Conference on Climate Scenarios, Financial Risk and Strategic Planning – Summary of Day 2

1 November 2017, London

I. Summary

On October 31 and November 1, 2017, the TCFD and the Bank of England hosted a conference on the use of scenario analysis in assessing climate-related risks and opportunities in firms' strategic planning and risk management processes, and in supporting improved firm disclosures.

The objective of the conference was to bring the world's major scenario producers together with private sector participants, foster better collaboration and, ultimately, more rigorous scenario analysis. 'Scenario producers' are organisations, such as the International Energy Agency (IEA), that use economic models to project how economies could evolve under certain policy, technology and socio-economic assumptions.

Day 1 of the conference covered what scenario analysis is and how firms in various sectors are already using it internally and for disclosures. The agenda can be found on the conference website, and all first-day presentations and videos are available online.

Day 2 of the conference provided an opportunity, under Chatham House rules, for scenario producers, disclosing firms, and users of climate-related disclosures to discuss the application and implications of scenario analysis to the strategic and financial aspects of climate-related risks and opportunities. This paper provides a summary of Day 2 of the conference. It reflects solely the views expressed by conference presenters and participants and does not reflect those of the Bank of England or the TCFD. This paper should therefore not be reported as representing the views of the Bank of England or the TCFD.

TCFD recommendations and scenario analysis

The private-sector-led TCFD can contribute to safeguarding financial stability, by helping markets to better price potential climate-related risks. At present, the challenge is that investors do not have the information they need to assess climate-related risks and opportunities across industries and firms.

The TCFD recommendations, for voluntary adoption, can help firms to better understand and manage transition and physical risks, and help investors, lenders and insurance underwriters to identify which businesses are best adapting to medium and long-term trends and managing risks effectively. This, in turn, can reduce both physical risks and the risk of a late and abrupt transition.

The recommended disclosure on scenario analysis is a major component of the Task Force recommendations. It asks organizations to describe the resilience of their strategy, taking into consideration different climate-related scenarios. It is a means for firms to develop their strategy and communicate it to investors.

The TCFD's recommended disclosure on scenario analysis will require a dialogue between those that produce scenarios, those that use them for their disclosures, and those that assess firms' investment prospects. This conference was intended as a first step towards this dialogue.

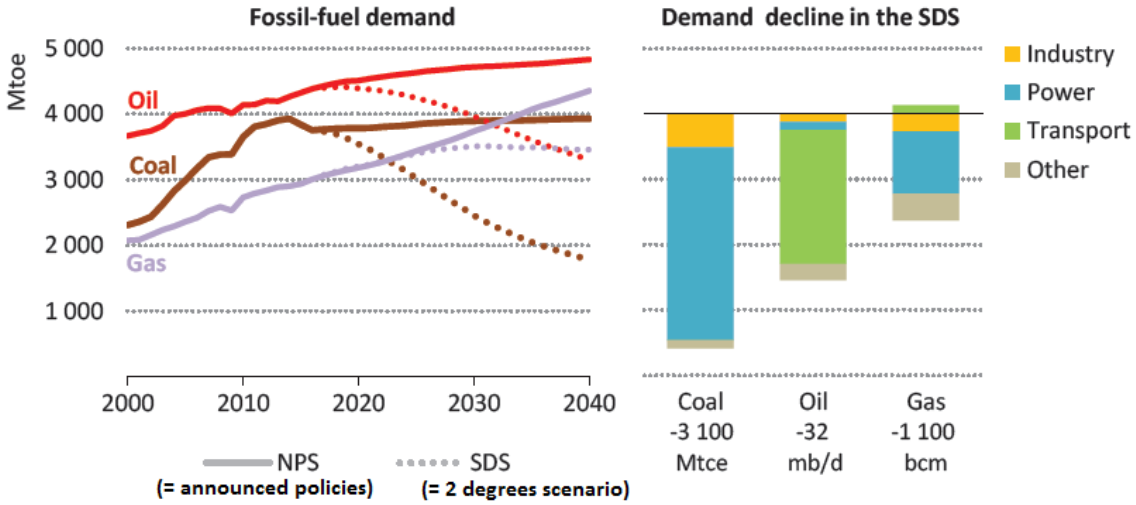
Key takeaways from the conference

Participants thought that scenario analysis is a highly important tool for assessing medium- and long-term risks and opportunities. Key takeaways from the conference include:

(I). Scenarios are data-driven stories about the future that can drive better decisions today. They are descriptions of possible external environments in which organisations may need to operate in the future. Participants emphasised that scenarios are not projections, forecasts, or predictions of the future, but rather a way to stretch thinking and explore plausible future paths under a number of assumptions. Since the future is unknown, a range of plausible scenarios can be used to explore future environments outside the 'base case' to inform strategy. In a climate context, a number of assumptions and indicators can be considered, such as demand pathways for fossil fuels by region and industry (**Chart 1**).

The *disclosure* of scenario analysis is a newer development and participants discussed how it can be most effectively used as tool to communicate the resiliency of an organisation's strategy.

Chart 1: IEA scenarios: global fossil fuel demand under a New Policies Scenario (NPS) and a 2°C scenario (which is called sustainable development scenario, or SDS)

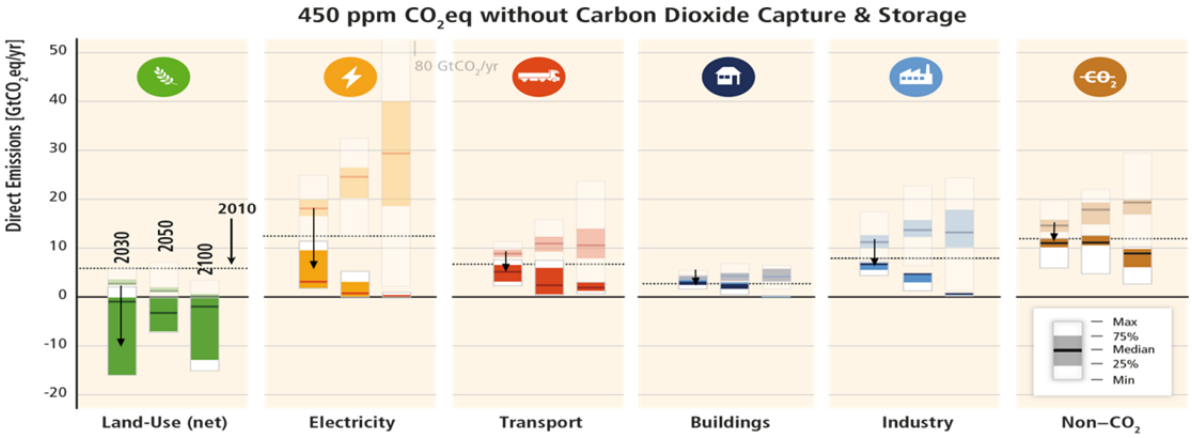


Source: IEA (2017).

(II). Multiple pathways are possible to achieve a scenario's assumed end-point, but there are some commonalities. Scenarios typically are based on an assumed outcome or end-point, such as a particular global temperature increase. Scenario producers emphasised that there is a range of possible ways to achieve a particular assumed outcome, such as limiting global warming to below 2°C (or any other given temperature target). For instance, there are differences in underlying models and assumptions. However, there are several trends that all 2°C scenarios have in common. These include rapidly moving to zero emissions by 2050 in the electricity sector and a significant reduction of emissions in the transport and industry sectors (**Chart 2**), partly driven by accelerated electrification of energy services.

In addition, most 2°C scenarios include global net negative emissions in the second half of the century, which include both dramatically reducing emissions and enhancing carbon sinks (including reforestation), and also likely negative emissions technologies like Bio Energy with Carbon Capture and Storage (BECCS). While carbon capture and storage (CCS) features heavily in a number of models, several participants highlighted that very little progress or investment in this technology has taken place recently.[1]

Chart 2: Global emissions in '2°C' scenarios from integrated assessment models and assessment by the IPCC by sector, for 2030, 2050 and 2100 (the shaded bars indicate the no-policy scenarios).[(a)]



(a) The bars indicate the range of different models. The brighter colours indicate the range of outputs of 50% of the models, as indicated in the legend on the bottom right. The 450ppm scenario has a 66% probability of limiting global warming to below 2°C. Source: IPCC (2014).

Participants agreed that, without additional policy incentives, technological change alone (eg declining costs for renewables) is very likely to be insufficient to achieve the 2°C target. Instead, to achieve this target, participants suggested that swift change across a wide range of sectors was needed, including the power sector, buildings, heavy industry, transport and land use. To achieve this target, scenario producers said that their models assume a steep rise in carbon prices, efficiency regulation, subsidies for clean technologies and phase out of fossil fuel subsidies.

(III). Many firms already use scenario analysis. Scenarios are being used for business strategy and financial risk analysis, both in climate-related and other contexts. In particular, firms said they tend to use multiple (including potentially extreme but plausible) scenarios in order to develop their strategy under various assumptions. For instance, the IEA's 450 Scenario (from 2017 called 'Sustainable Development Scenario') was used as a 2°C scenario by participants from various industries.

(IV). Nonetheless, there are significant gaps regarding existing scenarios and their use by firms. For instance, scenario producers – such as the International Energy Agency (IEA) and the Integrated Assessment Modelling Consortium (IAMC) – already provide a range of 2°C scenarios, which businesses could consider for their strategic planning and disclosure. But businesses found that they still lacked a full understanding of *how to interpret* scenarios. Participants were also interested in learning more about the *underlying assumptions* used to produce scenarios (eg assumptions on technology costs). And some said that scenarios needed to provide *higher resolution of outputs* (eg more data on the near term, on

[1] See for instance, IEA World Energy Outlook (2017).

investment needs, and on stock and flow data for demand in various sectors), in order to make the use by businesses easier.

(V). Regarding <u>further work</u>, there was interest from participants for:

- More use of scenario analysis in financial markets for assessment of medium- to long-term risks and opportunities.
- More occasions to exchange views and collaboration, for instance, scenario producers to interact with businesses in order to ensure scenarios and their assumptions are well understood.
- On the side of scenario producers (such as the IEA and IAMC members), making existing scenario data more readily available. This could include increasing the resolution of outputs (including more data on the near term, on investment needs, and on stock and flow data), more information of underlying assumptions and more frequent updating of results (the IEA, for instance, already provides yearly updates).
- Possibly establishing a process to agree on (a range of) 'anchor scenarios', ie scenarios that are internally consistent and have relevant and highly transparent assumptions (on technology, policy and socio-economic developments). Firms could then use these anchor scenarios to explain how their own scenarios differ, improving comparability.
- Exploring ways to improve disclosure of scenario analysis, such (i) working towards disclosing how exactly scenario analysis is used in firms' strategic planning and (ii) being more clear about underlying assumptions used in scenarios to enable greater compatibility.

II. <u>An introduction to climate scenarios</u>

Presenters introduced the concepts of transition scenarios and climate impact (physical risk) scenarios. Transition scenarios model how economies might adjust *given* a temperature target and *given* government policy. Climate impact scenarios, on the other hand, investigate what the impacts climate change could have on economies, societies and ecosystems, *given* an assumed level of emissions. The discussions at this conference focussed mostly on transition scenarios.

Speakers explained that a diversity of models and assumptions are used to produce scenarios (**Box I**). These result in a diversity of potential 2°C pathways.[2] (Similarly, there is a diversity of potential 1.5°C pathways, 3°C pathways etc.) Nonetheless, there were a range of model findings that most 2°C scenarios have in common. One such commonality, participants said, is the need for further government climate policy actions. For instance, carbon pricing regimes covered only 15% of global greenhouse gas (GHG) emissions in 2017 and, for three quarters of the covered emissions the carbon price is less than $10/tCO2 equivalent.[3] In the IEA 2°C scenario, global carbon prices rise to above $60/tonne in advanced economies and more than $40/t in big emerging markets (**Table 1**).

[2] The models discussed at the conference all narrow down the number of possible pathways by solving for the cheapest ways to reduce emissions – hence they are called 'least-cost' scenarios.
[3] See also World Bank (2017): Carbon Pricing Watch.

Table 1: Carbon prices in IEA Sustainable Development Scenario (consistent with 2°C) (prices in $/tonne CO2-equivalent)

Region	Sector coverage	2025	2040
Brazil, China, Russia, South Africa	Power, industry, aviation	43	125
Advanced economies	Power, industry, aviation	63	140

Another commonality of virtually all 2°C scenarios, it was argued, is the decarbonisation of the power sector. Coal demand would fall rapidly (but with differences across advanced and emerging economies). Participants regarded the transportation sector as central for mitigation and anticipated large changes in the future, but with high uncertainties around electric vehicles, automatic vehicles and ride sharing as well as in aviation and heavy freight. Large scale negative emissions technologies (eg BECCS and reforestation) would be needed by 2050 but, some argued, the investments for this are not forthcoming, which will make achieving the 2°C target even harder.

Participants highlighted that asset stranding could be limited in scale and confined to the power sector, if the transition is *smooth and* begins *early* (such as in the IEA Sustainable Development Scenario). But, for instance, in the IEA's 'Faster Transition Scenario' (see Box I), asset stranding could rise to about $840bn across a wider range of sectors, including upstream oil, coal and gas. And the IEA's 'Disjointed Transition Scenario' – which models a late and abrupt transition – stranded assets could rise to over $2tn.[4]

Further, it was explained that – since the warming from each ton of CO2 accumulates in the atmosphere – net CO2 emissions would need to be brought to net zero after mid-century. In addition, other hard-to-reduce GHGs like methane and nitrous oxide (mostly from agriculture and chemical processes) would also need to be reduced as deeply as possible.

A discussion followed on the sensitivity of 2°C pathways to underlying assumptions. Technology availability (e.g. the less carbon dioxide removal is available, the deeper near term emissions cuts would have to be), socio-economic developments (the higher GDP growth, the larger the amount of emissions reductions relative to baseline and the higher carbon prices need to be to achieve this), and policy developments (the longer stringent mitigation action is delayed, the steeper would future emissions reductions need to be).

Several participants stressed that scenarios are tools that can help businesses think through potential futures, but they are not forecasts or descriptions of the most likely outcomes. Rather, scenarios are about anticipating global trends, policy and technological changes and rigorously estimating what their outcomes could be. Scenarios explore consequences of action or inaction and implications of goals and constraints. Scenarios help us to organise thinking, for policymakers and businesses.

Several scenario producers highlighted that, outside the scientific community, scenarios are often misleadingly referred to as 'projections' (or 'forecasts'), which they are not. Organisations like the IEA do also produce projections, but it was emphasised that their scenario work (which includes their 2°C scenario) is very much separate from that.

[4] See IEA (2017): Perspectives for the Energy Transition.

Box I: Publicly available climate scenarios

Scenario producers highlighted the various climate scenarios that they are producing. They are briefly summarised below. See the TCFD report's technical appendix for further information.

The IEA Word Energy Outlook (WEO) analysis is predominantly conducted using three core scenarios up to 2040:

- **Current Policies Scenario** – considers only those policies that are firmly enacted as of mid-2017. It can be regarded as the 'default' setting for the energy system and as a benchmark against which the impact of 'new' policies can be measured.
- **New Policies Scenario** – contains the energy-sector policies and measures that are already in place, and the aims, targets and intentions of policies that have been announced.
- **Sustainable Development Scenario** is a scenario that can achieve a long-term temperature rise of less than 2 °C (and so is referred to in this document as the IEA 2°C scenario). In addition, it incorporates achievement of the UN Sustainable Development Goals (which includes, as Goal 7, ensuring 'access to affordable, reliable, sustainable and modern energy for all'). In the Sustainable Development Scenario, CO2 emissions from energy and industrial processes peak before 2020 and steeply decline up to 2040.
- Alongside these core scenarios, the IEA does create and refer to others such as:
  - **Faster Transition Scenario** – this scenario models an increased chance of a lower global temperature rise. It is similar to the 66% 2°C scenario presented in IEA & IRENA (2017): *Perspectives for the Energy Transition*, in relation to Germany's G20 leadership agenda. It describes an energy transition of exceptional scope, depth and speed, leading to faster reduction of emissions before 2040, for example through additional investment to avoid locking in high-carbon infrastructure.
  - **Disjoined Transition Scenario** – this scenario explores the possibility that climate action is delayed until 2025 and then followed by an abrupt and unexpected step-change in mitigation policies, in line with the carbon budget that gives a 66% chance of limiting warming to 2°C. This scenario is presented in IEA & IRENA (2017).
  - **Low Oil Price Case** – this scenario examines what it might take keep oil prices the oil prices in a $50/bbl to $70bbl range all the way through to 2040. It was first done in 2015, and updated in November 2017.

The **Integrated Assessment Modelling Consortium (IAMC)** is the association of the major global academic producers of transition scenarios. The IPCC draws on this group of academic scenario development teams around the world for its assessment of 1.5°C, 2°C and other transition scenarios. The scenarios from this group can be found in the latest IPCC report (AR5) as well as online databases (on AR5 and SSPs) which include spreadsheets with input and output variables. They are characterised by full coverage of sectors and emission sources (from energy to land use), evaluation of their consistency with long-term climate goals and other Sustainable Development Goals, and conducts sensitivity analysis across a range of models and assumptions about future developments. Analysed scenarios include current policy, Paris pledges, median 2°C, well below 2°C and 1.5°C scenarios. This diverse range of models shows there are multiple pathways that can limit warming to 2°C, but all require decarbonising the power sector by mid-century, electrifying as many energy services as possible, substituting residual fossil fuel use in the transport, buildings, and industry sectors by zero carbon fuels and achieving negative emissions in the land-use sector ('carbon sinks') by end of the century. The scenarios also highlight efficiency enhancements as a key mitigation strategy.

III. Using scenarios for strategic decision making in individual firms

Participants highlighted that, when looking at scenarios from a company perspective, it is important to understand sector implications but more importantly what specific implications different scenarios pose to *companies*. It is not a matter of looking at probabilities but of looking strategically at possible long-term developments by 2030-2050 and analysing how a company would have to position itself for them.

Others highlighted that, for many industries, key strategic decisions are often focussed on the near term, in the next 3-5 years. Some firms in the energy sector, for instance, are already using a range of scenarios for their current business decisions. They use scenarios to gauge potential future cash flows and estimated current value of their investments. Given ranges of scenarios they form judgments on where the company should invest but also make sure there is flexibility to adjust investment plans as new technologies and policies evolve.

Practitioners highlighted that, when using scenarios, it is important to be clear about what the underlying assumptions are and what the period is for a certain risk to become material. For instance, a given scenario might show that less internal combustion engine cars will be sold in the future. Each company (or financial analyst) in that sector would need to ask itself 'what are the assumptions that drive this scenario?', 'will I be selling less?', 'what does that mean for my margins?'

The extent to which companies will be affected depends on the technology mix of firms and different geographies will have different paths of transition. For instance, national decarbonisation paths will depend on a country's development stage, energy resource availability and existing energy industries. That is why, participants thought, it is key to make use of the regional break-down that the scenarios in Box I are providing, rather than using a global aggregate scenario.

Participants found that scenarios are useful for developing a firm's strategy. They could be used as relevant input for CAPEX and product mix decisions and to anticipate future revenues and margins (**Table 2**). Firms could also evaluate what the impact different scenarios would have on various assets and on the firm's net present value (NPV).

Table 2: Illustrative example of strategic assessment of risks and opportunities using scenarios

Automotive	• **Loss of revenue**, due to changes in overall demand and product portfolio mix • Value chain configuration critical, esp. ownership of battery packaging, also for aftersales revenues. • **Volume loss** in Germany is **overcompensated by global growth** – growth strategy to be defined
Refineries	• **Substantial loss of revenue and assets**, due to loss in volume • **Refinery configuration** can indicate „winners" • Additional stress on revenue base, as oil revenues are also likely to decrease; **alternative business models** to be analyzed
Utilities	• **Future profitability of assets depends** on scenario, location and technology • **Renewables are not necessarily winners**: In a 2 °C scenario, these benefit strongly in carbon-intensive and emerging markets; however, in low carbon markets, they depend on supplemental financing mechanisms • **Grid management options can substantially impact** all players' revenues

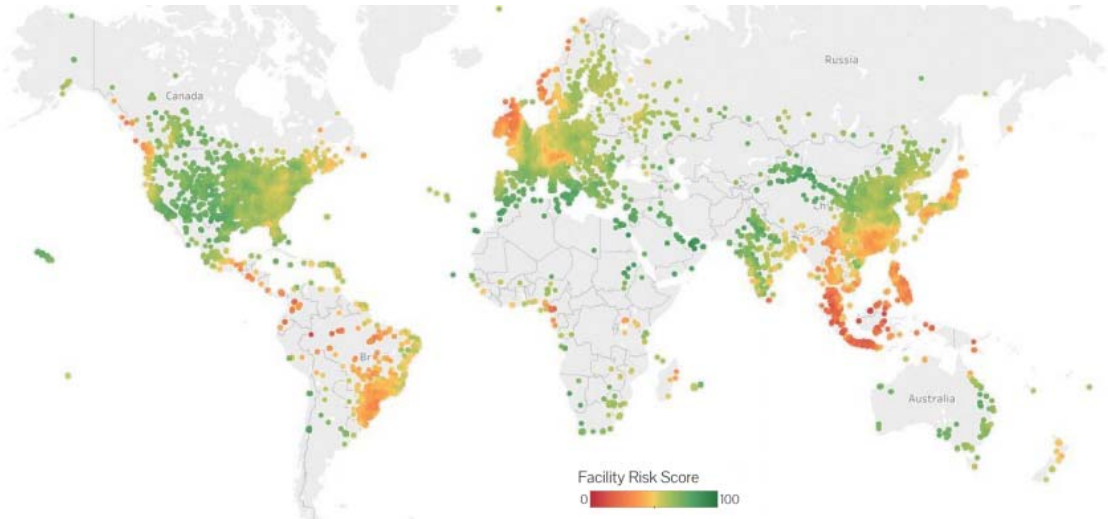
Source: The CO Firm.

It was argued that firms need to evaluate the impact that the climate transition might have on them up to 15 years in advance, as adaptation of the business strategy takes time. And, if companies are aware that their current market might suddenly change or that new growth markets are forming in the process, they need to position themselves and analyse how early that change will happen.

Finally, participants provided some perspectives on how businesses may want to use scenarios when formulating their strategies.

- When using scenarios, it is important to understand what the key underlying assumptions are. Firms were encouraged to question key underlying assumptions. One example given was CCS: while many scenarios (including the IEA's 2°C scenario) see significant deployment of CCS post-2030 very little investment is currently going into the development of this technology.[5] Absent CCS more aggressive policies would be needed to achieve the 2°C target.
- Participants also stressed the need to keep in mind that scenarios are usually developed to answer particular questions. They may not be applicable in contexts for which they were not developed.
- Pay attention to the detail; even seemingly small differences in scenarios can make a large difference for a business strategy.
- Granular data exists, both on physical and transition risk scenarios – see **Chart 3** for an example of facility-level physical risk scoring. (More on this in the next section.)
- Physical risks are real. For instance, Hurricane Maria shut down, for several weeks, a large part of Puerto Rico's pharmaceutical production which is worth $15bn and accounts for as much as 50% of global supply for certain medicines.

Chart 3: Example of mapping physical risk from extreme weather on production facilities



Source: Four Twenty Seven (2017).

[5] IEA World Energy Outlook 2017, p. 60.

IV. Using scenarios for asset pricing and investment decisions

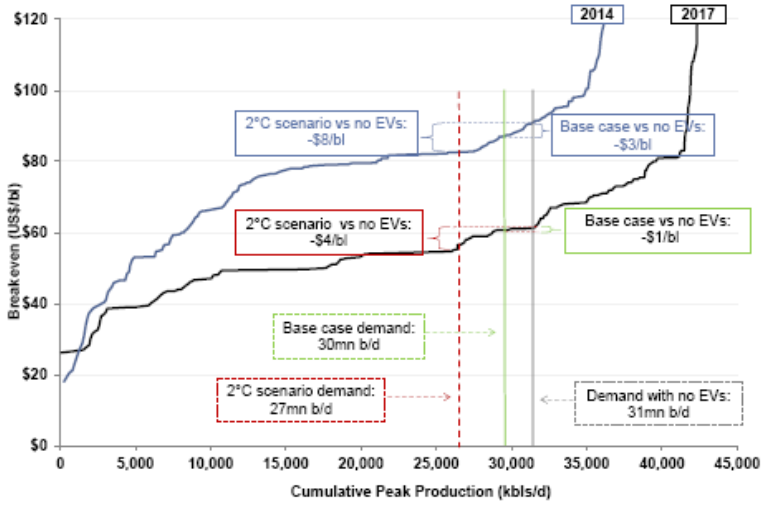
Participants thought that, given transition and physical risks, it is advisable for investors, lenders and insurance underwriters to start acquiring data and expertise to conduct scenario analysis.

Scenario analysis for pricing individual assets

On the pricing of individual assets, participants thought that there was currently a gap. It was argued that markets may often be too focused on short-term performance when pricing long-dated assets. For instance, it was argued that, in the energy sector, asset pricing often is based on *one single central case*, which is heavily influenced by current commodity prices. Upside and downside scenarios were less important for influencing pricing decisions.

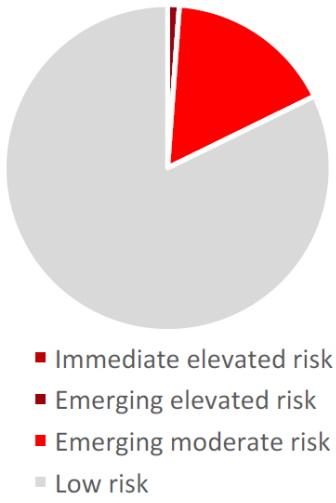
Participants highlighted that, for instance, for pricing oil & gas companies, scenarios could be useful for exploring uncertainties on the demand side, including a potential shift to electric cars. **Chart 4** shows an illustrative example of how electric vehicle scenarios and climate policy can be used to explore potential oil price developments.

Chart 4: Illustrative example of using electric vehicle scenarios for oil price scenarios



Source: Goldman Sachs (2017).

Chart 5: Illustrative example of fixed-income assets at risk in a portfolio



Source: 2DII, based on Moody's risk assessment.

Similarly, scenarios could be used to explore uncertainties on the supply side. For instance, some participants mentioned that shale could be a key uncertainty. One scenario was that it could have high production outturns in the short term, production declines over 2 years and then stabilise at around 10-15% of initial levels for the longer term. Scenario analysis could be used, it was argued, to explore the potential financial implications of such a dynamic.

Scenario analysis for portfolios of assets

Participants explained that using scenario analysis on entire portfolios increases the scale of the exercise. One needs to run scenario analysis many times, on the multiple assets contained in a portfolio. For instance, different assets in a portfolio may belong to varying

sectors and geographies, so different scenario may apply. **Chart 5**, for instance, shows how diversity of assets in a portfolio can mean diversity of risks in the portfolio.

Second, participants said that, as when pricing individual assets, data on the assets in the portfolio needs to be collected (from disclosures) or purchased from data providers (see **Table 3** for an illustrative and non-exhaustive list). To conduct scenario analysis it can highly useful to obtain – ideally forward-looking – information on firms' production plans. One could then compare their forward-looking plans with forward-looking scenarios in their key markets.

Table 3: Illustrative examples of databases that include forward-looking production plans of firms in high-emission sectors

Sector	Type	Database	Website
Oil&Gas	Commercial	GlobalData	Link
	Commercial	WoodMackenzie Upstream Data Tool	Link
	Commercial	Rystad Energy Ucube	Link
Coal Mining	Commercial	SNL Energy Metals & Mining	Link
	Commercial	WoodMackenzie	Link
Automotive	Commercial	WardsAuto/AutoForecastSolutions	Link
	Commercial	IHS Automotive	Link
	Commercial	Marklines	Link
Power Generation/ Utilities	Commercial	GlobalData	Link
	Commercial	Platts WEPP	Link
	Commercial	EnerData Power Plant Tracker	Link
	Commercial	Bloomberg New Energy Finance (BNEF)	Link
Aviation	Commercial	CAPA Fleets	Link
	Commercial	FlightGlobal Ascend Fleets	Link
	Commercial	CAPA airport investors database	Link
Shipping	Commercial	Rightship GHG Rating	Link
	Commercial	IHS Seaweb	Link
	Open Source/ Commercial	shippingefficiency.org BetterFleet	Link
Iron & Steel	Commercial	Clarksons	Link
	Commercial	PlantFacts	Link
	Industry-led Private	WorldSteel	Link
Cement	Commercial	Global Cement Directory	Link
	Commercial	Global Cement Review	Link
	Industry-led Private	WBCSD GNR	Link
Real Estate	Commercial	GRESB	Link
	Commercial	Geophy	Link
Cross-sector	Government	EU ETS	Link
	Government	EPA GHGRP	Link
	Government	Australia's National Greenhouse and Energy Reporting Scheme	Link
	Government	Canada's GHG Emissions Reporting Program	Link

Sector	Type	Database	Website
Power Generation/ Utilities	Government	Japan's Mandatory GHG Accounting and Reporting System	Link
	Open Source	CoalSWARM	Link
	Open Source	Enipedia/CARMA	Link
	Government	EPA eGrid 2012	Link
Aviation	Open Source	OpenFlights	Link

Source: 2DII.

Participants highlighted that, while forward-looking data exists for high-emission industries and scenario data is available too, it would be desirable for financial institutions to experiment with how the two can be connected. There is already significant expertise, for instance, in energy-sector equity and fixed-income analyst units in using the data highlighted in Table 3, participants thought, but there is more room for climate scenarios to feature in their modelling. They said this was a new field and they would benefit from a continued dialogue between companies, data providers, financial analysts and scenario developers.

Participants re-iterated that, for financial analysis, it would be desirable to not only use 'smooth and early transition' scenarios but also 'late and sudden' scenarios. Such late and disjointed scenarios could lead to disruptive changes which, they said, are important to consider as tail risks.

V. Next steps:

Participants agreed that the conference was a very useful first step towards making scenario analysis more widely used for strategic decision making and the pricing of risk and opportunities in financial markets.

Many were keen to further pursue conversations that began at the event. Points discussed were:

- Creating further opportunities for scenario producers (such as the IEA and IAMC members) to explain their scenarios and underlying assumptions and learn more about the needs and use cases of businesses.
- Holding more detailed discussions about methods that investors can use to connect scenarios to the assets in their portfolios, in order to better reflect medium- and long-term risks and opportunities.
- The need for scenario producers (such as the IEA and IAMC members) to make existing scenario data more readily available, for instance through online visualisation tools and data portals.
- Providing tutorials on how to interpret and use climate scenario information in a business context, in order to facilitate scenario analysis by firms.
- Explaining how to interpret scenarios and making clearer what underlying assumptions are (eg assumptions on technology costs or negative emissions). And providing a higher resolution of outputs (eg more data on the near term, on investment needs, and on stock and flows in various sectors) in order to make the use by businesses easier.
- Establishing a process to agree on 'anchor scenarios' that are publicly accessible, highly relevant, and have transparent assumptions and model documentation. Firms could then use these anchor scenarios as reference points to explain how their own

scenarios differ from them. Participants emphasised the usefulness of anchor scenarios to improve comparability of disclosures while at the same time allowing firms to flexibly develop and use their own scenarios.

- Exploring ways to improve disclosure of scenario analysis, such (i) working towards disclosing how exactly scenario analysis is used in firms' strategic planning and (ii) being more clear about underlying assumptions used in scenarios to enable greater compatibility.