medium term and translating that impact to a company level is extremely challenging. One thing is certain: staying on top of climate policy is going to be vital for oil and gas companies from now on, as it could change suddenly.

"It is absolutely instrumental for the [oil and gas] sector to understand that the regulatory environment is changing fast," says Valentina Kretschmar, director of corporate research at energy research firm Wood Mackenzie. "Oil and gas companies have to be prepared for a sudden shift in the oil outlook because that will have a huge impact on [demand and] prices."

According to Wood Mackenzie, under a business-as-usual scenario, demand for oil will rise to 110 million barrels per day (bpd) by 2040, from around 98 million bpd today. In this scenario, global temperatures would hit between 3.6°C and 5.5°C. On the other hand, a 2°C limit would see oil demand peak in the 2020s, falling to 70 million–90 million bpd by 2040.

To go even further and limit the rise to only 1.5°C, emissions would need to reduce by 7.6% every year until 2030, according to Paul Simpson, chief executive of UK non-profit CDP (previously the Carbon Disclosure Project). While many see this scenario as overly optimistic, it is likely nonetheless that oil and gas firms need to factor in a greater level of demand destruction than they are doing now, analysis suggests.

Think-tank Carbon Tracker, for example, estimates that the world's listed oil and gas majors must cut combined production by more than a third by 2040 to keep emissions within international climate targets.<sup>2</sup> It sees significant variation between companies, with ConocoPhillips needing to cut by 85% and Shell by as little as 10%.

Other analyses see demand continuing to grow up to 2040. The International Energy Agency (IEA), for example, publishes several scenarios in its *World Energy Outlook 2019*.<sup>3</sup> Its Stated Policies Scenario (SPS) (formerly New Policies Scenario, or NPS) forecasts the impact of current policies and targets as well as existing measures, while its Sustainable Development Scenario (SDS), sets out a Paris Agreement-aligned world. Both scenarios represent change from its "business as usual" Current Policies Scenario (CPS).

Under the SPS, global oil demand growth will slow but not peak before 2040, when demand will reach 106 million bpd, some 8 million bpd above current levels.

On the other hand, the SDS foresees global oil demand falling to around 66 million bpd in 2040. Gas consumption will continue to grow at an average rate of 0.9% annually over the next 10 years, peaking at 4,264 billion cubic metres (bcm) by 2030, versus 3,955 bcm in 2018, according to the World Economic Outlook. After this, greater use of renewables, energy-efficiency measures, biomethane and later hydrogen, will affect gas consumption, albeit at different rates in advanced versus developing economies.

With so many possible futures, taking a scenario-based approach to assessing transition risk is the only option, say energy risk managers. It requires assessing global demand under different scenarios and then for each one translating that into company-level demand, which can require a regional or even asset-level approach.

### Stranded assets

Not all firms are getting it right, some believe. In a September report, Carbon Tracker claims that last year every oil and gas major sanctioned non-Paris-compliant projects "including the European majors that are making the greatest moves to reassure investors that they are consistent with the energy transition – Shell, BP, Total and Equinor".



**"It is absolutely instrumental for the [oil and gas] sector to understand that the regulatory environment is changing fast"**

Valentina Kretzschmar, Wood Mackenzie

When compared with the IEA's climate policy scenarios, 83% of capex on new oil projects would not go ahead in an estimated 1.6°C scenario and 60% would not happen under 1.7–1.8°C, even with a "large roll-out" of carbon capture and storage, according to Carbon Tracker's analysis.

These investments risk becoming stranded, Carbon Tracker says in its December report. "Companies that continue to sanction higher-cost projects that do not fit with a lower demand scenario risk destroying significant shareholder value through the creation of stranded assets, as well as contributing to the failure to achieve climate goals," the report says.

A spokesperson for Shell said its LNG Canada project – one of several highlighted by Carbon Tracker as outside a 1.7–1.8°C budget – is aligned with its thinking that "knocking out coal" with natural gas provides the fastest route to reducing carbon emissions. Indeed, the strategy of transitioning to less carbon-intensive gas production is playing out at organisations across the industry.

Recent research from BNP Paribas looked at the risk of stranded oil production due to the rise of electric vehicles (EVs).<sup>4</sup> "With gasoline and diesel demand for vehicle segments at risk of competition from EVs accounting for 36% of global oil demand, and power generation for a further 5%, our analysis implies that investing in new oil projects with break-even costs of \$20 per barrel or higher will put up to 40% of future annual output from new projects sanctioned today at risk of stranding over the long term," says Mark Lewis, global head of sustainability research for BNP Paribas Asset Management.

Investors are also becoming increasingly wary of the possibility of stranded assets and are demanding more transparency from oil and gas firms on climate risk. CDP research shows the percentage of shareholder resolutions calling on oil and gas companies to produce climate resilience reports increased from an average of 21% in 2014, to 53% in 2018. "The momentum here is very clear," says CDP senior analyst Luke Fletcher.

Oil and gas firms are responding in different ways. Equinor (formerly Statoil), for example, plans to include a Paris-aligned scenario in its overall stress-testing from now on.

"We apply a price on carbon on all our investment decisions, including those in geographies where there is not a price on carbon today," says a spokesperson for the Norwegian energy firm. "We also stress-test our portfolio against a range of future scenarios," he says, adding that Equinor started assessing its portfolio, including new material capital expenditure investments, this year against the IEA's SDS, NPS and CPS.

While Total did not respond to requests for comment, BP told *Energy Risk* that it is working to improve disclosure in this area. "At this year's AGM, we supported a shareholder resolution that will require us to describe how our strategy, and our major investment decisions, are consistent with Paris. This will be included in our next reporting cycle," says a BP spokesperson.

As the sustainable investment movement grows, calls are becoming louder for improved data quality and standardisation across climate reporting in order to compare organisations. "There



is no consistent way of measuring the 'E' in the ESG [environmental, social and governance] metric," says Wood Mackenzie's Kretschmar. And while many energy companies are making the right noises in relation to the energy transition, investors still struggle to compare activity across the industry.

"Companies do not always disclose [this information], or certainly not with the same amount of rigour," says Mike Ferguson, director, sustainable finance at S&P Global Ratings. "And it's not always clear what is material from an [investment] decision-making point of view."

The Group of 20 Financial Stability Board's Task Force on Climate-related Financial Disclosures is creating voluntary financial risk disclosure standards to help companies inform investors, lenders and other stakeholders about how they are managing climate risks. Market participants also see the European Union Taxonomy as the most promising set of guidelines for sustainable finance. A proposal for the green classification system was published for comment by the European Commission last June in a bid to support organisations in becoming more environmentally friendly. "It's really in a very embryonic stage, but I would say it's coming fast and corporations are working very hard on trying to understand what this means for each one of them," Kretschmar says.

In the private sector, rating agencies are also working on new climate risk assessments. S&P Global Ratings launched a benchmark for ESG performance and preparedness last April while rating agency Moody's has been working on a carbon transition tool.

James Leaton, senior credit officer, climate risk at Moody's, says the aim for the latter is to provide more depth for investors. Again, gauging future demand is seen as key. "We are trying to take a more tailored approach [that accounts for] future demand, rather than some good housekeeping initiatives or slight improvements in the efficiency of how they get oil and gas out of the ground," he says. "That's where the debate has started to move on: what do these companies think about the future demand for their products and how does that affect their strategy?"

An overarching framework to help organisations gather information and report in a more standardised format would certainly support sustainable investment decision-making further. Rasmus Skov, head of sustainability at Danish energy firm Ørsted, says the "plethora of rating agency and reporting frameworks" shows the growing interest in this type of investment in recent years, but he adds: "If there was one framework to rule them all that had settled upon accounting standards and ensured comparability, it would make our lives much easier, as well as those of investors."

**"Companies do not always disclose [this information], or certainly not with the same amount of rigour. And it's not always clear what is material from an [investment] decision-making point of view"**

Mike Ferguson, S&P Global Ratings

## Taking action

When it comes to taking climate-related action, European majors have been the most active to date in terms of setting targets and planning other activities linked to energy transition preparedness, according to CDP. Equinor, Total, Shell and Eni were the top four in terms of business readiness in a CDP analysis of 24 of the largest publicly-listed oil and gas companies.<sup>5</sup> "They are pivoting portfolios towards gas, setting climate-related targets and investing in low-carbon technologies," the report says.

For organisations committing to spend on renewable energy development, this is part of a gradual process that currently makes up a small slice of their total capital expenditure. "Out of the 24 companies we assessed for the report, the five European majors – Shell, Equinor, Total, BP and Eni – were the only organisations that have committed a certain proportion of capex spend to renewable energy in the near term," Fletcher says. Most of these organisations plan to spend around 3–5%, while Shell has pledged closer to 6–10% – or \$2 billion–3 billion per year from an annual spend of \$30 billion, for the 2021–25 period. Equinor has set a longer-term target of 15% by 2030. "I think this is very much because of investor pressure [created by] shareholder resolutions," he adds.

Other energy companies have made the move already. By shedding both its upstream oil and gas business and dropping the now unsuitable moniker

Danish Oil and Natural Gas, Ørsted completed a decade-long transformation into a green energy company in 2017. It has a 25% share of the offshore wind market and aims to reduce its carbon emissions by 98% by 2025, from its 2006 levels. "We want to step up on the climate agenda and we want to inspire others to do the same," says Skov.

While dipping a toe into the renewables sector makes sense for some oil and gas firms now, the idea of exiting fossil fuels completely is not on the agenda for them at the moment. "It's very difficult to make a long-term plan [to stop producing fossil fuels] when every forecast is showing that the world will continue to need these commodities," says Wood Mackenzie's Kretschmar. She warns though, that the fast-changing regulatory environment could change the outlook very quickly. It would make good risk management sense to prepare for lower demand now by moving portfolios as much as possible to the lower end of the cost curve in anticipation of a lower oil price environment, she says. ■

Previously published on Risk.net

<sup>1</sup> Axia (December 2017), Axia accelerates its commitment to fight climate change, <https://bit.ly/2l14OGJ>

<sup>2</sup> Carbon Tracker (November 2019), Balancing the budget: Why deflating the carbon bubble requires oil & gas companies to shrink, <https://bit.ly/3cMfbHE>

<sup>3</sup> International Energy Agency (November 2019), World Energy Outlook 2019, <https://bit.ly/39LC5Nx>

<sup>4</sup> BNP Paribas, Investors' Corner, Wells, wires, and wheels – Eroci and the tough road ahead for oil, <https://bit.ly/2W7WVmn>

<sup>5</sup> CDP (November 2018), Beyond the cycle – Which oil and gas companies are ready for the low-carbon transition?, <https://bit.ly/2xsWY1z>

## TAKING CREDIT

Energy sector credit ratings have not yet been impacted by concerns about climate risk and the energy transition, but experts predict the issue will soon start to bite. "It hasn't been a primary driver of credit, but we see it as something that is coming in the next few years," says James Leaton, senior credit officer, climate risk at rating agency Moody's.

"The investments that are being made now will play out in a different market in five or 10 years, and that is something we are talking to energy companies about in terms of their capital



James Leaton

deployment strategy and how that is being adjusted for different future scenarios."

More generally, Thomas Watters, managing director and sector lead for oil and gas ratings at S&P Global Ratings, says that, although "more investors are shying away from heavily polluting companies", the oil and gas sector is still a far cry from the coal and tobacco industries in terms of investor sentiment. However, once energy companies start to see this issue as a "huge financial threat", spending on alternative/clean energy sources will start to increase, he says.

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# A sea change

## Driving awareness to confront climate risk

Amid a global push towards green policies, the reality of overhauling how industries worth trillions of dollars operate is causing concern. A forum of market participants and sponsors of this report discuss the levels of awareness of climate risk and its prevention at all levels, whether current regulatory targets are achievable and where the responsibility lies for gauging climate risk







Soledad Díaz-Noriega  
Partner  
[www.managementsolutions.com](http://www.managementsolutions.com)

### To what extent are financial and energy firms still in denial about climate change?

**Soledad Díaz-Noriega, Management Solutions:** Bearing in mind that the answer varies depending on geography, in general terms we observe that firms are at one of three stages:

1. Those fully aware of climate risk, who have been developing their climate risk management framework for several years already.
2. Those who have recently become aware that climate change will have a relevant impact on their future, and who are taking tentative but solid steps to manage it.
3. Finally, those who still address the phenomenon of climate change only from a reputational perspective.

In the latter case, social pressure, investors and – in certain regions, such as Europe – emerging regulation will push these firms to transform either by conviction or by obligation.

**Aiman El-Ramly, ZE PowerGroup:** I don't believe they are in denial about climate change at all. More so, I believe they are realists when it comes to understanding the economic dependency on energy and the technical difficulties in moving to a non-fossil environment. While regulation can provide punitive means to pursue desired changes in fossil dependency, substantive technical advancement in storage and grid management is necessary. Moreover, a mismatch in global climate policy and initiatives means that isolated activities are less impactful and create economic disadvantages.

**Marion de Marcillac, MSCI:** Until now, measuring the potential impact of transitional or physical risks, or the economic impact of climate change, on portfolios was limited owing to the lack of tools available to investors. If firms don't have accurate information on which to act, they cannot effectively price climate-related risks and opportunities, and may risk systematically misallocating capital.

To date, regulation has focused on the assessment of current, short-term risk exposure rather than forward-looking assessments as recommended by the Task Force on Climate-related Financial Disclosures (TCFD). Fund managers and financial analysts generally have horizons that do not extend beyond the next five years and, as a result, corporate reporting rarely includes forward-looking disclosure beyond that timeframe. In 2020, only 11% of MSCI All Country World Index – now known as MSCI ACWI – constituents disclosed all TCFD-recommended information regarding their carbon emissions reduction targets. Of the remaining firms, 54% had not disclosed any carbon emissions targets and 35% had disclosed targets without further specifying the base year, targeted reduction per annum or target year.<sup>1</sup>

**Kevin McGeeney, SCB:** We should bundle climate change deniers with those who draw up short of doing enough. Inaction ends up in the same place as denial. More broadly, equating denial and inaction, financial and energy firms are nowhere near where they need to be on climate change. However, if expressing concern was enough, the financial and energy industries could be regarded as fully prepared for climate change.

**Adityadeb Mukherjee, Standard Chartered:** We do not believe most financial and energy firms are in denial about climate change – although, understandably, the speed and intensity with which firms are responding to the challenge varies greatly. Standard Chartered has long recognised climate change as the biggest existential threat of our times, and has taken bold actions – for example, from initially committing to not funding any new coal-fired power plants, to more recent ambitious targets around clients dependent on thermal coal, and significantly increased targets around renewables. Thematic scrutiny from regulators, investors, clients, non-governmental organisations and other stakeholders on this topic is ever-increasing, and the science is quite clear – so denial is not really an option. However, challenges remain in future projections and the uncertainty around timings and impact in the short term, which is hindering globally co-ordinated action on climate change, and impacting the pace of integration of climate change into all business decisions. Standard Chartered believes working together with a wide spectrum of stakeholders is the way to overcome this.



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**Naeem Siddiqi, SAS:** There's increasing awareness among financial firms at the board level, but it hasn't always filtered down to lower levels such as the modelling teams. At the top there's effort to recognise climate risk exposures and pre-empt impending regulations requiring disclosures. That will vary by region, but the likes of BlackRock, the European Construction Bank and Societe Generale announcing intentions to scrutinise companies deeper on disclosure and reduce exposure to coal industries and other fossil fuels may help banks accelerate their disclosure regimes sooner.

We've seen a shift in awareness among financial companies since the Network for Greening the Financial System (NGFS) – the global association of 60-plus regulators and central banks – last year documented its commitment to managing climate risk.

In places such as Canada, the oil industry dominates the economy in certain regions, so local banks are pursuing policies to be green – but at the same time it's unrealistic to walk away from hundreds of billions of dollars of business. This is a complex and nuanced issue where government policies and regional politics all come into play. The transition is much easier for smaller European countries to move away from fossil fuels because there is less money at stake.

Banks have been active in the environmental, social and corporate governance (ESG) and sustainability spaces, but this was often more about trying to look good – about marketing and reputation.

**Morgan Després, NGFS and Banque de France:** From an NGFS perspective, the mispricing of climate risk is at stake. For a number of reasons, climate risks are currently not appropriately priced by market participants. There is a lack of disclosure and forward-looking approach to measuring exposures. In general, firms may be reluctant to adopt a longer-term perspective and they don't necessarily want to voluntarily expose their material risks to climate change. It's our job as supervisors and central banks to find the right metrics and methodologies to provide more clarity on exposures, and reach a better allocation of capital, more in line with climate objectives.



**Maryam Golnaraghi**  
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**Maryam Golnaraghi, The Geneva Association:** I don't believe companies are, in general, in denial about the scientific evidence behind climate change – nor the need for transitioning to a resilient low-carbon economy. However, there are shortcomings regarding the urgency and speed with which they are approaching the transition. This could be addressed through a clear public policy signal and related incentives from government to the private sector.

The Paris Agreement on climate change requires all parties to put forward their best efforts through nationally determined contributions (NDCs) and to strengthen these efforts in the years ahead. While governments have shared their NDCs, not all are aligned with Paris Agreement targets. This may be a generalisation but, in every sector, around 5–15% of the largest firms – although this percentage is typically higher in the financial and insurance sectors than in carbon-intensive sectors – have initiated their systematic integration of climate risk and opportunity into their core business.

This means climate change has been raised to a strategic topic linked to core business for boards and C-suites, with individual accountability. These firms are adopting the recommendations of the Financial Stability Board's TCFD – not just for the sake of disclosure and reporting but as a way of mobilising and engaging their companies in the process of assessing risks and opportunities to drive climate change strategy and policy for the corporation. These companies are actively investing in tools, data and expertise to build their climate risk analytics capacities, working with regulators to shape future regulations and investing in a variety of technologies and innovations in their core business.

For many others, boards and C-suites want to develop a climate strategy and implement it, whether as an integral part of their overall sustainability programme or not. The key issue is they need help with how to do it.

Those that remain in denial will have difficulties turning their companies around if they have not planned for transition to low-carbon business models.

To help businesses align more quickly with the Paris Agreement, a number of actions are needed.

Governments must establish clear and aligned sectoral public policy, supported by effective legislative and regulatory frameworks to enable a planned transition phase. Conflicting government subsidies send inconsistent signals to the market. To this end, government consultations with industry leaders, financial and insurance sector and technology firms would be essential in defining viable transition paths.

At the same time, credit rating agencies could step up their efforts to factor climate change into corporate ratings, influencing consumer preferences and raising demand for low-carbon products and market conditions.

Investors and shareholders should be actively engaged in support of company transitions. Business leaders also need to take a more proactive role in steering their firms strategically and effectively through the change process. This would require board-level directors and C-suites to assess risks and opportunities and develop a transition plan, engaging all divisions and departments. They must build their expertise in this area, and consider climate change a part of their core decisions, from corporate governance and strategy to enterprise risk management and the entire supply chain. They will need to invest in climate risk

analytics and expertise, integrate climate risk assessment and management in all aspects of their business decisions, and break through their institutional silos and cultural barriers to develop more integrated and holistic solutions.

These firms must engage with their insurers to identify innovative solutions for protecting their assets, enabling and financing the transition to new business models. Access to a strong, vetted ecosystem of data and analytics, management and strategy consulting, insurance, financial and legal support services could help corporations with their transformation.

**Nazim Osmancik, Centrica:** I cannot speak for the entire industry, but I believe that most firms have recognised climate change and are actively doing something about it. Centrica embedded enabling the transitioning of customers and energy systems to a lower-carbon future as an official business ambition with clear metrics to measure progress.



**MSCI** 

**Marion de Marcillac**  
Executive Director, ESG Products  
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### How realistic is the Paris Agreement on climate change's target of keeping global warming to "well below" 2° Celsius above pre-industrial levels?

**Marion de Marcillac:** In a report published in October 2018, the Intergovernmental Panel on Climate Change (IPCC) projected an increase from the present 1°C above pre-industrial levels to 1.5°C of average warming between 2030 and 2052 if warming continues at its current rate.<sup>2</sup> Warming of 1.5°C will already pose unprecedented but potentially manageable climatic challenges to ecosystems and societies. Even if the Paris Agreement is implemented as envisioned and its objectives fully realised, the frequency and severity of extreme weather will continue to increase, and chronic, slow-onset manifestations of physical climate change – such as sea-level rise or temperature increase – will continue to unfold.<sup>3,4,5</sup>

MSCI has developed a 'warming potential' metric, which is expressed as a temperature, to help investors understand how their portfolios align with the Paris Agreement target of 1.5°C. Warming potential is calculated by combining top-down data derived from the Paris Agreement, and bottom-up economic, sector and company data to establish a forward-looking set of climate-related metrics. We also apply the metric to 10,000 companies.

**Nazim Osmancik:** It will be possible, but very challenging, to meet the Paris Agreement's targets. Major changes to the existing energy supply mix, transport infrastructure and building stock will be required while serving growing demand for energy, especially in the developing world. But, the difficulty around meeting the Paris Agreement targets does not mean we should not try as hard as we can, and we have recently seen strong momentum in terms of action taken by governments and the private sector. Centrica is taking on the challenge on three different fronts:

1. By helping customers reduce their emissions via the services and solutions we provide
2. By offering flexible, distributed and low-carbon technologies
3. By reducing its own emissions in line with the Paris Agreement.<sup>6</sup>

**Kevin McGeeney:** It is not credible to believe the Paris Agreement goals of 1.5°C or even 2°C can be attained solely through government compulsion on reluctantly co-operative companies. The pace of industrial change through compelled actions is too slow. For example, a gallon of road transport fuels has been decarbonised by 7% over 15 years of forceful programmes in the US and European Union. That is an example of slowness and a lack of ambition from the top. However, to achieve even that goal, the people working in the space did so diligently and enthusiastically.

**Maryam Golnaraghi:** The past 40 years have seen unprecedented partnerships established in the scientific community to enable co-ordinated research – of which there have been 25 years of international climate change framework negotiations. There has been a global effort to mobilise capital and activate financial markets to fund the transition to a net-zero economy, motivated by the TCFD and the emergence of the sustainable finance frameworks. But we are still far from reaching the objectives of the Paris Agreement.

Responses to climate change are still more in the form of talk and generating headlines than action. Deeply fragmented initiatives and silos persist across many institutional stakeholders. Reaching the goals of the Paris Agreement will require evolving away from the siloed public policies of the 20th century, and reimagining our institutional structures, consumption behaviours and socioeconomic values.

Defining net-zero solutions and feasible pathways to transition will only be possible through unprecedented alliances across all levels of government, the insurance and financial industries and the fields of science and technology.



Aiman El-Ramly  
Chief Business Officer  
[www.ze.com](http://www.ze.com)

**Aiman El-Ramly:** It is unrealistic in the current policy-heavy and innovation-light business and regulatory environments. Population growth and deforestation alone make those objectives near impossible. In the absence of major shifts in global consumption behaviour, it will not happen.

**Peter Plochan, SAS:** Very few people can estimate this, which creates lot of uncertainty – that's the problem banks face. The objective of the Paris Agreement is very ambitious and the currently submitted action plans from countries are still not sufficient, with their forecasted impact resulting in a temperature increase more in the range of 3°C. With stress-testing, banking regulators and banks are considering a few alternative scenarios – for example, below 2°, 2.5° and 3°C warming – and are trying to assess the portfolio impact of each. This is very hard to estimate because of the uncertainties around actions taken to fight climate change, their effectiveness and the resulting impacts on the economy and banking portfolios. A speaker at a global risk conference I attended recently said, at 3°C warming, the world becomes uninsurable, so let's hope we don't get there.

This is a global problem, so coming up with a plan that everyone can stick to is probably more important than drawing a line in the sand that's not realistic.

**Adityadeb Mukherjee:** Current projections and academic research suggest it will be quite challenging to meet the target set out by the Paris Agreement unless urgent action is taken over the next 10 years. The concentration of greenhouse gas and carbon in the atmosphere has reached unprecedented levels. Furthermore, there would be a lag between any potential reduction of carbon concentration and a resulting reduction in warming levels. Standard Chartered's *Opportunity2030* report reiterates the scale of investment required between 2020 and 2030 to drive the climate action necessary to achieve the Paris Agreement target.<sup>7</sup>

**Morgan Després:** It is probably still feasible, but there is always a trade-off involved. If you take a realistic look at the political situation and how things progressed at the UN Climate Change Conference of the Parties (COP) in Madrid last year, you may question the willingness of governments to take action. That's probably why – with the UK presiding over this year's COP 26 – much is expected from other stakeholders, such as the private sector and central banks, for governments to bring in more ambitious targets.

#### To what extent have firms been able to take advantage of new technology and analytics in this area?

**Maryam Golnaraghi:** Driven by the TCFD and sustainable/green finance initiatives in jurisdictions such as the EU, the UK, France, Australia and Canada, there are a number of developments worth highlighting.

On the demand side, the degree of adoption by companies differs by jurisdiction, sector, line of business and size. In Europe, for example, the greatest take-up has been among banks, asset managers and insurers, compared with corporations in carbon-emitting economic sectors such as energy, transportation and agriculture. In Japan, however, more corporations have been adopting TCFD and reporting than the financial sector.

The main needs – in terms of technology and analytics – are data, standard tools and methodologies and expertise in modelling, interpreting and using climate risk analysis in all aspects of decision-making. Some companies are investing in new climate risk analysis tools and exploring cutting-edge climate and weather data and forecasting technologies.

In addition, companies such as large (re)insurers and Fortune 100 firms with complex supply chains are considering digitisation, big data, cloud platforms cloud computing, the internet of things and artificial intelligence (AI) for system-wide predictive risk analysis, responsive management and predictive maintenance of their assets. To this end, some are also deploying advanced control systems and sensors, satellites and drones as part of system-wide monitoring for optimisation, and anticipation of system failures from recurrent weather extremes, for example.

On the supply side, a complex landscape of physical and transition climate risk modelling providers is emerging, deeply fragmented in terms of type of risk, underpinning methodologies, target sectors and other factors.

The UN Environment Programme Finance Initiative and insurance industry platforms The Geneva Association and ClimateWise are urging banks, asset managers, insurers and climate experts to review, assess and collectively develop approaches to integrating physical and transition risk in financial decisions and core insurance business.

A range of sustainability, accounting and management consulting firms are offering services to corporations to assess their climate risks under different scenarios such as those set by the International Energy Agency and IPCC.

Simultaneously, catastrophe risk modelling firms are increasingly considering how to incorporate forward-looking climate data. More than 30 environmental financial technology – known as fintech – firms and climate risk data start-ups have emerged in recent years, offering a wide range of tools and methodologies, from rudimentary big data analytics to sophisticated climate risk modelling and assessments.



The insurance industry is pooling resources and expertise through The Geneva Association to explore and develop the next generation of climate risk models with forward-looking climate information. Through cross-sectoral mobilisation, the aim is to develop a road map for advancing and augmenting physical and transition climate risk modelling, linked to both sides of the balance sheet. Bridging the latest science and technologies with financial and core business decisions will be central to future initiatives.

### What role should regulatory stress-testing play in helping the financial industry assess climate risk?

**Peter Plochan:** The approach that would work for climate change would have to be similar to Basel II or III – providing a set of international principles and a level playing field. For any regulatory actions such as capital allocation and disclosures, the TCFD and NGFS are key. The regulators need to agree on a standard approach globally for it to be successfully adopted by international banks.

Regulations are currently a patchwork worldwide. Some countries have plans for mandatory TCFD disclosures while, in other jurisdictions, regulators are leaning towards voluntary disclosure. This disparity will continue until some sort of international agreement is established. In the meantime, initiatives of large institutional investors such as the Investor Agenda or Climate Action 100+ are leading the way by promoting low-carbon investments globally and spurring firms to disclose their climate change exposures. Another prompt may come from consumers boycotting the worst-offending companies and the banks that finance them.

It is also likely regulators will impose some sort of capital charge for 'brown' assets. Climate change is now becoming a financial risk management topic. Regulators are convinced there's increased credit risk from certain types of assets that are more exposed to climate change than the others. Banks need to recognise this as a long-term issue and plan for it, whether it's increased allowance for losses or changes to lending and investment policies, capital, stress-testing or any other area of a bank's operations.

**Adityadeb Mukherjee:** Stress-testing – and, more broadly, scenario analysis – is critical to the assessment of climate risks, perhaps even more than conventional financial risks. The long-term nature of climate risks and uncertainties in future policy, technology and consumer preferences make scenario analysis imperative in climate risk management.

**Morgan Després:** Within the NGFS and Banque de France, the focus is on scenario analysis. If you look at exposures using, for example, the TCFD measures, you'll have a view at a given time, but it will give you limited insights on the dynamics of your exposures over the longer term. We need to marry the climate scenarios with financial data, developing a dynamic analytical approach using scenarios as a complement to the classic snapshot of exposures. It's a key objective for the NGFS, and we're due to release some detailed scenarios by the end of this year.

**Maryam Golnaraghi:** An explicit recommendation of the TCFD, scenario analysis and stress tests are developed to assess the resilience of a company or industry under a range of climate change paths, and they are particularly useful where historical data is limited or non-existent. Scenario analysis can be performed on a qualitative basis, with a clear scenario narrative and/or using quantitative information to illustrate potential pathways and outcomes. There is ongoing debate over whether companies should produce their own scenarios, for which boards of directors would be accountable, rather than use a standardised scenario, or set of scenarios, that would apply to a company, sector or across the board.

Climate change stress tests are becoming a key consideration for regulators, who likely see them as comparison and benchmarking tools. Supervisors worldwide – notably in Europe and Asia-Pacific – intend to carry out climate change-related stress tests in 2020. However, approaches vary across jurisdictions. This can make it challenging for groups participating in these exercises as well as for supervisors assessing a group's overall resilience to climate change and comparing results across firms. However, this is in its very early stages – there is lot of work and experimentation ahead. Bridging the latest advancements in climate science – particularly understanding Earth's climate system's carbon budget and atmospheric response to lower carbon emissions – would be central to the development of scenarios.



Kevin McGeeney  
Chief Executive  
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**Kevin McGeeney:** Once investors gain sight of the climate stress tests in the financial industry, they may take their investments elsewhere, which can be a catalyst for change. Studies show that ESG investing has higher returns and lower volatility. That is why the sector has grown to upwards of \$30 trillion in capital in just a few years.

**Soledad Díaz-Noriega:** Regulatory stress-testing will become an essential component of the climate risk assessment, mainly for two reasons: it will be a wake-up call for institutions less mature in climate change risk management; and it will lay the methodological foundations of a data-driven quantification of climate risk, which should in turn raise awareness.

In the short term, it will improve the understanding of climate risk, pinpoint priority issues and mobilise organisations into achieving an objective understanding and an effective approach to sustainability. In the long term, climate risk stress-testing is expected to be effectively embedded in the different management processes and the resource allocation decisions, as a means to promote financial stability.

**Aiman El-Ramly:** I am not sure it does play a role. The financial industry is not responsible for climate change. Governments are meant to enable change through supporting technical leadership. It has been a long time since we have seen initiatives such as the 1930s' New Deal, which saw substantive infrastructure development to affect meaningful change. Responsible central planning has taken a real back seat in the West.

**Marion de Marcillac:** Central banks and other financial market regulators are actively trying to map and quantify climate risks in their respective markets. A range of institutional investors may see transition and physical risks materialise over the medium to long term. Because of this, climate-related scenario analyses and stress-testing are evolving as methods to assess future conditions and the resilience of financial systems and inform climate change risk strategy.

Regulatory stress-testing is aimed at helping financial market regulators understand risk exposure, so they can plan and prepare for potential financial risks in the future. Central banks have recently been piloting climate risk disclosure requirements and surveying market stakeholders as a first step before regulatory measures might be taken.

As a potential response, MSCI Climate Value-at-Risk (VaR) provides a stressed market valuation of a security after the current market value is compared to the present value of future security-specific climate change costs, which have been determined by MSCI ESG Research's climate risk models.<sup>8</sup> The Climate VaR scenarios could help regulators understand if, and to what extent, climate risks pose a material risk onto the financial stability of their markets.

**Nazim Osmancik:** I am not sure to what extent stress-testing for climate risk needs to be part of the regulatory toolkit yet. However, generally speaking, stress-testing is a useful approach to assessing climate risk because of the high degree of uncertainty around the forecasts and inherent model risk. Despite advances in climate science, there is material uncertainty around how exactly the climate will change. This translates to an even higher degree of uncertainty around the impact on society, the economy and the business environment – especially in the near future relevant to corporate planning. Companies would need to map these interactions and determine the impact on their own activities, which is difficult to do accurately. Stress-testing is very useful when it comes to assessing such potentially high-impact risk factors that are difficult to measure precisely.

#### Whose responsibility is climate change within financial and energy firms – and whose should it be?

**Kevin McGeeney:** Boards of directors need to regard climate risk as their responsibility. Climate risk needs to be embedded in all strategy and risk management – and not thought of as a separate workstream. It requires significant effort to incorporate such changes throughout a firm. Unfortunately, I believe most companies will not be able to make such changes.



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**Nazim Osmancik:** It depends on a large number of factors; however, given the seriousness of the matter, I would expect responsibility to ultimately sit with boards and executive managers.

**Soledad Díaz-Noriega:** At an initial stage, responsibility for climate risk management commonly lay with the sustainability function, addressed as part of the corporate social responsibility, and linked to reputational risk.

As organisations mobilise to develop specific risk frameworks, the tendency is to transfer the responsibility to the risk function. As climate risk measurement techniques become more sophisticated, and due to the transversal nature of climate risk (impacting credit, market, operational and conduct risk, among others), greater co-ordination with the rest of the firm's risk managers is needed. In any case, it requires a major co-ordination effort with other impacted areas (strategy, business, investments, finance, and so on).

**Naeem Siddiqi:** For financial firms, responsibility lies with the chief risk officer (CRO). A survey published last year cited bankers claiming credit risk teams should be looking at climate change, rather than operational risk departments – which are the teams currently examining this area – but, ultimately, it's not an either/or issue. Climate change will affect market, operational and credit risk so the response has to be bank-wide. For example, BlackRock estimated there would be pressure on municipal bonds because of shrinking GDP in certain affected regions. There's an impact for equity investors in companies producing energy from coal. Then, on the retail corporate asset-lending side, there will be an impact on defaults due to physical and transition risks. Beyond that, there's also the reputational risk of companies deemed 'dirty'. Therefore, it is a CRO's – or even chief executive's – responsibility.

This is an area that has seen a shift. The impact on banks' physical operations has been considered for some time, whereas assessment of the impact on banks' portfolios is newer and adds complexity. For example, a farmer's land and property may be affected by flooding – this is known as physical risk. However, how will a plastic drinking straw manufacturer coming to the bank for a loan repay it in 10 years' time if there is a government ban on single-use plastics? This is transition risk.

**Aiman El-Ramly:** The responsibility for change rests with the population requesting governments take meaningful action. Punitive financial market mechanisms do not inspire substantive technological innovation or changes to consumer consumption. Demand-side management initiatives supported by government as it existed pre-electric deregulation, with meaningful incentives for adoption and technical leadership in government, did work.

**Adityadeb Mukherjee:** Climate change is a multifaceted issue, so clarifying an organisation's approach and assigning responsibilities accordingly is a critical first step to an effective response. As noted in its 2019 *Climate change/TCFD report*,<sup>9</sup> Standard Chartered's approach to climate change is structured around managing the ways in which we contribute to, and our exposure to the risks arising from, climate change by:

1. **Accelerating sustainable finance** – led by our global banking team
2. **Reducing direct emissions** – led by our global property and sustainability teams, and financed emissions, measurement of which is led by the enterprise risk team
3. **Managing climate risks** – the framework for which is led by our enterprise risk management team.

For managing climate risks, Standard Chartered's group CRO is the designated senior management function, supported by a central climate risk team housed under the enterprise risk management function given the cross-cutting nature of climate risks. Once the framework and standards are implemented, managing climate risks must become a first line of defence responsibility – of frontline business colleagues, for example – as is the case for established risk types.

**Morgan Després:** The main focus should be teamwork. From the perspective of central banks, supervisors and the NGFS, we always take a risk-based approach. Sometimes the risk and ESG teams don't speak the same language. One of the benefits of our dialogue with financial institutions was to bring these two areas closer, with the insights communicated to the board to drive decision-making.

**Marion de Marcillac:** MSCI recently published *The MSCI principles of sustainable investing*, which urges all investors globally to integrate ESG considerations – and, in particular, climate risk – into their investment processes.<sup>10</sup> There should not be specialised ESG investing on one side and non-ESG investing everywhere else. ESG integration is a transitional step to full incorporation of ESG considerations embedded as a core component of standard security selection, portfolio construction and risk management practices. This is a permanent change to how investment strategies will be constructed and how investments will be allocated and managed. To that end, MSCI calls on all investors and financial institutions to embrace fully and rapidly accelerate this evolution. It is the right thing to do, it is the smart thing to do and now is the right time to do it.

### How can firms best incorporate climate risk within their strategic and risk management frameworks?

**Aiman El-Ramly:** Energy and financial companies will look at climate risk with an economic bent. Can the firm make money by selling green at a premium, or will the firm outlast carbon-based competition if renewable portfolio standard (RPS) targets and the like actually hold out. The longevity of RPS – 100% by 2045, for example – will eventually come up against the utility mantra of providing safe and reliable electricity. Can highly interruptible sources such as wind, hydro and solar be reliably transmitted without the availability of dynamic gas-powered generation? Is there the ability to build storage measured in gigawatt hours? Can transmission systems safely deal with surges in renewable power generation? What is the effect on wildlife, water resources and land use by renewable generation at scale? What is the impact on manufacturing and chemical production if there is no demand for fossil production in energy?



Peter Plochan  
Principal Risk Management Advisor  
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**Peter Plochan:** There has historically been a focus on banks' physical operations, but the impact of climate change on banks' portfolios will increasingly form part of banking risk assessment processes and strategic planning. Inclusion of forward-looking analysis, of which stress-testing is just a part, is the area where climate risk should be assessed and firms steered away from brown assets as part of a mid- to long-term strategy. It's not just stress-testing but also business-as-usual planning. What will the impact of climate change be on long maturity portfolios? If a firm already has a flexible methodology in place that enables it to assess credit losses in its portfolios based on future macroeconomic scenarios, it could be relatively easy to adapt it for the climate change stress-testing framework.

**Marion de Marcillac:** Investors need tools and data designed to enable them to address a variety of needs, including measuring and reporting on climate risk exposure, implementing low-carbon, fossil fuel-free strategies, factoring climate change research into risk management processes and engaging companies and external stakeholders.

Investors can also manage climate-related risks and opportunities through systematic portfolio construction. A passive approach using low-carbon or climate change indexes historically reduced carbon emissions attributable to the portfolio and increased exposure to companies providing solutions to the low-carbon transition, while offering broad market exposure.<sup>11</sup>

**Morgan Després:** Firms have made huge progress recently – financial institutions in particular have developed their governance. The industry is saying that it is up to us as supervisors and central banks to provide clarity and consistency to make it easier to compare methodologies. The NGFS scenarios will help and we hope central banks will follow suit. There are other things we can do, such as harmonising definitions, using a common taxonomy and defining risk metric preferences.

**Kevin McGeeney:** Better data is becoming available, which is improving modelling. Case studies are gaining more publicity and seeing best practice assists all of us in moving forward. Embedding climate risk data and best practice throughout a company is the best way of addressing climate risk. If a company has built a separate silo to address climate risk, it will then need to disseminate the information and responsibility throughout the organisation.

**Soledad Díaz-Noriega:** A first step of paramount importance is to have a solid governance model that ensures clear ownership and accountability for climate risk at both senior management and board levels.

Once this is achieved, companies are advised to carry out an assessment of where they stand, and define a strategic three- to five-year horizon plan to adapt to climate change. The main challenge is for this plan to contain a deep and thorough reflection by senior management on how the firm will look in 10 to 15 years' time – thus longer than usual strategic plans.

A third point is to ensure climate risk is addressed like any other relevant risk in the firm, and therefore has an adequate framework containing all fundamental aspects: governance, appetite, organisation, strategy, methodology, risk management, and reporting and disclosure. Additionally, the firm should define a target operating model that develops all of these aspects in depth.

The fourth aspect is to ensure the necessary resources – human resources (HR), budget, and so on – required to manage this emerging risk are available. HR should be adequate in terms of number as well as in terms of skill sets and knowledge.

Finally, firms should develop specific workstreams to ensure a profound climate risk cultural change takes place across the organisation.

**Nazim Osmancik:** Every firm is different. The approach will depend on how much a firm is potentially exposed and what role it decides to play in the wider challenge to tackle climate issues. A good starting point could therefore be establishing an in-house view on these two areas, followed by a detailed strategic long-term action plan and establishment of measurable metrics to monitor progress.

**Adityadeb Mukherjee:** A systematic and rigorous approach is perhaps the best way forward here. Firms should first identify how climate risk manifests through their existing mainstream financial and non-financial risk types, and then systematically update the relevant frameworks, policies and processes. This must be supplemented with a comprehensive training programme to ensure organisation-wide awareness of climate risks, and how it needs to be treated in day-to-day activities. The key to success here is to integrate climate risk into mainstream activities, rather than climate risk being perceived as an additional or separate layer. In many ways, this will require a behavioural change across the financial sector with rising awareness as much as it will require innovative tools.



### How are firms' approaches to climate risk modelling evolving, and what are the key challenges in modelling exposure?

**Morgan Després:** The biggest problem here is the mismatch of timeframes. Banking books typically have an average maturity of a three- to five-year maximum time horizon; whereas when measuring climate change exposure the horizon is 15, 25 or 35 years. This is what the governor of the Bank of England, Mark Carney, called the "tragedy of the horizon".

Another problem is in defining exposures. Banking reporting, for example, isn't fully aligned with a climate risk approach. Banks can tell us their exposures to the energy sector, for example, or their biggest counterparty, but we don't know whether it relates to oil and gas, renewables or something else.

**Kevin McGeeney:** Climate risk for a company starts as a data task. It's linked to putting a true price of carbon on every aspect of a company's activities. Access to accurate pricing is difficult, and much of the emissions analysis is assumption-heavy. However, it's quickly getting much better. Once the data has been assessed and emissions and carbon prices established, there will be the twin track of getting to net zero – first via carbon credits, and second by process and industrial change.



Adityadeb Mukherjee  
Head of Climate Risk Management  
Standard Chartered  
[www.sc.com](http://www.sc.com)

**Adityadeb Mukherjee:** Approaches to climate risk modelling are becoming increasingly quantitative, although qualitative understanding and expert judgement are still extremely important. Challenges remain around data, such as accurate and validated emissions information, particularly in emerging markets; complexity, for example, effectively translating climate science into actionable insights; depth and breadth of impact, such as climate risk impacting a multitude of mainstream financial and non-financial risks; uncertainties about future projections; and associated model risk.

**Nazim Osmancik:** Translation of climate risk into economic cost has been studied for some time, largely led by academic research and the insurance sector. However, this is changing as policy action, consumer trends and investor activity are creating momentum behind decarbonisation. Businesses are exposed to transition risk, which can manifest in many different ways, impacting, inter alia, on the value of assets, the effectiveness of business models and competition. The need to understand these exposures is therefore driving strategy and risk functions to seek solutions that can provide quantitative insight.

Regarding modelling challenges, macroeconomic growth models are typically adapted to take into account climate change impacts through feedback loops. These models are most relevant to analysing policy and societal costs at macro level, which makes it difficult for a particular sector or individual firm to derive their specific exposures. Therefore, firms need to undertake detailed work to translate costs and risks at macro level into what it really means for them.

Another modelling challenge is around standardisation, which particularly impacts finance and insurance sectors, as currently there is no common approach to modelling climate risk and applying to, for example, credit assessment or risk capital.

**Naeem Siddiqi:** Modelling climate change is quite different from credit or market risk models. The first issue is that there's little or no historical data, driving the need to focus on forward-looking analysis. There is then the problem of the prediction horizon. Unlike market or credit risk – which is typically assessed over one or two years – the impact of climate change may take decades. Therefore, small shifts in assumptions or inputs can cause a great divergence in results. The final issue is causality – you can't really use local factors to determine what's going to happen to a particular customer in a particular region as the cause may come from another part of the world. Analytics at the moment are at a very high level – such as using historical data on hurricane losses to predict future frequency and impact under worsening weather conditions. The industry needs a set of consistent measurements and methodology, which regulators could provide – similar to the Basel Committee on Banking Supervision's standard calculation of risk-weighted assets.

**Marion de Marcillac:** Managing climate risk has become an increasingly important tenet of the investment process along with the ability to measure the impact of climate change and build portfolios resilient to climate risk.

Depending on the intended use of scenario analysis results, different levels of data accuracy may be needed. For example, it is important to have a high degree of accuracy when engaging with companies and conducting fundamental investment analysis on securities or real assets. MSCI's Climate VaR model aims to overcome the challenges of insufficient and inconsistent disclosure among companies by estimating their greenhouse gas emissions. This model also aims to address some of the complexities of conducting physical scenario analysis – for example, by integrating asset-specific information and modelling the potential effects of extreme weather events in those locations. This emphasises the need for companies to disclose material climate data – including asset-level data – in a consistent and comparable way.

**Aiman El-Ramly:** At this time, corporate modelling of climate risk is inadequate and reflects current policy without technical adoption. The actual meaningful generation mix is undefined.

**Soledad Díaz-Noriega:** Most firms are starting with expert-based approaches and less sophisticated methodologies with a top-down view, and are focusing their efforts on evolving towards more advanced methodologies and including sensitivity to bottom-up factors.

In the case of the financial sector, and in addition to assessing its own physical and transition risks, the challenge is to assess the risk of each portfolio. This includes assessing client risk at an industry or geography level, and then evolving towards a more individualised approach. Industries most directly exposed to climate change are being assessed first, and supply chain impact methods are being used for those sectors indirectly impacted.

The main challenge in both cases is to develop a data-driven approach, sensitive not only to the current situation of the firms but also to their mitigation capacity and strategic action plans. An equal challenge is to incorporate a long-term view (10–15 years) in the analysis and to get reliable results in a context of great uncertainty.

**What are the most important metrics for measuring climate risk? To what extent have firms been able to take advantage of new technology and analytics in this area?**

**Peter Plochan:** You can look at it from several dimensions – banks can look at climate change exposures on the banking book or trading book for example but, ultimately, you want to measure how much money you can lose under certain scenarios and how you can mitigate that risk. For example, what will the impact of climate change be on mortgage books in a certain region in terms of likely default rates? Banks typically insure against these risks, but that may not be possible.

One starting point for banks is to begin clustering their portfolios into different rating buckets based on sensitivity to climate change risks. This means they can identify climate change concentration risks and think about how to steer away from riskier areas.

Some are mining unstructured data for this purpose, analysing publicly available data to assess potential exposure to climate change events and the impact on credit risk across a firm's supply chain.

Climate change risks will place new demands on risk technology in two main areas. The first is individual borrower risk assessment. New rating factors will need to be incorporated into the process, which means collecting and processing a much greater volume of data. And the second is in portfolio and forward-looking scenario analysis, where new scenarios will need to be introduced and the impact on portfolios assessed across the new rating buckets and multiple time horizons. The current lack of a standard measure for climate risk means banks will need greater flexibility and the capability to cope with multiple methodologies.

**Soledad Díaz-Noriega:** There is no single optimal metric encompassing all the characteristics required to track the climate risk profile of a firm, and climate risk metrics are closely linked to the firm's industry. It is generally advisable to build up a range of complementary metrics so that the cons of some are offset by the pros of others. For example, metrics aiming to reflect the current situation of the firm that permit benchmark comparison (for example, carbon footprint or weighted average carbon intensity) should be complemented with others that reflect, in a forward-looking manner, the transformational effort the firm is making (for example, avoided emissions from approved projects, portfolio's futures emissions pathway). In this sense, possibly one of the most comprehensive and risk-sensitive forward-looking metrics would be climate VaR, although this is challenging to implement.

Likewise, reporting should be enriched with other metrics that reflect the firm's diversification objectives, disclosing separately the activities most exposed to climate risk from those that are part of the solution to it, such as energy mix produced or used, or the mix of green/brown share in financial institutions.

New technologies and advanced analytics will allow obtaining asset-level data, performing real-time ESG market sentiment analysis, or developing new methods to model climate risk, among others. However, there are some limitations in their current application because of difficulties in data sources, problems with non-standardised information, lack of predictive capacity of historical data or uncertainties that make it difficult to have a forward-looking vision, among others.

Despite this, many firms still have room for improvement, taking advantage of the available information and the possibilities offered by technology.

**Aiman El-Ramly:** The measurement of climate risk is in an immature state. The cone of uncertainty in current models is enormous. It is difficult to incorporate model results without other operational risks too. From an economic perspective, regulatory policy change is probably the greatest climate risk at this time.

**Marion de Marcillac:** MSCI Climate VaR provides investors with a quantitative, forward-looking analysis on how climate change may affect the investment return in portfolios. The metric allows investors to assess and mitigate future risks from climate change, while identifying new investment opportunities.

MSCI Climate VaR quantifies both transition and physical impacts in a climate scenario context. It provides several scenarios that incorporate different pathways to help assess the climate impact of investment portfolios.

The warming potential metric aligns a company's current business activities in addition to current and future green profits with carbon budgets required to limit global warming to 3°, 2° and 1.5°C. It delivers an exact temperature value that signifies which warming scenario – for example, business as usual, 3°, 2°, 1.5°C, and so on – the company's activities are currently aligned with.

Given that current and future regulatory actions – and thus market actions – are likely to be informed by the warming scenarios and warming levels, 2°C-aligned investment portfolios are likely to be more resilient compared with other business-as-usual portfolios.

**Adityadeb Mukherjee:** New technologies and analytical capabilities are increasingly being piloted and leveraged by banks. For example, Standard Chartered is piloting 2Degrees Investing Initiative's Paris Agreement Capital Transition Assessment methodology as part of the Katowice Commitment, while also assessing other potential tools for transition and physical risk assessment. It is critical that the underlying governance for the innovative solutions are proportionately rigorous, and the assumptions are well understood by providers and users alike. Given many of these are new, usage of these innovative tools will undoubtedly become more effective over time.



Morgan Després  
Head of Secretariat, Network for  
Greening the Financial System,  
and Deputy Head, Financial Stability  
Department, Banque de France

**Morgan Després:** For physical risks, you need to look at exposure to extreme weather events – using climate and weather-related data. For transition risks, it has to do with CO<sub>2</sub> emissions and prices. Usually in scenario analysis, we want to test what is going to happen to the pricing of one tonne of CO<sub>2</sub> under a particular scenario compared with today.

**Kevin McGeeney:** The most valuable immediate innovation will be companies working with partners that can help track carbon footprint, and then identify carbon prices for different aspects of a firm's activities. The single biggest metric for measuring climate risk is a genuine stress test on carbon pricing. In some industries, firms are already paying in excess of \$450 per metric tonne for CO<sub>2</sub> reduction. Identification of the risks is only the start of this process.

**Nazim Osmancik:** At a macro level, trends in new greenhouse gas emissions, total greenhouse gas concentration in the atmosphere, catastrophic climate events and estimated costs while, at firm level, emissions known to impact the climate are among the most important metrics.

When taking advantage of new technologies, I think it is fair to say we still have a lot to learn and improve in how we measure climate risk. There are

interesting proposals to leverage tools in catastrophe modelling to better capture climate-related risks. There are also case studies where new advanced analytical methods such as machine learning have been applied to identify risk drivers and improve predictions. However, I am not sure there is sufficient evidence to conclude such tools have provided measurable benefits so far.

### Where is the biggest potential for innovation in helping firms manage climate risk?

**Naeem Siddiqi:** AI has lot of potential to help identify exposures – particularly for larger complex banks with many instruments and investments. They will need to identify and measure direct and indirect exposure to climate risk through lending as well as investments in instruments such as collateralised debt obligations, hedges and mutual funds.

Some are already exploring real-time streaming analytics and natural language processing tools, which could be used to provide early warning signs on firms affected by climate change.

As firms start to incorporate and measure different aspects of climate change risk, more frequently and with multiple forward-looking scenarios, we are likely to see increasing drag on current technological capability, flexibility, performance and speed. Capacity becomes an issue, so firms will need to find new ways to manage the volume and speed of calculations and analysis required.

Last but not least we should not forget the simplest solution, which is a change in individual human behaviour. Organisations can adopt greener policies and incentivise environmentally friendly behaviour among their staff, and more widely by influencing their customer or lending base.

**Morgan Després:** Modelling is the primary area. We're still at a stage where we don't know the impact of climate change on the economy as a whole, so understanding scenarios and the macro impact, with a better, more refined view of exposures, is a key goal. To do that we need better macroeconomic models and a more complete set of data.

There are promising technologies such as satellite that can be used to help assess political risk. Big data could also be used to put together large amounts of weather-related data and build some variables over time.

**Adityadeb Mukherjee:** The next stage of innovation on climate risk would result from closer collaboration between the academic and financial services communities. Standard Chartered has partnered with Imperial College London to unlock these opportunities over the next few years.<sup>12</sup>

The other area of innovation would be around sourcing relevant data, potentially from alternate sources – including geospatial analytics – as bridging the data gap credibly would enable faster integration of climate risk into mainstream risk management processes.

**Aiman El-Ramly:** A reasonable balance between traditional approaches for delivering safe and reliable energy that progressively move to a greening of energy utilisation. This demands a central approach to technical innovation that is funded and/or supported by government. Storage, combined with distributed generation, is the most critical element. The other important potential is dynamic demand response. Energy consumption at home and work will need to take on a variable aspect or have built-in storage to shape energy availability by micro-firming. There will need to be a feedback loop between substations and energy-consuming appliances; in the future, the electric car would be considered an appliance.

**Nazim Osmancik:** More often than not, new innovation and technologies come unexpectedly and are therefore difficult to predict.

Based on what we currently know, there is material potential for innovation in three areas related to climate risk mitigation and management:

1. Facilitating investment in the energy transition and hedging exposures
2. Energy services and solutions to help consumers and businesses reduce greenhouse gas emissions
3. Converting energy through means that release few or no greenhouse gases – such as renewable wind and solar; carbon capture, utilisation and storage; and electrified transportation.

**Kevin McGeeney:** SCB has assisted companies under regulatory obligations to reduce CO<sub>2</sub>, with transactions that represent the abatement of more than 300 million metric tonnes of CO<sub>2</sub>. More recently, SCB has been working with companies volunteering to reduce or offset their emissions. This represents a big increase in scale. With scale can come better technological innovation to decrease the administrative burden in managing climate risk and working towards net zero. SCB is building its capacity to assist more companies across all sectors. Individual companies should try to keep the administrative burdens associated with a net-zero target as low as possible.

**Marion de Marcillac:** Scenario-based analysis is particularly innovative and encourages forward-looking, long-term assessment of the financial implications of climate change. Organisations may wish to consider the potential evolution of climate-related risks and opportunities over time under various conditions, as well as their potential implications.

Scenario analysis sheds light on possible futures. For example, how transition and physical impacts affect an investor's portfolio under a 1.5°, 2°, 3° or 4°C warming world by the end of the century.<sup>13</sup> It can also offer clarity on the extent to which investors could face increasing risk levels if policy actions are delayed or if extreme weather impacts reach the upper bounds of estimated ranges.

Innovative data sources will be an important aspect as well. Things such as patent data will help identify which companies are investing in low-carbon technologies. These are therefore likely to capture the future opportunities associated with a shift to a low-carbon economy, and can support investors in better management of those risks and opportunities.<sup>14</sup> ■

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<sup>1</sup> MSCI ESG Research

<sup>2</sup> IPCC (October 2019), Special report – Global warming of 1.5°C, <https://bit.ly/2wgHmOd>

<sup>3</sup> The Paris Agreement aims to keep global warming to 2100 well below 2°C above pre-industrial temperatures.

<sup>4</sup> Current nationally determined contributions are only on track for a 3°C rise by 2100 (The Royal Society, 2018).

<sup>5</sup> While the term 'weather' describes short-term variation in the atmosphere, 'climate' refers to a location's weather averaged over a period of time, <https://bit.ly/2UyW0O>

<sup>6</sup> IPCC, AR4 climate change 2007: The physical science basis – Chapter 10: Global climate projections, <https://bit.ly/2QGBTYd>

<sup>7</sup> Centrica, Enabling the transition to a lower carbon future, <https://bit.ly/2TTU1jn>

<sup>8</sup> Standard Chartered (January 2020), Opportunity2030 – Standard Chartered sustainable development goals investment map, <https://bit.ly/2PmHjHr>

<sup>9</sup> MSCI Climate VaR is provided by MSCI ESG Research.

<sup>10</sup> Standard Chartered (December 2019), Climate change/Task Force on Climate-related Financial Disclosures report, <https://bit.ly/2HTAMzF>

<sup>11</sup> MSCI, The MSCI principles of sustainable investing, <https://bit.ly/32HkBPY>

<sup>12</sup> J Badani, S Doole, N Kumar and M Shadwapee (July 2019), Climate change and climate risk – An index perspective, MSCI, <https://bit.ly/2TxK7T5>

<sup>13</sup> Mark Smith, Standard Chartered (February 2020), Climate risk is here, it's evolving fast, and this is how we're responding, <https://bit.ly/2Tem4Zh>

<sup>14</sup> There are distinct limitations to physical analysis under the timelines useful for investment decision-making. The modelling is being limited to a time window of 15 years, within which the manifestation of physical impacts remain limited and similar between emissions pathways. Beyond those 15 years the physical impacts of climate change are forecasted to drastically intensify, especially under higher greenhouse gas emissions pathways including a 3°C one.

<sup>15</sup> MSCI (2020), 2020 ESG trends to watch, <https://bit.ly/32FXZ25>

>> The panellists' responses to our questionnaire are in a personal capacity, and the views expressed herein do not necessarily reflect or represent the views of their employing institutions



# Tackling market risk in climate change

Rostin Behnam, commissioner at the Commodity Futures Trading Commission wants to see new derivatives products to help mitigate climate threat. By James Ryder

**B**eating the drum on greater awareness of the risks posed by climate change can be a tough sell in the US. Rostin Behnam, commissioner at the Commodity Futures Trading Commission (CFTC) knows this – but he also has a plan he hopes allcomers can get on board with: the development of thriving new climate derivatives markets to help mitigate the risk.

In June 2019, Behnam – a Democrat nominee who chairs the CFTC’s Market Risk Advisory Committee (MRAC) – announced the formation of a subcommittee dedicated to understanding and managing the risks posed by climate change to the financial system.

Where other watchdogs have made responsibility for managing climate risk a conduct issue – a case in point being UK regulators’ move to force firms to single out a senior manager with responsibility for assessing the risk of financial loss to their firm – Behnam’s remit is broader: to focus on the potential market impacts of climate change where it affects firms’ ability to assess and appropriately lay off risk.

Its mission is simple, if difficult to achieve, Behnam says: to “create more resilient markets, more stable markets, so that over the next few decades, you don’t have to worry about this element of the effects of climate change”.

The new body will bring together a group of “15 to 20” experts from across the financial markets, says Behnam – “banks, asset managers, and clearing houses and exchanges, but then also energy companies, insurance, reinsurance, environmental groups, climate academics [and] public interest groups”.

It will also build on work conducted by other regulatory bodies in the US: Behnam points out that the Federal Reserve banks of Dallas and San Francisco – based in states already suffering from the physical manifestations of climate change – have also begun serious work on the issue.

The subcommittee’s formation caused a stir in Washington, DC, with Democratic senators Chuck Schumer and Sherrod Brown publicly praising

the decision. While Behnam pointedly declines to comment directly on the climate policies of the Trump administration during his hour-long conversation with *Risk.net*, or the impact he hopes his work might have on its policies, he makes clear his awareness that his group has its work cut out. Donald Trump’s attitude to climate change and global warming is well documented – from the stated intention to withdraw the US from the Paris Agreement on climate change, to the infamous tweet calling man-made climate change a ruse dreamt up by China to render US manufacturing non-competitive.

But, as Behnam sees it, the risks that climate change poses to the smooth running of the financial system are not a partisan issue. One area he hopes those on both sides of the debate will be able to get on board with is a markets-led solutions to climate risk, based on doing what his industry does best: building deep, liquid and efficient futures markets. Behnam hopes his committee “can come up with ideas that would foster innovation and derivatives products that would help people manage risk, and lay off risk”.

A liquid market in weather derivatives already exists, of course – CME Group, for one, offers average rainfall contracts and temperature derivatives – but firms looking to mitigate the impact of flooding, whether from extreme weather events or rising sea levels, at present have few choices outside traditional insurance. Such policies will likely face a fundamental repricing in years to come, as severe flooding across the US eastern seaboard becomes the norm, rather than the exception – assuming insurers and reinsurers are happy to continue offering cover to high-risk areas at all.

Behnam hopes that, by bringing all corners of the market together and developing a clearer picture of where risks are building up, his subcommittee can foster the development of new risk transfer products where they’re needed – “whether it’s flooding ... [or] sea temperature and levels. I don’t know who would be willing to take that risk on,” he adds,



**“There are knock-on effects of climate change: that’s the conversation about national security, that’s the conversation about the economy and growth”**

Rostin Behnam, CFTC

“but it always seems [that] within this space, you have sophisticated market participants who are readily available and ready to ship risk away from end-users.”

One other critical aim Behnam hopes the group can contribute to is greater standardisation in climate-related disclosures. But if firms don’t have access to reliable and accurate reads on exposures to climate-related risk, Behnam notes, a productive disclosure regime can’t be established. It’s only when firms coalesce around a common approach to risk measurement that regulators, participants and commentators alike can understand the health of the market.

He says he hopes to see “standardised, comparable and effective” systems of measurement for climate specifically, and acknowledges that the existing methods might not be appropriate. In that case, Behnam says, “new metrics” must be found.

### Why did you decide to establish the subcommittee?

**Rostin Behnam:** It’s kind of been a years-long process. Before I started as a commissioner, I worked in the financial services space as an attorney and in a policy position in the US Senate, working on agriculture issues. So climate and the effects of climate change certainly came up a lot in my work, and [those] effects were what we were grappling with, and trying to manage from a policy perspective, with respect to agriculture.

I started this job in September 2017. I started to dig in a little bit more and think about the relationship between climate and financial markets and market stability and resiliency. I read a lot of the science and data telling us about the next decades and where climate is going, and then starting to put together a larger puzzle of what that might mean for market risk. And then, finally, a lot of the drive behind this has been recognising a lot of the work that’s been going on, in the UK, with the Bank of England, with the Network for Greening the Financial System [NGFS], and within the Financial Stability Board, the Task Force on Climate-related Financial Disclosure [TCFD]. Reading that work, and speaking with those folks over the course of many months, I thought it was a good idea to champion the issue within the CFTC.

Within my committee, the MRAC, I have somewhere between 35 and 40 market participants, academics, public interest groups, and, within the market participant silo, exchanges, clearing houses, dealers and asset managers – the full scope of market participants. In the past, I’ve examined the Libor transition, clearing house risk and some other issues. So when you put together all that work I had done going back to thinking about that agricultural exposure, and then reading the literature and thinking about the financial market risk of climate change, I thought it was a perfect opportunity to dive deeper into the issues and the challenges, start to examine some of the questions that people are posing and, hopefully, come up with some policy solutions.

In the next two months, my goal is to convene a group of experts across the spectrum of financial market participants: [people in] financial services, banks, dealers, asset managers, and clearing houses and exchanges. But then also energy companies, insurance, reinsurance, environmental groups, climate academics, public interest groups. That’s not

exhaustive, but just to give you a sense of what I’m trying to accomplish and a full-scale point of view on the issue.

There’s a 60-day open period for folks to apply to be on the subcommittee, and we’ll wrap that up in about mid-September. Then I’ll select a group of the applicants, fulfilling that larger goal of having a broad spectrum of experts on the committee. Ultimately, I view this as a months-long process to examine the issues from an operational risk standpoint, and from a transition risk standpoint. And then more broadly, like I said, [examining] financial market risk and stability and resiliency across the spectrum.

### How many members will the subcommittee have?

**Rostin Behnam:** My goal is to have the right number of people that represent the right sort of points of the industry. I’ve generally found that at 15 to 20 people, you sort of cross this threshold. So it’ll all depend on who applies – the types of experts and views they represent – and ultimately getting the right people together that can deliver.

### Individuals can be nominated by any member of the public – who’s being considered for membership so far?

**Rostin Behnam:** It’s too early to say. Knowing how this kind of process works, it does take a few weeks for these organisations to settle in and identify the right [people], and figure out if they want to be a part of the conversation. So it’s no surprise to me, at this point, [that] we’ve had maybe a dozen individuals nominated – a few from the existing MRAC, and then some outside folks from different organisations. Sixty days takes us to about September 9 or 10.

### What kind of influence do you hope the subcommittee is going to be able to exert?

**Rostin Behnam:** [This is] something that I care about deeply, that I think is important to financial markets and, more broadly, the larger conversation about climate change and what effects that might have. My hope is that the subcommittee will produce a document that will influence policy leaders, policy-makers and elected officials to think about the risks and challenges that lie ahead in the short-term, mid-term and long-term horizon[s]. And, quite frankly, the fact that we need to start thinking about mitigation and preparedness with respect to climate and financial markets.

When people generally think about climate change, they think about human health and safety in the environment, which in my opinion as a civilian, is the number-one priority, given some of

these extreme weather events that we’ve seen in the past and the danger that could potentially cause individuals and communities. But there are knock-on effects of climate change: that’s the conversation about national security, that’s the conversation about the economy and growth. And ultimately, within my bailiwick, that’s the conversation about financial markets, where my expertise lies.

I’m hoping that this effort and this initiative will expose and bring some ideas to the forefront of a broader, larger conversation about climate and what we can do to create more resilient markets, more stable markets, so that over the next few decades, you don’t have to worry about this element of the effects of climate change.

### The committee is focusing on the market risk impact of climate change. How good a job do you think banks currently do of modelling for the impact of something so difficult to quantify?

**Rostin Behnam:** All those conversations and all those issues that I previously noted, whether it’s national security, or the economy, or the environment or human health, they all have some relationship to financial markets, right? Whether it’s the financing behind mortgages, for homes, insurance, infrastructure development ... I mean, you name it, everything goes back to capital markets or derivatives markets in one way or another. From what I understand, our largest financial institutions in the US and across the globe are integrating – or are in the process of integrating – climate change scenarios into their risk modelling.

For the CFTC as a risk management agency within the derivatives space, scenario analysis becomes extremely important. But the question becomes: ‘What types of scenario analyses are you doing with respect to climate?’ And I couldn’t agree more that there’s so much unknown about the climate and what’s going to happen. Notwithstanding weather derivatives, which I know many market participants use, especially in the energy and utility space. That’s definitely something that I’ve thought about. On the one hand, there’s the policy idea of what we could be doing as a financial market ecosystem with respect to disclosures and governance and best practices.

But certainly within the derivatives space, hopefully this committee can survey current practices and come up with ideas that would foster innovation and derivatives products that would help people manage risk, and lay off risk, that are taking a few steps beyond just broad weather-related derivatives – whether it’s flooding, whether it’s air temperature, whether it’s sea temperature and

levels. I don't know who would be willing to take that risk on. But it always seems [that] within this space, you have sophisticated market participants who are readily available and ready to ship risk away from end-users.

One thing I think about often is one of the many lessons we learned in 2008 about contagion and the interconnectedness of the financial markets. To take a narrow look at this would not do it justice, because there's so much interconnectedness, and the relationships are so deeply embedded across the financial system. You have to look at every element to have a comprehensive review.

And at the most basic level, I think about the registrants at the CFTC, which are the largest dealers, the largest exchanges, the largest asset managers. All of these entities and organisations are registered with different regulators in Washington, DC, the UK, the European Union and Asia. These large players pervade in a good way the financial system, so risks that may pop up in their capital markets stream or their fixed income stream or their asset management stream certainly will have knock-on effects throughout the institution, and can affect different markets. That was certainly a lesson from '08, and [a topic] that I would hope that the committee, as we get into September and October, considers.

## So you hope to come up with new risk transfer products that allow the laying off of risk?

**Rostin Behnam:** I am fully cognisant of what my role is. The business side, the academics, the exchanges, will come up with products that clients demand. So I'm not trying to impose any new products on the market. What I'm hoping this exercise will accomplish is a stimulation of new ideas for products that might be able to mitigate these risks. But I am fully aware of the fact that, as a regulator, as a policy-maker, within my seat and capacity at the CFTC, it is not my job to take a view of different products or what clients or what the market demands from a business standpoint, and from a risk standpoint.

But hopefully this exercise will shed light on a lot of the work that's been done globally, domestically, [and] also dig more into some of the risks that we may face in the decades to come and what businesses could do to facilitate risk mitigation and risk transfer. That would be great. I've read a number of academic papers about some of these different novel ideas in the derivatives space, about different products that would help mitigate climate-related risks. But like I said, and like you said, at this point, they seem to be very vanilla weather-type derivatives.

## With respect to scenario generation, one of the criticisms of its use in Comprehensive Capital Analysis and Review (CCAR) has been that it's very difficult to compare outputs and gauge whether people are doing a good job of assessing the risks. How do you solve a problem like that with something like climate change?

**Rostin Behnam:** This is a priority of TCFD. You can't have an effective or a useful disclosure regime unless you have matrices that are standardised and comparable across the board. So what does that mean with respect to climate and risk? Perhaps, again, this exercise – or one that is an outgrowth of it – will start to think about how we [approach] climate-related financial market risks and whether or not we need to create a new matrix of standardised scenario analyses or risk analyses that would be specific to climate.

My answer to that question is that, above all else, you need standardisation. And you need an appropriate measure of risk. Does it exist within the climate space right now? My probable answer is no. And could it? Could the existing systems, CCAR or others, be effectively applied to climate? My guess is no. But I think we would certainly try. And if it doesn't prove effective, then we would have to get the economists and the statisticians together and think about new metrics for measuring risk in the space. And above all else, again, making it standardised and comparable and effective.

## What kind of data is the most important for firms to be gathering on climate-related financial risk at this point in time?

**Rostin Behnam:** We need to examine the data and the science that's been published about what we're seeing in the climate currently, and what the next decade and few decades will likely manifest over time. The data and science is key – what we're seeing on a day-to-day basis here in the US and across the country. Last year saw heatwaves in the EU. These floods, these fires and hurricanes, all of these weather events that are happening more frequently, are an indication of things that we need to be thinking about.

And then, more forward-looking, what the science is saying about the decades to come. Ultimately, financial market risk is about risk exposure, right? And it's the lending institution that has insurance exposure, mortgage exposure, general lending exposure. What type of exposures do these financial institutions have to either hard assets or individuals or entities that are exposed to climate? And what risks could those bring or show in the future? I'd certainly want to think what the

subcommittee could dig up and think about on a more granular level of what factors or what things we need to consider within that larger remit of risk analysis and scenario analysis.

## Do you think your work will get the attention of the current federal government?

**Rostin Behnam:** I think certainly it will. There's been a bit of work done at the regional Fed offices – San Francisco, Dallas. It's my understanding that folks are thinking about this. I know there's a voluntary disclosure system at the SEC [Securities and Exchange Commission]. So the conversation is, I believe – and this is just my opinion, I don't know for sure – happening. I know, certainly, that the San Francisco Fed and Dallas Fed are thinking about climate-related risk to the economy and financial risks. And that makes sense. If you think about San Francisco, the forest fires in California, and Dallas, with Hurricane Harvey down in Houston.

I'm trying to take a measured approach to an issue that I think is real and that the data and the science is indicating is going to continue to happen, that real-world events are demonstrating on a weekly and monthly and yearly basis via these extreme weather events. So, practically speaking, if your question is on the potentially partisan nature of this issue, I don't view this as a partisan issue. I view this as an issue that's important to policy-makers and to the country and to the globe. [An issue that], if we address it in a thoughtful way, I think we can mitigate some of the risks that are actually occurring across the country.

We saw that recently [in] this past spring, with the flooding in the Midwest, the forest fires out west in California last year, and some of these hurricane events in the recent past – Hurricane Michael and [the] fall of 2018. So I'm not trying to reinvent the wheel here. I do think a lot of this was driven by, again, the work I did in ag, and the literature I read. But ultimately, it's my expertise in financial markets and my position, but also what I see and read and hear about every day, and what seems more frequently about what's happening across the country with respect to climate, and what a lot of the literature is telling me about where the climate is headed in the decades to come. So I'm hopeful that folks will at least consider it, think about it. And [that] it will spur additional conversations within the space. Ultimately, maybe it'll lead to some policy changes that will be effective and helpful for financial markets. ■

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# Ready or not, the future is green

"We're here to enable a transition to a low-carbon economy," says The Geneva Association's Maryam Golnaraghi. By James Ryder

**G**lobal capital is crucial to leading toward a greener planet, but it's not enough on its own – governments have to be involved. And if they don't act, consequences for workers could be dire.

So says Maryam Golnaraghi, a climate scientist and director of extreme events and climate risk at The Geneva Association think-tank for insurance, the industry on the hook when monster weather strikes. She is concerned that all the officious buzzing around the financial risk part of climate change is drowning out a larger goal: smoothing the way to an economy that will run on far less carbon.

"People in the financial sector are getting carried away with stress-testing and scenario analysis," says Golnaraghi. "We're losing sight of the main purpose: we're not here to do analytics, we're here to enable a transition to a low-carbon economy."

The thinking needed to bring business to the idea of life in a very different-looking economy is not yet here.

"I think the world is too fragmented," she tells *Risk.net*. "We are stuck in the siloed thinking and specialisation of the 20th century. And we are having a hard time breaking through our institutional structures and cultural biases to actually think that we need new business models."

Case in point: the oil and gas industry. A day is already discernible when a good chunk of these industries could go the way of the horse-drawn carriage.

"So is it better for them to go bankrupt and sell off their assets, or can we work proactively with them to find solutions?" says Golnaraghi. If those industries began to die off, a managed exit would be preferable to a disorderly tumble into liquidation, she says.

"Behind every corporation are workers," notes Golnaraghi. The sudden disappearance of industries could lead to mass unemployment with its attendant social problems, she adds.

She also has serious doubts on the asset-stranding thesis – the idea that the private sector, by marking down, or 'stranding' assets degraded by climate change, would compel global economic decarbonisation – and that this would occur independent of any government prompting. Golnaraghi dismisses the idea: to assume industries will police their own assets this way is wishful thinking.

She also castigates global governments for a lack of leadership on climate.

"While governments don't have clear policies, corporations don't have the support and the know-how that's needed. And we'll still be talking about stress-testing, and that's not enough," she says.

Policies that work against each other can also give short shrift to alternative energy.

"You see what I call contradicting subsidies," explains Golnaraghi. "On one hand, there are still subsidies for oil and gas and carbon-intensive industries, and then there are also subsidies for green." Tax incentives for green alternatives are "absolutely fundamental" to making the sector competitive with its sootier, warming rivals.

She also suspects the financial industry's current twitches of activity in climate risk are, frustratingly, unrelated to the overriding goal – healing the planet.

"Mark Carney didn't bring out the Task Force on Climate-related Financial Disclosures (TCFD) because of climate scientists raising awareness," she says, referring to the Bank of England governor who was also chair of the Financial Stability Board (FSB) when the TCFD was created in 2015.

"It links back to the financial crisis of 2008," she continues. "Mark and his team at the FSB were looking to prevent the next 'big one', and climate change surfaced as a potential systemic risk."

Without the trauma of the financial crisis, says Golnaraghi, environmental topics might not sit particularly high on the financial sector's priority list, despite increasing social clamour.



Maryam Golnaraghi

## Back in the 1990s

In 1997, Golnaraghi was fresh out of Harvard with a doctorate in physical oceanography and had joined Harvard Business School as a senior research associate. Around that time, she addressed a large group of energy, insurance and agribusiness chief executives on the topic of climate-related risk and the importance of forecasting, she recalls. She urged the assembled chief executives to become familiar with scientific approaches, predictive tools and analytics as quickly as possible.

The response wasn't what she'd hoped for. "None of these climate risk issues will materialise in our lifetime," she quotes one executive as saying, echoing the group response. With the exception of one reinsurer, all dismissed her claims as too academic, too new, she says.

Then, later that year, El Niño came, bringing unsettling, freakish weather. The heating of both the sea water and the air caused floods, droughts, cyclones, super-typhoons and mass coral-bleaching.

Some of these possibilities she had mentioned in her talk, says Golnaraghi. But now executives were interested: How had she known? What methods and tools did she use to make her models and forecasts?

Shortly before, she had founded a company, Climate Risk Solutions, to guide corporate clients in developing climate-specific risk management. The firm also did consultant work for the US government, helping it to be ready for events on the scale of El Niño, which had dumped record amounts of rain on California.

The company was ahead of its time. “If you look at the market now, a new, physical climate risk modelling data-provider is coming out every day,” says Golnaraghi.

Its work inadvertently contributed to the creation of weather derivatives, she says. Soon after Climate Risk Solutions was founded, an energy firm sought its help in forecasting demand over its upcoming season. The database Climate Risk Solutions delivered became an early ingredient in the design of weather derivatives and parametric insurance products, she says, helping in the formation of a market. The CME Group began offering weather derivatives in 1999.

A few years later, she closed down Climate Risk Solutions and joined the World Meteorological Organization (WMO), an agency of the UN, as chief of the international programme for disaster risk reduction. The WMO has evolved into a key player on climate policy. In 1988, it helped create the Intergovernmental Panel on Climate Change, which today produces regular emissions targets for every country.

Upon joining, Golnaraghi once again set to work introducing policy-makers and executives to the concept of climatic risk. Among her early responsibilities was advising former US President Bill Clinton in his role as the UN’s special envoy for tsunami recovery in 2005.

“He governed a state that was hit by many disasters,” notes Golnaraghi, referring to flood- and tornado-prone Arkansas, where Clinton had been governor. And within months of his becoming



president in 1993, the Mississippi burst its banks in eight Midwestern states, causing loss of life, and waterlogging homes, businesses and crops. “So he was on the mark and ready to go,” she says of the disaster-hardened president.

In their work together, the two pushed what would become the global tsunami alert system.

“We briefed him about the benefits of development of a global early warning system for tsunamis, and he got very interested – a mechanism that was practical, doable and for which he could raise funds,” says Golnaraghi. “Since 2007, tsunami alerts are available to all at-risk nations, under five minutes.”

## Looking to the 2020s

Only recently have banks and energy companies begun measuring and managing their climate risk in any formal way, and that’s been at the prodding of regulators. At banks, for instance, stress-testing for climate disaster might mean adjusting the capital requirements on certain loans. Utilities, meanwhile, could find themselves forced to make investments to solidify vulnerable infrastructures.

But climate efforts in the financial world have been through some growing pains. Natixis, for instance, recently adopted a ‘green weighting’ policy for loans at its investment bank, scaling risk weights based on climate friendliness or indifference – only to face hostility from rivals that say such a method slants risk weightings away from their focus on the financial health of a company – their first purpose. The industry is also stuck in squabbles over disclosure and the moving target of taxonomy.

Regulators are hoping an expanded market in traditional risk transfer products such as derivatives will help firms offset their exposure to a changing climate. The US Commodity Futures Trading Commission, for instance, recently named the members of a special subcommittee to monitor the effects of climate on the smooth functioning of markets and the ability of firms to shield themselves from it (see page 36).

But building such markets is not easy, says:

Golnaraghi: “Temperature-based weather derivatives products were among the first in the market targeted at utilities. But you have to invest a lot of time preparing the historical data. You need to improve the historical records, fill in the gaps and remove non-weather-related factors.”

Within The Geneva Association, Golnaraghi and her colleagues will be pushing the insurance business toward more recognition of climate risk. The association certainly has the clout to do so – its members own nearly half of the world’s insurance premiums in aggregate.

“We’ve taken on the topic of infrastructure, where there is a massive investment gap,” she says. “Every dollar spent on future infrastructure should consider climate resilience and decarbonisation. The insurance industry, as investors and risk managers, can support this area.”

Consciousness of climate has moved from academic speculation decades ago to Greta Thunberg memes today. Yet the arc of warming continues. Golnaraghi does not want a repeat of 1997: she fears she will once again find herself playing Cassandra, making unheeded predictions.

In 2014, she, along with long-time colleagues in climate, was despondent on how little progress had been made after 20 years of effort: “the dial – not only has it not moved, it has gone backwards”. But they were hopeful: 2015 brought the promise of three new UN frameworks, among them, the Paris Agreement on climate change.

Even so, progress has been maddeningly slow. Government and business need to pick up the baton, and quickly, says Golnaraghi.

“We need clarity from government plans and sectoral policies, and related incentives. We need engagement of ministers of finance and economic development and local governments in this process,” she says. “On the other hand, the board of directors and C-suite need to steer their corporation strategically and effectively through the transitioning.” ■

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## MARYAM GOLNARAGHI

**2015–present:** Director, climate change and emerging environmental topics, The Geneva Association

**2014:** Special adviser, climate and disaster risk and strategic partnerships, Environment and Climate Change Canada

**2004–2014:** Chief, international disaster risk reduction programme, World Meteorological Organization (United Nations)

**1996–2004:** Chief executive and president, Climate Risk Solutions





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