CDP
DRIVING SUSTAINABLE ECONOMIES

CARBON PRICING CORRIDORS

THE MARKET VIEW

WE MEAN BUSINESS

CPLC CARBON PRICING LEADERSHIP COALITION

THE CARBON PRICING CORRIDORS INITIATIVE

Leading businesses and investors are now working out how to operationalize the Paris Agreement.

Carbon pricing is emerging as a key mechanism to drive greenhouse gas (GHG) emission reductions, which means that private and public stakeholders are seeking an informed view of how carbon-related price signals can develop in order to drive global emission reductions in-line with these goals.

In 2017 CDP and the We Mean Business Coalition launched the Carbon Pricing Corridors initiative with the objective of enabling large market players to define the carbon prices needed for industry to meet the Paris Agreement.

The Carbon Pricing Corridors initiative aims to provide a valuable benchmark for business and investors who are seeking to make strategic decisions consistent with a low-carbon economy, but who struggle with a lack of information about the risks and opportunities involved in the transition. The initiative can also inform governments; many are turning to carbon pricing as a mechanism to achieve their climate goals, and many more are seeking to reform existing carbon pricing policies to strengthen the market signal that they provide.

The initiative's work will complement the recommendations developed by the Task Force on Climate-related Financial Disclosures (TCFD), which are expected to outline the need for enhanced stress testing of climate-related risks. The Carbon Pricing Corridors has the potential to be used as a tool in scenario analysis, as organizations consider the potential financial, strategic, and business impacts resulting from the Paris Agreement in their decisions.

Our results will be delivered through an ongoing inquiry of the Corridors Panel—a group of experts selected from leading companies, the investment community, and international experts. Over the next two years the Corridors Panel will identify the range of carbon-related price signals needed through 2020, 2025, and 2030 to place the most polluting industry sectors on a trajectory to meet the long-term goals of decarbonizing the economy.

This first report focuses on the power sector, and over the course of 2017 the initiative will expand its scope to include other high-emitting sectors. Bi-annual publications in 2017 and 2018 of the Corridors Panel's latest findings will help investors and companies better understand the transition risks they face from technology, legal and market shifts, as carbon pricing matures and evolves as a driving force of decarbonization.

"Our CEO, Feike Sijbesma, and I believe that the Corridors initiative is very valuable to companies and investors who are seeking to prepare for a low carbon economy, which is why we joined as a founding panel member right from the start. We already include the financial impact of carbon emissions through a €50/ton CO_2 internal carbon price when reviewing large investment decisions. As a global industrials company, we are keen to join initiatives that advance our own thinking on how to "future proof" DSM. We are looking forward to the Corridors initiative expanding to include more sectors."

— **Geraldine Matchett,** CFO and Member of the Managing Board, Royal DSM

CORRIDORS PANEL MEMBERS

MATS ANDERSSON
Former CEO, AP4

ELSE BOS
CEO, PGGM

GERALD CARTIGNY
Member of the Managing Board, Chief Investment Officer, MN

SIR SHERARD COWPER-COLES*
Group Head of Government Affairs, HSBC Holdings Group

JEROEN DE HAAS
CEO, Eneco

ANDRE DORF
CEO, CPFL

JOSÉ MANUEL ENTRECANALES DOMECQ
CEO, Acciona

BOB INGLIS
Former Republican Member of the US House of Representatives, and Executive Director, rebublicEN

MICHAEL GRUBB
Professor of International Energy and Climate Change Policy, University College London

PHILIPPE JOUBERT
Chair, The Global Electricity Initiative

ABYD KARMALI
Managing Director of Climate Finance, Bank of America Merrill Lynch

RANA KAPOOR
Managing Director and CEO, YES BANK

MARK LEWIS
Managing Director, Head of European Utilities Equity Research, Barclays; Member of the Task Force on Climate-related Financial Disclosure

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CEO, Fortum Oyj

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GÉRARD MESTRALLET
Chairman, Engie

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CEO, Hermes Investment Management

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Managing Partner, DBL Partners

ROSS ROLFE
CEO, Infigen Energy

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Chairman and CEO, Iberdrola

FEIKE SIJBESMA
CEO, Royal DSM

IAN YADIGAROGLU
Managing Principal, Capricorn Investment Group

* Participating as an observer

EXECUTIVE SUMMARY

"Stress testing, built off better disclosure and a price corridor, could act as a time machine, shining a light not just on today's risks, but on those that may otherwise lurk in the darkness for years to come."

— **Mark Carney,** Governor of the Bank of England and Chair of the G20's Financial Stability Board

1. Climate change poses significant financial risks, but industry and policymakers struggle with how to price it. Nevertheless, companies and investors will need to prepare for the significant changes that climate change brings. This means adapting to physical changes in the environment, to wide-ranging and unpredictable impacts on the economy, and to shifts in market conditions as we transition to a low-carbon economy. The latter changes to market conditions will be significant but hard to measure. Market actors will need to be prepared for a range of scenarios.

2. The power sector is already experiencing these market changes. The sector's high emissions, its pivotal role in the economy, and its influence on the decarbonization of other sectors, such as transport, have made it a focus area for policymakers. Thus, the power sector is among the first to experience the risks and chase the opportunities of a low-carbon transformation of the economy. This poses a financial risk to market actors in this and related sectors, as well as to their investors and shareholders. It is also an opportunity for new players, different business models and a wide range of new products and services to emerge.

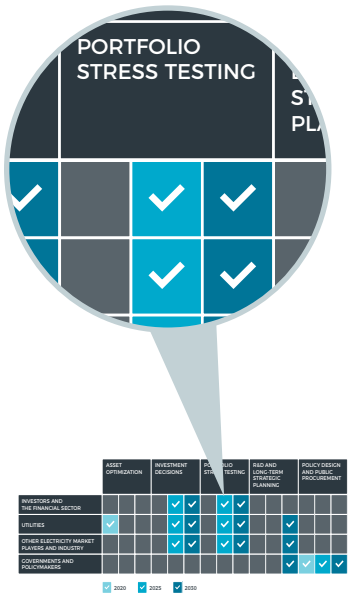
3. Pricing this transition risk has proven difficult. One method was suggested by the Task Force on Climate-related Financial Disclosure, which was established by the G20 in 2015 and is set to recommend that companies integrate into their financial planning the physical risks from climate change and the transition risks inherent as policy, legal and market conditions shift. The TCFD has highlighted the value of using internal carbon pricing to help measure the impact of this transition risk.

4. That's where the Carbon Pricing Corridors comes in. The Corridors provides an insiders' view of how carbon-related price signals will develop if we are to achieve the transformational emissions reduction goals that governments and private sector actors have set themselves, as defined by the UN Paris Agreement. The Corridors represent a range of carbon prices, over different time horizons, that can be used to guide financial decision-making.

5. CDP has been tracking a steady increase in the number of companies embedding an internal carbon price into their business strategies—a 23% increase from 2015-2016. Although policies that place an explicit price on carbon are increasingly being put in place by governments, many commentators note the signals they send are not consistent enough to be used for financial planning. Commentators have also noted that in many geographies there are implicit carbon pricing signals arising from policy, technology shifts or changing market dynamics, and that the sum of these can combine with carbon pricing policies to create a signal of the present and future cost of carbon.

6. The Corridors Panel, composed initially of 22 senior business leaders and experts, postulates that investors and companies could use a Carbon Pricing Corridor as a universal global metric to price transition risk into operational and investment decisions. The Corridors could provide a useful reference guide/risk proxy that encompasses the multiple changes occurring in a sector. This would help market actors better understand—and price—the transition risks at hand as carbon pricing matures and evolves as a key force in driving toward a low-carbon economy.

User matrix



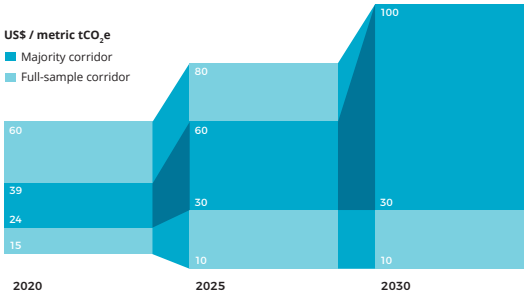
7. In this initial report, the Corridor is focused on the power sector. Over the course of 2017, the Carbon Pricing Corridors will develop to include additional, energy-intensive sectors as the initiative evolves and the Panel grows. This initial Corridor can be used by a wide range of market actors who have an interest in the changes taking place within electricity markets today. It should be particularly useful to those companies and finance sector players who are actively re-aligning their business and investment strategies to be in-line with the Paris Agreement.

8. This Corridor can also be used by policymakers in their cost-benefit analyses of policy proposals and in public procurement decisions. This latter area of government action is hitherto under-explored and has the potential to cause a ripple effect across markets and increase the momentum of the low-carbon economic transformation. In addition, increasing use of carbon pricing can set up a fruitful dynamic between public and private sectors, ensuring that policies are designed efficiently, enabling market actors to flourish as the economy transforms.

9. The Carbon Pricing Corridors initiative has developed a 'user matrix' detailing how different sectors could use the Corridors, over different time periods, to benchmark their investment decisions against carbon-related price signals.

10. The resulting Corridor for the period to 2030 does not differ significantly from those ranges previously created by institutions such as the International Energy Agency (IEA) and Carbon Tracker. However, the Corridor differs from these other ranges as the time-period approaches 2030, when some panel members believe that a lower price will be needed (in comparison to other models) with technology break-throughs and favorable renewable cost curves proposed as the driving force for this.

Corridors



11. Our findings suggest that while market actors are not confident that the explicit price signals from governments will be achieved in the short-term, carbon prices emerging by 2030—even though these may not need to be as high as some others have suggested—should be taken into account in CAPEX decisions being made by power companies today.

12. Ensuring that investments are robust in the face of predicted price ranges will be important to support the financial performance of companies and portfolios in the medium- to long-term. This in turn will help enable the transformation of the economy, decreasing systemic climate risk and supporting financial stability.

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This communication is a collective view of the Corridors initiative, and may not represent the individual viewpoints of Corridors Panelists and/or their respective organizations.

01 MANAGING CLIMATE RISKS EFFECTIVELY

"For too long, the global financial markets have been seen as separate to wider society, which is simply not true. The financial world is part of the real world and the decisions we take in it affect the economy and social cohesion. Those of us privileged enough to be trusted with the savings of everyday citizens have a responsibility to invest their capital responsibly. These are the people who will hold us to account if we do not tackle climate change—it is part of our jobs as the stewards of their capital to do so."

— **Saker Nusseibeh**, CEO, Hermes Investment Management

THE COST OF CLIMATE CHANGE

Climate change is widely recognized as one of the most significant economic and social challenges facing the world today. In December 2015, nearly 200 nations signed the Paris Agreement, committing to hold "the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels."[1] Although the potential impacts of climate change are widely recognized, the massive scale and long-term nature of the problem make it difficult to translate into economic terms.

This poses a serious challenge for participants in both the public and private sectors seeking consistent and quantifiable climate-related information to incorporate into their decision-making. This information is vital if we are to manage the risks that climate change poses to financial stability. This will support informed decision-making today—investors correctly valuing their assets, companies investing in low-carbon business strategies, and policymakers designing effective climate policies.

This report aims to support that informed decision-making by tackling one aspect of climate risk, namely transition risk, and proposes a metric, the Carbon Pricing Corridors, that can be used by market actors to help price transition risk into investment decisions and benchmark low-carbon strategies. It can also be used by policymakers in their cost/benefit analysis of policy proposals, in public procurement and to support the development of effective carbon price mechanisms.

ONE POLICY SOLUTION: CARBON PRICING

As the international community moves towards implementing the Paris Agreement, carbon pricing is seen by many as a key mechanism in driving emissions reductions in the private and public sectors. A carbon price assigns a monetary value to each tonne of carbon dioxide emissions; thereby allowing the associated costs to be factored into the economic rationale of actors making investment, business, and policy decisions. As such, carbon pricing is a powerful tool for the assessments of the risks and opportunities related to climate change.

Governments assign a cost to carbon pollution through regulation—through emissions trading systems or taxation—to incentivize polluters to reduce the amount of carbon they emit in what economists deem to be the most flexible and least-cost way to society. Well-designed carbon pricing policies also have the potential to stimulate market innovation and the development of new low-carbon drivers of economic growth. According to the World Bank Group, 40 countries and more than 20 cities, states and provinces already use carbon pricing mechanisms or are planning to implement them—representing 13% of global GHG emissions.[2] With several new systems in development—including the Chinese ETS—it is expected that 20–25% of global carbon emissions will soon be covered by a carbon price.[2] Additionally, 101 nations

1 United Nations Framework Convention on Climate Change. "The Paris Agreement," December 2015, http://unfccc.int/files/essential_background/convention/application/pdf/english_paris_agreement.pdf.

2 World Bank, Ecofys and Vivid Economics, State and Trends of Carbon Pricing (Washington, DC: World Bank, 2016). https://openknowledge.worldbank.org/

that signed the Paris Agreement plan to use carbon pricing and other market mechanisms to achieve their emissions reduction goals, as stated in their Nationally Determined Contributions (NDCs).[3] Some governments, including the US and the UK, use a 'social cost of carbon' in their regulation assessment process, to measure the damages of incremental increases in carbon emissions.

Despite this momentum, price levels vary considerably across economies leaving business and investors faced with a highly uncertain and heterogeneous context for making strategic decisions. Additionally, three-quarters of the emissions facing an explicit carbon price have a price below 10 USD/tonne, which economists highlight is too low to incentivize low-carbon investments at the scale needed.[4]

Carbon emissions can also be priced implicitly via energy taxes, support for renewable energy and energy efficiency trading schemes and standards, for example. In some cases such implicit mechanisms can also act against explicit carbon pricing mechanisms by reducing, or even negating the economic impact of a given price, i.e. fossil subsidies, which can in some cases, be substantial.[5] Robust carbon pricing is thus a key component in decarbonization efforts, although as discussed by many,[6] not the only component needed. The large-scale transformation needed in the power sector requires other policies such as support for research and development, for infrastructure development and for market design, which can take many forms. These complementary policies can mean that a given emissions reduction goal can be achieved with a lower explicit carbon price.[7]

THE POWER SECTOR—AT THE HEART OF THE LOW-CARBON TRANSITION

Arguably, climate change related risks and opportunities are most real and direct for the power sector. Not only does the electricity generation sector contribute to around 25% of annual global greenhouse gas emissions, but it is also a sector where revenue generation has for decades been dominated by fossil fuel combustion processes resulting in GHG emissions. The potential for decarbonization of the power sector is substantial with multiple low-carbon generation technologies available, as well as advanced electricity infrastructure and storage technologies.

Decarbonization of the power sector also enables sectors consuming electricity to reduce their emissions, as well as driving further reductions through electrification of transportation and heating. This puts the power sector at the heart of the low-carbon transition and underlines the importance of having carbon price signals that can deliver on the ambitions of the Paris Agreement.

Low-carbon scenarios for the electricity sector suggest therefore that CO_2 emission pathways for power generation, as opposed to other sectors, needs to be nearly 100% decarbonized globally by 2050 to keep the average temperature rise below 2°C as shown in Figure 1. To further reach a 1.5°C target, emissions need to be removed from the atmosphere through reforestation or innovative technologies such as bio-energy with carbon capture and storage (BECCS). The disruptive transformation of the power sector requires investments at scale that avoid locking in carbon intensive technologies, a phase-out of fossil-based electricity generation such as an early retirement of coal

3 EDF, IETA. "Carbon Pricing: The Paris Agreement's Key Ingredient", April 2016. http://www.ieta.org/resources/Resources/Reports/Carbon_Pricing_The_Paris_Agreements_Key_Ingredient.pdf

4 World Bank Group, 2016: State and Trends of Carbon Pricing.

5 Elizabeth Bast, Alex Doukas, Sam Pickard, Laurie van der Burg and Shelagh Whitley. "Empty promises: G20 subsidies to oil, gas and coal production," November 2015. https://www.odi.org/publications/10058-empty-promises-g20-subsidies-oil-gas-and-coal-production

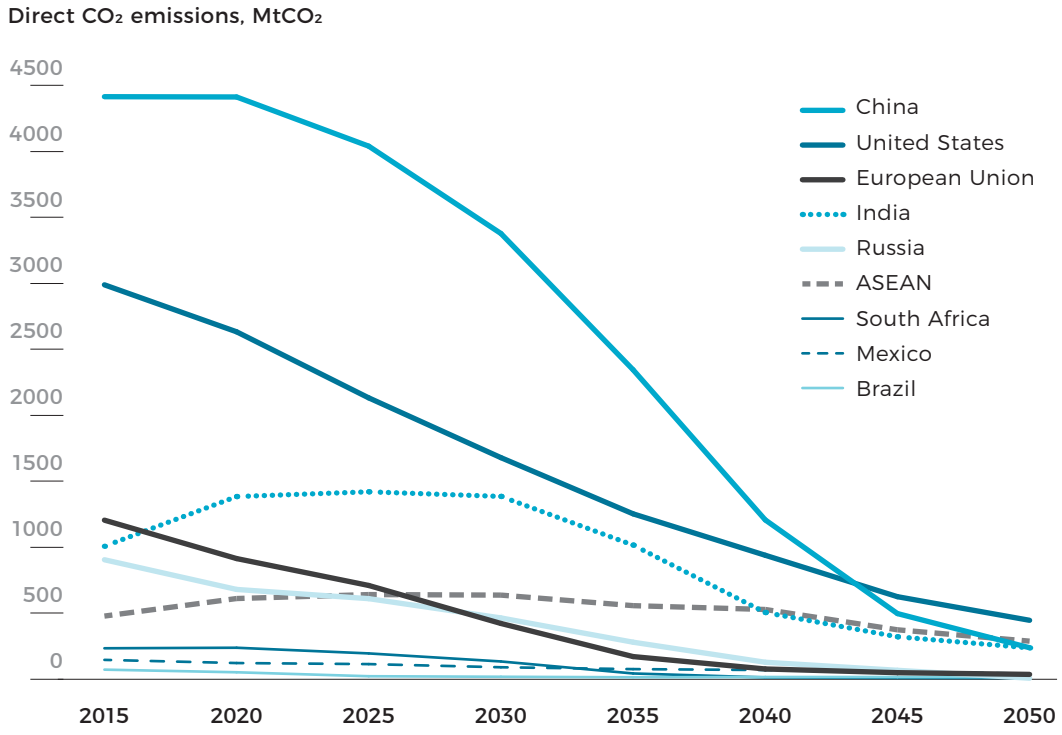
6 Carbon Pricing Leadership Coalition, "How can Carbon Prices and Policies be effectively aligned?", 2016. http://pubdocs.worldbank.org/en/221021478831141991/CPLC-Executive-Brief-Policy-Alignment-Nov2016-FINAL.pdf

7 Upcoming commission report: https://www.carbonpricingleadership.org/

"Based on what we know today, a sustainable energy future is defined by four products: renewables, energy storage, demand response & efficiency, and fast-start natural gas. Carbon pricing is a tool for supporting the business case behind investments in clean energy—but is not a panacea for large-scale infrastructure deployment. Pro-infrastructure financing policies, and market mechanisms, such as a Forward Clean Energy Market, can unlock competition towards securing sustained investments in clean energy, at the lowest costs to consumers. NRG has committed to science-based targets for reducing CO_2 emissions from the company's portfolio, reflective of the fact that by 2050, the entire US economy must emit less carbon than today's power sector."

— **Brian Marrs**, Group Director, Policy and Strategy, NRG Energy

Figure 1. CO_2 emission pathways for the power sector by region in a 2-degree scenario[8]



8 IEA, Energy Technology Perspectives, 2016

BOX 1

Charged or static: Which European electric utilities are prepared for a low-carbon transition?

CDP's latest study on European electric utilities shows the impact of carbon prices on a utility's bottom line. The assessment highlights that relatively low carbon price levels in the European Union Emissions Trading System (EU ETS) can already cause significant costs and impacts on earnings, with EBITDA losses between 0.3%-13.7% under a carbon price of €7.7/tCO_2e in 2015. Utilities with a high share of fossil fuel generation assets experienced the highest losses. This impact is expected to become more profound in the future as the EU ETS is currently being reformed with new measures to increase the carbon price. To illustrate this effect, carbon costs could rise to 38% of the EBITDA under a price of €30/tCO_2e, posing significant transitional risks to fossil fuel intensive utilities. A robust carbon price signal in this sense is powerful enough to drive shifts in investments and strategies in advance, driving fuel switching.

capacity or retrofits with carbon capture and storage (CCS) and a quick ramp-up of carbon-free technologies. This will go hand in hand with radical new designs of the electricity market reflecting the increasing importance of electricity storage and generation capacity. The role of explicit and implicit carbon pricing in this transformation is complex, particularly in view of the different regulatory settings for the power sector across the world, but is one of the tools that can play a key role in this transformation. It should not be viewed as a one-size-fits-all solution however, as the structure of a specific electricity market will play a critical role in when and how a carbon price will work—understanding this will be vital to driving the transformation of the sector.

The latest analysis suggests that despite the progress the sector has made in comparison to others in the energy sector,[9] the pace of decarbonization in the power sector is not fast enough. The 2017 CDP utility analysis shows that in Europe, of the 14 major utilities—representing half of the EU electricity generation—only three are on to a pathway to stay within their implied carbon budgets that help keep the average global temperature rise below 2°C.[10] The progress on CCS has been minimal as other low-carbon technologies are more cost-competitive, and CCS may not become commercially available in time to contribute to effective decarbonization if carbon prices remain low. At the same time, some utilities have expanded their renewable capacity to diversify their portfolio, with the renewable generation capacity for these 14 utilities having grown from 25% in 2010 to 32% in 2016. However, much more progress is needed to fully decarbonize the sector and some utilities will need to retire or retrofit their fossil fuel assets before their technical lifetime is complete. Utilities and investors will need to decide on how to mitigate, transfer, accept, or control the risks related to the accelerated retirement of existing fossil fuel assets and associated valuation write-downs.

Higher carbon prices could substantially affect the profitability of utilities with many fossil fuel assets as demonstrated in CDP's latest sectoral report (see box 1).[11] Carbon price signals can have a significant impact on decarbonizing the power sector. The carbon price floor in the UK was for example a key driver in achieving Great Britain's first day without coal-fired electricity since the first industrial revolution.[12]

9 U.S. Energy Information Administration, Carbon intensity of energy use is lowest in U.S. industrial and electric power sectors, May 2017. https://www.eia.gov/todayinenergy/detail.php?id=31012

10 CDP, Charged or static—Which European electric utilities are prepared for a low carbon transition?, 2017.

11 Ibid.

12 National Grid, 2017: Great Britain goes without coal generation for 24 hours, April 21, 2017.

"Climate change is increasingly a mainstream issue for investors, as the feedback loop between the policy framework and technological innovation—driving an irrevocable global energy transition away from fossil fuels towards renewable and clean energy sources—continues to intensify. The TCFD recommends that energy companies in particular acknowledge the reality of transition risk by running scenario analyses of potential future climate outcomes (including a 2°C scenario). In my view, central to any such scenario analysis should be gauging the impact of carbon pricing on company business models—over time capital will be re-allocated in accordance with carbon-pricing signals."

— **Mark Lewis**, Managing Director, European Utilities Equity Research, Barclay Capital; Member of the Task Force on Climate-related Financial Disclosure

FINANCIAL DISCLOSURE OF CLIMATE RISK AND OPPORTUNITIES

It clear from the above that a large group of companies are beginning to recognize the risks and are starting to adapt their business strategies in response. Given the possibility of increased financial disruption and the potential of stranded assets, the finance sector is increasingly turning its attention to the low-carbon transition and the changes it will bring.

A heightened focus on the need for transparent information on the financial implications of climate change is illustrated by the growing demand by lenders, insurers, and investors for consistent and comprehensive climate-related information. The Financial Stability Board (FSB) established an industry-led Task Force on Climate-related Financial Disclosures (TCFD)[13] in 2015 with the objective of providing guidance on how to integrate climate risk and opportunities into mainstream financial reporting. Composed of 32 private sector actors from across the G20's constituency, the Task Force represents a broad range of economic sectors and financial markets. Drawing on member expertise, extensive stakeholder engagement, and existing climate-related disclosure regimes, for example CDP's work to institutionalize climate change into mainstream reporting, the Task Force developed and will publish a final standardized framework for climate-related financial disclosure in June 2017. The outline of the TCFD's recommendations below are based on the their report published in December 2016.

The foundation of the TCFD framework involved categorization of financial risks and opportunities that impact the private sector—a topic that had been well-researched but not yet standardized. The framework divides climate-related risks into two categories: (1) risks related to the physical impacts of climate change; and (2) risks related to the transition to a lower-carbon economy. The latter category encompasses the extensive policy, legal, technological, and market changes that will likely occur in the transition to a low-carbon economy. Under certain circumstances, these changes may pose a material financial and reputational risk to organizations. The main types of risks and opportunities are described on page 11. While physical risks are a key factor to consider in determining the financial impact of climate change, this report focuses exclusively on transition risks and opportunities and the role carbon pricing can play in assessing these risks.

13 FSB-TCFC, 2016, Recommendations of the Task Force on Climate-related Financial Disclosures, December 14, 2016.

CLIMATE-RELATED FINANCIAL RISKS

Figure 2.
Climate-related transition risk and financial impact.[14]

1. Risks from **policy and legal** actions are expected to increase, as more policy is developed to mitigate GHG emissions and adapt to the impacts of climate change. For instance, there are already compulsory and voluntary carbon pricing mechanisms in use which usually aim to impact financial considerations.
2. Risks from the impact of low-carbon **technology** improvements and innovation can also have a significant potential impact on an organisation. The process is described as "creative destruction" where new technologies and related services emerge and shift the economic rationale for old technologies deployed in the incumbent system.
3. Risks and opportunities from climate change on **markets** is increasingly seen through shifts in supply and demand for certain commodities, products, and services. The lower-carbon economy may also open-up new **market opportunities**, such as underwriting or financing climate-related green bonds and infrastructure.
4. Risks for organizational **reputation** will rise from an increasing customer or community perceptions on climate-related actions.
5. Opportunities from organizational energy or **resource efficiency** measures create short-term operating cost savings for transport and production processes and estimates long- and medium-term financial benefits.
6. Opportunities are also realized from switching **energy sources** from fossil fuels to low-carbon alternatives such as wind, solar, biofuels etc. Over the last two years, investment in clean energy has surpassed that of fossil fuels, from which significant savings have been made on annual energy costs.
7. Companies can benefit from developing new low-carbon **products and services** as a competitive advantage, emphasising the reduction or avoidance of emissions.
8. Increased **adaptability**, which links to organizational profitability dependent heavily on suppliers and employees, is another category of opportunities. In specific sectors insurance companies have opportunities to underwrite new assets (e.g., renewable-energy technology installations).

14 Adapted from FSB-TCFD,2016: Recommendations of the Task Force on Climate-related Financial Disclosures, December 14, 2016.

"Carbon pricing corridors are key to managing the transition risk to 2°C : with the vision they give, they allow the gradual transformation of company business models and avoid the damaging effects of abrupt changes in economic and regulatory environments, while securing a level playing field for all actors.

In ENGIE we decided to use internal carbon pricing and it led to us making the decision not to develop coal any longer, gradually switching from coal to other low carbon technologies, and favor even more renewable developments."

— **Gerard Mestrallet**, President, ENGIE

INTERNAL CARBON PRICING

For many organizations, the most significant impacts of these transition risks will emerge over time and their magnitude is uncertain. Therefore, the TCFD recommends that organizations should use scenario analysis—a process of analyzing possible future events by considering alternative possible outcomes—"as a tool to assess potential business, strategic, and financial implications of climate-related risks and opportunities and disclose those in their financial filings." Scenario analysis helps organizations identify indicators to monitor changes in the external environment, allowing them to adapt their strategies and financial planning accordingly.

The TCFD specifically lists internal carbon pricing as a key metric that can be used to assess climate and energy transition related risks, recommending disclosure around the assumptions made about how internal carbon prices and ranges would develop over time; whether the price applies to specific facilities or projections of demand for fossil fuels; whether it is applied to specific economic sectors or across the whole economy and in what regions; or whether a common internal carbon price is used at multiple points in time or differentiated prices. The rationale is to provide investors with a proper understanding of the reasonableness of assumptions made as input for their risk assessment.[15]

CDP has been tracking the growing trend of internal carbon pricing in the private sector over the past few years. In 2016, over 1,200 companies disclosed to CDP their plans or current practice of utilizing an internal carbon price to manage climate-related risks and opportunities.[16] This includes more than 100 Fortune Global 500 companies with a total annual revenue of about 7 billion USD. These companies, across all industries and geographies, have identified internal carbon pricing as an approach to building prudent buffers into their business models in preparation for a carbon constrained future. They have told CDP that embedding the cost of carbon into CAPEX decisions, economic forecasts, and in some cases, their operations, can help them better manage the risks and opportunities posed by existing or emerging carbon pricing regulations, prioritize energy efficiency, and drive investments in renewable energy purchases and other GHG emission reduction activities.

The use of internal carbon prices, particularly among power utilities, is already well-established. In 2016, 80 utilities reported their plans or current practice of using an internal carbon price in their capital investment decisions. The average internal carbon price used among disclosing utilities is 35.33 USD/tonne. Proactive companies apply significantly higher carbon prices than current regulation and evaluate investment options against multiple carbon price scenarios. The US electric power sector also relies on internal carbon pricing, using it in integrated resources plans to assess future resource portfolio and decide on carbon asset retirement plans (see Box 2).

15 Ibid.

16 CDP, Embedding a Carbon Price into Business Strategy, 2016

BOX 2

Hedging an uncertain future: Internal carbon prices in the electric power sector

A recently published report from Resources for The Future demonstrates how carbon prices in the US electric power sector are used by companies and electricity regulators to manage regulatory risk in uncertain political climates and to changing customer interest. Internal carbon pricing is used in Integrated Resources Planning (IRP)—a public process in which planners work together with utilities to identify and prepare energy options that serve the highest possible public good—to assess future resource portfolios and decide on carbon asset retirement plans. The carbon prices are diverse, ranging in average between US$ 5–28/metric tCO_2e in 2020; US$ 5–60/ metric tCO_2e in 2025 and US$ 14–47/ metric tCO_2e in 2030.[17] This range depends on a variety of underlying factors within the IRPs, particularly on the potential for future constraints on carbon beyond actual state and federal policies. This is seen especially important in a new, less predictable, political environment that may be less supportive of climate policy.

"MN is the third largest pension asset manager of the Netherlands with an AUM of 120 bn. Euro. It is our fiduciary duty to ensure that the pensions of beneficiaries are not undermined by the serious risks that climate change presents to the risk/return of the portfolio and to financial stability more broadly. **We believe that pension funds should work together to align portfolios with the goals of the Paris Agreement and that the Corridors has the potential to develop into a global metric to help us to do just this."**

— **Gerald Cartigny**, Member of the Managing Board, CIO, MN

Carbon pricing can be used in scenario analyses to conduct risk assessments and to respond in kind. The rationale of this approach is to improve investors' and other market actors' ability to appropriately assess and price climate-related risk and opportunities. The models used to calculate the scenarios in line with a 2°C pathway[18] are complex and the choices made on which technologies to deploy are heavily influenced by assumptions such as the cost reductions of certain technologies. Many of those scenarios therefore include a techno-economic carbon price signal as a key proxy to model the complex explicit and implicit signals needed from low-carbon policies. *Carbon pricing thus has the potential to serve as a uniform, globally understood metric.*

Given the momentum generated around the Paris Agreement and specifically in respect of carbon pricing, a forecast for Carbon Pricing Corridors, which provides the range of prices necessary to drive the low carbon transition, will help bring much needed certainty to accelerate global emissions reductions efforts. The use of corridors, rather than one fixed forecasted price, which is established based on inputs from markets actors themselves, reflects regional differences, inherent uncertainties, and different stakeholder perspectives on the prices needed and provides stakeholders with a set of prices for a wide range of uses. This Corridor could be used as a reference guide / proxy that encompasses the multiple changes occurring in the transitioning market. It could be used by both investors and companies to better understand the transition risks at hand as carbon pricing matures and evolves as a key force in driving toward a low-carbon economy.

17 Calculated from RFF 2017: Hedging an Uncertain Future: Internal Carbon Prices in the Electric Power Sector.

18 A 2°C scenario lays out an energy system deployment pathway and an emissions trajectory consistent with limiting the global average temperature increase to 2°C above the pre-industrial average. The Task Force is not recommending that organizations use a specific 2°C scenario.

Figure 3. Corridor Inquiry G20 country coverage

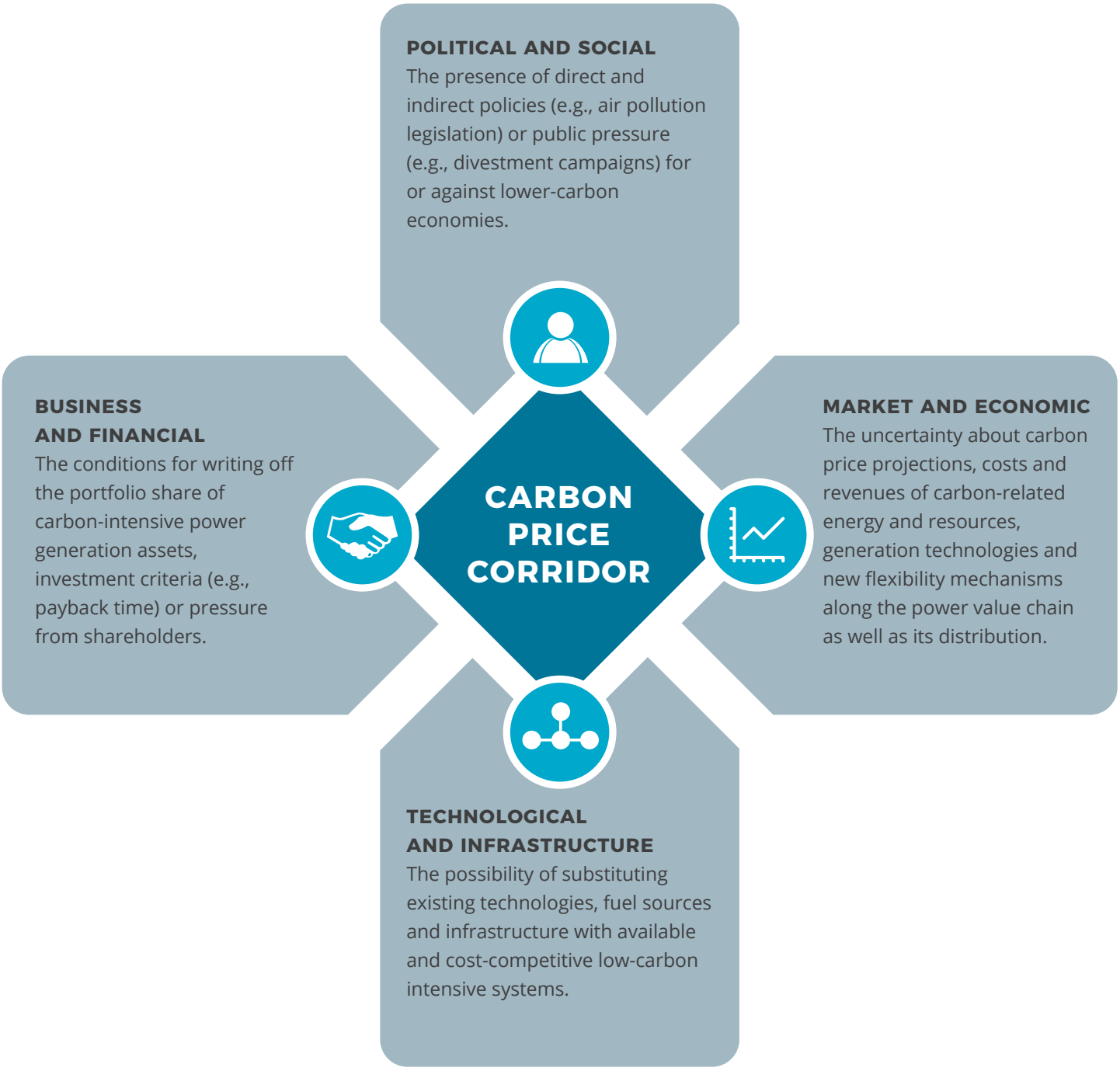
THE CORRIDORS INITIATIVE

In 2017 CDP and the We Mean Business coalition launched the Carbon Pricing Corridors initiative with the objective of enabling large market players to define the carbon prices needed for industry to meet the Paris Agreement. It is delivered through an ongoing inquiry with an expert Panel—a select group of leaders, primarily from the corporate and investment communities, alongside a handful of international experts. Over the next two years, they will create an informed view of the range of investment-grade carbon-related price signals that will decarbonize electricity generation and heavy industry through the short- to medium-term (2020, 2025 and 2030). It is distinct from similar initiatives and research efforts in that it involves the market actors themselves and is iterative, allowing for the analysis to develop as market dynamics shift and understanding deepens.

Expert opinions are obtained via a process of inquiry,[19] asking panel members to respond to a small set of quantitative and qualitative questions. The results are collected and analyzed to determine an aggregated projection for the corridor of carbon prices over time and fed back to the panel between each iteration. This iterative process allows for updates and refinement as market dynamics change and private sector leaders develop their views. The resulting Carbon Pricing Corridors will be published at regular intervals, providing a projection of future carbon-related price signals that deliver on the ambitions of the Paris Agreement. It will also begin to highlight those factors that provide the price signals and investment certainty, making high-carbon activities more expensive and / or catalyzing lower costs of capital for low carbon investments.

19 The Corridors initiative uses the Delphi Method which entails a group of experts who anonymously reply to questionnaires and subsequently receive feedback in the form of a statistical representation of the "group response," after which the process repeats itself. The goal is to reduce the range of responses and arrive at something closer to expert consensus. The Delphi Method has been widely adopted and is still in use today.

Figure 4. Factors considered when creating the Carbon Pricing Corridors



"The Carbon Pricing Corridors Project provides a better understanding of the key role that carbon pricing has to play in decarbonizing the power sector, as it is a signal for consumption, investment and operational decisions. The involvement of other sectors in the project will allow us to build a better picture in future editions at a broader economy-level."

— **Ignacio S. Galán**, Chairman and Chief Executive Officer, Iberdrola

This initial report focuses solely on the power sector, with the inquiry expanding its scope to include other high-emitting sectors mid-2017. The inquiry was designed to provide panel members' insight into:

- The carbon price needed to facilitate the decarbonization of the electricity sector by 2050, differentiated in time (in 2020, 2025 and 2030)
- The likelihood of such prices materializing in those time periods
- The factors that influence the carbon price needed

Panel members were asked to comment on the importance of factors in four categories: political and social, market and economic, business and financial, technological and infrastructure (Figure 4). Please see the appendix for a comprehensive list of factors.

By using carbon prices that would be needed to fully decarbonize the power sector in their decision-making, utilities and investors can assess climate-related risk as well as identify commercially attractive carbon-free alternatives.

BOX 3 **High-level Commission on Carbon Prices**[20]

The inquiry comes at the same time as the formation of a commission on carbon prices, chaired by economists Joseph Stiglitz and Lord Nicholas Stern. The Commission's objective is to identify indicative corridors of carbon prices which can be used to guide the design of carbon pricing instruments and other climate policies, regulations, and measures to incentivize climate action and stimulate learning and innovation that will help deliver on the Paris Agreement. Their report will explore explicit carbon pricing options and levels that would induce the necessary change in behaviors, including investment, with its main audience being policymakers. The Corridors initiative covered in this report forms a complement as it is industry-led involving market players themselves and seeks to draw links with climate-related financial reporting. With both initiatives working with the Carbon Pricing Leadership Coalition at the World Bank Group, momentum for carbon pricing gets a boost in both public and private spheres.

20 Upcoming commission report will be released and available online: https://www.carbonpricingleadership.org

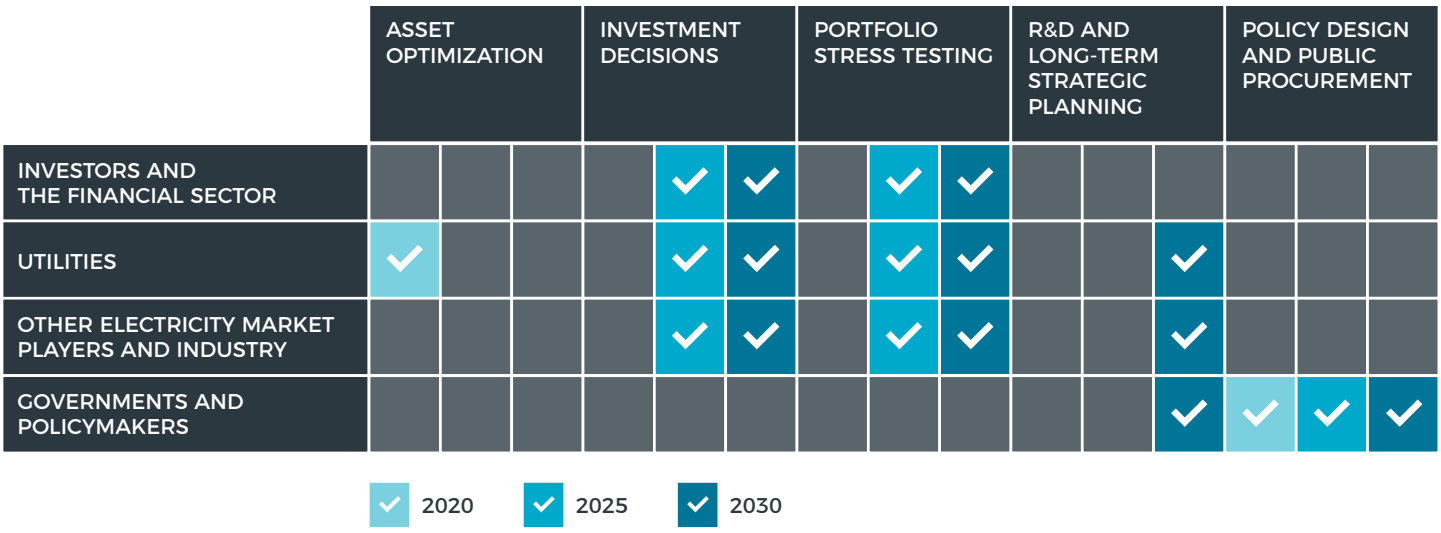
02 HOW THE CORRIDORS CAN BE USED

The Corridors are carbon price signals for 2020, 2025 and 2030 that the Panel considers is needed to decarbonize the power sector and meet the ambitions of the Paris Agreement.

It provides organizations with a tool for scenario analysis to meet the TCFD recommendations of assessing and disclosing implications of climate-related risks and opportunities. This allows organizations to consider the potential financial, strategic and business impacts resulting from the Paris Agreement in their decisions. It represents an internal pricing scenario that can be used by the private sector when stress testing against a 2°C scenario. Whether the Corridor for 2020, 2025 or 2030 is more appropriate to use depends on the timeframe of the decision. The Corridors could also be used by policymakers in assessing the efficacy of explicit carbon pricing systems either under development or already in existence.

Investors and the financial sector could use the Corridors as a unified global metric to assess climate-related transition risks and identify new revenue opportunities in the power sector and for those sectors where power represents a significant cost. By applying the Corridors to the carbon footprint of their investments in utilities and other electricity market related assets, it can help them to determine the financial robustness of their assets and loans in a decarbonizing world, assess the materiality of the risks in their assets, and optimize their portfolios to minimize the risk of value loss. Investors could also use the Corridors to assess the best and worst case return on investment (ROI) performance of their investments and set appropriate hurdle rates to take these climate-related risks or opportunities into account.

Figure 5. User matrix, how investors, industry and governments can use the Carbon Pricing Corridors



"Carbon pricing is a critical tool in the global fight against climate change. A standardized mechanism to price carbon will enable businesses to recognize the cost of greenhouse gas emissions from their business activities, and thus catalyze industry-wide de-carbonization. Carbon Pricing Corridors provides financial institutions like YES BANK, who are committed to climate action, an opportunity to integrate carbon pricing into investment decisions, optimize operational performance and mobilize finance towards a low-carbon future."

— **Rana Kapoor**, MD & CEO, YES BANK

Utilities could use the Corridors to assess what their potential additional carbon costs could amount to and how it would affect the competitive position of their portfolio units in a changing electricity market landscape. This would allow them to make informed decisions on optimizing the deployment strategy of their current assets in the short-term and diversify their portfolio in the medium- and long-term. It could also be used by companies in other sectors who have decided to source their energy from alternative technologies—the metric could be used to help improve the business case for such investments. The Corridors could also be used for scenario analysis of new investments, long-term strategic planning or R&D decisions, testing the robustness of these decisions against the ROI requirements and other criteria with the power sector having to fully decarbonize.

Other electricity market players and the private sector more broadly could use the Corridors to assess the potential direct and indirect impact of additional carbon costs along the energy value chain. In an ongoing integration of the energy supply and demand side, additional carbon cost will have a mutual business impact among many players. Increasing energy supply cost will be forwarded and shift among market players and not only directly impact the cost structure of, for example, energy intensive industries but also enable new revenue streams from new intermediating energy services such as flexible demand response or energy efficiency measures. Implementing carbon pricing as a financial metric could be used as one of the tools to identify and participate in new business models and help strategic decision-making accordingly. It can also be used by those companies that have chosen to align their business strategies with the goals embedded within the Paris Agreement and are focused on decreasing the emission intensity of the power they use in their operations and value chains. The metric could be used to help improve the business case for investments to do this.

Governments and policymakers could use the Corridors as a basis to design new policies or reform existing policies to provide the carbon price signals needed for low-carbon investments. In addition, policymakers could use the Corridors as an internal carbon price to guide public procurement decisions as well as assessing of policy proposals. This includes designing long-term strategies regarding the country's energy supply in line with the Paris Agreement and decisions on R&D funding for technologies to capitalize on the decarbonization of the power sector. This could help harmonize mitigation incentives across government agencies, rationalize government investments across competing objectives, and catalyze a broader discussion about effective policy design with the private and public sectors.[21]

We summarize this iin Figure 5, the user matrix, indicating how the 2020, 2025 and 2030 Corridors established in this report could be used. Examples of questions these different groups of stakeholders could answer with the corridors are provided on the next page.

21 Adele Morris. Why the federal government should shadow price carbon. July 2015. https://www.brookings.edu/blog/planetpolicy/2015/07/13/why-the-federal-government-should-shadow-price-carbon/

EXAMPLES OF QUESTIONS KEY STAKEHOLDERS COULD ANSWER WITH THE CORRIDORS

ASSET OPTIMIZATION

How can I, as an electricity company, optimize the use of my current assets given the Corridors and the prevailing explicit carbon price in the jurisdictions I am active in?

INVESTMENT DECISIONS

Would my investments still meet ROI requirements if I apply short- to mid-term Paris compatible carbon pricing corridors to the ROI calculations and what does this mean for the allocation of investments in my company?

PORTFOLIO RISK ASSESSMENTS

Is my portfolio of assets or loans financially robust when applying the Corridors to the emissions embedded within it and how can I optimize it?

R&D DECISIONS

How robust are my R&D and market development choices when applying long-term Paris compatible carbon pricing corridors?

PUBLIC PROCUREMENT

What level of carbon price should I use in public procurement procedures to ensure the energy and materials I purchase help us to achieve the goals embedded in the Paris Agreement?

POLICY DESIGN

How can I design policy so that they yield the carbon pricing corridors required to place the power sector on a Paris compatible trajectory?

"To succeed in establishing an effective signal towards sustainable investments and emission reduction measures Carbon Pricing Corridors are key in setting ambitious and incremental targets as a roadmap for 2020, 2025 and 2030. These corridors can be used by companies, investors and policymakers to help manage climate risk and to actively shift investments to the growing clean economy—Acciona will be including them in our own business planning going forward."

— **José Manuel Entrecanales Domecq**, Chairman & CEO, ACCIONA

03 THE CORRIDORS

THE RESULTING CORRIDORS

Panel members considered a wide range of factors that influence the carbon price levels needed to decarbonize the power sector. For example, these factors may be direct or indirect costs or incentives associated with transitioning to zero-carbon power sector. As highlighted before, carbon pricing is not the only policy mechanism governments deploy to support the transformation of the economy.

Figure 6 shows what the panel members deem to be the necessary price levels by 2020, 2025 and 2030 to decarbonize the power sector by 2050 and meet the targets under the Paris Agreement. Fifty percent of the Panel's responses fall within the 'majority corridor' shown in the darker blue color below. The light blue represents the full sample of panelist responses.

For 2020, the needed carbon price corridor runs from 24–39 USD/tonne, according to most of the panel members. This forecasted corridor increases to 30–60 USD/tonne in 2025; and to 30-100 USD/tonne for 2030. The range of the corridor widens over each time-period. This trend aligns with the increasing level of uncertainty panel members have when forecasting into the future; and provides argumentation for regular renewal of the corridors. Interestingly, the bottom range of the corridor remains at 30 USD/tonne from 2025 onwards. This can partially be explained by the expectation that the levelized cost of renewable energy sources will continue to decrease; therefore, a lower carbon price will be needed to make renewable energy competitive with fossil-fuel generation. The lower end of the corridors is still well above the current explicit carbon prices in most jurisdictions, highlighting a consensus view by the panel members that higher prices than currently observed are needed. The following factors section will further explore the variety of factors which influenced the carbon price levels forecasted by the panel members.

Figure 6. Resulting Corridors from 2017 Inquiry

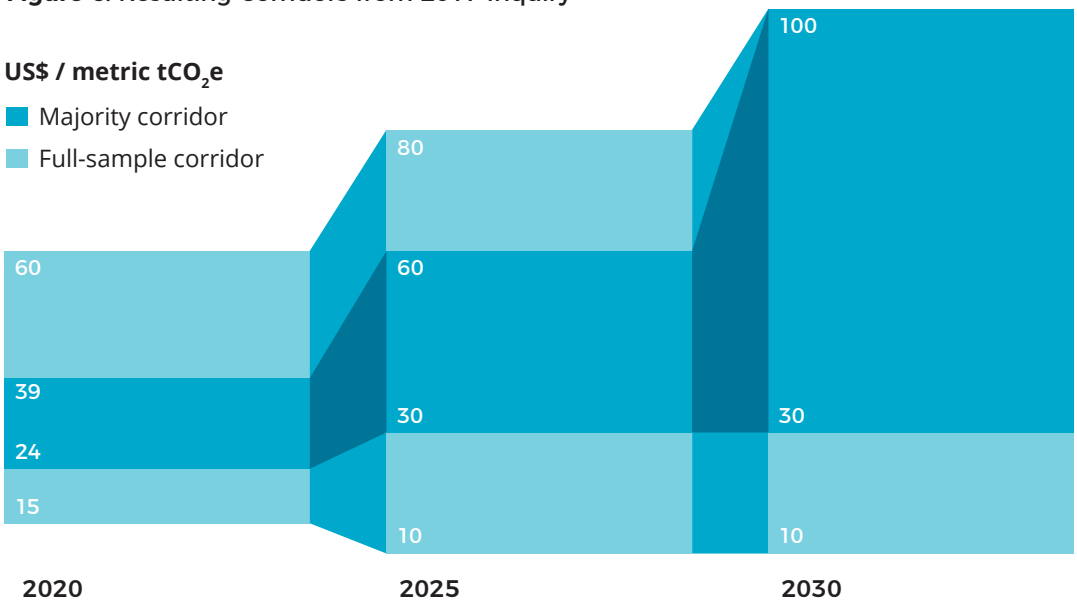
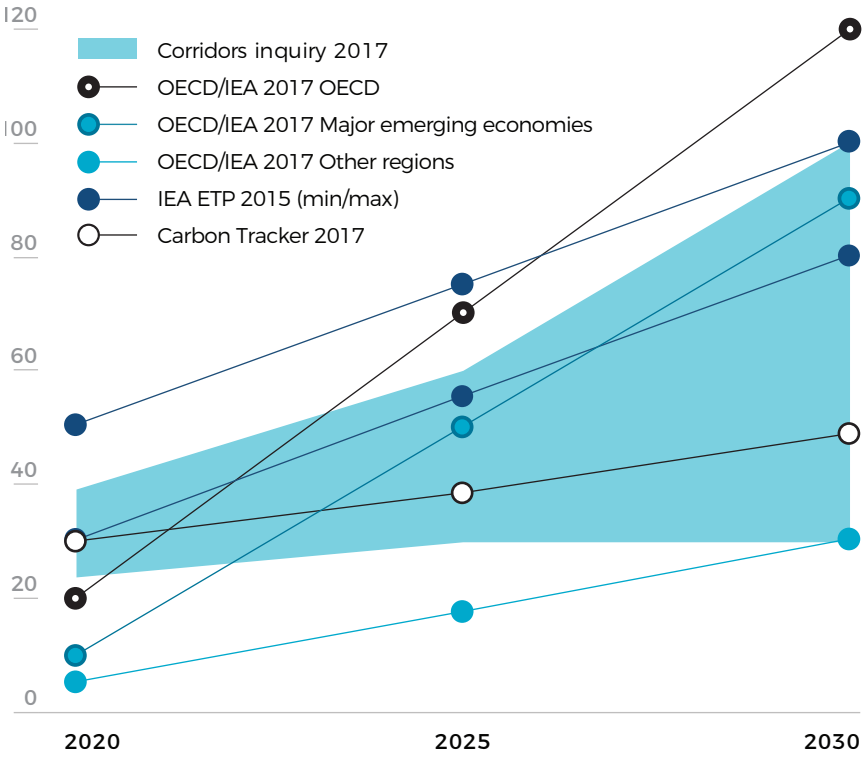


Figure 7. Corridors 2017 inquiry results in comparison with other pathways towards a 2˚C scenario



Source: IEA Energy Technology Perspectives (2015), Chapter 2 of Perspectives for the energy transition—investment needs for a low-carbon energy system ©OECD/IEA 2017, Carbon Tracker initiative & Grantham Institute at Imperial College London (2017).

Figure 7 shows the carbon price corridor results from the Corridors inquiry (shown as shaded surface) compared to three other key studies on carbon price pathways towards a 2°C scenario. The Corridor of the Corridors inquiry overlaps with most of the other carbon price pathways. The key differences between the studies are that they use different underlying assumptions in their carbon price projections, cover different sectors and even have different starting points in terms of emission reduction ambitions. This is also the main explanation for the differences between the three studies and the resulting Corridor. Of the three different studies, the OECD/IEA 2017 study has the most ambitious scenario with about 95% of the global electricity coming from low-carbon sources including CCS and zero emission power in several OECD countries. This also corresponds to the highest carbon prices. In the IEA ETP 2015 study the ambition in its 2°C scenario is lower with 93% of the global electricity coming from low-carbon sources, but the carbon price also covers a variety of sectors apart from the energy sector. The Carbon Tracker 2017 pathway has the lowest carbon price projections as these are based on the Nationally Determined Contribution (NDC) pledges submitted by countries to deliver on the ambitions of the Paris Agreement. However, as the Carbon Tracker and other studies point out, the NDCs—and with that the carbon prices projections in the study—are insufficient to the meet the 2°C limit.

The range of the Corridor is relatively wide as the panel members each have their own view of the future with their views diverging over time. This is also partly explained by the geographical region the panel members represent, which also roughly corresponds to the range in OECD/IEA 2017 study for different regions. Another important factor explaining the range of the Corridor is the views of the panel members on the expected levelized cost of electricity (LCOE). While the lower end in 2030 roughly correspond to the lower end of the OECD/IEA study, the high end of the estimate is lower. This could be explained by many panel members indicating that they expect a rapid decrease of the LCOE of renewable technologies over time, while the IEA has been shown to underestimate this development in the past. A rapid decrease of the LCOE would contribute to lowering the carbon price needed and narrow the Carbon Pricing Corridor.

As noted above, the soon-to-be-published report of the High-Level Commission on Carbon Prices also examines carbon price corridors needed to deliver on the Paris Agreement. Its findings differ from those in this report, but the two analyses are consistent as the High-level Commission also includes non-energy sectors where the required carbon price is higher than in the power generation sector considered in this report.

IMPLICIT AND EXPLICIT FACTORS INFLUENCING THE CORRIDORS

Factors were divided into four categories: political and social, business and financial, market and economic, and finally technological and infrastructure factors. Figure 8 gives an overview of the number of times each category of factors influenced the panel members' carbon price corridor.

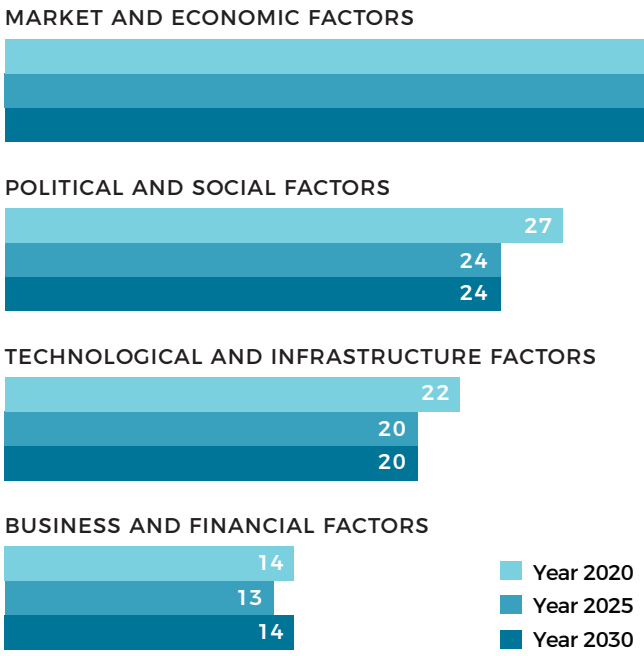
Political and social factors are considered an important set of drivers for investment. The presence of other decarbonization support policies besides carbon pricing is described as crucial by investors, utilities and experts. At the same time, most panel members agree that this would have a downwards impact on the carbon price needed for decarbonizing the power sector. Investors see a need for additional support policies such as feed-in tariffs for renewable power generation on top of carbon pricing to switch to a low-carbon energy system, especially in saturated energy markets with constant energy demand. However, some panel members from the utility sector expect that less saturated energy markets such as those in emerging countries where energy demand is growing and therefore new generation capacity is still increasing, are less dependent on higher carbon prices. The rationale is that as low-carbon intensive generation and storage technologies become increasingly cost competitive, they become the preferred investment choice for new investments, thus reducing the need for high carbon prices. This trend is already beginning to emerge in places such as India.

Capacity remuneration mechanisms and pro coal, oil, and gas policies are noted as policy factors which negatively impact carbon pricing measures, as they subsidize the old energy infrastructure and hamper the development and integration of new innovative technologies and renewable sources.

It was further noted that it is uncertain how policies will change beyond the 2020 timeframe given uncertainties in major global factors such as migration and weather changes. This means that the way policy factors will influence the carbon price signal needed is also uncertain.

Compared to the other factors, legislation, e.g., in more controlled power markets that restrict or prescribe the deployment of certain technologies is considered less of a factor influencing the carbon price signal needed. Where it was considered important, panel members saw them pushing up the carbon price signal needed. Investors highlighted public pressure as being important but with different opinions as to whether it would result in a higher or lower carbon price needed for the power sector to decarbonize.

Figure 8. Number of times each carbon price factor category was mentioned in the inquiry



"To use an internal price for carbon to evaluate assets in investment decisions has been proven to be a sound business practice that clearly protects the long term interests of the company. It is the boards of directors' duty to take care of these interests for a company, therefore boards should defend and even promote the adoption of such a tool. You are not doing your due diligence if you increase the risks of stranded assets for the company you serve as a director."

— **Philippe Joubert**, Chair, The Global Electricity Initiative

The answers clearly indicate the complex and diverse regulatory settings for the evolving electricity markets globally with explicit carbon pricing only directly influencing the costs of fossil-fuel based power generation, with the costs and revenue generation of the overall power system being influenced by many constantly changing factors. Some panel members highlighted the fact that carbon pricing alone will not drive the necessary investment in zero-carbon technologies such as renewables.

Business and financial factors are considered the least important set of factors for driving low-carbon investment, although some mention these factors will become more important over time. This could indicate that if carbon price signals lead to favorable economics and market conditions for low-carbon investments, most panel members are confident that these investments could be made. Some did see it as important, with the portfolio mix of current generation assets noted as affecting the carbon price signal needed to decarbonize.

A company's investment requirements is noted as increasing the carbon price needed. A higher hurdle rate may be deemed necessary due to the perceived additional risk premium given the uncertainty of the future carbon price.

Market and economic factors are highlighted the most by panel members. Examples include developments in underlying economics such as power and commodity prices and the levelized cost of renewables.

The impact of the decreasing cost of low-carbon generation technologies on investment decisions is significant.

Also mentioned is the uncertainty of revenues based on the level of the expected electricity price, electricity demand and market share in the future. Wholesale power prices and underlying commodity prices such as gas and coal determine marginal prices and merit order fuel switches. Carbon price effectiveness is therefore dependent on developments of these factors. Again, the underlying market is also important, if not fundamental, when assessing the effectiveness of the price signals.

Also highlighted was the availability and cost of energy storage and/or demand side management deployment as key in attaining an affordable low carbon energy system. Starting with relatively high capacity and low volume storage, increasing volumes of storage are required to provide energy in periods of low wind or scarcity of sun.

Regarding **technological and infrastructure factors**, most panel members highlighted the availability of renewable resources

as priority, followed by the availability of infrastructure for low carbon technologies. As more renewable capacity is being built over time, this could lead to a strain on certain renewable resources such as offshore wind with suitable areas of deployment running out.

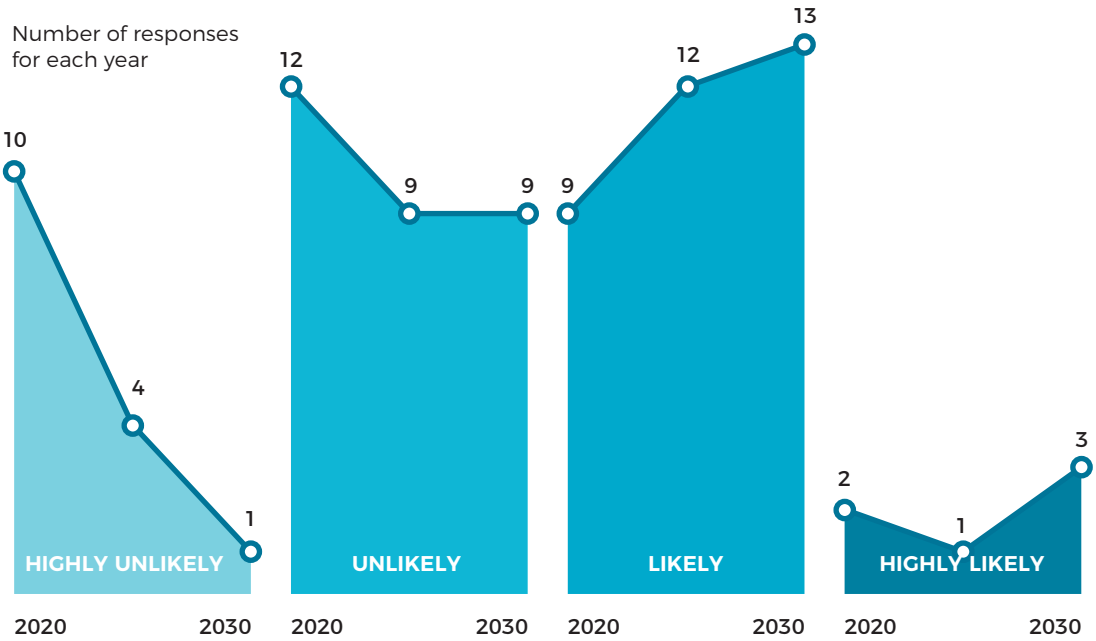
Also, the fear of blackouts was seen to put pressure on carbon pricing, as the current infrastructure is considered inadequate to support a renewables-dominated system. Should the infrastructure to support the low-carbon development become available, this would lower the carbon price needed.

ARE THESE CARBON PRICES LIKELY?

Panel members were asked to consider the likelihood of their carbon prices materializing as explicit carbon prices in their market. Figure 9 below summarizes the responses over the 2020, 2025, and 2030 time periods. There is uncertainty regarding the likelihood of these prices materializing in the market until 2030 as explicit carbon prices. Interestingly for 2025, opinion on the likelihood of the EU adopting the needed carbon price remains split, but there is more optimism in other regions including Canada, Mexico, South Africa, and the United States.

The longer-term ranges are important for utility, infrastructure and energy companies now given that some of the physical assets in the power sector have a technical lifetime of 40 or more years and CAPEX invested now has economic lifetime (i.e. the time over which the investment needs to be earned back) of 10–15. This means that the 2030 prices should be taken into consideration now when making CAPEX investment decisions.

Figure 9. Likelihood of the needed carbon price materializing in the market



SUMMARY OF FINDINGS

Internal carbon pricing can be used to conduct risk assessments and to respond to climate-related risks and as a basis for climate-related financial reporting.

By using carbon prices that would be needed to fully decarbonize the power sector in their decision-making, utilities and investors can assess climate-related risk as well as identify commercially attractive carbon-efficient alternatives as part of their scenario analysis.

Whether the Corridor for 2020, 2025 or 2030 is more appropriate to use depends on the timeframe of the decision. Existing market and economic factors are considered to be the strongest factors in determining the price level needed to drive change e.g. developments in the underlying economics such as power and commodity prices and the levelized-cost of renewables. Political and social factors are considered an important set of drivers for investment and the presence of other decarbonization support policies besides carbon pricing is described as crucial by investors.

The Carbon Pricing Corridor identified does not differ significantly with models created by institutions such as the IEA and Carbon Tracker, although for 2030, some panel members anticipate a lower price would be needed, with technology break-throughs and favorable renewable cost curves being highlighted as the driving force. This suggests that, at least in the short term, companies are familiar with and concur with the various sets of economic modelling.

For policymakers, utilities, and investors there is agreement that much higher carbon prices are needed to support the decarbonization of the power sector. For utilities, for longer term strategic planning, new investments etc. a carbon price of at least 30 USD/tonne, would assist with driving transition but a figure of 100 USD/tonne (i.e. being the 2030 range) would provide a more compelling case to engage in the transition.

Perhaps most importantly, while there is uniform recognition of the need to increase pricing, there is a lack of confidence that this is likely to be achieved in the short-term but more likely in the medium-term, at least for explicit carbon pricing policies. This has implications for long-term investments being made now. There is also widespread agreement that the explicit carbon price policies are not the only factors that will drive investment decisions and the decarbonization of the power sector.

MOVING FORWARD

This is the first in a series of Corridors reports that will be published over the next two years.

The scope of the inquiry will now be expanded to energy-intensive sectors such as steel, cement, paper and pulp and aluminum, and repeated to update the Corridors on a regular basis. The initiative will continue to recruit leaders from relevant industry and the investment community to join the Corridors Panel. Analysis and feedback from each inquiry process will improve the Panel's understanding of the multiple and fast-changing factors that influence the needed carbon price-signal. Iteration is at the heart of the research process, allowing the panel and authors to incorporate these changing dynamics and the process itself delivering new insights.

As the Corridor gets tested by different stakeholders, the initiative plans to report on the efficacy of its use and continue to refine its application. It will also be incorporated into the work plan of the Carbon Pricing Leadership Coalition (described on the following page), as it works to place a price on carbon emissions across the economy. Given the scale and geographic scope of the transition to decarbonization, the Corridors initiative welcomes opportunities to engage with others working on carbon pricing from the macroeconomic, industry and investor perspectives. Delivering better information and insight to investors and other stakeholders will contribute to accelerating the shift the world needs to see to stay below 2°C.

Please direct any questions or comments related to the Corridors initiative to: **carbonpricing@cdp.net**.

CARBON PRICING LEADERSHIP COALITION

ADVANCING DIALOGUE ON CARBON PRICING, CLIMATE RISK AND BUSINESS OPPORTUNITY

The Carbon Pricing Leadership Coalition (CPLC) brings together leaders across national and sub-national governments, the private sector, and civil society with the goal of putting in place effective carbon pricing policies that maintain competitiveness, create jobs, encourage innovation, and deliver meaningful emissions reductions. The Coalition aims to drive action through knowledge sharing, targeted technical analysis and public-private dialogues that guide successful carbon pricing policy adoption and accelerate implementation. The CPLC began forming from a groundswell of support for carbon pricing at the 2014 United Nations Climate Summit, where 74 countries and more than 1,000 companies expressed support for carbon pricing. The Coalition now consists of over 90 private sector partners, more than 30 strategic partners, and over 25 governments.

The CPLC engages the private sector to advocate for successful carbon pricing by deepening understanding of the business case for carbon pricing, sharing pathways for expanding carbon pricing as a climate change solution, and encouraging, where appropriate, corporate adoption of internal pricing. The work of the Corridors will be shared with the CPLC network, and will help spur dialogue, inform policy design and shape business strategy as companies aim to measure and manage their climate risk—and unlock new investment opportunities. For more information on how to get involved, visit www.carbonpricingleadership.org.

CPLC CARBON PRICING LEADERSHIP COALITION

APPENDIX

FACTORS USED IN CORRIDORS INQUIRY

Below is a list of factors that may make a transition to providing zero-carbon emissions in the future easier/cheaper or more difficult/costly. They may be direct or indirect costs or incentives associated with transitioning to zero-carbon emissions (examples here could include fossil fuel subsidies making these fuels cheaper or the lack of available of battery storage solutions; while on the other hand decarbonization policies such as renewable targets decreasing the costs of raising capital). They could also be factors such as shareholder pressure to decarbonize and the employment costs associated with hiring talent in the fossil-based versus renewable technology industries.

	DRIVERS	DESCRIPTION
1	**Political and social drivers**	
1a	Presence of other decarbonization support policies	Presence of policies that support the decarbonization of the power sector on top of the carbon price needed either directly, e.g. feed-in tariffs for renewable power generation or in-directly e.g. air pollution legislation
1b	Presence of policies counteracting decarbonization	Presence of policies that counteract the carbon price signal or incentivize carbon-intensive generation, e.g. fossil fuel subsidies or capacity market mechanisms
1c	Technology deployment restrictions	Legislative restrictions in deploying certain low-carbon power generation technologies, e.g. limit on wind on land, no CCS allowed or restriction on biomass sources allowed
1d	Public pressure	Presence of public pressure, e.g. divestment campaigns
2	**Business and financial drivers**	
2a	Portfolio mix of current assets	The power generation assets currently in the portfolio and the conditions to meet for writing off the carbon-intensive assets
2b	Company investment requirements	Investment criteria to meet, e.g. payback time, risk premium policy, internal competition for financial resources
2c	Pressure from shareholders	The pressure from shareholders to decarbonize the generation portfolio, e.g., to minimize stranded asset risks

	DRIVERS	DESCRIPTION
3	**Market and economic drivers**	
3a	Uncertainty of the carbon price level	The impact of volatility of the carbon price in the past and expected variations in the future
3b	Uncertainty of revenues	The level of the expected electricity price, electricity demand and market share in the future
3c	Cost of resources	The expected impact of coal, oil and gas prices and/or impact of price of biomass and nuclear fuel on decarbonization investment or deployment decisions
3d	Decreasing cost of low-carbon generation technologies	The expected impact of the decreasing cost of renewable energy, nuclear and CCS on decarbonization investment decisions
3e	Availability and cost of energy storage and/or demand side management deployment	The possibility to employ high levels of variable (renewable) generation capacity without jeopardizing the electricity grid safety in a commercially viable manner though energy storage options
3f	Distribution of energy system costs over public and private sector	The extent to which governments are willing to take over (some of) the costs related to a more renewable energy system (e.g. costs for energy storage, smart grids, CCS infrastructure etc.)
4	**Technological and infrastructure drivers**	
4a	Possibility for fuel switching in existing assets	The possibility for existing assets or presence of infrastructure to employ fuel switching from e.g. coal to natural gas or biomass
4b	Availability of infrastructure for low-carbon technologies	The expected availability of infrastructure to employ low-carbon technology, e.g. CO_2 pipelines for CCS or larger electricity cables for renewable electricity transport
4c	Availability of new low-carbon technologies	The expected availability of new and cheaper low-carbon technologies through technological breakthroughs and other innovations
4d	Availability of renewable resources	The expected availability of renewable resources to enable decarbonization, e.g. sun, wind, biomass, hydro

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CDP is a non-profit running the global environmental disclosure system for companies and sub-national governments. **www.cdp.net**

We Mean Business is a coalition of organizations working with thousands of the world's most influential businesses to accelerate the transition to the low-carbon economy. **www.wemeanbusinesscoalition.org**

This report is supported by The Children's Investment Fund Foundation, MacArthur Foundation and We Mean Business.

DESIGN
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