CARBON ASSET RISK:
DISCUSSION FRAMEWORK

WRI AND UNEP-FI PORTFOLIO CARBON INITIATIVE

WORLD RESOURCES INSTITUTE

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Participation in this process does not suggest or imply endorsement, and is not an endorsement, of the framework, or any of the concepts described herein, by the individuals or their respective institutions. Nothing in this paper should be construed as investment advice or investment research. The framework also describes a variety of commercially or freely available tools that may be used to support carbon asset risk assessment. The highlighted tools are ones available at the time this document was published from providers who were involved in the development and review of this framework; the list will not be updated over time. The list of tools is intended to be for illustrative purposes only and should not suggest or imply endorsement, and is not an endorsement, by WRI, UNEP-FI, or any of the participants in the process or their respective institutions.

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EXECUTIVE SUMMARY

After decades of research, strong consensus has emerged within the world's scientific community that human influence, particularly the burning of fossil fuels and deforestation, has been the dominant cause of observed warming in the global climate system.[1] Climate change presents enormous economic, social, and financial implications for economies around the world. In response, many governments have enacted, or are considering enacting, policies to reduce greenhouse gas (GHG) emissions and increase deployment of low-carbon technologies. This is occurring in the context of changing regional and global energy markets, as evidenced by recent volatility in global energy commodity prices.

These policy and market dynamics have led a number of investors and other stakeholders to question whether loans or investments in carbon-intensive physical assets or companies could be at risk. In this context, the risk is that a loan is not repaid or an investment does not perform as expected, because of various policy, technology, market, and economic, or social trends that emerge within a GHG-constrained global economy.

This framework focuses principally on non-physical risks, such as policy, market, and technology risks, associated with carbon and climate change. The decision to exclude physical climate risks (for example, severe storms, floods, etc.) from the scope is not intended to diminish their importance or potential significance for financial intermediaries or investors. It was made because the process of identifying, evaluating, and managing physical climate impacts is significantly different from the same process for other carbon risk factors, such as climate policies. Physical climate risks warrant their own separate treatment from a group with the requisite expertise.

This discussion on **"carbon risk"**[1] has been influenced by research undertaken by the International Energy Agency (IEA) and the Carbon Tracker Initiative, among others, which suggests that, absent carbon capture and sequestration or other technological solutions to manage GHG emissions, a significant quantity of the world's fossil fuel resources, especially coal, will need to remain in the ground (that is, unexploited) if the worst effects of climate change are to be avoided. At the same time, most leading experts predict that fossil fuels will need to remain a part of the world's energy mix for some time into the future, even under global carbon constraints; nevertheless, addressing climate change will require countries to reduce their reliance on fossil fuels steadily over time. This is a phenomenon that will carry broad implications for governments, companies, financial intermediaries, and investors.

For example, if a large quantity of fossil fuel resources cannot be extracted and produced (whether because of policy, market or other carbon-related constraints), companies whose business is principally focused on such activities could be negatively impacted, both operationally and financially. The implications for fossil fuel commodity prices are crucial in any valuation scenario for such companies. This concept is referred to in this framework as "operator carbon risk" and affects carbon-intensive companies and asset operators (see Chapter 2 for details).

Further, this reality has led to a broader discussion about whether financial intermediaries, such as commercial and investment banks, and investors, are thoroughly integrating considerations of operator carbon risk when evaluating, pricing, and financing carbon assets and companies. In particular, concern has emerged around the potential for operator carbon risk to translate to "carbon asset risk," which is the potential financial risk affecting intermediaries and investors with a financial stake in or relationship with these companies.

FRAMEWORK OBJECTIVE

The dialogue around carbon asset risk has grown over time, but it has occurred in the absence of a comprehensive, generally accepted framework to guide institutions and other stakeholders in their efforts to think consistently and systematically about the issue. To meet this important need, the World Resources Institute (WRI) and UNEP Finance Initiative (UNEP-FI) launched a process in early 2014 to develop a framework to help financial intermediaries and investors, as well as stakeholders with an interest in this topic, more systematically to identify, assess, and manage carbon asset risk.

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1. All references to "carbon" in this document refer to all greenhouse gas emissions rather than just carbon dioxide

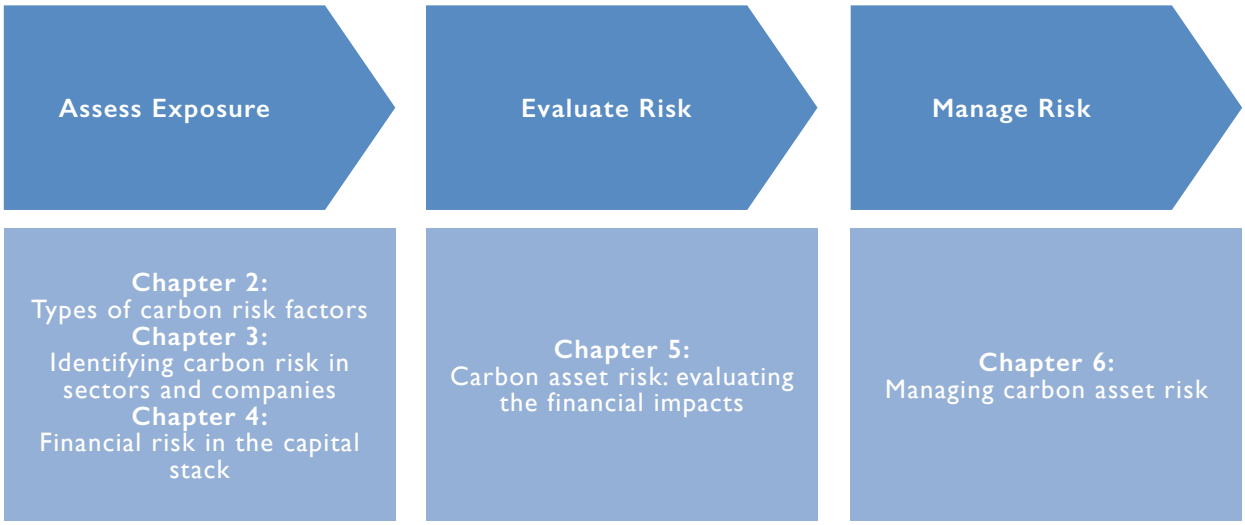
This framework is intended to be useful for institutions with a diverse range of risk appetites, as well as perspectives on the probability and impact of various types of carbon risk. It was developed through a multi-stakeholder process that included investors, academics, consultants, and representatives from banks, insurance companies, and environmental advocacy organizations.

The framework is not intended to be a prescriptive methodology for carbon asset risk management, nor is it intended to opine on the potential likelihood and impact of operator carbon risk. Rather, this conceptual framework is intended to help financial intermediaries and investors think more consistently and systematically about carbon asset risk—what it is, and how it can be evaluated and managed—as well as to highlight existing analytical tools that may be helpful in this process. In other words, the framework discusses how investors and intermediaries might think about carbon asset risk rather than what they should think about it. The concepts are intended to enhance users' existing risk management processes and systems and ultimately strengthen overall decision-making.

FRAMEWORK STRUCTURE

The framework, which is structured across six chapters, covers the key elements of addressing carbon asset risk during the process of making new financing or investment decisions and when managing existing investment portfolios. As shown in **Figure ES-1** below, the document starts with assessing exposure and follows with a discussion of evaluating and managing carbon asset risk.

Figure ES-1: Summary of Framework Structure



CHAPTER HIGHLIGHTS

- **Chapter 2** explores types of risk factors related to carbon risk. This framework draws an important distinction between how carbon risk factors can affect carbon-intensive companies/operators ("**operator carbon risk**") and how such risk, depending upon the nature and severity of impact, could affect financial intermediaries and investors that have a financial relationship with these operators (**"carbon asset risk."**) The framework discusses three core carbon risk factors that exist today—policy and legal, technology, and market and economic—as well as reputational risks and further discusses several issues and trends that will be important to monitor over time. Many of these factors are closely intertwined and not always easy to isolate. For example, policy changes can lead to new economic incentives and also drive technological innovation and deployment.
- **Chapter 3** explores factors that might make certain industry sectors and types of companies more or less exposed to carbon risk. To date, public dialogue has focused principally on physical assets and operations heavily reliant on fossil fuels, such as upstream fossil fuel exploration and production and fossil-fuel-fired power generation. This is a logical focus, given that these activities contribute the largest share of GHG emissions to the global economy and are most likely to be impacted directly by carbon (and other air-pollution-control) policy regimes, such as cap-and-trade programs or carbon taxes. Nevertheless, other sectors, such as fossil-fuel-dependent infrastructure and fossil-fuel-intensive industries that face

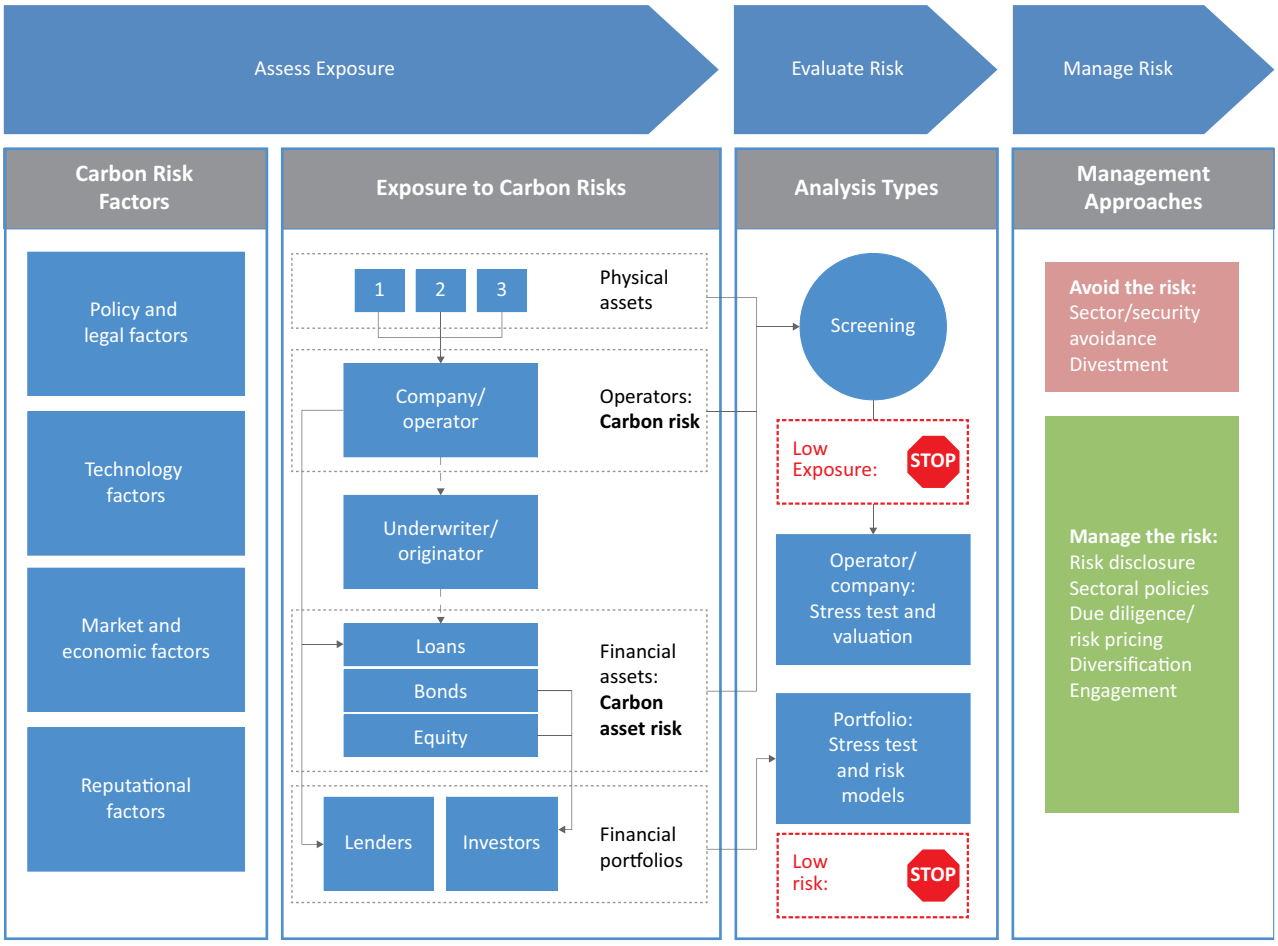
competition from low-carbon competitors, may also be exposed to operator carbon risk.

The chapter introduces several important considerations relevant to determining a sector or operator's potential exposure to carbon risk, including the profile of its assets (for example, type, fuel mix, location, operational lifetime, GHG emissions, etc.), as well as its operator's earnings margin, and whether it faces low-carbon competitors. Exposure is also a function of "operator carbon strategy," which is the ability to manage risk through strategies like future development/capital expenditure (capex) plans, asset diversification, and operational risk management efforts (for example, methane mitigation). These factors are important because operators within a sector with high risk (for example, oil and gas or utilities) might own very different types of assets and operate in various jurisdictions with diverse operating conditions. As a result, they might face very different types and levels of carbon risk.

- **Chapter 4** describes how, even for investments in sectors or companies that face high levels of operator carbon risk, carbon asset risk is largely a function of the type of financial relationship with the operator (for example, corporate loan, project finance, equity or bond) and the likely duration or "tenor" of the relationship. This requires an understanding of where different types of financing sit in the capital stack, which is the sum total of capital invested in a project or company. Specific aspects of financing, including the type of capital provided, the tenor, the seniority of capital, and whether it is secured by collateral, all affect the risk and return profiles of a financial investment and are important considerations in determining whether operator carbon risk may translate to carbon asset risk for an intermediary or investor.

Collectively, these carbon risk factors, operator characteristics, and financial asset type and tenor, inform the carbon risk exposure of an investment. This is shown in **Figure ES-2**, which visualizes the framework as a whole. As discussed above, after assessing exposure, the financial impact of carbon asset risk is assessed and where necessary, managed.

Figure ES-2: Framework for Assessing Carbon Risk and Assessing and Managing Carbon Asset Risk



Carbon Asset Risk: Key Considerations

- Carbon risk faced by operators of carbon assets (**operator carbon risk**) could lead to **carbon asset risk** for financial intermediaries and investors with a financial interest in these assets. While carbon asset risk depends on a number of factors, fundamentally, a financial intermediary or investor cannot be exposed to carbon asset risk unless the underlying operator with which it has a financial relationship is exposed to carbon risk.
- Operator carbon risk is a function of the characteristics of physical assets managed by an operator, the nature of the risks to which these assets are exposed, and how the operator is managing these risks.
- There could be instances where an operator is exposed to carbon risk but a financial intermediary or investor faces little to no carbon asset risk. This could stem from the type of financial relationship at hand (for example, a loan versus an equity investment), as well as the expected duration and liquidity of the position.

- **Chapter 5** discusses the process by which financial intermediaries and investors can evaluate this potential financial impact. As a first step, intermediaries and investors can screen the key exposure data associated with the operator, including its portfolio of carbon assets (for example, fuel types, locations, cost of production, emissions intensity, etc.) and its operator carbon strategy (for example, future development/capex plans, asset diversification, operational risk management, etc.). This assessment might entail an evaluation of qualitative information and quantitative data reported by a company in its annual report, corporate responsibility or sustainability reports or other public disclosures, as well as conversations with company management. Intermediaries and investors also need to consider the nature of the financial relationship (for example, type of financing and expected duration) in place or under consideration, and the role of this financing in the company's capital structure.

  For those loans or investments that have a low exposure to carbon asset risk, further action might not be necessary. However, for those where potential risk is identified, further due diligence and assessment might be warranted. As discussed in Chapter 5, two analytical approaches can inform this assessment: 1) an individual operator-level approach starting from physical assets and rolling up to a portfolio, and, 2) a portfolio approach that evaluates the impacts of risk factors on an entire portfolio of investments. These approaches can be used separately or in conjunction with each other.

  Following the initial screening assessment, the key focus of the operator-level approach is on stress testing and scenario analysis, using general economic frameworks to forecast potential future outcomes under a range of different assumptions (for example, a future world where governments take action to avoid global average temperatures rising by more than 2°C above pre-industrial levels). The outputs of this assessment can inform valuation models, such as discounted cash flow (DCF) analysis. Screening for exposure is important because evaluating the risk can require significant resources, and analysis should focus on investments with the highest potential exposure. Investors likely prefer to see the companies doing the detailed stress testing on themselves at the operator level.

  While collecting risk data can entail a significant effort, many entities supply basic data for scenarios for example, the IEA, think tanks like the Carbon Tracker Initiative, investment analysts, and other commercial tool providers (see Appendix 2 for a sample). Further, in addition to referencing information disclosed by companies, intermediaries and investors may also want to engage directly with companies to understand their approach, assumptions, and analysis. Intermediaries and investors can then use information from all of these sources—statistical agencies, NGOs, commercial tool providers, investment analysis, and the operators themselves—to make a determination about the materiality of risk.

The Portfolio approach analysis evaluates the influence of risk factors at the portfolio level, taking into account both high- and low-carbon investments and the expected risk correlation between them given an assumed scenario. Such analysis could have significant advantages over the operator-level approach in terms of practicality and scalability; however, tools to perform such evaluation are only emerging now and are generally only available through commercial providers. More research is needed to produce practical tools capable of stress testing investment portfolios for carbon asset risk.

- **Chapter 6** discusses strategies that financial intermediaries and investors can pursue to manage carbon asset risk, if the evaluation process leads to the conclusion that the risk is material. The options for managing carbon asset risk will vary depending on the role of the intermediary or investor (for example, underwriter, bondholder, lender or shareholder) and whether financing or investment is under consideration or has already been made. As shown in **Figure ES-3**, intermediaries and investors have two main options - avoiding risk altogether or managing it.

Figure ES-3: Risk Management Options by Investment Stage for Different Financial Sector Actors

		Financial Intermediaries (Underwriters)	Financial Intermediaries (Lenders)	Bond Buyers	Shareholders
New investments	Avoid the risk	▪ Sector/security avoidance	▪ Sector/security avoidance	▪ Sector/security avoidance	▪ Sector/security avoidance
	Manage the risk	▪ Promote risk disclosure ▪ Proper risk pricing ▪ Thorough due diligence	▪ Proper risk pricing ▪ Sectoral policies ▪ Thorough due diligence (potentially include covenants) ▪ Engage in key areas	▪ Promote risk disclosure ▪ Due diligence as possible in disclosure	▪ Invest with ESG screens ▪ Diversification
Current holdings	Avoid the risk	N/A	▪ Divestment at sector or loan level	▪ Divestment at sector or security level	▪ Divestment at sector or security level
	Manage the risk	N/A	▪ Diversification (sector and subsector) ▪ Engagement to understand operator risk management	▪ Diversification	▪ Diversification ▪ Engagement to understand risk management ▪ Engagement to align risk and return perspectives

Risk avoidance can be achieved by applying sector or company exclusions when making new investment decisions, or by choosing to sell or divest certain holdings from currently held positions. Some may choose to avoid certain types of financing or investments due to ethical reasons or because the perceived carbon risk is too significant. However, if the primary goal is to better manage risk (as opposed to ethical considerations) many other options can be pursued.

For instance, lenders and investors considering new opportunities can ensure that thorough due diligence has been performed and that investments have an appropriate risk-adjusted return. Likewise, risk can also be managed through portfolio diversification strategies and, in some cases, by engaging with companies around carbon risk disclosure and management. Furthermore, service providers like underwriters can also play a role by encouraging thorough disclosure of operator carbon risk in securities-offering documents, and ensuring the pricing of securities incorporates consideration of relevant risks.

THE ROLE OF POLICY

An important final consideration is that assessing and managing carbon asset risk is made more challenging by the substantial amount of uncertainty about the future direction of public policies on energy and climate change. The financial sector could play a role in working to reduce this uncertainty through engagement in public policy arenas. Having greater clarity on issues such as the potential nature and timing of GHG regulation and reporting and disclosure requirements would greatly enhance the ability to assess and manage carbon asset risk.

CHAPTER 1: INTRODUCTION

KEY POINTS

- **Some investors and stakeholders have questioned whether financial intermediaries and investors are adequately considering policy, market/economic and reputational risks from carbon-intensive physical assets**
- **Perspectives on the likelihood and potential impact of such risks vary considerably**
- **This framework provides approaches and tools for identifying, assessing, and managing carbon asset risk**

1.1 CONTEXT

After decades of research, strong consensus has emerged within the world's scientific community that human influence, particularly the burning of fossil fuels and deforestation, has been the dominant cause of observed warming in the global climate system since the mid-20th century. Furthermore, continued growth in greenhouse gas (GHG) emissions is likely to cause further climatic changes, which are projected to lead to continued sea-level rise, changes in precipitation patterns, and more frequent hot temperature extremes over most land areas.[2] These potential changes present enormous economic, social, and financial implications for economies around the world.

In response to these challenges, many governments have enacted policies to reduce GHG emissions and other pollution from sources such as power plants, and to increase deployment of low-carbon energy and other technologies. The share of renewable energy in the world's energy mix, while still relatively small, has increased substantially because of these policies, and a range of technological improvements has brought the cost of renewables closer to parity with fossil fuels. At the same time, ongoing evolution and changes in the development of fossil fuels have led to significant shifts in energy development in some regions. One prominent example is the growth of shale oil and gas development in the United States, which has been partly responsible for displacing significant amounts of coal-fired power generation.

These policy and market dynamics have led a number of investors and other stakeholders to question whether loans to, or investments in, carbon-intensive assets and companies - defined in this framework as physical assets or companies with direct or indirect exposure to high levels of GHG emissions, such as those in the fossil fuel industry, or that are heavily reliant on fossil fuels - could be exposed to financial risk. In this context, the risk is that a loan is not repaid or an investment does not perform as expected, because of various policy, economic, market, and social trends that emerge within a GHG-constrained global economy.

This discussion has been influenced by research from the International Energy Agency (IEA) and the Carbon Tracker Initiative, among others, which suggests that, absent carbon capture and sequestration or other technological solutions to manage GHG emissions, a significant quantity of the world's fossil fuel resources, notably coal, will need to remain in the ground (that is, unexploited). This will be a necessary part of any reasonable strategy to avoid a rise in global average temperature of more than 2°C above pre-industrial levels - the limit that scientists suggest is necessary to avoid the worst consequences of climate change (and the target level agreed to by the United Nations Framework Convention on Climate Change in 2010). This concept is often known as a "carbon

budget," and it applies to both 2°C scenarios as well as to higher emissions and higher impact scenarios (for example, 3°C), albeit with a higher budget for these alternative scenarios. While the IEA's modelling suggests that fossil fuels are likely to remain a significant part of the world's energy mix, even under a 2°C scenario, it also finds that addressing climate change will necessitate reducing reliance on unabated fossil fuel use over time--in particular, on the most carbon-intensive fuels.[3] This is a phenomenon that will carry broad implications for governments, companies, financial intermediaries and investors.

For example, if a large quantity of fossil fuel resources cannot be extracted and produced (whether because of policy, market, or other carbon-related constraints), companies whose business is principally focused on such activities could be negatively impacted, both operationally and financially. The effect on commodity prices and valuations is a key element. Further, this reality has led to a broader debate about whether financial intermediaries, such as commercial and investment banks, and investors, are thoroughly integrating considerations of operator carbon risk when evaluating, pricing, and financing carbon-intensive assets. In some cases, there have been calls for banks and investors to cease financing fossil-fuel companies and other high-carbon projects in light of concern about the risk of exposure to "stranded assets," or the risk that assets lose all (in an extreme case) or a partial amount of their value.

1.2 OBJECTIVE

As discussed above, this dialogue has grown over time both within the financial sector among financial actors and other stakeholders, but it has occurred in the absence of a comprehensive, generally accepted framework to guide institutions and stakeholders in their efforts to think consistently and systematically about carbon asset risk (CAR). To meet this important need, the World Resources Institute (WRI) and UNEP Finance Initiative (UNEP-FI) launched a process in early 2013 to develop a framework to help financial intermediaries and investors better identify, assess, and manage CAR.

The framework is intended to be practical and useful for executives, research analysts, deal teams, risk managers, and corporate responsibility experts from a diverse set of institutions in the financial sector, ranging from commercial and investment banks to asset managers and investors. It is also intended to be useful for readers with a range of risk appetites and perspectives on the probability and impact of carbon risks.

It is also important to note the scope and limitations of this framework. As discussed in Chapters 2 and 3, the document limits its coverage to risks associated with climate mitigation for energy-related CO2 emissions, as opposed to other sources of greenhouse gases (agriculture, land use and forestry, fluorinated compounds), and specifically large sources of energy-related CO2 emissions in fossil fuel production and electricity generation. Further, the framework discusses CAR assessment and management with little consideration of the potential development benefits associated with energy access in developing economies.

1.3 TERMINOLOGY

As with many topics in finance and the environment, our observation is that the public dialogue on carbon asset risk has been complicated by differences in the way that various stakeholders use terminology. We hope that this paper will provide useful clarity and consistency.

An example is the term "exposure," which will be used in this framework in a colloquial sense to mean "exposed to a risk" rather than the more formal quantitative definition of "potential loss." Additional examples include terms like "assets" (physical *versus* financial; here we have striven for clarity by defining what we mean when we use the term); "financial intermediaries" (here used to describe investment and commercial banks that underwrite equity and bond offerings, as well as make loans to companies and projects); and "investors" (here used to describe shareholders and bondholders, as well as asset managers).

The authors and technical working group members (see next section) strove to create a framework that will be broadly useful and understandable to the widest possible audience; however, some readers may encounter terminology used in unfamiliar ways. To guide readers, a glossary has been included as an appendix to the document.

1.4 FRAMEWORK DEVELOPMENT PROCESS

This framework was developed through an international multi-stakeholder process that included representatives from banks, insurance companies, and environmental advocacy organizations, as well as investors, academics, and consultants. An initial draft was created by a drafting team and reviewed by a technical working group, and a second draft was reviewed by a broader technical working group and other experts through public consultation. This process, which was facilitated by WRI and UNEP-FI, helped to ensure that diverse perspectives were considered during development, and was intended to ensure that the final product is ultimately practical and usable for its intended audience. The members of the technical working group that participated in the process are noted in Appendix 3.

CHAPTER 2:
TYPES OF CARBON RISK FACTORS

KEY POINTS

- **Carbon assets and companies can be exposed to a variety of potential risk factors related to climate change, including policy, legal, technology, market and economic, as well as reputational risks. Policy, technology, and market/economic factors are often closely interrelated and are the main focus of this framework, although reputational risks are discussed here and in Chapter 6.**
- **Carbon risks, which affect the operators of carbon assets ("operator carbon risk,") might present themselves as "carbon asset risk" to financial intermediaries and investors, depending upon their nature and severity of impact.**
- **While no less important, the physical risks stemming from climate change are excluded from the scope of the framework, because the approaches for identifying, evaluating and managing these risks differ significantly from approaches used for carbon risks.**

2.1 DEFINITION AND CONCEPTUAL FRAMEWORK

This chapter outlines the types of carbon risks and risk factors that could impact physical assets and companies, creating potential financial risks for financial intermediaries and investors with a related financial interest.

2.1.1 Defining types of carbon risk and risk factors

When defining risks related to climate change, it is important to distinguish between:

- **Physical climate risks**, which are risks associated with physical impacts from climate change that could impact carbon assets and operating companies. These impacts may include physical damage and/or capital expenditures necessary in response to variations in weather patterns (such as severe storms, floods, and drought) and "slow onset" impacts such as sea level rise, desertification, etc.
- **Carbon risks**, which this paper defines as non-physical climate change-related factors facing assets and companies. This principally encompasses policy and legal, technology, market and economic factors as well as reputational risks. Depending upon their nature and severity, carbon risks may translate to carbon asset risk to financial intermediaries and investors.

The impact of physical climate risks and carbon risks can be considered within the common framework of various types of financial risk; these include credit, market, policy, liquidity, operational, and reputational risks, among others. Whereas physical climate risks generally translate into operational risks (for example, an asset cannot operate due to physical impacts), non-physical carbon risk factors can influence many different types of risk, which may also carry financial implications for companies.

This framework focuses on non-physical carbon risk factors (primarily policy and legal, technology, and market/economic). Excluding physical climate risks from discussion is not intended

to diminish their importance or potential significance for financial intermediaries or investors. This decision was made because the process of identifying, evaluating and managing physical climate impacts is significantly different from that used for other carbon risk factors, such as policy risks. Physical climate risks warrant their own separate treatment from a group with the requisite expertise.

Similarly, reputational risk considerations are also important to consider. However, individual institutions generally have their own framework and processes for evaluating and managing such risks. Thus, while this document discusses reputational risks (section 2.3 and Chapter 6) it does not cover specific evaluation approaches.

Finally, the vast majority of recent public discourse about potential risks facing financial intermediaries and investors haves focused around how carbon risk factors affect high-carbon companies and industries, notably fossil fuel companies. Given this public debate, high-carbon assets are the main focus of this framework.

Carbon Risk and Low-Carbon Assets

This guidance focuses on carbon risks related to carbon assets, which are physical assets with direct or indirect exposure to GHG emission constraints, such as those in the fossil-fuel industry or that are heavily reliant on fossil fuels. Low-carbon assets, such as renewable energy, are sometimes discussed as a potential "hedge" against carbon assets because, in many ways, policy and market risks for low-carbon assets are negatively correlated with those of high-carbon assets (for example, carbon pricing is on the whole positive for wind energy and negative for oil and gas). We note that while low-carbon assets also face many of the same types of risk as carbon assets (for example, policy and market/economic risks), the nature of these risks is different from those facing carbon assets (for example, the risk that industrial or innovation policies supporting renewable energy are discontinued or not enacted). While low-carbon assets fall outside the focus of this guidance, the general strategies and concepts described to help assess policy and economic/market risks related to carbon assets might also be useful for assessing risks facing low-carbon assets.

2.1.2 Moving from carbon risk to carbon asset risk

It is important to illustrate how carbon risk, which affects operators of carbon assets, could potentially translate to "carbon asset risk," which affects financial intermediaries and investors. As an example, consider a power company that operates a fleet of coal-fired power plants. The company might face a range of carbon-related policies and other technological and market risks. These risks directly impact the company that operates the fleet; depending on the nature of the risks, they could, for example, reduce the amount of energy the operator can sell to the market, or threaten the operator's ability to continue running the fleet in the future. The utility company's financial backers (such as banks and investors) could be indirectly affected by these impacts on the utility company through increased credit risk or even loss of revenue, depending upon the severity of the impacts.

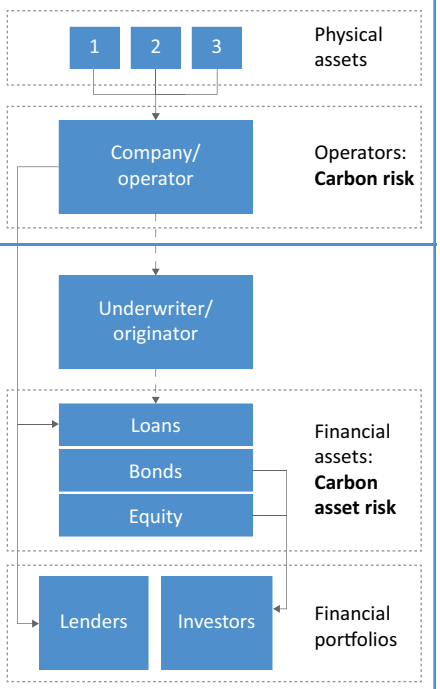
We distinguish between these risks to each party by referring to the direct risk to the company as "**operator carbon risk**" and the associated financial risk to financial intermediaries and investors as "**carbon asset risk**." This distinction is illustrated conceptually in **Figure 4**.

Figure 4: Illustration of Operator Carbon Risk and Carbon Asset Risk

Operator carbon risk: risk of financial loss to an operator of a physical asset due to non-physical climate change related factors (predominantly policy, market, and technology)

Operator carbon strategy: the strategy by which an operator of carbon assets minimizes its operator carbon risk by positioning itself to adapt to a carbon-constrained world

Carbon asset risk: Potential for a financial intermediary or investor to experience financial loss due to unmanaged operator carbon risk in its clients or investee companies



Because carbon asset risk is a function of operator carbon risk, a financial intermediary or investor cannot be exposed to carbon asset risk unless the operator is exposed to carbon risk. Operator carbon risk is a function of the underlying physical assets of the operator, the type and nature of risks facing the operator, and also how the operator is identifying and managing those risks. In addition to considering operator carbon risk, financial intermediaries or investors evaluating carbon asset risk need to consider their underlying financial relationship to the operator, including the nature and type (for example, loan, bond or equity) and duration. These considerations can have a significant impact on whether operator carbon risk translates into any significant carbon asset risk for a financial intermediary or investor. These issues will be discussed further in subsequent chapters.

2.2 CARBON RISK FACTORS

In addition to reputational risks, this framework focuses on three core risk factors that exist today, as well as several other issues that might become important in the future. These core risk factors are:

1. Policy and Legal Factors
2. Technology Factors
3. Market and Economic Factors

Other authors have identified similar categories, including the Climate Policy Initiative and Mercer.[4] For instance, Mercer identified three major risk factors in its recently updated 2011 work, Technology, Impacts, and Policy (TIPS; see further details in Chapter 5). We do not look at Impacts (related to physical climate risks) but our categories of Technology and Policy are similar. We further distinguish Market and Economic Risk and Reputational risk.

The following table and sections examine these risks in further detail; they cover definitions, impacts on operators or financial intermediaries/investors, and practical examples of each risk type.

Table 1: Primary Types of Carbon Risk Factors

Category of Risk	Definition	Nature of Impact	Examples
Policy and Legal	Policies or regulations that could impact the operational and financial viability of carbon assets	Impacts physical carbon assets and companies that own/ operate assets	Fuel-efficiency standards for personal vehicles; emissions trading systems; U.S. EPA regulations targeting air pollution and GHGs from power plants
Technology	Developments in the commercial availability and cost of alternative and low-carbon technologies	Impacts technology choices, deployment and costs and demand profiles	Energy storage technologies; advances in renewable energy technologies, carbon capture and storage; alternative fuels
Market and Economic	Changes in market or economic conditions that would negatively impact carbon assets	Impacts physical carbon assets and companies that own/ operate assets	Changes in fossil fuel prices; changes in consumer preferences

In many cases, the carbon risk factors outlined here may be closely interrelated. For instance, changes in market conditions that occur as a result of policy can be difficult to distinguish from risks that are a direct function of market dynamics.

2.2.1 Policy and Legal Factors

Definition

Policy and legal factors involve changes in international, national, and local government policies or regulations that could impact the operational and financial viability of carbon assets. These might be policies or regulations that impose limits on GHG emissions from certain types of physical assets, or those that indirectly impact such assets. Examples of direct policies or regulations include those that establish carbon-pricing systems (for example, cap-and-trade programs or carbon taxes) or directly limit GHG emissions. In addition, some policies or regulations that do not directly target GHG emissions might nevertheless impact GHG-emitting assets; examples include a policy that imposes limits on non-GHG air pollution from fossil-fuel-fired power plants, a policy that impacts industrial water use and discharge, or an energy efficiency standard.

On the other side, policies and regulations that support the development of low-carbon technologies and energy efficiency can also impact high-carbon sectors and assets, as well as the overall demand for energy.

Legal risks, which stem directly from disputes over the application or implementation of government policies and regulations, also have the potential to impact carbon assets, both at the point of development and during operation. These risks include actual litigation, or the threat of litigation, in response to alleged violations of, or disputes over the implementation of, government policy, regulation or law.

Nature of impact

Policy and regulatory risks stem from actual or potential government action, whether at the country, state, or local level. As a result, the nature of these risks will vary depending on the geographical context of a physical asset or company.

For example, while certain jurisdictions might have certain policies or regulations in place or under consideration, in other jurisdictions, such policies or regulations might be highly unlikely to be introduced or enacted. In addition, similar types of policies and regulations enacted across different jurisdictions can be different in design and implementation. For this reason, when evaluating the potential impact of policy or regulation, it is critical to understand specific elements of its design: for example, what sectors it targets and how; the timeframe for compliance; and (in the case of proposed policy or regulation) the likelihood of enactment or implementation. This is the case for policies and regulations directly targeting high-carbon assets, as well as those that are focused on encouraging alternatives. This insight will help inform the assessment of whether and how policy and regulatory risks might impact a physical asset or company and, in turn, a lender or investor.

The threat of legal risks facing carbon assets is closely tied to the policies and regulations enacted in a specific jurisdiction, as well as to the type of legal system in place. Such risks include legal challenges and claims arising from "black swan" events (for example, an extremely large oil spill) as well as those arising from alleged noncompliance with various policies and regulations. The outcomes and remedies sought by plaintiffs in a lawsuit are also factors to consider. For example, they can range from plaintiffs seeking to force operators of carbon assets to install pollution control

equipment or explore lower-GHG emitting technology, to demanding that an asset discontinue operation. In other instances, litigation can result in significantly delaying construction of new carbon assets or cause operators to incur large costs in the process of contesting litigation.

Examples

There are a range of examples of government policies and regulations with direct or indirect impacts on carbon assets. Carbon-pricing systems are increasingly being developed across the globe; a 2014 review[5] identified nearly forty systems in place or under development. They include cap-and-trade programs such as the European Union's Emissions Trading Scheme and the State of California's program in the United States, established by the passage of Assembly Bill 32 in 2006.

Other regulations impact GHG emissions indirectly, such as those issued by the U.S. Environmental Protection Agency (EPA) targeting mercury, and other air toxins and criteria air pollutants, emitted from fossil-fuel-fired power plants.[6] The EPA has also enacted regulations targeting GHG emissions from large new stationary sources such as power plants, and is in the process of developing new regulations that would target GHG emissions from existing power plants.[7] Furthermore, the upcoming U.N. Conference of Parties in Paris (in December, 2015) is focusing attention on future climate policy commitments that could be agreed by countries around the world. The United States-China Joint Announcement on Climate Change, which was issued in November 2014, is a key example.[8] With respect to alternative energy policy and efficiency, there are a significant number of policies and regulations in place, and under consideration, in many countries and at many different levels of government. Finally, the Intended Nationally Determined Contributions (INDCs), which countries are developing and submitting to the UNFCCC in advance of the international climate negotiations in Paris, will influence many government plans and actions over the next several decades.

With respect to legal risks, environmental litigation already is a prominent part of the legal landscape in the United States. Arnold and Porter LLP, in partnership with Michael Gerrard from Columbia University, provide an online tool tracking the number of cases and their outcomes.[9] Policies and regulations themselves can also be subject to litigation, which, in some cases, may go on for years or even decades. In addition to EPA's air regulations, which have been the subject of ongoing legal disputes, GHG emitters in the United States have been subject to various attempts (so far unsuccessful) to seek redress for the impacts of climate change under common-law nuisance claims.[10] Generally speaking, litigation is a common threat for many carbon assets these days, particularly in countries which, like the United States, have active environmental constituencies, and litigation is likely to continue in light of increased policy and regulation that directly and indirectly target GHG emissions, as well as by changing public opinion.[11]

2.2.2 Technology Factors

Definition

In the context of carbon risk, technology risks are those associated with changes and developments that could increase the commercial availability and attractiveness of alternative and low-carbon technologies. Many industries face technology risk in some shape or form, whether in energy, telecommunications, or computer hardware and software.

Nature of impact

Technology risks have the potential to impact carbon assets and companies in many ways. These include significant new technological breakthroughs - whether in cost, design or both - that lead to rapid displacement of existing technologies. More commonly, however, are incremental improvements in existing technologies that are developed over a longer period of time. In either case, existing technologies generally face some level of risk of displacement by newer alternatives that have a lower cost profile or greater function, efficiency, reliability, usability and, with respect to carbon, lower GHG emissions. Technology changes that lead to greater energy efficiency also have the potential to reduce overall demand for energy, thereby reducing the need for production or generation from existing technology assets.

Examples

Many technology changes have impacted companies in the energy sector, and many more changes are likely to occur in the future. A prominent example is the cost of solar photovoltaic (PV) panels, which has declined dramatically in recent years. This cost decline has led to a significant increase in

solar PV deployment; the Solar Energy Industries Association estimates that, since the third quarter of 2010, the average price of a PV panel has dropped by 63 percent.[12] Deutsche Bank analysts recently predicted that solar PV would reach grid parity in 80 percent of the world by 2017.[13]

In the United States, technological advancements led to the widespread use of horizontal drilling and hydraulic fracturing techniques in the past decade, which drove major increases in oil and natural gas production. This increased production has led to a significant decrease in the average price of natural gas, which has been one key factor in the decision of many U.S. power utilities to retire old coal plants in favor of building new natural gas plants, which emit fewer CO_2 emissions.

Other technology changes could include new developments in battery storage and smart grid technologies, for example, which could facilitate more widespread use of renewable energy. They also include potential developments with respect to biofuels (as a substitute for oil), carbon capture and storage, and small-scale nuclear power.

2.2.3 Market and Economic Factors

Definition

Market and economic risks encompass a set of risks that arise from changes in market and economic conditions that might impact the operational viability or financial profile of a physical asset or company. Such market and economic changes can be a function of changes in consumer demand for energy, technological advancements, and even government policies or political events.

Nature of impact

The potential impact that market or economic risks could have on a physical asset or company and - in turn, a lender or investor - will vary depending on numerous factors. These factors include the type of asset or company and what it produces; whether an asset or company is in an industry where barriers to entry are high; and whether demand for a product or service is inelastic (meaning not sensitive to increases in price). For example, globally traded commodities such as oil generally face different market and economic risks than commodities or products consumed within a more local or regional market. In many cases, it boils down to what drives demand, supply, capital expenditure, and output.

Examples

One recent example of how market changes can impact energy assets and companies is the recent significant decline in the price of oil, a globally traded commodity. Demand for oil has been low because of lower economic growth rates in many countries and increased efficiency, as well as robust supply in some markets, for example, the United States, where supply has been boosted by the exploitation of new reserves made accessible by horizontal drilling and hydraulic fracturing.[14] Oil and gas companies have found it more challenging to pursue higher cost development projects in a low-price environment. Weaker demand for coal in the United States - a result of lower natural gas prices and tighter pollution regulations, and the consequent retirement of many coal power plants - has similarly impacted many coal companies.

Future economic growth trends, particularly in emerging economies such as China and India, will have a significant influence on future trends in global energy demand. Demand will also be influenced by technology changes, particularly energy efficiency improvements, as well as potential advancements in distributed energy.

2.3 REPUTATIONAL RISKS

Definition

Reputational risks encompass financial or non-financial damage to reputation stemming from a direct or indirect association with an asset or company. Possible risks include damage to brand value or reputation, lost revenue, or additional capital expenditures.

Nature of Impact

Operators of individual carbon assets, as well as companies, might be exposed to reputational risk because of concerns surrounding the nature of their activities and impacts. For example, a

number of fossil-fuel companies have been targeted by a growing divestment campaign, where some investors have argued for fossil-fuel divestment on moral or ethical grounds, because of their concerns about climate change and potential environmental damage. Some companies have also been publicly criticized over particular types of carbon projects or the GHG-intensive nature of their business in general.

In addition, financial intermediaries and investors might also face reputational risk stemming from financing - whether debt, equity or even financial services - provided to carbon-intensive assets or companies. As with the nature of all types of risk, the potential impact of such reputational risk depends on a range of factors; these vary significantly depending upon the institution and issue at hand.

One key way that reputational impacts tend to differ from policy or market and economic impacts is that they have the capacity to occur very suddenly. This phenomenon has been enabled, in large part, by increasingly sophisticated and inter-connected communication networks, which facilitate the rapid spread of news. While market and economic changes can also occur quickly (one example being the recent volatility in global oil prices), they generally emerge and evolve over a longer time horizon.

Examples

Financial intermediaries and investors are increasingly subject to public scrutiny over financing provided to carbon assets and companies. For example, several banks (both commercial and development banks) have been the target of campaigns organized by environmental advocates, which have sought to publicize the perceived environmental damage associated with financing for activities such as coal-fired power generation, mountaintop-removal mining, and oil-sands development. Such campaigns are intended to encourage customers, employees, and investors to request changes in practice or the development of new policies to limit financing to such sectors or companies.

Equity investors can also face reputational risks associated with equity holdings in fossil-fuel companies; an example is the recent divestment movement focused on university and non-profit endowments, as well as the investments of pension and sovereign wealth funds. In response, some investors (e.g. Norway's sovereign wealth fund, the Rockefeller Brothers Fund) have chosen to divest all or some fossil-fuel holdings, while many others are developing targeted shareholder engagement and sustainable and responsible investment strategies as a means of managing this risk.

2.4 OTHER POTENTIAL DEVELOPMENTS: WHAT TO WATCH ON THE HORIZON

In addition to the core types of risk described above, there are several developments on the horizon that are worth watching. Potential changes to financial regulatory frameworks could impact the decision-making of financial intermediaries and investors, particularly with respect to carbon assets. For example, in 2014, the Brazilian Monetary Council approved guidelines that require financial institutions operating in Brazil to establish and implement a Social and Environmental Responsibility Policy. In France, the parliament is currently debating and is likely to pass an Energy Transition Law that includes provisions focusing on private listed companies and financial institutions, with particular regard to issues around disclosure and GHG emissions accounting. In addition, new discussions have emerged about the issue of fiduciary duty and whether consideration of environmental and social impacts, such as climate change, can be considered in investment decision-making.

Voluntary action on the part of investors on the issue of climate change is also starting to grow, in part through the efforts of investor and financial networks such as the U.N. Principles for Responsible Investment (UNPRI) and UNEP-FI. In September 2014, UNPRI launched the Montreal Carbon Pledge, a commitment on the part of investors to measure and publicly disclose the carbon footprint of their investment portfolios on an annual basis.[15] The goal is to attract US $3 trillion of portfolio commitments in advance of the U.N. Climate Change Conference in December 2015. In a closely related effort, UNEP-FI is coordinating the Portfolio Decarbonization Coalition, a multi-stakeholder initiative that seeks to drive GHG emission reductions by encouraging institutional investors to "decarbonize" their investment portfolios. By the time of the U.N. Climate Change Conference in December 2015, in Paris, the coalition aims to have institutional investors with a total of US $100 billion of assets under management (AUM) committed to decarbonizing their portfolios.[16]

CHAPTER 3: IDENTIFYING CARBON RISK IN SECTORS AND COMPANIES

KEY POINTS

- **Many types of physical assets and companies could be exposed to carbon risks: those that generally receive the greatest attention are companies involved in the production of fossil fuels, fossil-fuel-fired power plants, and infrastructure that is heavily reliant on fossil fuels.**
- **A financial intermediary's or investor's potential exposure to carbon asset risk can be assessed by examining information on the underlying carbon risks of the operators with which they have a financial relationship.**
- **In addition to broad sector-level screening, assessing exposure at the operator/company level is also important. This is because companies, even those within the same sector or industry, can have very different risk exposures, because of their individual characteristics, operating conditions, and management strategies.**

To date, the public discussion about carbon risk has focused principally on investments in GHG-intensive sectors, such as those associated with the production and combustion of coal, oil and natural gas. While there is a diverse range of sectors and physical assets across the global economy that could, in theory, be exposed to varying degrees of carbon risks, those that are heavily reliant on fossil fuels present a reasonable place for financial intermediaries and investors to focus their initial efforts on CAR assessment and management. This follows from the facts that combustion of fossil fuels for electric power, industry, and transport contributes the largest share of GHG emissions globally,[17] and that these sectors are likely to be the focus of most carbon regimes, such as cap-and-trade programs or carbon taxes.

Nevertheless, financial intermediaries and investors can apply the principles and approaches described in this paper to many other sectors and assets. Ultimately, users of this framework will need to make their own determinations about where to prioritize efforts, based on the nature of their business, their objectives, and their perspectives on risk exposure.

This chapter provides an overview of key sectors, as well as examples of tools and metrics that might be useful for identifying exposure to operator carbon risk. These broad insights can help financial intermediaries and investors to prioritize sectors and assets for in-depth risk analysis. Given the variety of sector categorizations, local regulatory landscapes, and time horizons applicable to different financial institutions and different investment classes, there is no one-size-fits-all priority list. The chapter will therefore describe a simple prioritization method, and provide some examples of results for readers to consider.

3.1 EXPOSURE TO CARBON RISKS AT THE SECTOR LEVEL

This analysis begins by assessing the potential implications for various types of physical assets and economic sectors in a scenario where strong climate mitigation actions - preventing average temperatures from rising more than 2°C - are taken.[18] (See **Table 2** below.) Note that this analytical framework can also be used to assess the potential implications of alternative climate scenarios, in which different levels of climate mitigation are achieved. Importantly, company-level Scope 3

emissions (for example, upstream supply chain emissions and downstream product emissions) are considered in the GHG profile of the types of assets listed below.

It should be noted that this discussion excludes biogenic emissions, or non-fossil-fuel emissions associated with land use, land-use change, and forestry, and GHG emissions unrelated to energy (e.g. agricultural emissions, production and use of fluorinated gases). While such emissions contribute significantly to global GHG emissions, the nature of carbon-related risks facing these activities is distinct from those involving fossil fuels.

1. **"Fossil assets"** include physical assets in sectors such as coal mining, and oil and natural gas production. In a 2°C scenario, global reliance on fossil-based energy assets will need to be curtailed. However, despite this reduction in the long term, most experts expect either growth or a gradual peaking of demand growth in the short term, primarily in the developing world, as global energy demand continues to grow and energy systems transition. For example, the IEA has estimated that global demand for both oil and natural gas is likely to grow modestly from 2011 levels to 2020 under a 2°C scenario.[19] In the longer term, under a 2°C scenario, demand for these assets is expected to decline as a result of initiatives that could include policies that reduce consumption and subsidies, and/or increase taxes on products/production.

2. **"Fossil-fuel dependent infrastructure"** describes assets that depend on accessible and low-cost fuels (notably gasoline and jet fuel) or are involved in the transport of such fuels. Key assets in this category include airports, fossil-fuel pipelines, electric transmission connected to fossil fuel generating facilities, rail lines that primarily transport fossil fuels, and, arguably, suburban real estate developments or certain road connections. The changes expected in these sectors are not explicitly described in climate scenarios, but the level of investment in these sectors may be impacted by climate and energy policies. All the same, there is no consensus on how technology may evolve (for example, a switch to electric cars or jet biofuels) or what impact such technology trends might have on the value of such infrastructure. Generally, the main avenue for a drop-in valuation relates to an increase in cost of either the fuels or the infrastructure itself. For instance, an increase in the price of jet fuel could decrease airport utilization on the margin, increase the use of alternative jet fuels, or both. The potential impact on the related companies largely depends on their business model (owning or only operating, contract length, etc.). A further consideration is the concentration of such investments within the same value chain and geography as fossil assets; for instance, if an investor owns a portion of a refinery and the pipeline supplying it risk would be compounded.

3. **"High-carbon assets facing shift to low-carbon technologies"** is a category that represents physical assets for which alternative, low-carbon technologies exist and are expected eventually to replace more carbon-intensive or fossil-reliant technologies. Companies can therefore adapt, but different technology bets will lead to different risk profiles for different companies. For instance, a utility with a high-carbon generation portfolio might be able to diversify into lower carbon electric power generation because such alternatives exist. For utilities, the risk of fully stranded assets is real and has materialized. Key sectors in this category include electric power generators and utilities, car and truck manufacturers, manufacturers of fossil fuel combustion equipment, road logistics, the short-haul business of airlines and related aircraft manufacturing, and pulp and paper. These sectors could be impacted by direct policies such as carbon taxes, taxes on energy consumption, or more stringent regulatory requirements, such as those pertaining to energy efficiency standards.

4. **"High-carbon assets without low-carbon competitors"** is a category that represents sectors for which no mature alternative low-carbon technology exists today. However, the introduction of climate policies or the eventual emergence of alternative technologies might still have impacts on their business. Such sectors include cement, steel, aluminium, glass, and the long-haul business of airlines and related aircraft manufacturing (it should be noted that electricity-intensive sectors are only carbon-intensive when their power supply is primarily fossil-fuel derived).

Other sectors generally have aggregate activities that emit few direct GHG emissions (and thus face a low potential impact of increased GHG costs on the average sector cost structure.)[20] Companies in these sectors, such as financial services, insurance, non-energy-intensive manufacturing, or product retailers, are unlikely to be directly targeted by climate or energy policies, though they might be impacted indirectly. **Table 2** below summarizes key aspects of these categories.

Table 2: Summary of Typical Risk Types and Asset Classes Associated with Each Category of Assets

Category	Example Sectors	Principal Types of Risk Facing the Category	Typical Financial Asset Classes
1. Fossil-fuel assets	Coal mining; oil and gas production	Policy; technology market and economic; reputational	Equities; bonds; corporate lending
2. Fossil-fuel dependent infrastructure	Oil and gas pipelines; rail lines (for example, those shipping coal)	Policy; market and economic; reputational	Bonds; project finance
3. High-carbon assets facing shift to low-carbon technologies	Fossil fuel-fired power plants	Policy; technology market and economic	Equities; bonds; corporate lending
4. High-carbon assets without low-carbon competitors	Cement; steel; glass	Policy; technology market and economic	Equities; bonds; corporate lending

3.2 ASSESSING EXPOSURE TO CARBON RISK AT THE SECTOR LEVEL

For each key sector potentially affected by climate and energy policy risks (primarily categories 1 to 3 as described above,)[21] **Figure 5** provides an overview of three key indicators related to carbon asset risk:

- *Sector carbon intensity of sales* (based on Inrate/Cross-asset Footprint data for 2011);
- *Physical assets lifespan;*[22] and
- *EBIT (earnings before interest and tax) margin* (based on Datastream data).

The indicators are applied to each key sector potentially affected by climate and energy policy risks (primarily categories 1 to 3 as described above.)[24]

The connection between each metric and potential risk is clear:

- Sectors that are large GHG emitters or that are very carbon intensive, all else being equal, generally face exposure to greater risk from a potential carbon price or direct regulation, because the increased cost would represent a higher proportion of cost structure;
- Sectors with higher average *physical asset lifespan*, all else being equal, generally face exposure to greater risk because of longer exposure periods; and
- Sectors with lower *EBIT margins*, all else being equal, generally face exposure to greater risk, because any increase in costs is likely to have a larger impact on profits.

Comparing these metrics across the sectors shown in the figure provides further justification for focusing on fossil-fuel production and utilities, because these industry sectors emit large quantities of GHG emissions and generally operate physical assets with a long lifespan.

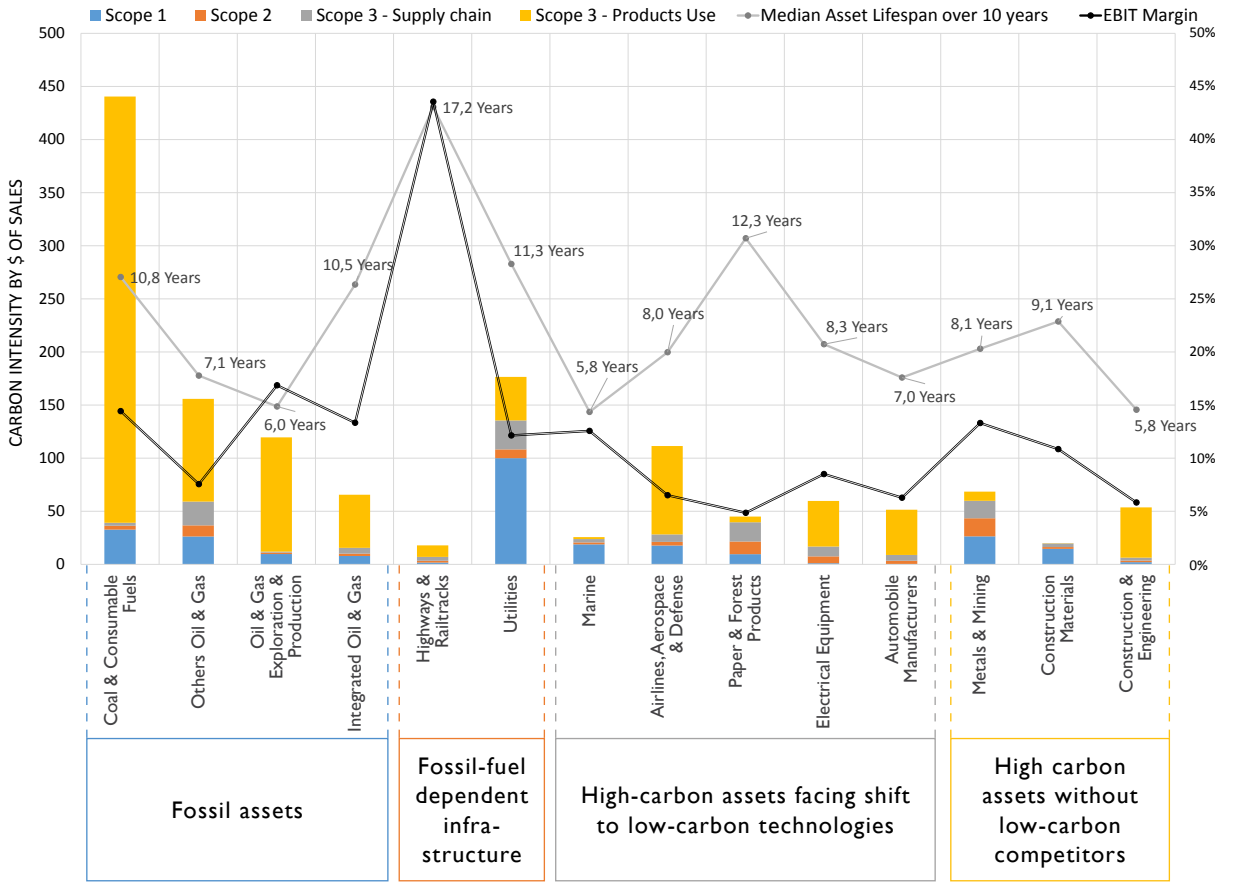


Figure 5: Carbon Intensity, Physical Asset Lifespan and EBIT Margin or Key Sectors Exposed to Climate Scenarios Source: 2° Investing Initiative, 2014

TOOLS: Providers of ESG Information and Analysis

The process of evaluating carbon risk exposure for companies can be viewed as a component of ESG analysis. Recognition of the value of ESG analysis has grown, in large part, because of growing awareness and acceptance of the fact that ESG issues can be material for companies. Today, a growing number of organizations and service providers aggregate and make available (sometimes for free and sometimes at a cost) various ESG data, information and analysis, some of which might be useful when assessing carbon risk. ESG information can be aggregated directly from company disclosures and, in some cases, developed through proprietary analysis. See Appendix 2 for a sample of CAR-related ESG information and tool providers.

3.3 ASSESSING EXPOSURE AT THE COMPANY LEVEL

Individual companies that can be categorized as fitting into a large, general sector (for example, oil and gas, or utilities) can own very different types of assets and operate in various jurisdictions with diverse operating conditions. Different companies therefore can face very different types and levels of risk with respect to carbon. As a result, in addition to sector-level screening, it is important to evaluate certain criteria and characteristics that could make individual operators or companies exposed to higher or lower levels of risk than their sector peers.

Different strategies and approaches can be used to assess, at a high- level, whether a company faces carbon risk. These involve developing an understanding of the types of assets controlled by

a company or operator and assessing whether, based on the profile of those assets (for example, type, fuel mix, location, etc.), further due diligence might be warranted (see Chapter 5 for further detail). In addition, it might also be useful to consider how a company or operator is positioning itself with respect to risk management and sustainability, which may entail an evaluation of qualitative information and quantitative data reported by a company in its annual report, corporate responsibility or sustainability reports, or other public disclosures. This analysis, which can be viewed as a component of environmental, social and governance (ESG) analysis, will be discussed in further detail in Chapter 5.

3.4 ADDITIONAL CONSIDERATIONS

When assessing company characteristics, it is important to consider some additional factors that might impact carbon risk exposure. One is whether an operator or company is able to pass through increased costs, resulting from either a carbon-pricing regime or from other market changes, to customers. If demand for an asset or product is elastic (meaning readily available substitutes exist) a company might be less able to pass through increased costs and maintain current revenue margins.

Another important consideration when assessing exposure indicators relates to the time boundaries inherent in various metrics. For example, current annual GHG emissions data are not necessarily representative of a company's future emissions profile; some companies will diversify or invest in lower-carbon assets over time, while others will not. For this reason, while it is important to assess a company's current profile, it is also critical to evaluate information that can provide insight into how that profile might evolve over time, including whether such changes could lead to higher or lower carbon risk.

Ultimately, given these considerations, institutions will need to make a determination about the type of sectors, companies, or assets on which to focus given their respective businesses, objectives, and perspectives on risk.

Financed Emissions and Carbon Asset Risk

An issue deliberated during the process of developing this discussion framework was whether or not "financed emissions" are a relevant measure to consider when assessing CAR exposure. Financed emissions are a type of Scope 3 (indirect) value chain emissions as defined by the GHG Protocol Scope 3 Standard; they measure the portion of GHG emissions from a company or asset that is "enabled" by financing, investment capital, or other services (for example, underwriting) provided by a bank or investor.

As a hypothetical example, consider calculating a bank's financed emissions associated with a loan made to an electric power company that emits 30 million metric tons of GHGs in a given year. If the bank's loan were responsible for two percent of the company's total financing, the financed emissions attributable to the bank would be 600,000 metric tons. Setting aside significant issues associated with the mechanics of calculating and reporting these emissions (particularly for a large financial intermediary or investor with thousands of transactions or holdings every year), the relevant question being debated is whether this measurement indicates that the bank could be exposed to risk to as a result of operator carbon risk facing the electric power company. If the answer is no, is there some other value in calculating financed emissions?

The relevance of financed emissions to carbon risk was discussed as part of a broader process related to both carbon risks and the "climate performance" of financial institutions, with technical working groups discussing both topics. Perspectives on the issue were divided in both risk and performance working groups. While there was some agreement among technical working group (TWG) members that a financed emissions measurement is not relevant when assessing risk, members of the TWGs were divided on the practicality and meaningfulness of using the financed emissions concept to provide transparency around the GHG emissions "enabled" by financing activity, and thus the climate performance of financial institutions. In response to this ongoing challenge, WRI and UNEP-FI, in partnership with the 2° Investing Initiative, established two work streams through 2015. Work is focused on evaluating existing methods and practices of measuring the carbon impacts of financing provided by banks and asset owners, and which appropriately meet the needs and goals of each constituency.

CHAPTER 4: FINANCIAL RISK IN THE CAPITAL STACK

KEY POINTS:

- **The "capital stack" is the sum total of all of the capital invested in a physical asset or company. Understanding where capital sits in the stack is crucial to understanding and evaluating exposure to risk.**
- **The principal types of capital used to finance carbon assets are debt (which includes loans and bonds) and equity. Debt has a higher position than equity in the capital stack, meaning that it gets repaid first and carries lower risk (as well as returns) than equity.**
- **Commercial and investment banks generally provide loans and may also underwrite debt and equity securities, which are then purchased and held by investors.**
- **The type of financing provided, the duration or tenor, and whether it is secured by collateral, all affect the risk and return profile of a loan or investment; these are important considerations when evaluating potential exposure to CAR.**

This chapter describes how to understand risk exposure in the context of various types of capital in the "capital stack," or capital structure,[25] which is the total capital invested in a physical asset or company, including types of debt and equity. It describes general concepts of financial risk that are important when evaluating the materiality of carbon asset risk for specific types of capital and for different financial actors. Understanding the capital stack is crucial to understanding the likelihood that operator carbon risk may present carbon asset risk for a financial intermediary or investor.

This chapter will outline the principal types of capital used to finance assets and companies, as well as the roles of different financial market participants. The chapter will also discuss how the financial sector generally thinks about risk, how risk is allocated in the capital stack, and general strategies for managing risk depending on the type of capital or service provided. Examples of common structures used to finance carbon-intensive physical assets are also briefly discussed, and presented in further detail in Appendix 1. Readers familiar with these basic financial concepts can skip to Chapter 5.

4.1 TYPES OF CAPITAL IN THE CAPITAL STACK

There are many types of capital that can be used to fund projects and companies. This chapter will focus principally on the core types that are most pertinent to funding carbon-intensive physical assets, which tend to be large, capital-intensive, and (often but not always) controlled by publicly listed or government-owned entities. **Table 3** presents a summary of some major characteristics of the main types of capital.

Table 3: Summary of Different Types of Capital in the Capital Stack

Category	Types of Capital	Physical Asset or Company Level	Type of Investment	Types of Intermediaries and Investors	Service Providers
Equity	Equity capital markets (stocks) Private equity (corporate or project)	Company-level (stocks, private equity) Asset-level (private and public equity)	Ownership, through direct holdings of shares or through funds	Institutional investors Retail investors	Banks (underwriting) Asset managers
Debt (Bonds)	Debt capital markets Private placements Project specific bonds	Company-level (corporate bonds) Asset-level (project bonds)	Lending (borrowing), though direct holdings or bonds or through funds	Institutional investors Retail investors	Banks (underwriting) Asset managers
Debt (Loans)	Corporate loans Project finance loans	Company-level (corporate loans) Asset-level (project finance loans)	Lending (borrowing), through direct loans or through a lending syndicate (multiple lenders)	Banks Institutional investors	Banks (lenders)

4.2 THE CAPITAL STACK: HOW IS CAPITAL RAISED?

Directing equity or debt to any sort of business activity can be examined from several perspectives including the seniority of capital in the transaction, the intermediaries through which capital is provided, the ultimate source of the financial resources, the transaction's risk profile, and the depth of knowledge regarding how the capital proceeds will be used.

Equity capital to acquire partial ownership of a corporation or project is commonly understood as an investor purchasing a company's publicly traded shares on a stock market. Equity can also be invested privately in the form of an angel, venture, or private equity investment, either into a special purpose vehicle for a project or as a Private Investment in Public Equity (PIPE) – either a registered or unregistered private placement.

Debt capital is a type of loan that entails a commitment to repay the principal capital borrowed plus interest. Debt capital can be raised publicly by issuing a bond on the public bond markets, or privately in the form of a commercial bank providing a loan (known as a bilateral loan) or a group of banks providing a loan (known as a syndicated loan) to distribute risk among the lenders. Debt can also be in the form of project finance loans, which are generally long-term loans used to finance infrastructure and other large assets, or a credit facility such as a revolving line of credit, which a borrowing entity can use as needed.

The sources of capital for any type of investment or financing include the savings of individuals placed in bank deposits, or investment funds and vehicles, including pension funds, retained earnings of corporations, the financial assets of investment companies, and national investment vehicles such as sovereign wealth funds.

There are numerous financial intermediary roles that facilitate investment and financing. For example, **commercial and investment banks** provide securities underwriting and advisory services, in addition to extending loans. **Asset managers** collectively facilitate capital flows and manage investments on behalf of institutional investors, such as pension funds, corporations, and foundations, as well as retail investors.

Securities underwriting refers to the process by which investment banks raise investment capital from investors on behalf of corporations and governments that are issuing securities (both equity and debt capital). The services of an underwriter are typically used during a public offering. This is a way of distributing a newly issued security, such as stocks or bonds, to investors. A syndicate of banks (the lead managers) underwrites the transaction, which means they take responsibility for distributing the securities to investors. Should they not be able to sell all of the securities to investors, they may have to hold some securities themselves. This means that underwriters take on

the risk that they might become part-owners of a physical asset or company if they are unable to sell a sufficient amount of the equity/debt security to investors.

4.3 HOW IS FINANCIAL RISK MANAGED?

Virtually any financing or investment has some element of risk. In the case of debt, this is the possibility that some or all of the principal capital and interest committed will not be recouped. In the case of equity, the risk is that an investor will not earn an expected level of return on capital invested.

Risk management generally entails characterizing threats, assessing vulnerabilities, evaluating the expected likelihood and consequences of potential impacts, identifying ways to reduce those risks and prioritizing and implementing risk reduction measures. The strategies for managing risk will differ according to whether lenders or investors are making a new financing or investment decision or whether they are evaluating an existing loan or investment.

The issue of time horizon is also very relevant: what is the duration of a loan or investment? Risk management must also balance the opportunity cost of resources spent on risk management or the opportunity cost of other investments that could be made. Ideal risk management minimizes the negative effects of risks and also the cost (time and money) of managing that risk. Without any risk there is no reward, so investors do generally want some level of risk. Risk tolerance depends on the investors' strategies and objectives, which necessarily differ among investors.

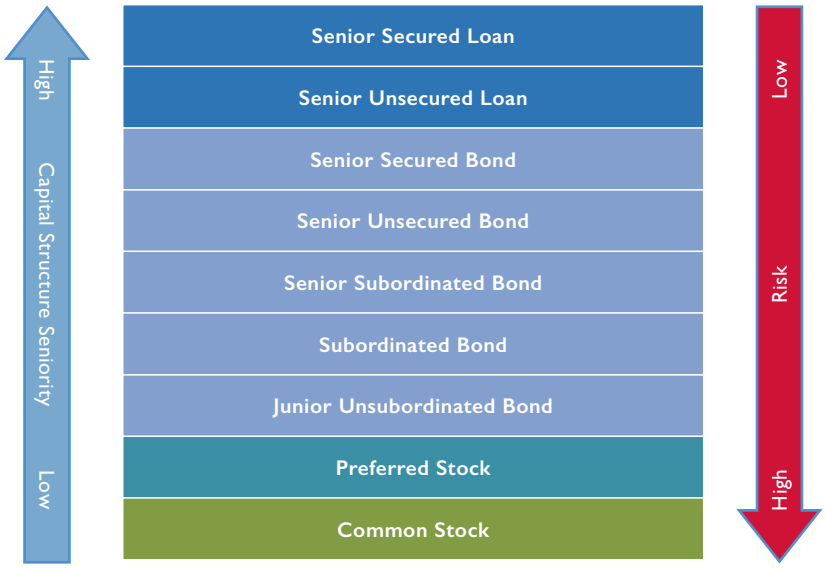
As is discussed more fully in Chapter 5, financial risk is generally assessed using a variety of tools including in-house due diligence, obtaining independent third-party opinion or analysis, scenario analysis, stress testing and forecasting. Levels of due diligence vary according to the type of capital being evaluated for commitment and where it sits in the capital stack. In the case of bonds and corporate loans, credit ratings by third party agencies will often be used (if available). The bond investor or entity making a corporate loan will be interested in the likelihood of the company being able to pay back the bond/loan. Project finance deals require higher levels of due diligence on project level risks (because the loan is generally longer term and will be repaid solely through project cash flows) and the involvement of the sponsor and project developers. For equity investments, higher levels of diligence are likely but also depend on the size of the investment compared to other investors (that is, if a controlling interest is being pursued, very high levels of due diligence are likely).

In finance, risk is not inherently something to be avoided. The key lies in understanding the risks being taken, and ensuring that lenders and investors are being compensated appropriately for the level of risk they are assuming. Greater risk generally equates to a higher potential return for investors and higher interest rates for lenders; in turn, a project or company with a greater risk profile will generally have to pay more to access capital.

4.4 RISK IN THE CAPITAL STACK – WHO IS TAKING RISK, HOW MUCH, AND HOW CAN IT BE MANAGED?

The distribution and management of risk in any transaction or financial asset is a key issue. **Figure 6** shows how lenders who sit higher in the capital stack have a lower risk and return expectation than equity investors who sit lower in the capital stack (for example, investment grade debt is lowest risk and has lowest return expectations). The seniority of capital is also relevant to understanding the degree of risk in the capital stack, because it refers to the order in which investors will be repaid in the event of default. In this case, debt is always senior to equity while secured debt is senior to unsecured or subordinated forms of debt capital.

Figure 6: The Capital Stack



Source: Adapted from Guggenheim Investments

Secured debt is debt backed by collateral to reduce the risk associated with lending (for example, a house could be seized if the owner defaults on the mortgage). Unsecured debt is not backed by any physical assets. Unsecured debt therefore has a higher interest rate because it carries greater risk to the lender. Subordinated debt is a loan or security that ranks below other loans with regard to the priority of claims on assets or earnings. Capital with higher degrees of seniority will generally offer lower returns.

Depending on the type of capital provided, lenders and investors can manage risk using a number of practices. These are discussed in greater detail in Chapter 6.

Once a lending or investment decision has been made, the degree of ongoing risk management and monitoring will vary according to the type of capital committed and its position in the capital stack. Investing sponsor equity generally involves high levels of due diligence and ongoing engagement with the company. Secured debt providers are usually content to receive periodic updates from the company as their recourse over company physical assets reduces some of the need for intensive monitoring.

4.5 TYPICAL STRUCTURES USED TO FINANCE CARBON ASSETS

Many different types of financial structures can be used to finance carbon assets, including corporate loans, reserve-based lending, pre-export financing (sub-level), project finance (asset-level), and various credit enhancement options. Each structure has unique characteristics in terms of how physical assets are owned and operated and how risk is managed. These structures are described for interested readers in Appendix 1.

CHAPTER 5: CARBON ASSET RISK: EVALUATING THE FINANCIAL IMPACTS

KEY POINTS

- **If a financial intermediary or investor has determined that an underlying physical asset or company is exposed to carbon risk, the next step is to determine whether that translates to potential carbon asset risk.**
- **Scenario analysis and stress testing are used to assess how risk factors (that is, policy, markets, and technology) might evolve over time and what the financial impact could be. Such analysis can be performed in two ways: at the operator/company level, or at a financial portfolio level, focusing on how risk factors affect a diversified portfolio of investments.**
- **The operator/company approach applies scenarios to companies and their physical assets, testing the potential financial impact to assets as measured through valuation methods like discounted cash flow (NPV, IRR, Break-even price). At this level, governance structures, operational management, capital expenditure, and capital management impacts are all relevant. These can be addressed at the appropriate capital stack level and, if material risk is found, it can be managed (Chapter 6). We note that many FIs and investors will rely, as a starting point, upon operators carrying out and disclosing as much of this type of information as possible.**
- **A top-down, portfolio-level approach is also possible for investors. Here, risk factors are identified from scenario analysis, as they are in a bottom-up approach, but these risk factors are then used to measure the overall portfolio exposure and, potentially, to optimize asset allocation depending on which scenario is believed to be most likely. This approach relies on industry standard models.**

While carbon risk factors are a newer addition to the many different types of risks (for example, market risk, credit risk, liquidity risk) that analysts typically evaluate during financial due diligence, their fundamental concepts are not. As discussed, CAR has come to represent the risk that loans to, and investments in, carbon assets do not financially perform as expected, because of new policy, economic, market, and social trends that emerge within a global GHG-constrained economy. Such risk is multidimensional and can overlap with existing regulatory, market, and reputational risk management approaches in financial decision-making, but it might also require the testing of new scenarios and assumptions in risk models that are not based on historical experience.

As discussed in previous chapters, the CAR evaluation process consists of identifying risk factors, screening portfolios or new investments for exposure, and then evaluating the potential financial impacts - the focus of this chapter.

Given the diversity of views on the likelihood of various carbon risk factors that would drive CAR (and thus the materiality of CAR with respect to different types of financing and investments) this chapter does not define parameter values or modelling approaches. Instead, it provides a framework that financial intermediaries and investors can use to assess the likelihood and potential impact of CAR across a range of investment structures. It will connect these concepts and discuss methods to assess potential financial risk associated with these carbon risk factors. All the analysis we present here can be utilized by both financial analysts and more specialized ESG analysts.

We note here that this chapter focuses explicitly on policy, technology, and market and economic factors. Reputational risk factors, while very important, generally do not lend themselves to the type of quantitative analysis described here. Each institution will need to make its own determination about the threats and impacts of reputational risk factors, based on its respective business and risk appetite. Chapter 6, which outlines risk management strategies, includes a discussion of strategies for managing reputational risk associated with financing for, and investments in, carbon assets and companies.

5.1 CARBON RISK AND CAR ASSESSMENT FRAMEWORK

Before discussing an approach to evaluate CAR, it is useful to review the main points discussed in the previous chapters.

Chapter 2 discusses four main types of carbon risk factors, primarily policy and legal, technology, and economic and market factors that impact physical carbon assets or operators/companies, as well as reputational factors that generally impact investors or intermediaries.

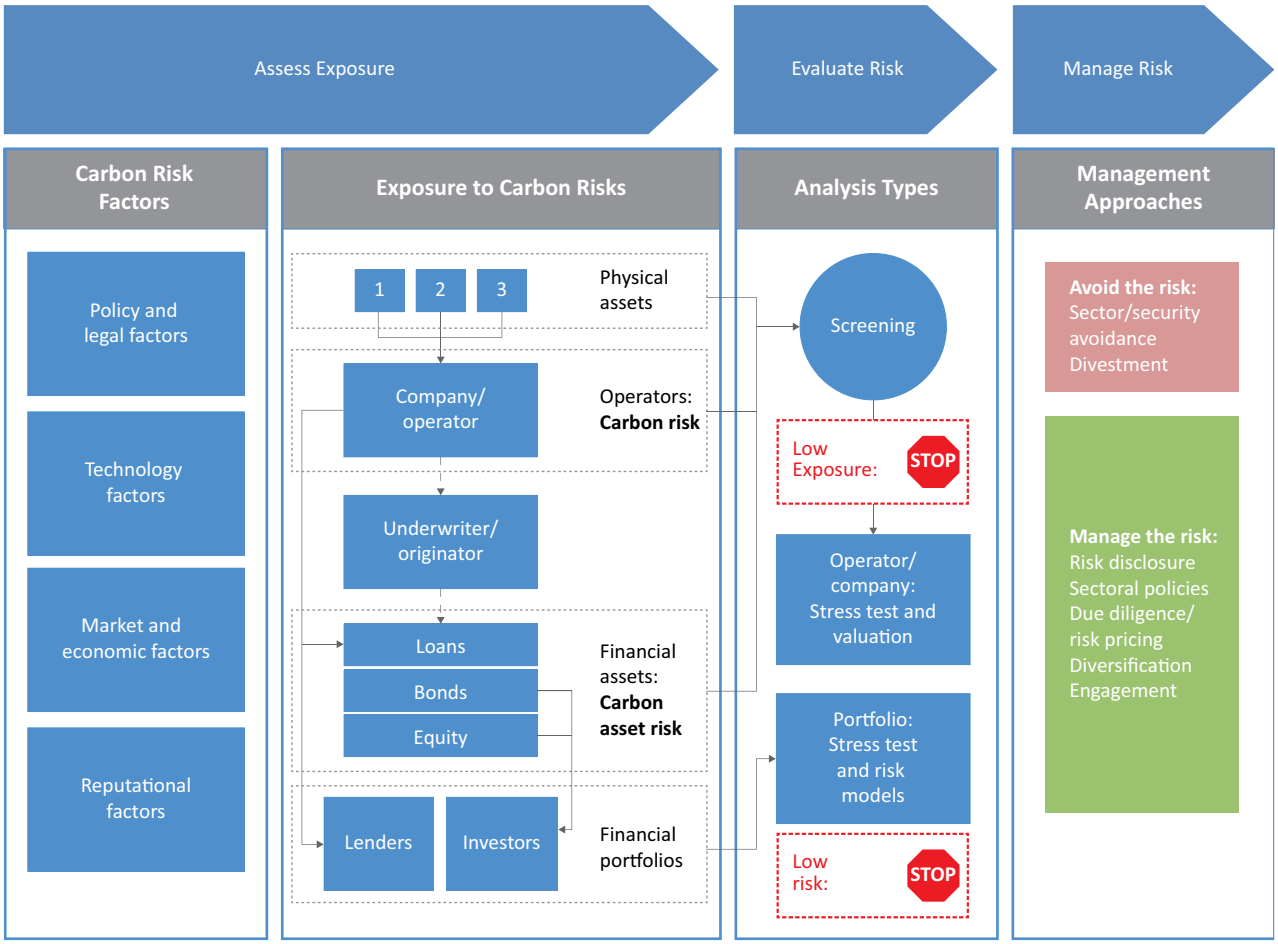
Chapter 3 highlights considerations that can influence the degree to which types of assets, sectors and operators/companies might be exposed to carbon risks. These include carbon intensity, typical physical asset lifetime, and earnings margins. At the operator/company level, it is also important to assess pricing power (that is, elasticity of demand), the individual characteristics of its assets and operating environment, and how the operator/company strategically manages its exposure to carbon risk.

Chapter 4 discusses how to understand risk exposure in the context of various types of capital (for example, loans, bonds equity) in the "capital stack." It describes general concepts that are important when evaluating the materiality of carbon asset risk for specific types of capital and for different financial actors.

These concepts are brought together in **Figure 7** below. The figure shows a linear process:

- Beginning on the left with identifying relevant carbon risk factors (Chapter 2)
- Then, screening carbon risk exposure, starting from the physical assets owned by operator/companies (carbon risk). Depending on the nature and type of financial relationship, and location in the capital stack such carbon risk might translate to CAR exposure to investors and financial intermediaries (Chapters 3 and 4). Investors and intermediaries can have different types of financial relationships with different levels of a company, from a subsidiary/direct operator of an asset up to the holding company level; we use the terms "operator" and "company" here to describe both, but it should be noted that carbon risk and CAR obviously vary at different levels, depending on the different asset portfolios at these different levels.
- For those assets or operators/companies facing carbon risk exposure, the next step is to assess the potential financial impact using risk and valuation models, either at the operator/company level or the portfolio level (Chapter 5).
- Where carbon risk translates to CAR for financial intermediaries and investors, it can finally be managed through a variety of risk management practices and strategies (Chapter 6)

Figure 7: Framework for Assessing Carbon Risk and Assessing and Managing Carbon Asset Risk



As shown in the figure, after screening for exposure (see section 5.2.1), for those types of financing and investments with a low potential exposure (because of low carbon intensity, or the expected duration of the financial relationship, etc.) further action might not be necessary. However, for financing and investments where a potential risk is discovered, additional analysis might be warranted. In this chapter we identify and discuss two main types of approaches to evaluating carbon risk and CAR:

1. The operator/company level starting from physical assets - applicable to both existing portfolios and new investments:
   a. The impact of potential risks to physical assets controlled by an operator/company can be assessed through scenario analysis and stress testing, using various valuation and risk assessment models.
   b. Operators/companies can similarly be tested for risk in their portfolio of assets, using the same approaches. However, at the operator level, analysis takes into account not only the characteristics of physical assets in the operator/company portfolio, but several other factors including the operator's carbon strategy - its approach to managing its assets via governance and specific operational approaches. A key outcome is then capital management in relation to project investment and shareholder returns.
2. The financial portfolio level - applicable mainly to existing investment portfolios:
   a. Scenario analysis is first used to calibrate risk factors.
   b. These data are then used to drive portfolio-level risk optimization models that look at diversification, correlation, and risk factors at the portfolio scale.

The following sections introduce these different types of analyses in more detail.

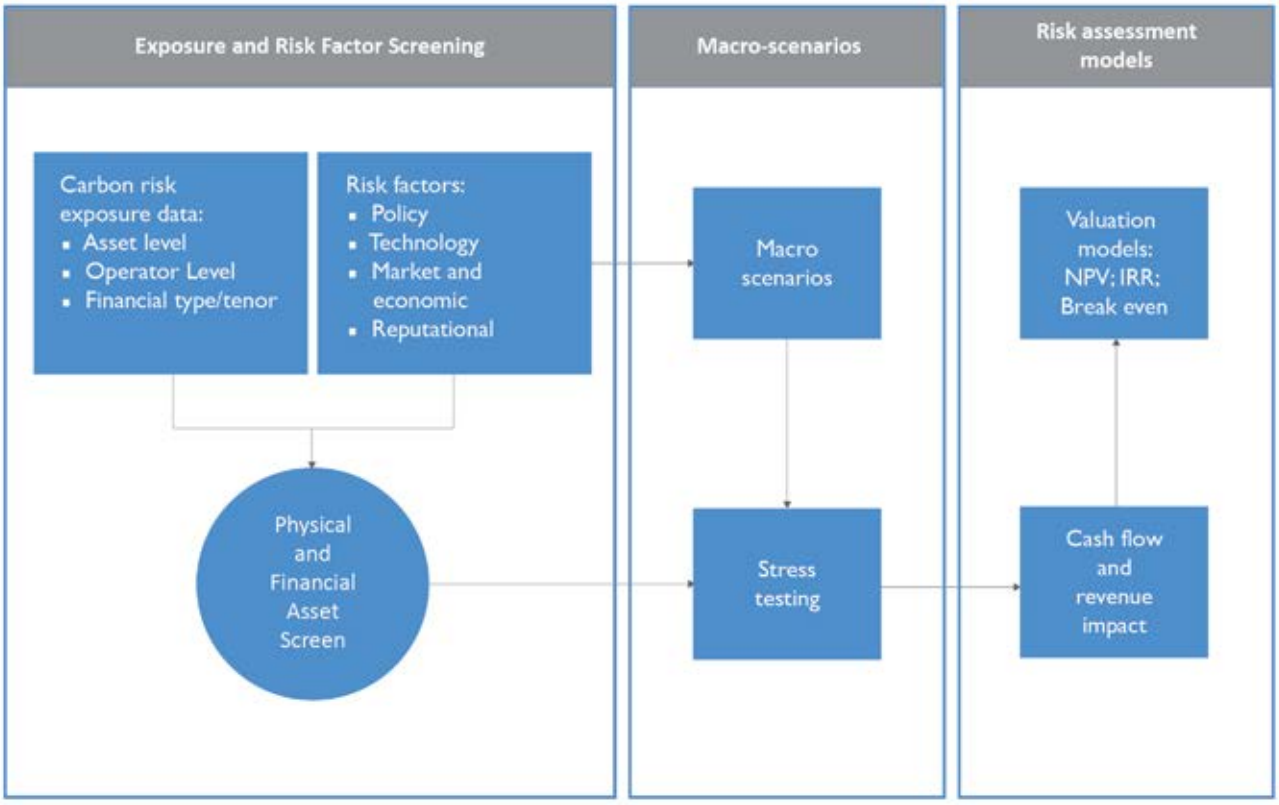
5.2 EVALUATING CARBON ASSET RISK: THE OPERATOR/COMPANY LEVEL

Like many other types of risk, carbon risk factors can be uncertain and dependent on future scenarios that might be very different from the past. Yet, as with assessment of other risks, standard tools such as scenario analysis, stress testing and other valuation and risk models/approaches can be applied to evaluate the probability of a risk materializing and what the potential financial impact could be for an intermediary or investor.

Figure 8 below provides a summary of the operator/company level approach to screening, starting with evaluating risk data at an asset and company level; looking at the nature of the financial relationship (type of financing or investment, and the duration or tenor, see **Chapter 4**); and considering the most likely future scenarios for policy, technology, and market factors.

Such screening is important because stress testing has the potential to require significant resources, and analysis should focus on investments with the highest potential exposure. For certain types of financing and investments that are higher risk due to capital stack location or tenor, such as project finance, scenario analysis and stress testing will be appropriate. For corporate loans and bonds, or even equities - particularly in a portfolio that consists of multiple small holdings - detailed scenario analysis and stress testing might be impractical.

Figure 8: Expanding Fig 7: High-level Summary of Operator/Company Risk Assessment Process



Note: Investments are first screened using exposure data and risk factors (expected future policy, technology, and market conditions) at the physical asset, operator, and financial relationship levels. This exposure information is then used with macro-scenarios (for example, IEA) to generate a full risk-dataset reflecting impacts to cash flow and revenue. These data then feed into valuation models such as discounted cash flow (DCF), which are used to calculate how these impacts will affect the asset/operator (carbon risk) and its financial backers (carbon asset risk).

Following the initial risk factor and exposure screening, the key focus is on scenario analysis and stress testing using general economic frameworks. Such methods examine supply and demand using scenarios and generate data such as expected impacts on cash flow that, in turn, drive valuation models. While different types of valuation models are used in different parts of the financial industry and for different types of financial assets, we focus here on valuations such as discounted cash flow (IRR/NPV/Break-even - see below). This is for several reasons: first, such valuations are widely used at the physical asset, operator, and financial asset levels. Second, timing is a very

important factor when assessing carbon risks, and scenario analysis using cash-flow or similar models can incorporate a range of assumptions regarding when material events (for example, policy changes) may occur in the future. Further, scenario analysis can be used to evaluate the performance of a financial asset throughout the asset's lifecycle (for example, due-diligence, ownership, and wind-down or exit) and across a range of assumptions, including both the probability of a policy or market shift and the financial impacts of the shift. At the industry level it can be used to take estimates of the whole industry's revenue and compare NPVs across different scenarios.

Capital management, using these valuation models on future capital expenditure associated with developing an asset, then becomes a key operator management outcome, linking to investor engagement as a risk management strategy (see Chapter 6). The following sections examine each of these steps: risk screening, scenario analysis, and valuation.

5.2.1 Screening Using Exposure Data and Risk Factors

Several tools and approaches can be used by financial intermediaries and investors to help evaluate the potential financial impact of a company's carbon risk exposure. Evaluation begins with identifying and evaluating key exposure data and risk factors pertaining to an underlying operator/company. Such screening might entail an evaluation of qualitative information and quantitative data reported publicly by a company, an ESG information provider, and/or disclosed in conversations with company management. Pertinent data and information can be classified in three main categories:

- Operator/company and physical asset-level information;
- Type and duration of the financial relationship; and
- Baseline scenario data (how risk factors are likely to evolve over time).

Operator/company and physical asset-level information

Screening at the operator level takes into account two types of information: the characteristics of the operator's portfolio of physical assets and the operator carbon strategy. Relevant information to examine about the specific assets controlled by an operator can include:

- Types of assets
- Fuel mix/profile
- Location
- Expected lifetime
- Cost of production
- GHG emissions profile of the assets (that is, absolute emissions or intensity data, depending upon the most relevant measure for the specific asset type, and including all material Scope 1, 2, and 3 emissions as defined by the GHG Protocol). Note that certain emission scopes may be more or less relevant to consider, depending upon the specific project and/or company and nature of risk(s) being evaluated. Readers will have to use their judgment about which ones are material in the context of assessing risk.

In addition to developing an understanding of an operator/company's assets, it is also important to evaluate how a company is positioned to manage carbon-related risks. While risk can never be completely eliminated, those operators and companies that display a strong organizational commitment to, and capacity for, managing such risks might be better positioned to withstand challenges that arise over time. To that end, a risk-screening might warrant consideration of the following:

- Corporate strategy, policies and management capacity
- Capital structure
- Specific operational management approaches (for example, methane capture, flaring, etc.)
- Strategy for effectively assessing and managing key risks, including carbon risk
- Strategy for managing capital investment and development plans in relation to carbon risk factors
- Efforts to engage with investors on carbon risk

The assessment of operator governance and capital management is a key part of screening but it also represents one of the more challenging aspects (see Box: **Risk Screening - ESG Analysis**). Such strategy assessments are subjective by their very nature, and difficult to quantify outside of quantitative metrics related to the company's portfolio of assets.

Risk Screening - ESG Analysis

The process of evaluating carbon risk exposure for companies can be viewed as a component of environmental, social and governance (ESG) analysis. Despite ongoing debates about the most effective approach to conducting ESG analysis, growing recognition of the value in this work is based on an understanding that these issues, if they are not well managed, can have a negative impact on a company's performance. In addition to providing insight into where a company is performing well, ESG analysis can also highlight areas with potential gaps, or even significant risks, that an investor might want to examine in further detail, possibly through scenario analysis or stress testing.

ESG analysis is not without its challenges. Not all ESG issues are equally relevant for all sectors or companies, and different analysts often have different opinions regarding what they believe to be material or significant issues for a given sector or company. Adequate information and data from companies are not always readily available (although, notably, through ongoing dialogue with investors, some fossil fuel companies have been disclosing significant amounts of information on their exposure to carbon risk). Furthermore, there is not one agreed-upon model or approach to performing ESG analysis. In fact, although some investment analysts regularly examine ESG issues as part of due diligence, they do not always label their activities "ESG analysis." Indeed, the more specific aspects of direct corporate management of carbon risk are still developing at present, Appendix 2 describes a subset of the many tools available to perform ESG analysis for carbon risk and CAR.

Type and Duration of the Financial Relationship

As discussed in Chapter 4, it is also critical to consider the type of relationship that a financial intermediary or investor has with an operator/company, including:

- Type of financing or investment (for example, corporate loan, project finance loan, bond, equity, etc.)
- Expected duration or tenor
- Expected liquidity

Baseline scenario data

Following evaluating the types of information described above, it is then important to consider macro-scenario data (that is expected evolution through time of risk factors; see next section) during the initial screening process, although less thoroughly than when performing detailed stress testing. This is because such scenarios provide the context in which the analyst can understand how risk factors (policy, market, technology) are most likely to change over time at a macro level and, thus, how assets and operators are likely to be affected within that context. As an example, at this stage it is relevant to ask whether a change in climate change policy is possible or likely in the geographical location of a physical asset over the expected holding time, although it might not be necessary to quantify the financial impact such a policy change unless all other screening criteria are met.

Screening: synthesizing the results

When determining whether a type of financing or investment warrants further analysis, it is important to keep several considerations in mind. Particularly important is moving beyond static or backward-looking data and information (for example, a company's present-year GHG emissions) and considering, in addition, how operators/companies might look in the future, particularly in the timeframes when carbon risk factors could materialize. In order to develop a more realistic understanding of the impacts of carbon risk on a loan or investment, a financial intermediary or investor should develop an understanding of the operator/company's governance and operating

strategy, potential future demand for its product(s), and how its portfolio of physical assets could change in the future.

This last point is directly related to development and capital management strategies, which are critical to understanding how companies are planning today to run their businesses in the future. For example, is a company in the process of making significant investments in low-carbon technology that will come on-line in future years? Are corporate managers planning to (or able to) diversify their operations or assets? These are just a few of the questions that might be useful when considering a new financing or investment decision, or evaluating an existing one. Such questions can play a significant role in informing decisions about whether more detailed analysis should be considered. For that, we turn to the next step – scenario analysis and stress testing.

5.2.2 Scenario Analysis – Generating the Risk Data - the Economic Context

Scenario analysis provides a useful way to understand the financial implications of potential policies, regulations, and market forces that might impact the financial intermediary or investor.

The process of collecting data and information for scenario analysis and stress testing can involve a significant amount of effort. However, useful information is available from many entities, such as the IEA, think tanks like the Carbon Tracker Initiative, investment analysts, and other commercial tool providers (see Appendix 2 for a sample). Further, in addition to referencing information disclosed by companies, intermediaries and investors may also want to engage directly with companies to understand their approach, assumptions, and analysis. Intermediaries and investors can then use information from all of these sources - statistical agencies, NGOs, commercial tool providers, investment analysis, and the operators themselves - to make a determination about the materiality of risk.

Scenarios generally account for several types of uncertain variables, notably macro-level policy and economic factors like government actions, technology trends, and investment trends. Financial instrument-specific CAR scenario analysis also includes assumptions regarding risk and return objectives; risk mitigation options; and liquidity, tax, legal, and other relevant unique concerns. All these factors must be considered in the context of a specific time horizon - an extremely important factor (see Box: **Timing of Carbon Risk Factors**).

Timing of Carbon Risk Factors

Many of the scenarios on global energy are based on very long-term horizons—out to 2050 in some cases. Some of the scenarios have shorter term "pathways," which is important given that most financing and investment timeframes are relatively short term.

The question of time horizon is a critically important issue when assessing the materiality of CAR. Generally speaking, the issue of CAR involves long-term physical assets or operators/companies that can be associated with financial vehicles that can be long-term (for example, equity or project finance) and short-term (for example, short-term corporate loans).

Further, different financial actors will have different expected holding periods (given an expected market liquidity), asset management strategies, and views on the likelihood of market and policy changes over any given timeframe. Even short-term time frames can be significant, however. For example, an underwriter has limited time exposure but in that time can carry substantial reputational risk if the deal does not disclose sufficient aspects of the risk factors addressed here and then runs into financial difficulties.

Given these complexities, financial intermediaries or investors must make their own determinations about the appropriate timeframe for scenario analyses with respect to CAR assessment. Important sources of information include the International Energy Agency (see next section) and individual countries' climate policies as laid out in their Intended Nationally Determined Contributions (INDCs) to the UN Framework Convention on Climate Change.

Carbon risk factors can be seen as either an extension of current trends ("current risks"), or as more uncertain "event risks," which stem from unpredictable policy or market changes. Crucially, if such event risks are believed to be possible or likely, then historical or parametric data and assumptions are unlikely to be very useful; instead, probability analysis and risk weighting become more important. Given the high levels of uncertainty across and within scenarios, quantitative analysis that treats the probability distribution of what drives the cash flow - commodity prices in particular - can also be applied. These methods can be drawn from Value at Risk (VaR) models that are commonly used in shorter term horizons and applied to complex security portfolios held by Banks.[26]

IEA's World Energy Outlook – a starting point for long-term scenario data

Scenario analysis generally starts by turning to an accepted and trusted source of information. The International Energy Agency's (IEA) annual World Energy Outlook and other related publications (such as IEA's Energy Technology Perspectives), as well as scenarios published by energy companies (including Exxon, BP, and Shell) are some of the leading points of reference. Analysts often use the IEA model directly, or cross-reference their internal models with the IEA models, because it is comprehensive and respected (though, like any model, far from perfect). Because the underlying IEA World Energy model is comprehensive with respect to macroeconomic variables and energy sector detail, it allows for all the demand and supply forces in the economy to be applied together. The model's scenarios can be used to analyze CAR at several levels, building from a specific investment to an asset class, portfolio, and industry.

The IEA's models include several comprehensive scenarios that are developed on the basis of key assumptions about the future global economy, energy system, and policies. They provide an "outlook" of potential future energy demand and supply and other trends (such as fuel mix, GHG emissions, and commodity trends), both on a global scale and within certain regions, countries, and industries. The following are the key scenarios that extend to 2040 and 2050 (these are fully referenced in the bibliography).[27]

1. **Current Policies Scenario**: A scenario in the *World Energy Outlook* that assumes no changes in policies from the mid-point of the year of publication (previously called the Reference Scenario).
2. **New Policies Scenario (NPS**): A scenario in the *World Energy Outlook* that takes account of broad policy commitments and plans that have been announced by countries, including national pledges to reduce greenhouse-gas emissions and plans to phase out fossil-energy subsidies, even if the measures to implement these commitments have yet to be identified or announced. This broadly serves as the IEA baseline scenario.
3. **450 Scenario**: A scenario in the *World Energy Outlook* that sets out an energy pathway consistent with the goal of limiting the average global increase in temperature to 2°C by limiting the concentration of greenhouse gases in the atmosphere to around 450 parts per million of CO_2. The 450 Scenario assumes considerably more climate mitigation and thus lower fossil-fuel demand.
4. **The 2°C Scenario (2DS)** is the focus of Energy Technology Perspectives. The 2DS describes an energy system consistent with an emissions trajectory that, recent climate science research indicates, would give an 80 percent chance of limiting the average global temperature increase to 2°C. It sets the target of cutting energy-related CO_2 emissions by more than half in 2050 (compared with 2009) and ensuring that they continue to fall thereafter. Importantly, the 2DS acknowledges that transforming the energy sector is vital, but not the sole solution: the goal can be achieved only if GHG emissions in non-energy sectors are also reduced. The 2DS is broadly consistent with the World Energy Outlook 450 Scenario through 2035.

IEA considers the New Policies Scenario to be its baseline or "central" scenario. Thus, it is important to test companies' baseline scenarios compared to the NPS, especially with respect to assumptions regarding demand. Similarly, a financial intermediary or investor may also decide to test the potential implications of other scenarios (for example, 2DS), if one thinks such scenarios could materialize.

Practical Considerations for Applying Scenario Analysis

IEA scenarios provide an excellent starting place for research teams, although analysts should also examine underlying assumptions with respect to energy efficiency, alternatives, and economic

growth, particularly in the region(s) that are applicable to an operator/company. The choice of scenarios (and any alterations to underlying assumptions) should reflect perspectives on the most likely manner in which risk factors (policy, technology, and market conditions) will play out over time. The scenario should also reflect the time frame that is consistent with financial exposure; for example, if the nature of a financial relationship is relatively short, analysts might want to construct scenarios drawing on only certain aspects (years, relevant geographical areas, etc.) of the outlook, and customize the scenario using additional data where relevant. Of particular importance is ensuring scenarios account for all current and likely-to-be-enacted policies and commitments, such as a country's Intended Nationally Determined Contribution to the UN (which will be reflected in future versions of the IEA New Policies Scenario).

Assumptions regarding demand can be crucial, and they are fundamental in two ways. Firstly, these assumptions drive company choices regarding potential capital expenditure to meet that demand. Secondly, they form a key input to forecasting commodity prices. Commodity price forecasting is highly complex and relies not only on long-term supply considerations but also on assumptions regarding how key actors on the supply side (such as OPEC in oil markets) might operate. Demand scenarios will lead to different conclusions if OPEC is expected to push for more market share than is estimated in IEA's own price forecast. Financial institutions and investors can choose to apply their own perspectives on energy demand trends and commodity prices when undertaking a risk assessment. Many investors will look to the operators or companies to carry out much of the evaluation on their own businesses. For example, there have been several shareholder proposals filed with fossil fuel companies in the past couple years, which have requested greater disclosure on carbon stress testing and related analysis.

It is important to remember that scenarios (whether published by IEA or other entities) are only a forecast based on various assumptions. Any type of economic forecasting, particularly forecasting that spans very long time horizons, is inherently challenging. As a result, scenario analysis should be seen only as a useful guide to explore the range of potential outcomes based on certain assumptions. Analysts should also rely on other forms of information and test multiple scenarios and assumptions using sensitivity and uncertainty analysis, and use their own judgment to make informed assessments.

5.2.3 Operator-Level Valuation Models: Key Metrics and Outputs

To some extent Chapters 3 and 4, together with the previous two sections, create the "risk data" (time series costs and impacts to revenues and cash flow) for input to valuation models. We do not attempt here to set out the details of such techniques because they are well known in financial circles, and large amounts of information are available online on their basic usage.[28]

Figure 8 above summarizes how various risk data and outputs/metrics are associated with each type of risk model. Returning to the hierarchy set out above:

- The outputs from the scenarios in simple terms are cash flows and revenues
- Physical Assets can be tested for the cash flow impact of changes in risk factors
  - The simplest and most widely used valuation approach is a discounted cash flow (DCF) model, which produces output metrics like Net Present Value (NPV), Internal Rate of Return (IRR), or Break-even price[29]
  - These can be overlaid with more sophisticated quantitative techniques drawn from methods like VaR
- The operators of these assets/companies can be tested for overall risk of assets in their various capital structures by applying DCF analysis to the portfolio of assets the company operates. Because new investments are, in effect, capital investments by the operator, they need to be put in the context of capital management overall, relative to shareholder returns and dividends/buybacks and diversification
- At an industry level, it is possible to derive revenue estimates under different scenarios, generate NPVs, and look at the differences for a risk assessment

An Example: Capital expenditures and engagement at the operator/company level.

The following example shows how an operator-level assessment works in practice. It focuses on global exposure of carbon assets in the oil & gas sector and how individual assets (or new projects) could be affected by different demand scenarios.

EXAMPLE: Scenario Analysis Applied to Capital Expenditures

In 2014, Carbon Tracker and Energy Transition Advisors developed global analyses of the project economics of potential coal and oil production over the next few decades, translated into the resulting CO_2 emissions. After developing a demand forecast based on the IEA NPS, adjusted for accelerated technology deployment, they combined this with a global supply curve derived from Rystad Energy. Figure 9 shows the supply curve for global oil.

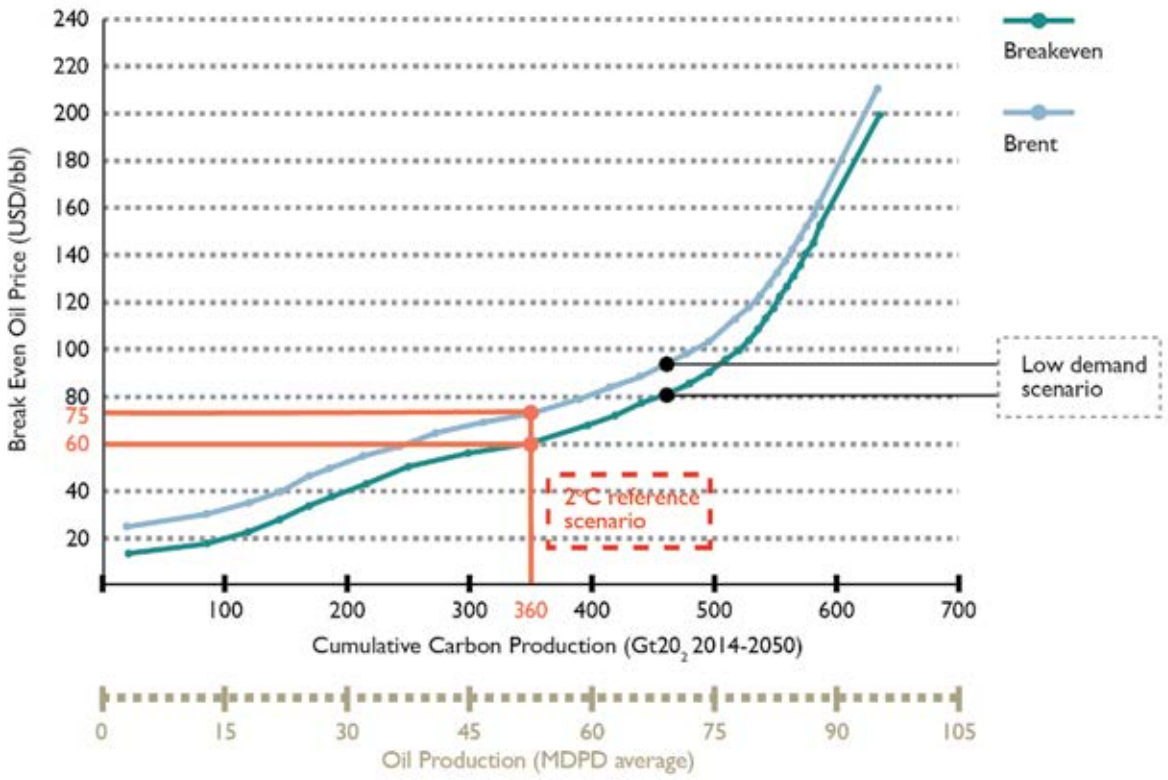


Figure 9: Global Oil Supply Cost Curve

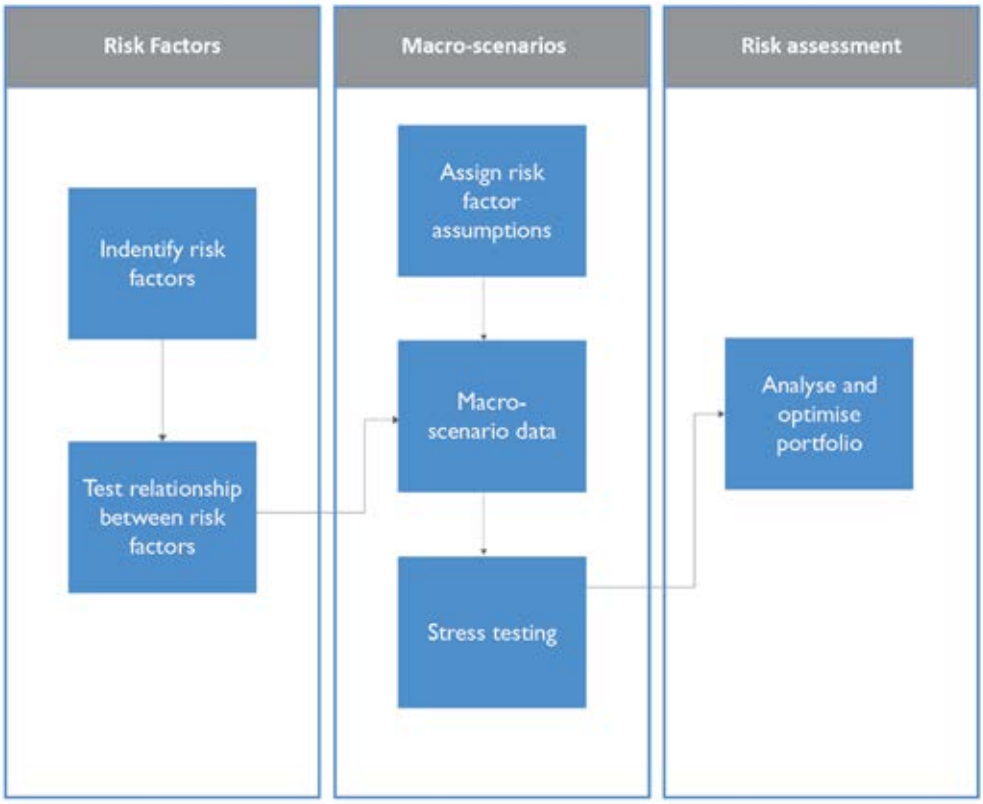
The analysts then focused on the capital expenditures associated with new projects that could be spent to 2025 under the scenario. This approach provided a tool that stress tests the level of exposure of different companies and projects to an alternative demand scenario. As a result, investors are able to understand how a company's portfolio of assets is spread along the cost curve. This analysis, which is publicly available (reference 49), enables users to:

- Differentiate between companies, based on their exposure to the high end of the cost curve;
- Understand how adjusting demand and price scenarios as a proxy for carbon budgets impacts the viability of future projects;
- Apply a forward-looking indicator to the sectors with direct carbon risk exposure to their products;
- Make a direct link to the financial analysis of future revenues and returns, and use of cash flow for capex and returns to shareholders by companies; and
- Identify high-risk securities with challenged business models that they might wish to avoid, and prioritize topics for engagement with ongoing holdings.

5.3 EVALUATING POTENTIAL FINANCIAL IMPACTS OF CAR: RISK OPTIMIZER PORTFOLIO APPROACH

The portfolio-level approach is more oriented toward portfolio analysis. **Figure 10** shows a visualization of how the process works. The core of the process - stress testing - is similar to the bottom-up process described above. However, there are critical differences, notably that the stress test is applied to the overall portfolio, tracking interaction and correlation among investments (and thus diversification with low-carbon assets and other sectors). Further, since the analysis operates at portfolio level, it is possible to optimize asset allocation based on which scenario an analyst believes to be most likely.

Figure 10: Expanding Fig 8: High-level summary of portfolio-level risk assessment process.



Note: The process first identifies risk factors and then tests the relationships among them to ensure they are unique. These factors are then combined with macro-scenario data to stress test the portfolio and generate the data describing the impacts of changes in risk factors to the portfolio. In the final step the portfolio is analyzed and potentially optimized with regard to the risk factors.

Mercer's Technology, Resource Availability, Impact, and Policy (TRIP) risk model, in its 2015 report (building on the 2011 report), is one of the few top-down portfolio risk analysis models available. As described in Chapter 2, the identified risk factors map to the ones set out in this study except that Impact and Resource Availability (here called physical climate impacts) are not discussed here and economic factors are covered in a wider sense. The model uses scenario analysis to evaluate the relative impact for each risk factor under each scenario to estimate the climate impact on return between 2015-2050 for portfolios, asset classes and industry sectors. (see box below). MSCI's well-known industry BARRA Risk Model can also integrate ESG factors from their offerings (see Appendix 2). However, these examples illustrate one of the other differences from the operator-level assessment; given the complexity of such portfolio models, it is unlikely that individual analysts or institutions can build them and commercial software is usually required.

More work using optimization models, and risk factor models looking at the effects of correlation and diversification would be welcome in the CAR space.

An Example of Portfolio-level Risk Assessment Modelling

Investing in a Time of Climate Change is the recently launched 2015 update to Mercer's original 2011 study. The Mercer approach identifies four climate scenarios and four climate risk factors, and integrates these in the investment modelling process alongside more traditional market assumptions, scenarios, and risk factors. The modelling results estimate the climate impact on return for portfolios, asset classes and industry sectors between 2015 and 2050.

The risk factors capture indicators for policy and technology, together with physical impacts driven by catastrophic incidents (for example. storm, wildfire, and flood) and long-term weather changes affecting key resources such as water. The model's scripting methodology maps the pathway over time for each risk factor under each scenario and identifies the relative magnitude of expected positive or negative impacts on return.

The results provide investors with an insight into potential impacts on return distribution expectations for strategic asset allocation, enabling them to examine the implications of different climate scenarios for their asset class and industry sector exposures, in the context of a total portfolio, and consider resulting actions to manage risks and access opportunities, such as:

- Developing a formal point of view on climate risk and associated implementation strategy
- Identifying risk, and risk management solutions, at the asset class and industry sector level (for example, real asset physical risk exposure across the portfolio)
- Framing questions on sector-level impacts that asset owners (and consultants) can use in their oversight of external managers, and managers can use in their oversight of companies
- Considering opportunities to access low-carbon, high-growth investments across asset classes
- Developing an appropriate stakeholder relations strategy

Annual monitoring of a range of indicators has the potential to keep investors "up to speed" on the climate path as it unfolds, and help to address the uncertain timing that surrounds our transition to a low-carbon economy.

5.4 Summary: Framework for Carbon Asset Risk Assessment

Figure 11 provides a high-level summary of the preceding analysis framework. At the highest level, the financial impacts of carbon asset risk can be evaluated using an operator-level framework aggregating physical assets up to portfolios or an assessment framework starting at portfolio level and analyzing underlying investment types. In both cases, carbon risk exposure data and risk factors (that is, scenario inputs) serve as inputs to valuation and risk assessment models, creating outputs and metrics that summarize impact to investment value.

Figure 11: Summary of Risk Data (Inputs and Drivers for Risk Models), Types of Risk Models, and Key Outputs and Metrics for Each Level of Analysis

<table>
<tr><th></th><th colspan="2">Exposure data and risk factors</th><th>Valuation and risk assessment models</th><th>Metrics and outcomes</th></tr>
<tr><td>Operator/asset level</td><td>Asset characteristics: type; location; fuel; lifetime; cost of production, GHG emission profile</td><td rowspan="2">Scenario inputs: economic growth; demand/price; policy developments; technological change</td><td rowspan="2">NPV, IRR, Break even prices

Quantitative Analysis</td><td rowspan="2">Cash flow impact

Valuation impact

Capital management</td></tr>
<tr><td>Operator/company level</td><td>Operator/company characteristics: Asset portfolio; management capacity/governance; future capex plans; ability to pass through costs</td></tr>
<tr><td>Financial portfolio level</td><td colspan="2">Mix of investments in high versus low carbon

Expected risk correlations</td><td>Factor analysis portfolio optimisation</td><td>Factors, diversification</td></tr>
</table>

TOOLS AND RESEARCH: Risk Assessment Models

In addition to the publicly released studies highlighted above, a number of commercial providers and research organizations have released or are developing tools or methods to evaluate the future impact of CAR on investments and portfolios, as discussed in Appendix 2. Given that CAR is an emerging consideration for many firms and analysts, many such tools are still in development or are being improved over time. The portfolio level appears to be the most under-serviced at present.

Research and tools range from very specific examinations of the fate of a single sector in a single geographic region to broad examinations of new methods for stress testing and scenarios analysis together. Different efforts and tools focus on different aspects of the overall field of CAR, including how scenarios impact capital expenditures, earnings, and margins, and how pricing power/cost pass through capacity affects risk profiles. In general, such tools and research are evolving quickly and interested intermediaries and investors should keep abreast of tool, metric, and research developments as they occur.

CHAPTER 6:
MANAGING CARBON ASSET RISK

KEY POINTS

- **Financial intermediaries and investors have a number of options for managing CAR. At the highest level, the options can be summarized as a choice between avoiding the risk entirely or managing it.**
- **There are two distinct times in the investment lifecycle where financial intermediaries and investors have the opportunity to actively manage CAR - at the initial point of originating, making a loan, or investing, and after capital has already been provided (in current portfolios). At each point, different options exist to manage CAR and they depend on the role played by the intermediary or investor (underwriter, lender, bondholder, or shareholder).**
- **Risk management may be hindered by uncertainty about future climate and energy policies. The financial sector could play a role in working to reduce this uncertainty through active engagement in public policy.**

Financial risk management best practices have been applied for centuries. The term "CAR" is a recent addition to the types of risks that can be managed. However, risk analysts might well be addressing some of its elements already, such as through commodity price scenario analysis. The following sections outline CAR management options across types of financial institutions and stages of investment.

6.1 PATHWAYS TO MANAGE CARBON ASSET RISK

This chapter discusses the range of options available to financial intermediaries and investors to manage CAR that is judged to be material. At the highest level, the options available to manage current and future carbon asset risk can be categorized as a choice between avoiding the risk altogether or managing it.

The specific options will be different for each financial intermediary and investor, depending on the nature of their exposure and investments.

For example, at an individual investment or relationship level, an investor or intermediary might conclude from its analysis that it should:

- Not hold financial assets with a particular carbon risk profile;
- Adjust the risk premium it seeks for future financing of particular physical assets or companies, including engaging with management; or
- Seek changes in the structure of the financing to limit the risk exposure for a particular position in the capital stack.

In general, financial intermediaries and investors have two primary intervention points where they can act in order to alter their carbon asset risk exposure. First, they can address concerns about carbon asset risk at the point in time when they make an investment decision, extend a loan or credit, or originate a security. Second, they can address concerns about carbon asset risk in their existing investments and loans.

As previously discussed, while CAR analysis techniques and tools are similar across different investment stages (that is, risk factor assessment and stress testing can be used for both new investments and current holdings), risk management approaches can vary. **Figure 12** summarizes the main management strategies available to financial intermediaries and investors at these different stages. The following sections describe these options for risk management of new (6.2) and for existing investments (6.3).

Figure 12: Risk Management Options by Investment Stage for Different Financial Sector Actors

		Financial Intermediaries (underwriters)	Financial Intermediaries (lenders)	Bond buyers	Shareholders
New investments	Avoid the risk	▪ Sector/security avoidance	▪ Sector/security avoidance	▪ Sector/security avoidance	▪ Sector/security avoidance
	Manage the risk	▪ Promote risk disclosure ▪ Proper risk pricing ▪ Thorough due diligence	▪ Proper risk pricing. ▪ Sectoral policies ▪ Thorough due diligence (potentially include covenants) ▪ Engage in key areas	▪ Promote risk disclosure ▪ Due diligence as possible in disclosure	▪ Investment with ESG screens ▪ Diversification
Current holdings	Avoid the risk	▪ N/A	▪ Divestment at sector or loan level	▪ Divestment at sector or security level	
	Manage the risk	▪ N/A	▪ Diversification (sector and subsector) ▪ Engagement to understand risk management	▪ Diversification	▪ Diversification ▪ Engagement to understand risk management ▪ Engagement to align risk and return perspectives

6.2 MANAGING CARBON ASSET RISK WHEN MAKING NEW INVESTMENT DECISIONS

We begin with risk management for new investments (including underwriting as well as new loans or investments), and describe risk management approaches available to intermediaries and investors.

6.2.1 Underwriters

Underwriters help companies raise capital, either debt or equity, from investors through the capital markets. Underwriters have a role in pricing securities and working with issuers and legal counsel on disclosure of financial information, operational information and relevant risk factors so that investors evaluating the purchase of debt or equity securities can make informed decisions. Underwriters also take responsibility for distributing the securities to investors; in some cases, should they not be able to sell all of the securities to investors, they may have to hold some securities themselves. For this reason, a group of banks will often work together as a syndicate in an underwriting transaction to leverage resources and manage risk.

To the extent carbon risks are a relevant factor to consider, underwriters can play a role in ensuring risks are considered in the pricing of a security. In addition, underwriters may have an opportunity to engage with issuers and legal counsel to ensure such risks are disclosed in securities offering and loan documentation made available to investors.

In addition, as the underwriting process is often public, an underwriter may face reputational risk due to association with a company that is raising capital. For this reason, each underwriter will have to make its own determination about how to manage potential reputational risk. In some cases, underwriters might decide not to participate in a particular transaction.

6.2.2 Lenders

In Chapter 4 and Appendix 1, we distinguish among several different types of lending for carbon assets, including corporate lending, reserve-based lending, and project finance. While there are important differences with respect to assessing carbon asset risk, most of the aspects of managing

carbon asset risks across these structures are similar. The particular range of carbon asset risks facing lenders is influenced by the duration and nature of their credit commitments to companies. For example, a ten-year project finance loan inherently bears more risk than something like a five-year corporate loan. Given that many loans (with the exception of project finance) are relatively short-term, many lenders may not face material carbon asset risk in their lending portfolios. However, where the potential for carbon asset risk exists, lenders have a range of options during the loan decision process to help manage these risks.

Lenders have an opportunity to engage with companies around potential risks, opportunities and best practices. This can occur during due diligence and throughout the course of a lender's relationship with a company or operator.

If engagement is not a viable strategy, a lender could choose to avoid risks by not lending to certain companies based on a range of factors, including industry or sub-industry categorization and geographic exposure, among others. However, risk avoidance does not have to be quite so black or white. A lender could take a more targeted approach and seek to avoid either limited categories of companies or those that, in their view, face greater operator carbon risk, due to the specific types of assets they maintain, their strategy and/or governance, or other factors. Such an approach could be similar to "sectoral policies" that have been adopted by many banks (see box below) to deal with broader ESG risks. Lenders might also set thresholds for the degree of carbon asset risk they would accept, based on similar criteria - either avoiding transactions or ensuring appropriate risk pricing and provisioning where risks were found to be significant.

As previously discussed, considering reputational risks in decisions about credit is a fairly mature area, at least for major banks. Most have established procedures for considering these issues on a transaction basis as well as across portfolios. The management of reputational risks associated with high-intensity carbon assets is fairly similar to the discussion of these issues for underwriting, above. Lenders can manage these risks through careful due diligence, and, in particular, engagement with clients.

Sectoral Policies

Many banks have internal policies or guidelines that frame their approach to conducting environmental and social due diligence on transactions. These may include requirements that certain sectors or activities undergo enhanced due diligence (for example, transactions that require application of the Equator Principles, which pertain to certain project finance transactions and project-related corporate loans). In some cases, such policies or guidelines may also prohibit transactions associated with certain sectors or activities (for example, forced labor or mountaintop removal mining).

An important distinction here is the relative responsibilities of different parties (companies/operators versus intermediaries and investors) with respect to CAR disclosure. Several efforts are underway that are focused on encouraging operators of carbon assets to increase disclosure. As the providers of capital to these operators, financial intermediaries and investors have also faced pressure for greater disclosure on a variety of different topics, including their climate performance (using metrics like financed emissions; see box at the end of Chapter 3) and CAR in their portfolios. In response, through the Portfolio Carbon Initiative, WRI and UNEP FI are developing an evaluation of metrics and other information that could be used by financial intermediaries and investors to measure and potentially report on their "climate performance" in lending and investment portfolios.[30]

6.2.3 Bond Buyers

Chapter 4 explained the categories of bonds distinguished by seniority in the capital stack and whether or not they are secured by physical assets. These distinctions are important for determining the level of carbon asset risk, but they do not fundamentally change the risk management techniques available to holders of different bonds.

Bond buyers have similar options for managing carbon asset risk as lenders do. In selecting their investments, they can choose either to avoid certain securities or to purchase them, provided risk is being priced appropriately. There are, however, several important differences for bond buyers.

The ability of bond buyers to analyze credit risk and operator carbon risk of a particular issuer is usually dependent on risk disclosures in the offering and the degree to which the credit rating agency has considered the issues in its rating process. In addition, bond buyers can request information through the company (for example, through the investor relations team), acquire data or information from other providers (for example, through ESG providers) and engage with companies on issues. There is generally greater opportunity for dialogue around such issues in a primary market transaction, as opposed to a secondary market transaction.

Second, bond buyers typically have greater liquidity, with longer duration, at least in the usual form of a bond with a principal bullet payment versus an amortizing loan. This suggests there could be greater risk for bond buyers relative to lenders due to longer duration, though there are often significant options to manage those risks over the life of the bond through selling.

To date, bond buyers have not been subject to the same degree of stakeholder attention and reputational risk as have lenders and equity owners. This could change in the future.

6.2.4 Equity Investors

There are many different types of shareholders, ranging from individuals to large public pension funds and sovereign wealth funds. Shareholders have a range of options for managing carbon asset risk when making an investment decision; these options are likely to vary for different investors, depending upon their mandates and investment style.

In selecting stocks, investors can choose either to purchase (provided they feel the stocks are priced appropriately) or avoid purchasing stocks of certain companies. Some investors, on the basis of their own ethical standards, might choose not to buy certain stocks, regardless of the level of potential carbon risk. For investors that end up owning shares through an Index fund, avoiding certain stocks might not be so easy. In addition to exploring alternative Index funds, investors could opt to engage with the management of certain companies on issues of concern, including carbon risk. Shareholder engagement strategies are discussed in further detail below.

6.3 MANAGING CARBON ASSET RISK IN CURRENT INVESTMENTS

In many cases, strategies for managing carbon asset risk in current holdings are similar to those for new investments. Thus, to avoid repetition, this section will discuss areas where options differ from those for new investments. In general, financial intermediaries and investors who choose actively to manage CAR in current investments can do so by diversifying risks, hedging, exercising active ownership principles, and changing investment performance benchmarks.

6.3.1 Underwriters

Because the CAR exposure of debt and equity underwriters is typically of only a very short duration, this section is not applicable to underwriters. While they can face reputation risks, there is neither on going investment nor carbon asset risk to manage.

6.3.2 Lenders

Lenders have several options for managing carbon asset risk in existing loans. First among these is diversification. Lenders concerned about carbon asset risk can track their industry and sub-industry activity exposures to both low-carbon and high-carbon assets and seek to avoid unintended risk concentrations. Specific CAR portfolio risk models would help greatly in this effort.

While lenders do have an opportunity to engage their borrowers, their influence is more limited compared to that of an equity investor. The exception is with project finance loans, which are generally long-term and highly-structured because lenders do not have recourse to other assets of the borrower in the event of default. Project finance loans require significant due diligence and engagement with project sponsors to negotiate loan terms, covenants, and other agreements to manage risk.

6.3.3 Bondholders

The options of current bond-holders to diversify and hedge carbon asset risks are similar to those of lenders. Current bond-holders can engage issuers on carbon asset risk, if they feel it has the potential to become a credit issue. To date, most engagement has come from current equity investors.

6.3.4 Equity Investors

As with the situation described in Section 6.2.4, an investor's mandate will dictate its CAR management options. For those investors with the interest and ability to manage CAR actively, the leading options include engagement, diversification, hedging, and divestment.

Shareholders can achieve different objectives by engaging actively with the management of companies whose shares they own. Engagement can take the form of ongoing discussions with company management, as well as filing shareholder resolutions. Shareholders may seek to engage companies to develop a more detailed understanding of the company's current approach to assessing and managing carbon risks (for instance, their assumptions regarding the critical risk factors and scenarios described in Chapters 2 and 5). In certain cases, shareholders may choose to work with a company to reconcile differences in their assessment and perspective of carbon risk. They might, for example, engage in discussions of assumptions about timing, probability, nature, and magnitude of the risks, as well as capital expenditure decisions. Over the past couple years, in conjunction with Ceres, a group of institutional investors has been working in a coordinated fashion to engage with fossil-fuel companies on issues of carbon risk; recently, shareholder resolutions at several large oil companies were recently supported by an overwhelming majority of shareholders , as well as by company management.[31]

A shareholder could manage risks through refined investment decision processes, such as investing with a screen that either excludes certain holdings or tilts the portfolio towards lower risk assets. There is a range of secondary decisions to be made under this approach, including relative and absolute degrees of risk tolerance, at both the security and portfolio levels. Shareholders can also manage carbon asset risk through diversification: they can assess where risks are concentrated and seek opportunities to diversify this risk across their portfolio, either within sectors or across sectors. Investors should also evaluate whether their diversification at the operator issuer level is adequate. For example, smaller and less diversified companies might have a different carbon asset risk profile from large, diversified companies.

Investors have the option of selling or divesting from certain companies or industries. There has been much deliberation about the merits and drawbacks of fossil-fuel divestment. There are many arguments on both sides about its impact and effectiveness, and arguments extend far beyond the topic of carbon asset risk. Ultimately, investors will need to develop their own opinions about divestment as a potential strategy.

Regardless of the approach, CAR management should be viewed as a dynamic, ongoing effort.

Finally, as described in the following box, shareholders seeking to manage carbon asset risk can develop new investment performance benchmarks with lower carbon risk in order to attribute returns to this as a separate risk factor across their portfolio.

TOOLS: Alternative Benchmarks (Low-Carbon Indices)

Various research firms have begun to develop alternative indices to the broad market indices that may be tilted toward higher GHG-intensity sectors and companies. Indices are now available to support a range of alternative investment strategies, including those that eliminate fossil fuel securities altogether, tilt the portfolio by sector, or attempt to pick best-in-class securities within specific sectors, while maintaining low tracking error to overall markets. Examples of such indices are presented in Appendix 2, Section A2.4. and were recently reviewed by the Global Investor Coalition on Climate Change (reference 57).

6.4 PUBLIC POLICY ENGAGEMENT

An important final consideration is that assessing and managing carbon asset risk is made somewhat more challenging by the substantial amount of uncertainty about the future direction of public policies on energy and climate change. The financial sector could play a role in reducing this uncertainty by more actively engaging in public policy arenas. Policies that provide greater clarity on issues such as the potential nature and timing of GHG regulation, as well as reporting and disclosure requirements, would enhance the ability of financial intermediaries and investors to assess and manage carbon asset risk.

GLOSSARY

Capital stack: the legal organization of all capital in a company or physical asset through investing or borrowing, including common and preferred equity, secured and unsecured bonds and secured and unsecured loans. Used synonymously with "capital structure" in this report.

Carbon asset: a physical asset with relatively high GHG emissions, either directly (for example, a coal-fired power plant) indirectly through purchased energy (for example, an aluminium plant using large amounts of fossil-fuel-powered electricity) or through the sale of products that will emit large volumes of greenhouse gases (for example, wells in a basin producing oil or natural gas)

Carbon risk: non-physical climate change-related risks facing assets and companies, principally encompassing policy and legal, technology, market and economic, and reputational factors. See also operator carbon risk and carbon asset risk.

Carbon asset risk (CAR): Potential for a financial intermediary or investor to experience financial loss due to unmanaged operator carbon risk in its clients or investee companies.

Climate risk (a.k.a. physical risk): risks associated with physical impacts from climate change that could impact carbon assets and operating companies. These impacts may include physical damage and/or capital expenditures necessary in response to variations in weather patterns (such as severe storms, floods, and drought) and "slow onset" impacts such as sea level rise, desertification, etc.

ESG (Environmental, Social, and Governance): a broad term describing environmental, social and governance issues or factors that may materially impact company performance. ESG is often associated with socially responsible or sustainable investing.

Financial intermediary: a financial institution that channels funds between lenders and borrowers, most commonly banks. Financial intermediaries act as both providers of capital (lenders) and underwriters of securities that are purchased by investors.

Financial institution: in the context of this framework this term is used generally to describe both financial intermediaries and investors.

Investor: in the context of this framework this term is used generally to describe any non-financial intermediary (individual or institution) providing capital with the expectation of financial return, most commonly shareholders or bondholders.

Operator carbon risk: the risk of financial loss to an operator of a physical asset due to non-physical climate-change related factors (predominantly policy, market, and technology).

Operator carbon strategy: the strategy by which an operator of carbon assets minimizes its operator carbon risk by positioning itself to adapt to a GHG-constrained global economy.

Scenario analysis: involves using general economic frameworks to forecast potential future outcomes under a range of different assumptions.

Stranded assets: economically under-performing assets, at the extreme fully written down.

Stress testing: a method of assessing how certain factors or changes (for example, the introduction of a carbon tax, or a change in commodity prices) could affect the financial performance of an asset or company.

ADDITIONAL READING

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2. Smith School of Enterprise-Stranded Assets and Scenarios 2014 http://www.smithschool.ox.ac.uk/research/stranded-assets/Stranded%20Assets%20and%20Scenarios%20-%20Discussion%20Paper.pdf
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APPENDIX 1: COMMON STRUCTURES USED TO FINANCE CARBON-INTENSIVE ASSETS AND COMPANIES

As a supplement to Chapter 4, this appendix discusses general aspects and characteristics of several types of financing structures and financial tools that may be applied to energy assets and companies. It also includes discussion of strategies and approaches that are often used to manage risk.

- Corporate lending
- Reserve-based lending
- Pre-export financing
- Project finance
- Credit enhancement

Corporate lending is a type of debt financing that is generally used by mature companies with stable, reliable cash flows from business operations. As such loans are typically made to a parent company, they provide borrowers with the greatest flexibility on how they can use the capital – for example, for acquisitions, disposals, capital investment, etc.

Lenders generally assess borrowing capacity based on the strength of a company's balance sheet and other financial performance indicators. Lenders generally develop and assess their own valuation of the company using conservative financial assumptions. A corporate loan facility generally does not require a pledge of assets in the event of default (such a loan is known as unsecured). However, to manage risk, loans generally include covenants, which are a set of requirements and terms that must be met by the borrower during the term of the loan; if covenants are not met, the lender may have the right to recall its loan.

Reserve-based lending, which is also known as "borrowing base" lending, is where a loan is collateralized by the value of a commodity reserve, such as oil or natural gas. It allows companies to borrow against a portfolio of reserves (generally only those that are proved and producing), which could be a subset of their overall reserve portfolio, to fund production activities. The structure provides the borrower with a degree of flexibility in the management of its portfolio of assets through the ability to take assets in and out of the borrowing base, subject to controls. Lenders rely on the underlying value of the reserve as security.

Debt capacity is assessed based on the projected future cash flows associated with the underlying portfolio of reserves. While reserve-based loans are generally three to five years in tenor, cash flows are typically re-evaluated on a regular basis by the lender, typically every 6 months, to account for changes in commodity prices. Lenders use conservative commodity price assumptions when determining debt capacity.

Pre-export financing is a type of loan extended to a borrower that has a long-term off-take agreement from a buyer for a product, but requires financing in order to develop the product and fulfil its supply agreement. Pre-export financing is often provided by development banks in countries where other financing options are limited.

Lenders assess debt capacity based on expected cash flows from the off-take arrangements. Debt is generally repaid directly through payments made by the off-taker, mitigating credit and transfer risk. Pre-export financing generally does not require a pledge of underlying assets as collateral, but typically entails the assignment of export contract(s) and receivables, pledged collection accounts, conservative debt service coverage ratios, and debt service reserve accounts (to provide additional security to a lender in the event of a disruption in cash flow).

Project finance is a type of loan where the debt capacity is assessed and repaid through cash flows generated by a specific project (as opposed to a parent company), which is often structured as a project company or special-purpose vehicle. Project finance is typically used only for large,

greenfield infrastructure and energy projects with long life-spans that require long-term financing. It is not as frequently used as other types of financing.

In project finance transactions, in the event of default, the lender generally has recourse only to the project being financed, not the other assets of the borrower. For this reason, project finance transactions are typically highly-structured and carry detailed covenants and requirements, and controls over project operations, cash flows and debt service that are intended to reduce risk for the lender. Significant project and financial due diligence (including scenario analysis and stress testing) is required on the part of both project developers and the lenders, and project development and financing terms generally requires negotiation and approval of all participants. While project finance transactions can take significant time and effort to structure, the benefit is that project developers can often access greater leverage and finance projects off their balance sheet.

Credit enhancement tools are used to improve the credit profile of a borrower to enable them to access financing from commercial financial institutions and/or do so on better terms. Credit enhancement is generally most useful for borrowers facing higher levels of risk – either due to their project or technology (for example, new technologies that have not yet been deployed at a commercial scale) or the nature of the jurisdiction where they're operating (for example, countries deemed higher risk). Credit enhancement can take many forms, such as loan guarantees (a guarantee to repay a certain portion of the principal in event of default), co-lending (to distribute risk among multiple lenders) and political risk insurance (to provide protection in the event of political risks). It can be provided by a range of institutions, including multi-lateral and development banks, governments and the private sector.

APPENDIX 2: COMMERCIAL TOOLS AND RESEARCH FOR ASSESSING EXPOSURE AND IMPACTS OF CAR

This appendix describes a sample of commercial and freely available tools and services that can help intermediaries and investors to assess their exposure to CAR or CAR impacts. This list of tools is meant to be illustrative only and is not meant to be comprehensive. Further, it represents tools available at the time of printing and the list will not be updated over time. Tools are highlighted from providers who were involved in the development and review of this framework but do not suggest or imply endorsement by WRI, UNEP FI, or any other process participants. All tool descriptions were written by tool providers, and any claims have not been verified or endorsed by WRI, UNEP FI, or any other participants. All tools are organized by tool provider in alphabetical order. A summary of the tools highlighted in the appendix is shown in the summary Table below.

Table 5: Commercial Tools and Research for Assessing Exposure and Impacts of CAR

Tool type	Tool Provider	Tool Name (if applicable)	Page number
Exposure assessment	MSCI	MSCI ESG CarbonMetrics, CleanTechMetrics	55
Exposure assessment	South Pole Group	Several offerings	55
Exposure assessment	RVA Consulting and Queen Mary University of London	RVA Project	55
Exposure assessment	Trucost	Several offerings	56
Exposure assessment	YourSRI.com	YourSRI.com	56
Exposure and Strategy assessment	CDP	CDP Investor Information Request, Oil & gas sector module	56
Strategy Assessment; Engagement	Ceres	SEC Climate Disclosure Search Tool, databases on engagement initiatives	57
Exposure and Strategy Assessment	MSCI	MSCI ESG Intangible Value Assessment (IVA)	57
Risk Evaluation	2° Investing Initiative	Energy Metrics Project	58
Risk Evaluation	Allianz Global Investors, Allianz Climate Solutions, The CO-Firm, and WWF Germany	Pilot carbon risk project	59
Risk Evaluation	Bloomberg	Carbon Risk Valuation Tool	59
Risk Evaluation	Mercer	Strategic Asset Allocation/TIPS	59
Low-carbon indices	CK Solactive	CK Solactive Low Carbon Index Family	60
Low-carbon indices	MSCI	Several index products	60

A2.1 EXAMPLES OF TOOLS FOR ASSESSING EXPOSURE TO CARBON RISK

MSCI

MSCI ESG Research offers multiple tools designed to help institutional investors assess their exposure to carbon asset risk from a number of angles:

Company-level carbon exposure

- **Risk exposure from current carbon intensity**: MSCI ESG CarbonMetrics allows users to identify the largest carbon emitters and most carbon intensive companies. It offers a comprehensive set of data on direct and indirect carbon emissions (Scope 1, 2 and 3) for approximately 9,000 issuers in the MSCI ACWI Investable Market Index.
- **Risk exposure from potential future emissions**: MSCI ESG CarbonMetrics allows users to identify the largest owners of fossil fuel reserves in their opportunity set. It provides the volume of proven and probable reserves for oil, gas, coal, oil sands, shale oil and shale gas, as well as the potential carbon emissions embedded in those reserves.
- **Exposure to the potential opportunities of Clean Tech**: MSCI ESG Research CleanTechMetrics allows users to identify companies in their opportunity set that derive a significant proportion of their revenue from clean tech activities. It provides the percentage of revenue derived from activities in alternative energy, energy efficiency, sustainable water, green building and pollution prevention for companies in the MSCI ACWI Investable Market Index.

Portfolio-level carbon exposure

- **Benchmarking and communicating a portfolio's carbon footprint:** Gain clarity on the carbon footprint of your portfolio as a tool for engagement, manager monitoring, reporting and carbon risk mitigation. MSCI ESG Carbon Portfolio Analytics reports analyze the ESG characteristics of a portfolio based on carbon reserves and emissions exposure, the strength of carbon management, investments in clean technology and other relevant metrics, placed into context with the inclusion of relevant benchmark comparisons.

RVA Consulting and Queen Mary University of London

The RVA project (RVA) brings together practitioners with finance industry experience, regulatory impact assessment, and advanced software to generate innovative graphical-user interface (GUI). The objective is to provide users with a unique approach to visualizing financial performance and regulatory impact risk. This toolkit informs investors and financial institutions (FIs) about risks attached to their capital stack positions.

The work over the last 10 years has been to construct high quality robust benchmark datasets such as with our FTSE 100 and S&P500 datasets. RVA and Queen Mary University have operational datasets and software toolkits that rank a firm's relative performance and have the ability to map a firm's relative carbon-financial intensity.

The RVA toolkits are designed to inform investors/ financial institutions (FI's) about their capital stack positions and the trade-offs between financial performance and carbon intensity. RVA can deploy and visualize composite firm performance metrics whereby firms can be compared to other firms, industry peers, members of their business model or compared to all members of a stock market index simultaneously across a range of performance metrics.

RVA's latest report is due in May 2015 and will map out carbon-financial risk for the S&P 500 and FTSE 100.

South Pole Group

South Pole Group provides a variety of tools for investors to measure and manage their climate impact for multiple asset classes. The options range from investment carbon footprints to forward-looking impact assessments.

130 climate change specialists can assist with detailed analysis on fossil fuel reserves, the Carbon Bubble and stranded assets, clean tech exposure, scenario analysis, regulation analysis but also natural resource research on water, forestry, biodiversity and other environmental topics. Assessments

and benchmarking take place on a holding, sector, portfolio and multi-portfolio level. South Pole Group covers the entire investable equity universe with all indexes (over 40,000 companies), but also Fixed Income, Private Equity and Real Estate investments. For Scope 3 emissions, supply chain and product usage data (LCA) can be included. Online do-it yourself screening tools powered by South Pole Group can be found on YourSRI.com and on Bloomberg terminals (APPS CARBON).

In addition, South Pole Group provides consulting and training on analyzing climate impact information, using of metrics, setting targets, defining low- and no-carbon strategies, internal and external communication and capacity building.

Trucost

Trucost supports financial institutions to measure and monitor exposure to carbon risk across asset classes at the sector, company and project level that is related to both current exposure and forward-looking risk and opportunity. Trucost provides this support in physical (tCO2e) and financial ($) terms via its Stranded Assets tool, related data sets and by leveraging a team of environmental economists to conduct customized research for unique questions.

Current Exposure: Financial institutions can conduct a "stranded assets footprint" by engaging Trucost' s research team to provide such analysis on their behalf, or on their own by using Trucost tools via the Eboard. This analysis provides a snapshot of exposure to embedded carbon emissions in firms with carbon assets across sectors. In combination with the standard portfolio carbon footprint, a firm can test the impact of Carbon Optimized, Low Carbon, Divestment, and Climate Solutions thematic strategies.

Forward-Looking Strategy: In addition, Trucost can help investors understand future risk to holdings to support:

- Integrating future carbon legislation and oil price dynamics to:
  - Assess exposure to potential risks vs a benchmark
  - Measure a firm's revenue dependent on high-carbon sectors
  - Quantify impacts on future cash flows
- Identifying firms that are investing in lower-carbon business models (for example, Renewable Generation)

Trucost's data and tools also support measuring exposure beyond carbon to comprehensive natural capital impacts, and stranded assets beyond fossil fuels.

YourSRI.com

YourSRI.com allows investors to screen any equity and corporate bond portfolio online. On YourSRI.com, the investor uploads identifiers and sector weightings and then downloads an investment carbon footprinting report, based on South Pole Group data. The analysis includes overall portfolio emissions, sector and detailed company analysis. Moreover, most sustainable mutual funds can be found pre-screened for their carbon footprint on YourSRI.com. The tool also calculates an overall cost of externalities and allows for automatic emission reductions in developing countries. YourSRI.com is endorsed by the Montreal Pledge to be used by investors for reporting their greenhouse gas emissions.

A2.2 EXAMPLE TOOLS FOR ESG ANALYSIS

CDP

CDP collects key data points from over 5,000 companies worldwide, providing investors with access to a global source of year-on-year information that supports long-term, objective analysis of strategies for managing climate change, water and deforestation risks. CDP also has a number of sector-specific climate change modules, including one for the oil and gas sector, described below. CDP synthesizes company responses into disclosure and performance scores, which are applied universally across sectors and geographies. These scores can be used to identify good internal management, to identify best in class, and as an indicator of awareness of carbon risks and opportunities.

CDP includes questions around the integration of climate change into company business strategy highlighting regulatory and physical climate change risks and how they influence investment decisions and risk management processes. Oil and gas companies are asked to discuss their business

strategy in the context of continued exploration for and development of new hydrocarbon reserves, as well as development of low-carbon technology areas and renewable energy.

Oil and gas companies are also encouraged to utilize CDP's sector module to provide examples of the assumptions made in specific investment decisions, and to discuss the diversification of their energy portfolio into lower-carbon and non-fossil fuel products (for example, natural gas, biofuels, and renewable energy). They are also asked to give the methodology and assumptions used for the integration of future carbon prices into their hydrocarbon exploration strategy and investment decisions. In addition, CDP's questions around climate change risks ask oil and gas companies to consider the impact of national and international emissions targets and how those could affect demand for oil and gas products, and companies are encouraged to explain how their portfolio of reserves is evolving in response to these and other drivers.

Companies are asked to provide the average breakeven cost of current production, as well as whether or not they conduct any scenario analysis consistent with global efforts to mitigate climate change through GHG reductions, and, if so, whether this scenario analysis is consistent with the IPCC's mitigation scenarios., Alongside the main climate change questionnaire, the oil and gas sector module provides a comprehensive disclosure framework for oil and gas companies to discuss carbon risks to their business.

Ceres

Ceres has developed multiple tools to help assess ESG and carbon asset risk. One example is the SEC Climate Disclosure Search Tool, developed in collaboration with CookESG research. The tool, available at http://www.ceres.org/resources/tools/sec-climate-disclosure, facilitates searching SEC disclosures for climate risk related data. A user may create a unique search based on factors such as year of filing, company name, ticker or sector, and topic. The topics range from "climate and weather" to "climate and fossil fuel extraction" to "climate legislation" and several other topics. In 2015, risks related to water resources will be added to the tool.

Ceres also produced "The 21st Century Corporation: The Ceres Roadmap for Sustainability" which provides framework for stakeholders and investors engaging with companies and policy-makers to address issues ranging from Governance to Disclosure and Performance throughout the corporate structure.

In late 2014, Ceres also launched "Investor Expectations: Oil and Gas Company Strategy" jointly with IIGCC in Europe, the INCR in the U.S., IGCC in Australia/New Zealand, and AIGCC in Asia. This document sets forth sector-specific expectations that investors have developed geared towards reducing carbon asset risk. The document aims to further stimulate and facilitate more meaningful discussions of climate risk by a larger number of investors and oil and gas companies. Recommendations for company board and management consideration outlined in the *Investor Expectations* include:

1. Clearly define board and management governance of climate change risks and implications of energy transition dynamics.
2. Ensure business model is robust and resilient in the face of a range of energy demand scenarios through appropriate stress testing.
3. Embed 'stress testing' for climate risk within key business processes and investment decisions.
4. Communicate publicly the company's view of and response to its material climate change risks and opportunities and the key assumptions underpinning this.
5. Ensure there is broad oversight and transparency of the company's lobbying activity and political spending on this topic and related energy and regulatory issues.

Ceres also maintains a set of databases tracking shareholder engagement and company responses for its INCR members. By joining INCR, investors gain access to these tools to facilitate collaboration and engagement.

MSCI

MSCI ESG Research offers quantitative and qualitative assessments of companies' ESG performance. MSCI ESG Intangible Value Assessment (IVA) provides research, ratings, and analysis of companies' potential risks and opportunities arising from environmental, social, and governance factors for over 5,500 global companies. Through an analysis of material issues for the sector and

benchmarking against sector peers, MSCI ESG IVA is designed to help identify risks or opportunities that may not be captured by conventional financial analyses alone.

This analysis includes an assessment of companies' exposure to carbon risk, and their efforts to reduce exposure through carbon strategies, including carbon reduction objectives, production process improvements, installation of depollution or emissions capture equipment, and/or switch to cleaner energy sources.

Institutional investors can use MSCI ESG IVA Ratings to identify leaders and laggards in particular sectors, identify potential risks and opportunities in their portfolio, implement a best in class strategy, or identify potential candidates for engagement.

Smith School of Enterprise Stranded Assets Program

The Stranded Assets Programme at the University of Oxford's Smith School of Enterprise and the Environment studies environment-related risks (including carbon asset risk) driving asset stranding in different sectors and systemically. The program researches how environment-related risks might emerge and strand assets; how different risks might be interrelated; assess their materiality (in terms of scale, impact, timing, and likelihood); identify who will be affected; and what impacted groups can do to pre-emptively manage and monitor risk.

The program has produced a number of reports useful in understanding, evaluating, and managing carbon asset risk over the past several years. These include a high-level discussion of scenario analysis and its usefulness for assessing CAR, specific studies on subcritical coal power generation in different geographies, and an assessment of metrics useful for evaluating risk to capital expenditures in fossil fuel sectors. This last effort produced a capex balance calculator tool that analysts can use to apply the suggested metrics .

The Programme recognizes that the production of high-quality research on environment-related risks is a necessary, though insufficient, condition for these factors to be successfully integrated into decision-making. Consequently, the program also researches the barriers that might prevent integration, whether in financial institutions, companies, governments, or regulators, and develops responses to address them.

A2.3 EXAMPLE TOOLS AND RESEARCH FOR SCENARIO ANALYSIS

2° Investing Initiative Energy Metrics Project

2° Investing Initiative is leading a European research consortium currently pursuing a three-year, $3 million research program with the objective to develop 2° investing metrics. The project involves the Climate Bonds Initiative, the CDP, the Frankfurt School of Finance – UNEP Center, Cired/SMASH, the University of Zurich, WWF (Germany and European Policy Office), and Kepler Cheuvreux, The consortium also engages support from Energy Transition Advisors, Collaborase Advisory, Riskergy, IODS, and the Oxford University. The project has received a range of support letters from policymakers (German Environment Ministry, French Environment Agency, French Prime Minister's Office), private banks, private investors, asset managers, public banks, financial market stakeholders, academic institutions, and civil society organizations.

The objective of the three-year research program is to develop climate performance metrics that help inform financial institutions on the alignment of their loan book or financial portfolio with energy transition roadmaps, such as the ones developed by the IEA in its annual World Energy Outlook and World Energy Investment Outlook. The project includes research and development on defining climate-friendly assets, measuring and benchmarking a portfolio's exposure to energy transition scenarios, developing index and portfolio optimization tools based on these climate performance metrics, updating data frameworks, and research on integrating these metrics and tools into financial regulatory frameworks. The project provides a research and development response to the needs for indicators that inform on energy technology diversification. All results will be publicly available and without intellectual property rights.

From a carbon risk valuation perspective, the project may contribute to understanding the 'economic misalignment' of companies and financial portfolios with climate goals.

Allianz Global Investors, Allianz Climate Solutions, The CO-Firm, and WWF Germany

In 2014, Allianz Global Investors and Alliance Climate Solutions in partnership with The CO-Firm and WWF Germany ran a pilot to model carbon risks in portfolio analysis. The pilot focused on the cement and dairy industries in the US (California), China (Guangdong Province) and Germany. The aim was to assess the financial impact associated with carbon and energy regulation – as the most material short-term risk from scaled-up climate policy - on corporate return. The model develops plausible development paths for that regulation, resulting in scenarios that can be used for stress-testing purposes. This is not captured by conventional financial analysis.

To a large extent the margin impact is a function of a company's ability to adjust operations, carbon exposures and business models to a changing regulatory environment. As might be expected, the pilot study found that margin effects are strongest in the energy-intensive industries and in particular in an environment where costs pass-through power is limited. In a scenario based on politically plausible increases in carbon and energy prices over the next five years, regulatory costs might lower current margins by more than 70 % (see **Table 1**, column 2: 'margin at risk').

For example, if a cement company anticipates regulatory changes and takes operational measures by investing in waste heat recovery (a key technical improvement lever among a sample of measures), the negative margin impact is reduced and can even turn into a gain. It allows for improved margins in the selected scenario by 4.7 EUR/t cement (Germany), 1.6 EUR/t cement (USA, California) and 2.1 EUR/t cement (China, Guangdong) respectively (see **Table 1**, column 3: 'margin improvement potential'). This results in a margin gain of 1.1 EUR/t cement in China, Guangdong.

This approach takes a bottom-up view on risk, allowing investors to identify the factors that differentiate future corporate performance (such as alternative technological or business strategies) and thus make better investment decisions. This differentiation capability will allow investors to price in potential risks associated with the use of energy and GHG emissions, and engage industries and companies on mitigating strategies (for example, upgrading technologies).

Table 6: Enhancing Financial Analysis with Carbon Risk Measurements - Cement Sector Pilot

Region	Margin as of today	Margin at risk	Margin improvement potential
Germany	17.3	-12.4	4.7
USA-California	20.3	-3.2	1.6
China-Cuangdong	12.0	-1.0	2.1

Bloomberg

Bloomberg introduced a tool in 2013 to allow clients to illustrate the potential impact on earnings and share price of companies, particularly those in extractive industries, under carbon pollution constraints. The tool offers five pre-built scenarios, plus the ability to adjust assumptions. The scenarios provide the ability to apply some of the ways in which stranded asset risks could manifest themselves, including scenarios representing lower oil prices and decreases in EBIT over varying timescales. The tool relies on consensus earnings estimates data and standard financial metrics to build out a full income and cash flow statement for a company, followed by a scenario analysis that adjusts revenue and earnings based on low oil and gas demand scenarios. The tool also includes functionality to test how changes in environmental costs, including energy, water, waste, and wastewater costs, and resource intensity levels could impact financial returns.

Mercer

An update to Mercer's 2011 study, Climate Change Scenarios – Implications for Strategic Asset Allocation, was launched in June 2015. The Mercer SAA approach identifies four climate scenarios and four climate risk factors, and integrates these in the modelling process alongside more traditional market assumptions, scenarios, and risk factors.

The risk factors capture indicators for policy and technology, together with physical impacts driven by catastrophic incidents (for example, storm, wildfire, and flood) and long term weather changes affecting key resources (for example, water). The model's scripting methodology maps each risk factor, under each scenario, and identifies expected positive or negative movements, and the relative magnitude, for industry sectors within equities, and other asset classes, during 2015-2050.

The results provide investors with an insight to potential impacts on return distribution expectations for the SAA, enabling them to examine the implications of different climate scenarios in the context of their current asset allocation, and consider resulting actions and opportunities, such as:

- Developing a formal point of view on climate risk and associated implementation strategy
- Identifying risk, and risk management solutions, at the asset class and sector level (e.g. real asset physical risk exposure across the portfolio)
- Framing questions on sector level impacts which asset owners (and consultants) can use in their oversight of external managers, and managers can use in their oversight of companies
- Considering opportunities to access low carbon, high growth investments across asset classes
- Determining if your organisation is a Future Taker or Future Maker regarding climate risk
- Developing an appropriate stakeholder relations strategy

Annual monitoring of a range of indicators has the potential to keep investors 'up to speed' on the climate path that unfolds, and help to address the uncertain timing that surrounds our transition to a low carbon economy.

The Trucost EBoard's Calculator Tool

Trucost's interactive calculator tool allows a user to run scenario analysis on Trucost's estimates of revenue at risk related to the GHG intensity of investments. The user can apply alternative costs for greenhouse gases, as well as water, waste and air pollutants. This enables an analyst or portfolio manager to compute the financial impact on a company, portfolio or universe under different regulatory, taxation or scarcity scenarios. Trucost preloaded the calculator with some default price sets and frequently used scenarios. Trucost' s default set of prices applied to each environmental impact, formulated by our academic panel and derived from environmental economics literature. Trucost augments this set of prices with a number of market-based and social carbon cost options. With this tool, the user can test the sensitivity of a company, sector, portfolio or universe to carbon pricing.

A2.4 LOW-CARBON INVESTMENT INDICES

CK Solactive Low Carbon Index Family

The CK Solactive Low Carbon Index Family provides exposure to best-in-class companies in carbon intensive sectors, while maintaining benchmark exposure for companies in all other sectors. The indices available include: Solactive CK Low Carbon U.S. Index, Solactive CK Low Carbon Europe Index, and Solactive CK Low Carbon Canada Index. This index family has been designed to serve as benchmark or underlying for low carbon investment strategies.

The Solactive CK Low Carbon Index family is the first in the industry to use the Sustainable Industry Classification System™ (SICS®), established by the Sustainability Accounting Standards Board® (SASB®) to categorize industries based on resource intensity, sustainability impact, and sustainability innovation potential. A defining feature of these Low Carbon Indices is that they ensure a minimum 50% reduction in carbon intensity against the market benchmarks, as verified by South Pole Group.

MSCI

MSCI develops MSCI ESG Indexes representative of prevalent ESG investment strategies. Within the MSCI ESG Index family are the MSCI ESG Environmental Indexes, encompassing Low Carbon, Fossil Fuels Exclusion and Thematic indexes.

- The MSCI Global Low Carbon Indexes are intended to help identify potential risks associated with the transition to a low carbon economy while representing the performance of the broad equity market by addressing two dimensions of carbon exposure: carbon emissions and fossil fuel reserves.

- The MSCI Global Fossil Fuels Exclusion Indexes are benchmarks designed to help institutional investors who aim to eliminate or reduce fossil fuel reserves exposure from their investments.
- The MSCI Thematic Indexes are intended to identify companies with positive environmental impact for investors looking for thematic investment opportunities.
  - The MSCI Global Environment Index is comprised of the following sub-indexes: MSCI Global Alternative Energy Index, MSCI Global Clean Technology Index, MSCI Global Green Building Index, MSCI Global Sustainable Water Index and MSCI Global Pollution Prevention Index.
  - The MSCI Global Climate Index is an equal weighted index of 100 companies that are leaders in mitigating the causes of climate change. Index constituents are selected for their involvement in three environmental themes: Renewable Energy, Clean Technology & Efficiency, and Future Fuels.

APPENDIX 3: PCI ADVISORY GROUP MEMBERS AND MEMBERS OF UNEP FI'S CLIMATE CHANGE ADVISORY GROUP

PCI ADVISORY COMMITTEE MEMBERS

Christopher Bray	Barclays
Mark Campanale	Carbon Tracker Initiative
Giorgio Capurri	UniCredit
Mark Didden	World Business Council for Sustainable Development
Stanislas Dupre	2° Investing Initiative
Nathan Fabian	Principles for Responsible Investment
Julie Fox-Gorte	Pax World
Bill Harnett	Local Government Super
James Hulse	CDP
Kaj Jensen	Bank of America
Tom Kerr	International Finance Corporation
Sefton Laing	Royal Bank of Scotland
Karsten Loeffler	Allianz
Robyn Luhning	Wells Fargo
Sabine Miltner*	
Richard Pearl	State Street Advisors
Julian Poulter	Asset Owners Disclosure Project
Steve Priddy	London School of Business and Finance
Nick Robins	UNEP
Christopher Rowe	Prudential Investment Management
Namita Vikas	Yes Bank
Chris Walker	Ernst&Young**

*Sabine Miltner was an employee of Deutsche Bank at the time of writing but is no longer with the company

**Chris Walker was an employee of Ernst&Young at the time of writing but is no longer with the company

UNEP FI'S CLIMATE CHANGE ADVISORY GROUP (CCAG) MEMBERS

David Bresch	SwissRe
Giorgio Capurri	UniCredit
Bruce Duguid	Hermes
Abyd Karmali	Bank of America Merrill Lynch
Karsten Loeffler	Allianz (CCAG Chair)
Madeleine Ronquest	First Rand
Nick Robins	UNEP
Frederic Samama	Amundi
Eric Usher	UNEP FI
Merlyn VanVoore	UNEP

APPENDIX 4: TECHNICAL WORKING GROUP MEMBERS AND REVIEWERS

TECHNICAL WORKING GROUP MEMBERS

Srinath Komarina/Namita Vikas	Yes Bank Ltd
Sharif Ahmed Habibu	Modibbo Adama University of Technology, Yola, Nigeria
Øistein Akselberg	DNB
Dan Bakal	Ceres
Meredith Benton	Boston Common Asset Management
Kristin Bloser	Comerica Bank
Adriana Boscov	SulAmérica Investimentos
Benedict Buckley	ClearBridge Investments
Ben Caldecott	Smith School of Enterprise and the Environment
Mark Campanale	Carbon Tracker Initiative
Xiaoling Chen	Hejun Consulting
Hugues Chenet	2° Investing Initiative
Eric Christensen	WSP
Roland Clarke	Clarke Energy Associates
Majella Clarke	Indufor Oy
Ulf Clerwell	Money Footprint
Lauren Compere	Boston Common Asset Management
Dave Cooke	Best Foot Forward
Stephen Donofrio	CDP
Jacob Drejer	GE Capital
Louise Dudley	Hermes Fund Managers
Stanislas Dupré	2° Investing Initiative
Marco Ferreira	Quintessa Partners Análise e Investimentos Ltd
Thierry Fornas	EcoAct
Chris Fowle	CDP
Rob Fowler	Essential Change Advisory Services
Christoph Frischer	WWF Austria
Mark Fulton	Et Advisors
Sebastien Godinot	WWF
Marta Gomez	Credit Andorra
Julie Gorte	Pax World Management LLC
Amit Gupta	Emergent Ventures India Pvt Ltd
Matthew Hanes	CITIBank
Colin Haslam	Queen Mary University
Jessie Henshaw	HDS Systems Design Science
John Hodges	BSR
Maximilian Horster	South Pole Group
David Huberman	Bridges Ventures LLP
Romain Hubert	CDC Climat
Nancy Israel	Law Office of Nancy D. Israel
Shirley Jarrin	Banco Pichincha C.A.
Nathalie Jaubert	BNP Paribas
Kaj Jensen	Bank of America
Eapen John	UBS
Timothy Juliani	Center for Climate and Energy Solutions
Bethuel Kgobane	Industrial Development Corporation
Jan Köpper	imug GmbH

Cary Krosinsky	Columbia University
Gregory Larkin	Bloomberg Industries
Dae-Woong Lim	Eco & Partners
Karsten Loeffler	Allianz
Lang Louis	Recarbon GmbH
Yann Louvel	BankTrack
Yurily Lozynskyy	Ecofys
Robyn Luhning	Wells Fargo
Mampiti Matete	Land and Agricultural Bank of South Africa
Brigham McNaughton	PwC
Sabine Miltner*	
Richard MukasaMugambwa	National Environment Management Authority (NEMA)
Makuregye Nathan Justice Gahungu	Pro-biodiversity Conservationists in Uganda
Carolina NogueiraLearth Cunha	Banco Santander Brasil
Muhammad Obidur Rahman	Bangladesh Legal Aid and Service
Juan Pablo Castro	Climate Focus
Hjalmar Philipp	Oil Search Limited
Guilherme Piffer Salles	Banco Santander Brasil
Don Reed	PwC
Nick Robins	UNEP
Nicole Röttmer	The CO-Firm
Rob Rouwette	Energetics
Simone Ruiz	Allianz
Romly Slesh	Chamrouen MFI
Robin Smale	Vivid Economics
Vladimir Stenek	IFC
Elisha Stephen	Itire ikate local council development area
Luke Sussams	Carbon Tracker Initiative
IbrahimaSory Sylla	ONG Carbone Guinée
Jakob Thomä	2° Investing Initiative
Gabriel Thoumi	Calvert Investments
Kal Trinkner	EY
Elisa Vacherand	BNP Paribas
Liesel van Ast	Global Canopy Programme
Mary Ann van Bodegraven	WWF-Australia
John Wunderlin	Carbon Tracker Initiative
Yige Zhang	Beijing Environment Exchange Reviewers
Jane Ambachtsheer	Mercer
Rosemary Bissett	NAB
Nicole Bradford	GE Capital
Karl Hausker	World Resources Institute
Yann Kermode	UBS
Lydia La Ferla	La Ferla Associates, LLC
Michelle Lapolla Friedman	MSCI
James Leaton	Carbon Tracker Initiative
Gemma O'Reilly	Ireland Environmental Protection Agency
Shilpa Patel	World Resources Institute
Graham Sinden	EY
Cory Weiss	World Resources Institute
Jerry Blenman	Calidad Financial Services, Inc.

*Sabine Miltner was an employee of Deutsche Bank at the time of writing but is no longer with the company

END NOTES

1. IPCC (Intergovernmental Panel on Climate Change). 2013. Fifth Assessment Report, The Physical Science Basis, Summary for Policymakers. Available at: http://www.climatechange2013.org/images/report/WG1AR5_SPM_FINAL.pdf
2. IPCC. 2013. Fifth Assessment Report, The Physical Science Basis, Summary for Policymakers. Available at: http://www.climatechange2013.org/images/report/WG1AR5_SPM_FINAL.pdf
3. International Energy Agency, World Energy Outlook 2013.
4. CPI's typology includes political, policy, and social risks; technical and physical risks; market and commercial risks; and outcome risks. See http://climatepolicyinitiative.org/wp-content/uploads/2013/01/Risk-Gaps-Executive-Summary.pdf. Mercer strategic asset allocation project classifies carbon risks into three categories: technology, impacts (similar to physical risk), and policy. See http://www.mmc.com/content/dam/mmc-web/Files/Climate_Change_Scenarios_Implications_for_Strategic_Asset_Allocation.pdf
5. See the World Bank/Ecofys. 2014. State and Trends of Carbon Pricing.
6. For example in the United States, the Mercury and Air Toxics rule (http://www.epa.gov/mats/actions.html) and the Cross-state Air Pollution Rule (http://www.epa.gov/airtransport/CSAPR/_
7. See: http://www.epa.gov/nsr/ghgpermitting.html and http://www2.epa.gov/carbon-pollution-standards/clean-power-plan-proposed-rule
8. https://www.whitehouse.gov/the-press-office/2014/11/11/us-china-joint-announcement-climate-change
9. Available at www.climatecasechart.com
10. An example is Am. Elec. Power Co. v. Connecticut, 131 S. Ct. 2527 (2011).
11. See, for example: http://www.greenpeace.org/international/en/press/releases/Executives-facing-climate-denial-related-claims-could-be-personally-liable---NGOs/
12. http://www.seia.org/research-resources/solar-industry-data
13. http://cleantechnica.com/2015/01/14/deutsche-bank-predicts-solar-grid-parity-80-global-market-2017/
14. http://www.economist.com/blogs/economist-explains/2014/12/economist-explains-4
15. http://montrealpledge.org/
16. http://unepfi.org/pdc/
17. http://www.ipcc.ch/publications_and_data/ar4/wg3/en/figure-1-1.html. Accessed September 12, 2014
18. We will primarily use the IEA World-Energy Outlook 2035 scenario and Energy Technology Perspectives 2050 scenario. The landscape will be completed by an analysis of other scenarios listed in the study Stranded assets and scenarios, Oxford SSEE (2014).
19. IEA's World Energy Outlook, 2013
20. The carbon intensity of revenue (for example, annual GHG emissions per annual sales) can be seen as an indication of the potential impact of a carbon price on the cost structure of a sector, assuming all GHG emissions and all sectors are covered by the carbon price. Other intensity metrics may be more relevant for other types of analysis.
21. The sample covers 27 percent of the MSCI World Capitalization and 56 percent of consolidated scope 1+2+3 (supply chain and products use) emissions, excluding the financial sector. In line with the GHG protocol principle, Scope 3 emissions related to products and supply chain are accounted from each sector (for example, gasoline combustion emissions are accounted in oil and gas, automotive and highways). "Others Oil and Gas," for example, covers four GICS level 4 categories: O&G Drilling, O&G Equipment & Services, O&G Refining and Marketing and O&G Storage and Transportation. "Utilities" does not include water utilities. The sector classification is derived from GICS level 4, the MSCI classification.

22. To provide a rough indication of the relative lifetime of assets in the absence of robust metrics reported by companies, we use a proxy from the companies' books: the ratio accumulated depreciation/depreciation.
23. EBIT (earnings before interest and taxes) margin is defined as a company's EBIT divided by their revenues, a measure of the relative profitability of a company
24. See note 21.
25. The terms "capital stack" and "capital structure" are used interchangeably in this guidance, although these terms are used differently by different financial institutions and analysts.
26. See Carbon Tracker Blueprint: Managing corporate risk from an energy transition: an oil and Gas focus
27. World Energy Outlook 2014. International Energy Agency. See descriptions of IEA scenarios at http://www.iea.org/publications/scenariosandprojections/
28. For instance see CFA Institute's summary of equity valuation models here.
29. Definitions for these terms are available from the International Glossary of Business Valuation Terms.
30. See: http://www.ghgprotocol.org/Portfolio_Carbon_Initiative for more details
31. See: http://www.ceres.org/issues/carbon-asset-risk
32. Tool available at Stranded Assets Programme website: http://www.smithschool.ox.ac.uk/research-programmes/stranded-assets/publications.php

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