

CRRM³ WHITE PAPER

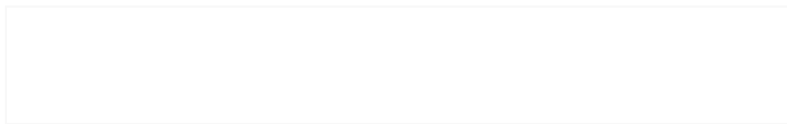
The Alternative Data Frontier for Climate Finance

CRRM3-WP1



CRRM3

3-D CLIMATE-RELATED
RISK MEASUREMENT



MAY 2022

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PREFACE

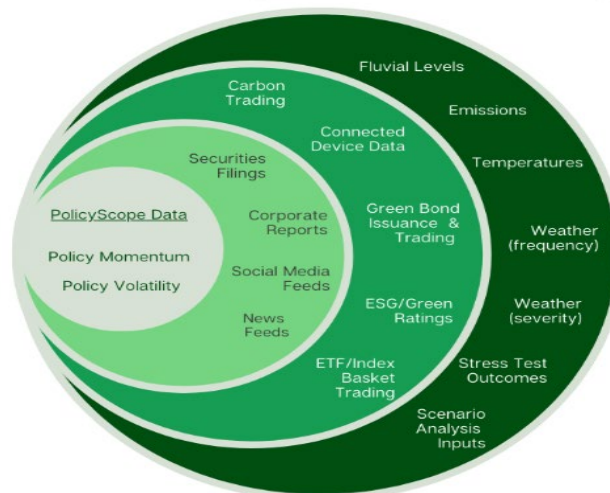
The climate transition will occur over a period of decades, too slowly for many. Successfully transitioning to a low-carbon or Zero Carbon economy during that period without massive economic dislocation requires a parallel – and faster – transition towards capital markets that deliver incentives to innovate and exert market discipline by explicitly pricing sustainability risks consistently, transparently, and globally. This Climate Finance Transition has just begun, turbo-charged by geopolitical imperatives to shift away from carbon-based energy sources following Russia’s brutal invasion of Ukraine.

Firms increasingly will be exposed to two dimensions of climate-related risks simultaneously: from the environment itself and from the financial system. Managing and mitigating these dynamically shifting risks requires far more and different kinds of data than are currently available.

Capital markets currently clamor for solid data concerning climate-related risks. Markets need data the way people need oxygen. It is essential for survival. Its absence creates material risks. Common standards for disclosure of climate-related physical risks (chiefly, at present, emissions) constitute only the tip of a very large iceberg. Reformulating risk pricing to incorporate climate considerations within the existing low-data context creates the potential for market volatility, mispricing, and intensified uncertainty as the environment, policy frameworks AND risk models all shift simultaneously.

The reaction function can create as much volatility as opportunity. Minimizing risk exposures and maximizing value creation effectively during the Climate Finance Transition requires far more data than merely corporate emissions. New and different risks arise for which traditional long-dated time series data may be less useful because previous prices did not include climate-related externalities. Advanced technology paired with rapidly growing investor demand for data generates a proliferation of new kinds of data (“alternative data”) that can help investors assess climate-related risks across a range of vectors.

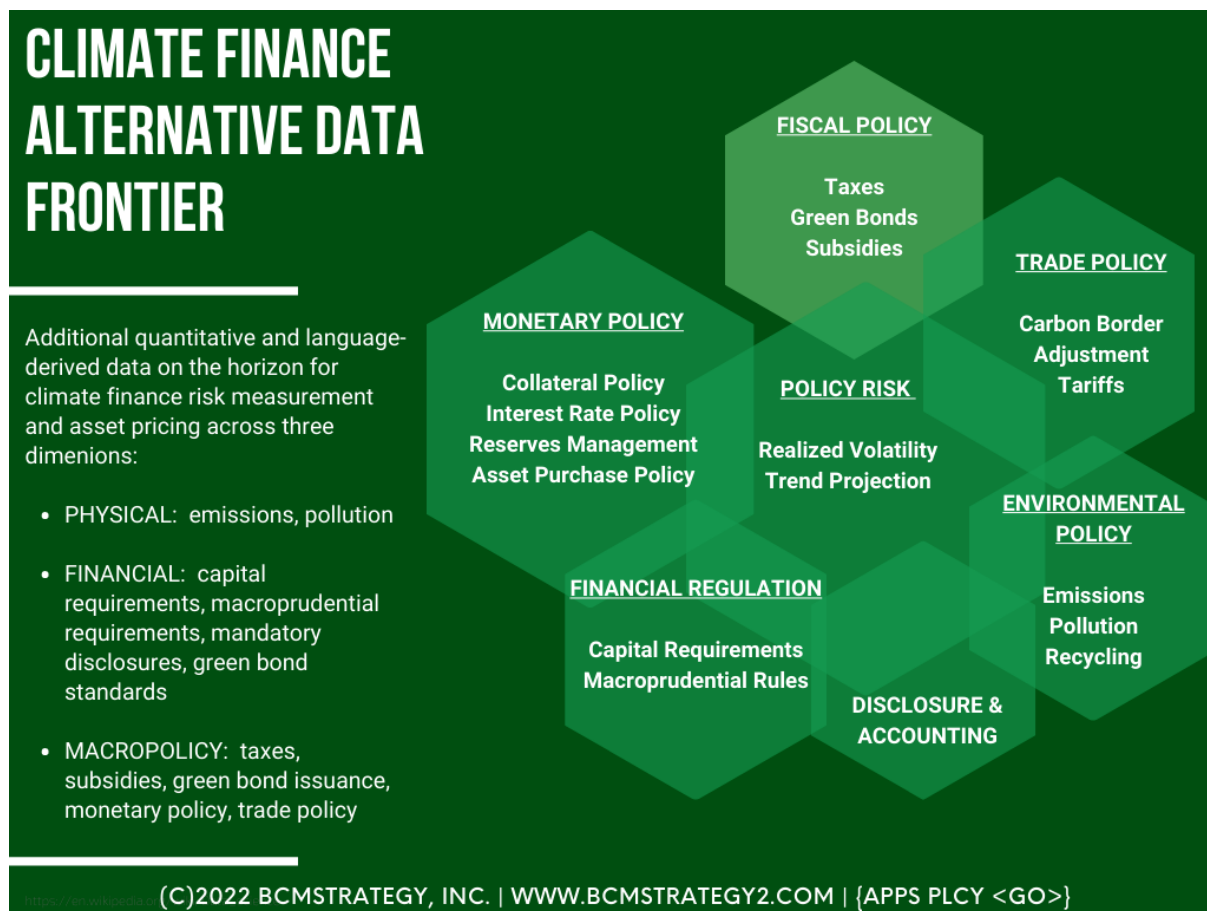
CLIMATE-RELATED RISK ALTERNATIVE DATA TODAY



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This is a moving target. The rules governing the economy are changing at least as quickly as the planet. Shifts in regulatory, fiscal, and monetary policy are accelerating in scope and pace. These new rules will change how balance sheet assets are valued and how risks are measured. Yet those policy risks present in the form of unstructured verbal data while markets measure risks in the form of integers.

Policymakers globally are aware of the challenge. In 2021, the Italian Presidency of the Group of Twenty (G20) launched a global technology competition in partnership with the Bank for International Settlements (BIS) focused on climate-related technology solutions. They sought to accelerate the development of innovative technology solutions to address the economic and financial risks associated with climate change. BCMstrategy, Inc. was named a Finalist in the competition. Our award-winning proposal paired quantitative data measuring public policy risks with publicly available government and third party data in order to provide dashboard users with a dynamic daily perspective on the reaction function between observable changes in the physical climate and observable changes in public policy responding to climate shifts.



As policymakers act, additional data points will become available across all three dimensions of public policy: physical/environmental policy, financial regulation policy, and macro policy (fiscal, monetary, trade). This CRRM³ White Paper describes the unique challenges investors face when using alternative data to identify, measure, and manage climate-related financial risks. We hope it helps advance the discussion so that investors can make better data-driven decisions and create responsible market incentives.

OVERVIEW

Factoring in climate-related risks is no longer the sole province of impact investors willing to forgo some portion of return in exchange for rewarding companies taking responsible approaches to climate risk mitigation. Nor is it merely a question of investing in “green bonds.” Increasingly, investors are making the business case that investing in climate risk mitigation measures is good business.

Russia’s invasion of Ukraine intensified and expanded the imperative for policymakers to accelerate the green transition.¹ A significant geopolitical overlay now supplements sustainability initiatives. Increased reliance on green energy delivers multiple economic and strategic advantages in addition to the beneficial climate impact. Specifically: accelerated adoption of renewable energy sources and energy efficiency holds the potential to decrease substantially Western Europe’s reliance on Russian fossil fuel exports.² The current embargo on those exports underscores the geopolitical importance of the green revolution.

Implementing the strategic pivot away from carbon-based energy and towards sustainable, renewable power generation requires more than government mandates and subsidies. Mobilizing private capital and market discipline at scale requires a dramatic extension of the regulatory infrastructure so that economic agents can make better decisions powered by comparable data. Most expect that increased disclosures regarding emissions and sustainability initiatives will create the capacity for private markets to reward good performance and penalize laggards. Slated for implementation in early 2023, the new standards cannot come into force soon enough for many. While helpful, they constitute a necessary but not sufficient condition for financial market participants to measure risks related to climate finance.

“We stand at a crucial moment in the transition where momentum is with us but the transition risks being shaped by firms who are acting with limited information and with the potential for complex unintended consequences. Successfully navigating this means we could be on a path to an orderly transition. Failing to transition in the right way may lead risks to crystallize...An effective transition requires the efficient allocation of capital to assets that are both green now and those that need greening, and the responsible retirement – over time – of assets which are not compatible with a net-zero outcome.”

--Bank of England Executive Director for Financial Stability Strategy and Risk, Sarah Breeden (April 2022)

¹ “The war in Ukraine has elevated energy security as a renewed priority, which could potentially accelerate the energy transition to net zero as countries aim to reduce their reliance on imports of Russian oil and gas.” *Assessing environmental impact of measures in the OECD Green Recovery Database*, Organization for Economic Cooperation and Development (April 2022).

² “Russia’s war in Ukraine has highlighted Europe’s dependency on fossil fuel imports from Russia and emphasised the pressing need to speed up the green transition.” *Letter from the ECB President to Mr Bas Eickhout and Mr Ernest Urtasun, MEPs, on climate change* (19 April 2022); “The European Union will phase out its dependency on Russian gas, oil and coal imports as soon as possible...Energy security and climate neutrality can only be achieved if the European Union relies on a robust and fully interconnected internal electricity market and a well-functioning carbon market. The European Council discussed how to take work forward on monitoring and optimising their functioning. It invites the Commission to take any necessary initiatives by May 2022...” *European Council Conclusions* (24-25 March 2022)

The Climate Finance Transition does not stop with disclosure standards. Climate-related regulatory capital standards for financial institutions, climate-related monetary policy, and shifts in fiscal policy (taxation, subsidies) will all be crafted in the coming years. The Climate Finance Transition will thus systematically (*but not sequentially*) shift the foundation for asset valuation and risk measurement by incorporating explicit quantitative values for carbon-related and broader sustainability externalities over the coming years.

Investors face a multi-dimensional challenge when prioritizing sustainability in their underwriting and risk assessment processes. Difficult questions remain about whether and how to use a broad range of historical economic data since prior datasets did not include climate-related pricing.

Finance professionals must conduct asset pricing and risk assessments with limited data (which decreases accuracy and increases exposure to volatility risks) amid a rapidly shifting regulatory policy environment which could impose new risk pricing and disclosure mandates. They must initially measure their climate-related risks across three large areas:

- **Climate-related (Physical) Risks:** Measuring direct and indirect exposures to emissions and other elements of the sustainability agenda³ requires access to comparable, consistent, verified information from corporations regarding these physical components. Financial firms increasingly use a broadening range of data points to estimate climate-related risks and opportunities. In the near-term they will also begin to re-price existing assets in order to account for implicit, embedded climate-related risks. The risk re-pricing challenges are considerable. Additional risk pricing challenges arise as new environmental regulations

"Without a doubt, financial market participants form expectations on both factors – the likely pathway of carbon prices and additional measures – to gauge the implications for asset prices. However, these expectations are conditional on the information available. Thus...sufficient information can be regarded as a precondition for the needed allocation of resources towards a greener economy."

--Bundesbank Gov. Weidmann

"Since past performance indicators offer limited insight into future risks and opportunities, forward-looking climate metrics are needed to assess companies' expected climate performance... However, there is currently insufficient information with respect to key forward-looking metrics to help judge whether firms are on a credible path to transition."

--Network for Greening the Financial System Report (April 2022)

"...climate change has become a risk that is too important for investors to ignore...The transition to a low-carbon economy will impact every sector. It is not just about renewables and electric vehicles. Greening will have to take place across all industries – steel, cement, mining, buildings, construction, maritime, agriculture, the list goes on. Given the scale of the transformation, asset values will change quite fundamentally."

--The Future of Capital is Green, Speech by Ravi Menon, Monetary Authority of Singapore (November 2021)

³ "...nature-related risks, including those associated with biodiversity loss, could have significant macroeconomic implications, and that failure to account for, mitigate, and adapt to these implications is a source of risks for individual financial institutions as well as for financial stability." *Statement on Nature-Related Financial Risks*, Network for Greening the Financial System (24 March 2022).

emerge, creating balance sheet constraints for firms implementing the new requirements.

- **Climate-related Financial Risks:** Trading markets for green bonds (corporate and sovereign) as well as green indices remain relatively shallow and prone to accusations of greenwashing. Assessing market liquidity and credit risks related to both green and brown assets requires a layer of market data in addition to mandated regulatory disclosures. Unless and until markets are pricing sustainability at scale *and across the term structure*, assessing climate-related financial risks beyond the physical environment will remain challenging.
- **Macro-Policy Risks:** Fiscal policy (taxes, subsidies), monetary policy (Green QE), macroprudential policy (bank stress tests), trade policy (tariffs), and geopolitical policy shifts that accelerate the green transition will generate significant horizontal effects across entire economic sectors. Markets continuing to price risk assets without perspective on the shifting macropolicy context face the risk of underestimating the scale and pace of change. This increases the risk of asset mis-pricing if markets are measuring interest rate risks based on traditional criteria and data amid central bank efforts to begin incorporating climate change into their rate-setting and collateral policy processes.

These are multi-dimensional moving targets with embedded reaction functions that remain undefined.

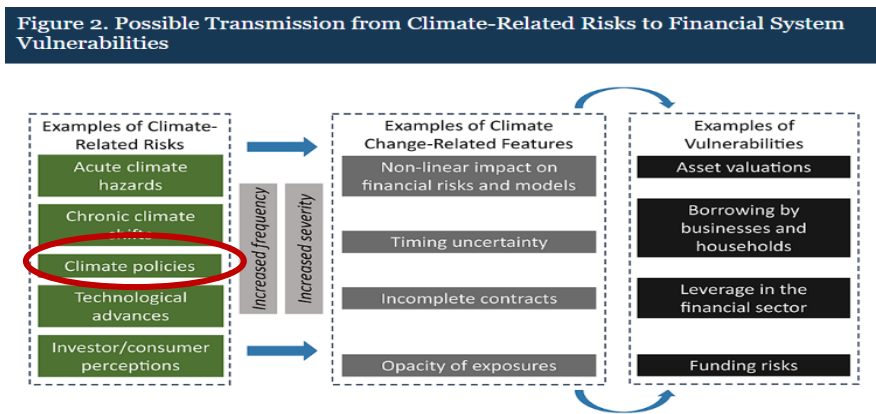
Today's public policy and market decisions will materially impact how climate-related risks are perceived, measured, and priced. They will also materially impact the scale, pace, and content of second-round regulatory requirements and, ultimately, the trajectory of the climate transition.

If the financial sector is to fulfill its role of pricing risks accurately and incentivizing welfare-enhancing behavior from a sustainability perspective, firms will need significantly more data beyond that which is under discussion for audited financial statements. A number of those risks have never been measured, complicating incorporation of new or alternative data into existing risk models.

Regulatory risks are part of the climate risk ecosystem. The first round of climate change scenarios and stress tests devised by central banks and financial regulators incorporate implicit assumptions regarding climate policy by defining scenarios with reference to whether the transition to a Net Zero economy by 2050 is fast, "delayed" or disorderly. The scenarios all attempt to measure the economic impact associated with increased carbon prices and/or increased environmental disruptions that lead to financial losses.

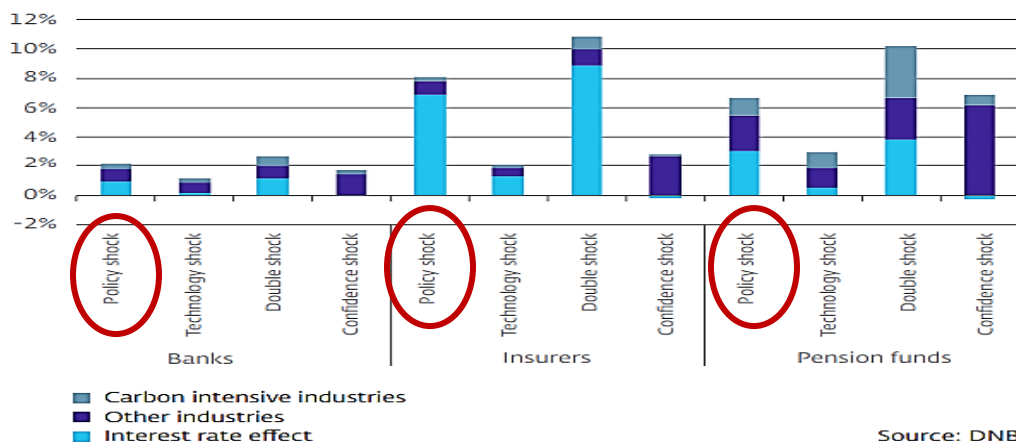
Policymakers increasingly reference public policy risks as a component of climate-related risks. The Bank of

Japan,⁴ the United Nations,⁵ and the International Sustainability Standards Board (ISSB)⁶ include public policy as a core climate-related transition risk. The ISSB is proposing that firms disclose specific metrics related to exposures to public policy risks among other climate-related transition risks. Federal Reserve research during 2021⁷ expressly included public policy risk as an example of climate-related risks:



In 2018, De Nederlandsche Bank estimated the financial sector impact of a “policy shock”⁸:

Figure 4.2 Impact on assets as a percentage of total stressed assets per sector, disaggregated by risk driver



Source: DNB.

⁴ “climate-related financial risks differ from conventional financial risks, in that (1) the degree of uncertainty regarding the nature and impact of climate change and related policy and technological changes is much greater, (2) the time horizon over which risks materialize is much longer, and (3) there are significant data gaps.” *Financial System Report*, Bank of Japan (April 2022).

⁵ *Economic Impacts of Climate Change: Exploring short-term climate related shocks for financial actors with macroeconomic models*, United Nations Environment Program Finance Initiative (May 2022).

⁶ Specifically, the entity shall disclose: (a) a description of significant climate-related risks and opportunities and the time horizon over which each could reasonably be expected to affect its business model, strategy and cash flows, its access to finance and its cost of capital, over the short, medium or long term. (b) how it defines short, medium and long term and how these definitions are linked to the entity’s strategic planning horizons and capital allocation plans. (c) whether the risks identified are physical risks or transition risks. For example, acute physical risks could include the increased severity of extreme weather events such as cyclones and floods, and examples of chronic physical risks include rising sea levels or rising mean temperatures. Transition risks could include regulatory, technological, market, legal or reputational risks.” [DRAFT] *IFRS S2 Climate-related Disclosures*, International Sustainability Standards Board (March 2022).

⁷ *Climate Change and Financial Stability*, FEDS Notes, Board of Governors of the Federal Reserve System (March 2021)

⁸ “Policy Shock” was defined as a “a set of policies that aim to reduce CO2 emissions leading to an increase in the effective carbon price of USD 100 per ton” over a period of 5 years. They found such a policy shock delivered 1970’s style stagnation for the first three years. *An energy transition risk stress test for the financial system of the Netherlands*, De Nederlandsche Bank Occasional Studies Volume 16-7 (2018).

Shifts in regulatory policy create risks for firms and investors. Balance sheet risks related to regulatory shifts regarding climate/emissions targets are real and, in some cases, material. Well-meaning regulatory policy changes will generate horizontal impacts on entire economic sectors, but the impact will not be uniform. Some firms have management teams that are more prepared than others for the climate transition. Some portfolios are better hedged than others.

Firms are not yet measuring quantitatively their exposure to climate-related public policy risks even as they scramble to find the latest emissions data from connected industrial devices and sustainability ratings. Why? Because public policy risks present verbally, while markets price risks quantitatively. Until recently, it has not been possible to convert those words into numbers that markets could use to price and measure risk.

The time has come for financial firms to begin measuring portfolio exposures (and the exposures of the companies in which they invest or to which they lend) to regulatory policy shifts.

We believe our company's award-winning patented process for generating objective quantitative data from public policy language (PolicyScope data)⁹ can help financial professionals adopt data-driven approaches to risks related to the momentum and scale of public policy shifts globally and daily. Quantifying momentum and policy trends objectively, using language sourced ethically from the official sector and media data mining licenses provides investors, ad analysts, (including advocates) with the ability to make data-driven strategic decisions dynamically. Investors can assess daily where policymakers are most active and adjust in step with shifts in the official sector.

This CRRM³ White Paper assesses how alternative data can support pre-trade risk measurement and strategic portfolio management. It also assesses how climate-related alternative data can facilitate rational re-pricing of existing risk assets, including language-derived data from the policy process itself.

Measuring climate-related public policy risks represents only one dimension of the climate risk pricing process. But it is a crucial one given the dramatic shifts likely in public policy over the next 3-5 years. This White Paper Series represents our humble contribution to that conversation.

⁹ [United States Patent: 9436726 \(uspto.gov\); www.bcmstrategy2.com](https://www.uspto.gov/patents/9436726)

CLIMATE-RELATED RISK – THE CURRENT ALTERNATIVE DATA LANDSCAPE

Capital markets need data the way that people need oxygen. It is a necessary input for survival. Within capital markets, quantitative data reflects an observable fact, usually based on volume, which has a material connection to economic or balance sheet valuations (e.g., temperatures, revenues, GDP growth).

The same data point can simultaneously deliver a windfall profit to one portfolio manager while imposing losses to another. Differential impacts are a function of portfolio structure and management quality.

Data suitable for use in the investment process is famously sparse. Well-known inconsistencies and data gaps characterize the climate-related risk landscape:¹⁰

- Not all firms currently track carbon or other emissions.
- Not all firms are significant emitters.
- Measuring carbon footprints consistently across a value chain remains a challenge.
- Firms prioritize different components of the sustainability agenda.
- Policymakers themselves grapple with definitional issues, which is a condition precedent for defining indicator metrics.
- Finally, even familiar metrics can be and are being reformulated to reflect the changing planet.¹¹

"our scientists designed all of these alternative ways of defining 'normal' to provide a better estimate of current or future climate conditions in an era of climate change...They can be especially helpful in long-term planning applications like determining where to build a power plant."

--NOAA

When even governments start issuing new kinds of data regarding familiar items (such as temperatures) in order to support strategic decision-making, it is clear that a moment in the sun has arrived for alternative data.

In addition, traditional data may have limited utility in the climate-related risk context.¹² Prior measures of economic activity did not include factors for climate-related externalities. More advanced data collection methods and new perspectives on what kind of metrics might matter generate demand for, and acceptance of, new data.

The current race to acquire new data and analyze it seems likely to generate new approaches to risk measurement and pricing in the coming years. Financial firms are understandably cautious when deploying "alternative" data within risk measurement and risk pricing models. Rigorous due diligence requirements and fiduciary obligations demand that new data sets deliver the same reliability and integrity as traditional data.

Five distinct types of alternative data currently

¹⁰ *FinTechs and the ESG Data Challenge*, BNP Paribas (2021); Bank of Japan Financial System Report (April 2022).

¹¹ *Defining Climate Normals in New Ways*, National Oceanic and Atmospheric Association (May 2021)

¹² "...current data used for green certification are mostly backward-looking, being based on existing or past environmental impact, and are thus of limited use for determining the future impact of green investments." *Greening the Financial System Report*, Network for Greening the Financial System (April 2022).

support climate-related investment and risk management decisions:

- Government-issued data (physical, stress tests, scenario analysis);
- Habit/Connected Device data;
- Aggregated Data and Analysis (i.e., ESG Ratings and Indices);
- Verbal Data (securities filings, news feeds); and
- Government Policy Data.

We expect the number and types of alternative data regarding climate-related risks to grow substantially over the next five years.

GOVERNMENT DATA: PHYSICAL DATA, STRESS TEST OUTCOMES, SCENARIOS

Physical Data: Government-issued quantitative data normally serves as the gold standard for objective, unbiased data to which no data privacy rights attach. It includes economic aggregates (e.g., unemployment rates, GDP growth rates, inflation rates) and physical observation data. It also includes the results of government-run studies that publish aggregated private sector data or publicly require specific data points be used by the private sector when assessing risks (e.g., climate scenarios, stress tests, quantitative impact studies, official sector dashboards).

Many of these traditional data points are being augmented, amplified, and recalculated in response to climate change.

¹³ *Progress report on bridging data gaps*, NGFS Report, May 2021; *Dashboard on Scaling Up Green Finance*, Network on Greening the Financial System (March 2021).

¹⁴ <https://climatedata.imf.org/pages/fi-indicators>

¹⁵ The NGFS has issued special scenarios targeting both transition and climate impact issues. Both are available through web-based interfaces

Governments and international organizations increasingly are compiling and issuing alternative data.

A range of entities has already made good progress on creating initial dashboards, particularly the Network for Greening the Financial System (NGFS)¹³ and the International Monetary Fund (IMF).¹⁴ These dashboards focus on supporting scenario analysis, including specially designed and data-rich scenarios¹⁵ issued by the NGFS itself.

The NGFS dashboard tracking government initiatives¹⁶ provides a dynamic web-based tool with a rich underlying and accessible structured data that permits access to national-level aggregates in addition to regional aggregates. It is a valuable resource, but it has limits.

Understandably, the key components are predominantly physical in nature. Components addressing public policy attempt to measure *compliance* with key standards. Metrics include the number of firms aligning disclosures with recommendations from the Task Force on Climate Disclosures on an *ex post* basis.

It is a good starting point for analysis, particularly for pinpointing potential financial system vulnerabilities. But stress tests and scenario analysis provide limited if any insight into the direction of policy formation.

The IMF's "Climate Change Indicators Dashboard" (published for the first time in early 2021) focuses predominantly on quantitative

displaying visualizations and time series data: [NGFS Scenarios Portal](#)

¹⁶ *Dashboard on Scaling Up Green Finance*, Network on Greening the Financial System (March 2021); *Note on the Dashboard for Scaling Up Green Finance and Data Gaps*, Network on Greening the Financial System (April 2021).

financial, physical and transition risk indicators. The web-based interactive dashboard includes the following components:

- Classic global indicators of physical climate change (global surface temperatures, CO₂ concentrations, sea level changes, climate-related disaster frequency data) and emissions (greenhouse gases, carbon)
- IMF estimates of embedded carbon emissions within national accounts (domestic demand and production, imports, exports, gross fixed capital formation, corporate ownership, direct investment).
- Financial indicators mostly reflect sovereign green bond issuance as well as IMF estimates for “carbon footprint-adjusted loans” relative to total loans for deposit-takers. National total non-life insurance premia as a percent of GDP are also depicted as a proxy for natural disaster/property damage related to climate change.
- Fiscal Policy Indicators include national aggregates for environmental taxes, environment protection subsidies, and fossil fuel subsidies.
- Analytical data: IMF staff have generated risk assessment scores showing preparedness levels for climate-driven hazards (e.g., natural disasters) and anticipated resilience/exposure to the transition to a low carbon economy.

Robust data from the IMF comes at a cost: timeliness. The most recent data available through the IMF dashboard dates to 2019. The IMF data have not yet been updated to reflect the proposed carbon border adjustment tax in

the European Union or the considerable subsidy programs implemented in advanced economies as part of broader COVID-19 relief packages in 2020. Failure to deliver timely data to market participants render the data nearly useless for real time risk pricing and management. Fortunately, the Organization for Economic Cooperation and Development (OECD) has published aggregated data demonstrating the distribution of green-related subsidies in response to the pandemic¹⁷:

Environmental impact of COVID-19 recovery measures by country

The impact of policies on the environment is illustrated by the following colours: positive, negative, or mixed impact.



Governments also revise periodically their own data collection and compilation standards, creating breaks in time series data even when the publisher remains the same.

Consider again the global temperature aggregates prepared by NOAA highlighted earlier in this report. Temperature averages are now being calculated on a rolling 30-year basis rather than against a fixed point. Multiple statistical methods are also being used. A single indicator is now being replaced with multiple versions, complicating comparisons with historical data.

¹⁷ *Assessing environmental impact of measures in the OECD Green*

Recovery Database, Organization for Economic Cooperation and Development (April 2022).

The central bank Network for Greening the Financial System (NGFS) and the Financial Stability Board (FSB) seek to bridge data gaps in part by delivering to markets an online directory of “important climate data sources,” including alternative or private sector data sources. These directories remain a work in progress. The NGFS directory is notable for its intended use as a foundation “to propose practical solutions and policy recommendations to bridge the climate data gaps and maximize the availability of climate data for the financial sector.”¹⁸ The FSB seeks to include only data that are available without a fee. The Federal Reserve also is collating and may share publicly a list of data sets they believe are best suited to support both risk modeling and research.¹⁹

“Unlike episodic or transitory shocks, climate change is an ongoing, cumulative process, which is expected to produce a series of shocks. Over time, these shocks can change the statistical time-series properties of economic variables, making forecasting based on historical experience more difficult and less reliable...even well-informed investors could underestimate the likelihood of large shocks related to climate change, resulting in systematic mispricing of risk...finally, vulnerabilities could result if climate risks in the aggregate are systematically correlated cross participants in the economy and financial system. These correlated aggregate exposures could be missed by risk models and difficult or impossible to mitigate fully.”

--Federal Reserve Governor Lael Brainard (March 2021)

We do not seek to debate the merits of these or other data points. We admire the innovation in the official sector and the effort to support data-driven decisions. We draw attention to the limitations of these data points for a simple reason: acquiring solid data to support decisions is far from straightforward even when the publishers are trustworthy governments.

Some official sector aggregates may not be

relevant to capital markets. Consider IMF efforts to adjust loans based on carbon footprint estimates. While it is true that economists are actively debating how such adjustments could occur at the loan level, it is also true that markets are not currently using these approaches to price credit risks at scale.

The calculation method matters greatly. For example, in 2010, The Guardian estimated the carbon footprint of a typical UK mortgage to be equivalent to two long-haul airline flights based on an input/output analysis that aggregated how much carbon banks contribute to the environment through their business

operations in relation to total UK emissions.²⁰ The journalists recognized that the measure was imperfect and recommended that consumers offset the carbon contribution from their mortgage activity by either borrowing from climate-conscious banks and/or foregoing home purchases financed by mortgages.

Much has changed in a decade, of course. Oliver Wyman and S&P Global recently teamed up to create a stress testing tool to assess different

¹⁸ *The NGFS launches a consultation on its repository of climate data needs and available sources*, Network on Greening the Financial System (26 April 2022)

¹⁹ *Building Climate Scenario Analysis on the Foundation of Economic*

Research, Federal Reserve Gov. Lael Brainard (Oct. 2021).

²⁰ *What's the carbon footprint of...a mortgage?* The Guardian (16 Sept 2010) [What's the carbon footprint of ... a mortgage? | Environment | The Guardian](#)

climate scenarios using S&P Global Market Intelligence data.²¹ The move advances considerably the capacity for financial markets to adopt more rigorous risk pricing processes by incorporating market data alongside increasingly standard assumptions regarding hypothetical shifts in global temperatures and related economic stress.

It will take time for investors and policymakers to reach consensus on which carbon metrics to use. No agreement yet exists on which specific metric is most valuable.

As the data points listed in the table²² here illustrate, a range of alternative data are now considered credible for measuring and managing financial risks. To the extent that the datapoints are collected using non-traditional methods (see the next section), they also qualify as alternative in nature.

None are yet generated or aggregated by governments.

Whether using traditional government data or alternative data generated by government processes, the data serves the same purpose: to assess exposure to climate-related risks. Given that capital markets typically require multiple

years of historical data in order to conduct statistical validation and forecasting, the acceptance of alternative data to support even qualitative decisions itself is notable.

But none of these data points provide perspective on the volume or volatility of government policy itself, which is a key driver in directing private sector behavior. The emerging standards for climate-related disclosures similarly focuses (understandably) on items related to the physical environment.

Table 3.2 Common High-level Carbon Metrics

Metric	Description
Portfolio Carbon Footprint	• Total carbon emissions for a portfolio normalized by the market value of the portfolio, expressed in tons CO ₂ emissions/\$M invested.
GHG Emissions	• Absolute Scope 1, Scope 2, and Scope 3 GHG emissions.
Absolute Scope 1, Scope 2, and Scope 3	• Financed emissions by asset class. • GHG emissions per MWh of electricity produced. • Gross global Scope 1 GHG emissions covered under emissions-limiting regulations.
Carbon Intensity	• Volume of carbon emissions per million dollars of revenue (carbon efficiency of a portfolio), expressed in tons CO ₂ emissions/\$M revenue.
Exposure to Carbon-Related Assets	• The amount or percentage of carbon-related assets in the portfolio, expressed in \$M or percentage of the current portfolio value.
Transition Risks	• Volume of real estate collaterals highly exposed to transition risk.
Assets or business activities vulnerable to transition risks	• Concentration of credit exposure to carbon-related assets. • Percent of revenue from coal mining.
Climate-Related Opportunities	• Net premiums written related to energy efficiency and low-carbon technology.
Revenue & assets aligned with climate-related opportunities	• Number of (1) zero-emissions vehicles (ZEV), (2) hybrid vehicles, and (3) plug-in hybrid vehicles sold. • Revenues from products or services that support the climate transition. • Proportion of homes delivered certified to a third-party green building standard.

Sources: TCFD (2020 and 2021).

The absence of standardized, comparable data alongside an increasingly urgent need to begin assessing the potential economic impact of climate change requires policymakers to become creative in their risk assessment processes. Scenarios and stress tests have become the primary mechanism used by central

²¹ *The Link Between Climate Change and Credit Risk*, Oliver Wyman (2021) [Climate Credit Analytics: the Link Between Climate Change and Credit Risk \(oliverwyman.com\)](https://www.oliverwyman.com/insights/publications/2021/04/the-link-between-climate-change-and-credit-risk)

²² Network for Greening the Financial System Report (April 2022).

banks and financial regulators to identify vulnerabilities.

Stress Test and Scenario Outcomes: Stress test and scenario analysis outcomes provide both policymakers and markets with standard benchmarks for assessing possible vulnerabilities. But these tools have limited utility for daily risk management due to their extended time horizons (stretching to 2050 and beyond), lack of granularity, and a focus on physical rather than financial performance aggregates.²³ These limitations create incentives for policymakers and financial firms to craft more targeted near-term scenario and stress test frameworks that incorporate components simulating macroeconomic policy reaction functions in response to near-term price disruptions.

The United Nations Economic Program leads the way in May with the publication of the first comprehensive near-term scenarios that estimate the economic impact of climate-related shifts such as (i) the (adverse) impact on investment due to credit constraints triggered by a sharp increase in carbon pricing and (ii) the impact on GDP and inflation from implementation of a carbon tax and (iii) the impact on government debt from a trade war triggered by a carbon border adjustment tax.²⁴

The outcomes from scenario analysis and stress tests deliver to markets data that can be useful for comparison, benchmarking, strategy formation and investment strategy. The data

may not be “hard data” because they reflect hypothetical values for possible future activity. But in the absence of concrete risk assessment data from individual firms at the asset or portfolio level, they represent a starting point from which the official sector and markets will be assessing climate-related financial risks.

HABIT/CONNECTED DEVICE DATA

Markets and the private sector are innovating as well. Real-time data can now be sourced directly from industrial machines, automobiles, farm equipment, and satellites in order to provide markets with data on weather-related shifts and mitigation efforts that impact emissions.

These data sets are considered alternative because they are collected using new technologies: connected devices²⁵ which generate and transmit habit and environmental data automatically. Automation addresses both timeliness and reliability/integrity issues as long as instrument calibration remains consistent.

This category of alternative data generates challenges regarding data normalization and comparability. Instruments can measure different items; calibrations can differ; local usage and machine maintenance practices may vary. Consequently, even identical devices can generate different readings.

Deploying connected device data for use in capital market risk pricing also requires a high degree of processing and analysis before financial firms can incorporate the data points

²³ *Economic Impacts of Climate Change: Exploring short-term climate related shocks for financial actors with macroeconomic models*, United Nations Environment Program Finance Initiative (May 2022).

²⁴ *Id.*

²⁵ [Alternative Data & Volatility Frontiers | LinkedIn](#)

into their automated workflows that focus on enterprise value and risk regarding tradeable instruments.

Automated data processing promises to provide policymakers and portfolio managers with significantly expanded, timely data sets to measure and manage a range of climate-related risks arising from environmental shifts as well as human habits. But adapting connected device data to capital market use cases requires alignment to tradeable instruments like equities, bonds, and currencies.

Consider the Intercontinental Exchange (ICE) acquisition of two alternative data companies recently. Each company paired geospatial data with third party corporate and other data to generate a climate risk analytics and decision tools. ICE mapped the data to three sets of financial securities: U.S. municipal bonds, mortgage-backed securities, and real estate markets.²⁶ But it is not clear whether this dataset could be used to assess U.S. equity market risks or risks in non-U.S. regions.

Finally, not every kind of climate-relevant data can be collected easily. Consider methane emissions related to livestock. Few would consider it feasible to insert measurement devices in cattle...which famously roam. Traditional data (e.g., volume measurements in terms of heads of cattle) paired with assumptions about average methane emissions are currently used to generate alternative data (estimated methane emissions from the cattle industry).

Deploying connected device data within capital markets also requires a level of due diligence by financial firms to ensure that the data sets not contain personally identifiable information such as cell phone records or car driving histories. The compliance risks are far from trivial. The Securities and Exchange Commission and markets themselves have become increasingly strident in their efforts to ensure that inappropriately collected information is not used by financial firms.²⁷

Firms committed to ethical data sourcing will likely see increased traction and contracting rates from financial firms relative to other data vendors that are slow to adjust their data collection processes. The effort required to anonymize connected device data may also price some vendors out of the market as they conclude that the cost of cleaning the habit data exceeds the price markets are ready, willing, and able to pay for the data points.

ESG RATINGS AND RISK INDICES

The challenges associated with collecting, cleaning, and harmonizing climate-related data lead markets to off-load assessment tasks to third parties like external rating agencies and consultants. ESG ratings and tradeable indices are particularly attractive mechanisms that enable investors to acquire actionable, perspectives on climate-related risks for individual firms without incurring the compliance risks associated with direct data purchases.

²⁶ ICE Expands Climate Change and Alternative Data Capabilities With Acquisitions of risQ and Level 11 Analytics, BusinessWire (9 December 2021).

²⁷ SEC Charges App Annie and its Founder with Securities Fraud,

Securities and Exchange Commission (14 September 2021)>

The dynamic and business case is a familiar one. Relying on robust third-party ratings can help de-risk an investment or risk decision efficiently by depending on validated expert judgement.

Third party ESG and Green ratings are proliferating. Major rating agencies (Fitch²⁸, Moodys,²⁹ S&P/MSCI³⁰), exchanges (ICE,³¹), and niche providers³² all purport to provide investors with expert judgement regarding corporate sustainability practices. The breadth and scope of coverage is impressive given that these ratings did not exist a few years ago.

Because external ratings are characterized by a high degree of professionalism, quality assurance, and market validation, the risk of implicit bias associated with expert opinions that generate the ratings is reduced considerably.

But it is not zero.

The choice of benchmarks and metrics against

which companies are judged is subject to some selection bias. Moreover, minimizing bias requires access to objective, quantitative data. While great strides are being made in data collection and normalization, this is far from a trivial task.

Official sector concerns regarding ESG ratings tend to focus on their heterogeneity. Well-established credit ratings frameworks use different proprietary mechanisms to estimate default probabilities, but they are still all

focused on the same metric: the risk of default. ESG rating processes, by contrast, vary dramatically.

Some ESG ratings measure only emissions; others measure broader sustainability elements. Some deliver a composite score for all three elements (environmental, social, governance). Few if any ratings provide perspective on how

"...ESG rating agency frameworks differ materially, and their environmental pillar scores are not well aligned with climate emissions, intensity, or evidence of reduction in intensity...(because they) reflect a wide range of factors, including physical risks, climate risk governance, waste, etc. that can contribute to financial materiality over the medium term."

--NGFS Report (April 2020)

²⁸ "Sustainable Fitch" provides comprehensive ESG Ratings regarding both issuers and individual instruments for all asset classes globally. *Climate Change & Credit Ratings: Climate Risk in Debt Capital Markets* (fitchratings.com)

²⁹ Moody's rates 300+ loans and bonds linked to green, social, and sustainability priorities. It has issued over 10m climate risk scores to sovereign and private issuers. It has also systematically incorporated climate considerations into all credit rating decisions, although the mechanism by which the climate element impacts the credit rating is unclear from publicly available materials. It did, however, made available to the market climate risk assessment tools during 2021. [Moody's ESG](http://moody's ESG) (moody's.io)

³⁰ Through MSCI, S&P has issued over 2,900 public company ESG and climate ratings. The ratings cover a diverse range of issues from Implied Temperature Rise, Decarbonization Target, ESG Rating, and ESG Rating

history. They also provide ESG rating aggregates by industry and by industry-specific ESG Key Issues through a tool that facilitates benchmarking and comparisons. [ESG Ratings & Climate Search Tool - MSCI](#)

³¹ ICE provides markets with a range of sustainability indices to facilitate risk pricing in relation to carbon and green bonds [Sustainability Indices | ICE \(theice.com\)](#). They also provide tools to measure municipal market issuer exposure to key physical climate/catastrophe/weather events (flood, wildfire, heat, hurricane). [ICE Climate Risk | ICE \(theice.com\)](#)

³² For example, Insight Investments has issued 1700+ climate ratings on private sector corporate issuers using a process "aligned with the framework developed by the Financial Stability Board's Task Force on Climate-related Financial Disclosures (TCFD)." [Prime climate risk ratings | Insight Investment](#)

ESG scores impact core enterprise risks important to financial analysts (credit risk market risk, operational risk, liquidity risk). In fairness, the precise relationship between any or all climate/sustainability ratings and default probabilities, loss given default, and liquidity risk has not yet been determined. Significant research is underway within the risk profession to define the appropriate risk measurement mechanisms. This could take time.

Measurement challenges abound. For example, a high volume or high amount of best-in-class sustainability corporate policies may not carry consistently positive correlations regarding good stewardship. The policies may have been issued in response to a court order or a shareholder derivative lawsuit following a documented problem.

More difficult yet is the time horizon and identifying how to incorporate changed behavior into risk models. Estimates of rising fluvial levels can adversely impact shoreline property values. But gradual shifts provide mortgage holders, lenders, and insurers time to adjust. The distribution of default rates and related losses on those properties is a function both of borrower behavior (default probability) and bank risk mitigation (capital buffers, new or different kinds of collateral to secure the loan). Rapid loss of value due to extreme weather events presents different risk characteristics. Serious assessments of these and related risk measurement conundrums are only just beginning.

³³ "ESG benchmark administrators rely on a wide array of methodologies to construct ESG benchmarks, which retail investors may not be fully aware of, while such differences can lead to different outcomes...(and) high overlap can be observed between the

Securities regulators are raising red flags regarding the impact that dramatically different ratings processes can have on investor protection and market integrity.³³

Finally, and most importantly, issuers and obligors face considerable and unique risks related to public policy shifts in the climate context. The heterogeneous rating frameworks at least share one common characteristic: they attempt to assess a company's exposure and preparedness to actual physical climate risks. Robust assessments of management quality are an important contributing factor when pricing credit risks and equity values, so markets are making some progress.

However, no ratings framework yet has the capacity to assess *quantitatively* the company's exposure to shifts in climate-related public policies like carbon taxation, securities disclosure regulation, or Green QE. To the extent that these factors are taken into consideration, it is only through expert, informed opinion.

LANGUAGE DATA: SECURITIES FILINGS & NEWS FEEDS

Technological advances in Natural Language Processing (NLP) expand the universe of potential data inputs from the quantitative to the verbal. Technology facilitates the acquisition and analysis of language content automatically and at scale to support analytical functions.

In the climate context, ample supply exists of

constituents of some ESG and non-ESG benchmarks with some ESG ETFs displaying a 99% correlation with the S&P 500. ²³ These issues raise the prospect of misalignment between investor expectations and the environmental and social impact of investments tracking ESG indices." *Joint Committee Report on Risks and Vulnerabilities in the EU Financial System* (March 20220).

words to assess corporate sustainability. The nearly infinite availability of information through electronic and media channels paired with discontinuous release cycles and the noise of the news cycle turbocharged by social media ironically makes it harder for stakeholders to find concrete facts amid an ocean of opinions.

The resulting information overload undermines efforts to deliver meaningful metrics to support action and mutes market discipline. It is thus hardly surprising to learn that corporate disclosures themselves have been mostly general rather than quantitative and specific³⁴ and that the amount of discussion regarding climate initiatives in annual reports did not necessarily correlate with actual business initiatives. Indeed, recent International Monetary Fund (IMF) research indicates that better ESG scores did not deliver statistically significant correlations regarding slower emissions growth.³⁵

"...because they are voluntary, companies that choose to disclose under these frameworks may provide partial disclosures or they may choose not to participate every year. In addition, the form and content of the disclosures may vary significantly from company to company, or from period to period for the same company... which can hinder investors' ability to understand and compare registrants' climate-related disclosures...Further, much of this climate-related information, particularly GHG emissions and targets, appears outside of Commission filings, in sustainability reports, and on corporate websites. Other analyses of current climate reporting have found a lack of transparency and standardization with regard to the methodologies companies apply in disclosing climate-related information."

--The Enhancement and Standardization of Climate-Related Disclosures for Investors (proposed rule), Securities and Exchange Commission (April 2022).

century, making securities filings available in XBRL³⁶ format. The move accelerated the analytical process associated with investment decisions. Sophisticated market participants quickly pivoted away from having human analysts read regulatory filings; they delegated the initial steps in the analytical process (ingesting and sorting information by category) to computer-based automation. Efficiency gains as well as advanced insights ensued.

Automated access to analytical information using language has gained momentum and depth in the ensuing years amid rapid development of increasingly advanced technology to parse and tag verbal data. Open source technology makes it possible also to acquire at scale and parse all language data filed by U.S. securities

issuers through the EDGAR system.³⁷

Securities Filings: The Securities and Exchange Commission was an early adopter of language technology at the start of the 21st

³⁴ Julia Anna Bingler, Mathias Kraus, Markus Leippold, *Cheap Talk and Cherry-Picking: What ClimateBert has to say on Corporate Climate Risk Disclosures*, March 2021.

³⁵ *Limits to Private Climate Change Mitigation*, IMF Working Paper WP/12/112, April 2021.

³⁶ eXBRL (eXtensible Business Reporting Language) "is a software standard that was developed to improve the way in which financial data is communicated, making it easier to compile and share this data...(it) uses tags to identify each piece of financial data, which then allows it to be used programmatically by an XBRL-compatible program. XBRL allows for easy transmission of data between businesses." eXtensible Business Reporting Language (XBRL) (investopedia.com)

³⁷ OpenEDGAR: Open Source Software for SEC EDGAR Analysis, MIT Computational Law Report (20 November 2020) [MIT Computational Law Report](#)

Language is the data.³⁸ It supports a range of use cases that eliminate the need for humans (professional, institutional investors) to read securities disclosures. For example, NASDAQ automatically receives and compiles corporate securities filings in order to generate standardized ESG metrics for each firm.³⁹ Machine readers process the language of those filings and aggregate/categorize the information based on decision rules set by human experts. Those data feeds are then made available to institutional investors that use them to support analysis as well as investment product construction.

Large capital market participants like Blackrock⁴⁰ and Invesco⁴¹ undertake similar verbal data mining and combine that data with other inputs to generate investment vehicles such as exchange-traded funds available to retail market participants seeking investment opportunities with a climate focus. These tools and the investment products built using these tools are particularly useful in the climate-related finance context given the wide variation of language and metrics used by firms to disclose to markets their climate risk mitigation, stewardship, and leadership initiatives. They increase the efficiency of capital allocation to firms and sectors perceived to operate using best practices and making headway in reducing carbon emissions.

However, they do not generate a complete picture of a firm's exposure to climate-related financial risks.

The new public disclosure standards under consideration simultaneously in the European Union, the United States, and at the international

level strive to improve the information available to investors regarding a firm's potential climate exposures. If the current consultation processes remain on track, the first disclosures will be ready for markets during earnings season in 2024.

The new disclosure standards will be important, but limited in scope. The current proposals if implemented would provide more perspective on which firms generate more direct greenhouse gas emissions than others. Global and consistent comparative analysis will help market discipline operate properly. But the quantitative disclosures will not provide perspective on a firm's potential economic exposure to climate-related risks. Analysts and strategists will need to extrapolate from verbal rather than quantitative disclosures to assess risk to economic enterprise value. Risks assessments in the near-term seem likely to remain rooted in hypothetical scenario and stress test outcomes. It's better than nothing.

In this context, many are likely to welcome the SEC proposal that firms disclose publicly material assumptions and parameters used when undertaking scenario and stress test analysis. Providing this information would deliver improved transparency to capital market processes. But the reality remains that a firm's contribution to climate risk through emissions is fundamentally different from a firm's exposure to climate-related risks from obligors and suppliers, not to mention its exposure to shifts in public policy.

Technology may facilitate and automate the process of reading voluminous and dense materials, but it cannot cure the lack of comparability. The language and metrics used

³⁸ *Language is Data: Measure it Objectively*, AltData & Volatility Frontiers, LinkedIn (February 2022).

³⁹ *ESG Reporting - Sustainability Reporting Software | Nasdaq OneReport*
This tool is one of many ways in which NASDAQ delivers ESG-related data and investment decision support tools to capital markets.

⁴⁰ *BlackRock Sustainability | BlackRock*

⁴¹ *Invesco ESG ETFs: Investing for a brighter tomorrow | Invesco US*

by firms to disclose climate-related risks and sustainability initiatives is famously heterogeneous. Data filed by issuers with their securities regulators may incorporate some bias. More importantly, the legal (and sometimes criminal) penalties associated with misstatements or omissions of material facts constrain considerably how much and what kind of information issuers can release in their regulatory filings.

In rapidly moving normative contexts (such as those related to climate risk) which include a growing number of well-funded activists and stakeholders, potential litigation risks associated with even well-meaning disclosures encourages firms to be careful about what and how they depict their sustainability initiatives and climate-related risks. Indeed, many in the climate community view with disappointment the inability of global or national-level regulatory officials to define robust, concrete, binding requirements for issuer disclosures regarding specific climate-related metrics such as emissions and pollution.⁴² To minimize the chilling effect on disclosures, the SEC staff has proposed a series of exemptions.

Automating the process of reading securities disclosures generates operational efficiencies for equity analysts seeking to spot trends, patterns, and outliers regarding sustainability disclosures by securities issuers. But these tools by definition cannot provide perspective on potential future regulatory and compliance risks. Nor do they provide the kind of data needed to assess a firm's exposure to financing risks or inflation related to climate-related monetary policy or climate-related regulatory capital requirements on banks.

⁴² *Financing the Future: Measuring and Reporting Climate-Related Risks,*

Automatically analyzing securities filing language cannot assess potential benefits or competitive challenges associated with the distribution of subsidies and green bond revenues or sustainability taxes.

Additional tools are required to assess exposure to shifts in the cost structure of a business associated with shifts in government policy.

News Feeds: The current risk assessment process regarding public policy is surprisingly analog and highly dependent on human expert judgement. Some automated language parsing tools currently exist, but they tend to focus primarily on the legislative process (which moves slowly) and the news cycle (which moves quickly but is dominated by noise). The majority of these tools deploy sentiment analysis to identify likely legislative intent.

Measuring policy trends based on sentiment is, at best, a flawed approach.

Legislators can support new laws and standards for a range of reasons, some of which have nothing to do with the underlying substance of the legislation. Legislators can trade support for different draft laws in order to advance two bills at the same time. In the United States, campaign contributions can impact policymaker priorities. Polling and public opinion – the will of the people – as well as the most recent election results will drive the values and priorities for legislation, but they are not necessarily dispositive of regulatory outcomes. Finally, implementing regulations are often needed before a legislative decision takes effect.

Atlantic Council (June 2021).

Regulatory officials in key functions (e.g., monetary policy, banking regulation) are often insulated by law from direct political interference. Regulatory policy officials tend to avoid emotive, sentiment-laden language. Their remit is to implement policy shifts supported by data.

Sentiment-based language detection mechanisms pointed primarily to the legislative process and the news cycle therefore miss policy shifts that impact enterprise value. The personal sentiment of a speaker can shift across time and may be less dispositive of an outcome than other activities. The technical regulatory shifts may not attract attention from journalists and pundits.

Key regulatory policy shifts are hiding in plain sight. They can materially impact the economic growth trajectory for industries as a whole. The specific impact of a policy shift on an individual firm....and even the impact on different securities issued by that firm....will differ based on the quality of management, a firm's balance sheet strength, and its capital market/loan market posture. Investor risk profiles additionally will be impacted by the specific hedging and portfolio construction context in which their positions in individual firms appear.

None of these insights can be gleaned from automated language processing applied to corporate regulatory filings and legislative process monitoring initiatives, particularly if those processes assess language through a filter of sentiment.

Using sentiment-based engines generates embedded bias by imposing a normative overlay to determine which regulatory policy shifts are "good/positive" or "bad/negative".

Policy shifts will always have supporters and opponents. Sentiment-based automated language analysis, especially mechanisms relying on machine learning and artificial intelligence, also requires a large number of observations. The search for language at scale leads many to seek inputs across relatively low value but readily accessible sources that have no meaningful impact on policy decisions or which are highly biased.

Assessing exposure to public policy risks in general requires objective quantitative data that measures the momentum towards a decision. It requires inputs from the regulatory policy process. Measuring the momentum and volatility of public policy formation can provide powerful leading indicators of emerging public policy risks. Pairing that data with the automated language data generated from securities filings can provide particularly sharp insights quickly about which specific firms are likely to be more impacted by the accelerating shift towards a decision.

This kind of analysis is particularly important in the climate finance context. Investors seeking to support sustainability initiatives and investors seeking to understand better their multi-year exposure to climate-related risks at present are flying blind because until last year they had no capacity to measure which parts of the public policy process were generating concrete public policy risks.

The patented process that generates PolicyScope data fills this void.

LANGUAGE DATA: PUBLIC POLICY MOMENTUM AND VOLATILITY

Capital markets seeking to manage exposure to policy-related systematic risks traditionally rely

on expert opinion and human intelligence to interpret public policy signals. This is inefficient. Consider the typical sequence of events:

- **Action:** Policymakers act (the action need not be a final decision)
- **Observation:** Insiders/experts learn of the action; Journalists report on the action
- **Analysis:** Subject matter experts read the action and/or the observation reports
- **Risk Assessment:** Subject matter experts notify portfolio managers and risk managers, who then assess the risk through shifts in assumptions and parameters within asset pricing and scenario analysis models.
- **Transaction Execution:** New buy/sell/hedge positions are taken in the market.

Each process takes time to migrate from verbal to quantitative.

Sophisticated technology increases the velocity with which those words travel through the capital markets. From the telegraph, tickertape, telex, and the Bloomberg Terminal to the Blackberry, iPhone, and automated news feeds, capital markets have consistently pushed for faster access to transmit information and analysis at the speed of light.

New advances in natural language processing push the boundary of the innovation frontier to deliver efficiency gains not by accelerating the velocity of communications but by automating analytical processes.

But the problem still remains that public policy risks are expressed in terms of words whereas financial risks are expressed in terms of numbers. Portfolio managers experience difficulty

incorporating verbal public policy risks into quantitative workflow processes.

The resulting misalignment complicates considerably the ability to integrate policy risks within structured financial analysis. As a result, investors face downside risks and missed opportunities from shifts in policy. Efficiency gains that facilitate better estimation of systematic risks require a repeatable process for generating consistent data that converts the words into numbers analytically, without bias.

The risks compound in the climate context given the reaction functions related to transition risks and a dynamically shifting policy response function.

Public policy and the environment operate within a mutually reinforcing reaction function. Shifts in the environment turn up the heat (pardon the pun) on policymakers to take action. Shifts in the real economy and financial markets operate as accelerants or brakes regarding financial regulation, fiscal policy, and monetary policy. If high level corporate disclosures in annual reports continue to disappoint as a driver of change, activists and policymakers will react by seeking more stringent requirements.

Measuring climate-related risks thus requires the capacity to spot how BOTH environmental and policy trajectories are evolving simultaneously. It requires access to good data.

Fortunately, advanced technology provides the capacity to measure quantitatively the risks related to public policy shifts daily, automatically, and objectively.

BCMstrategy, Inc.'s patented process incorporates 9+ layers of patented analytical automation in a manner that converts the words of the public policy process into numbers suitable for use in asset valuation and risk analysis. We assign scores to global public policy activity in relation to commitment levels objectively, without a normative or sentiment-based overlay.

PolicyScope™ data measures the path towards a decision, delivering daily, time-stamped weighted scores that provide advance notice of public policy shifts. The quantitative data refreshes every 24 hours, delivering a daily updated multivariate time series data that reflects the public policy reaction function.

This is entirely new data for capital markets. Initial use cases for the quantitative data involve using the public policy data to anticipate market volatility. Because the data detects policy activity and measures momentum levels, it provides automatic visibility into public policy shifts within 24 hours, *before* journalists and pundits have had an opportunity to convey the information verbally to the markets.

The application to climate-related risks and finance could not be better. Capital markets are only just beginning to price consistently and at scale the climate components. Implementing standardized disclosures during 2023 aligns with growing investor demand for consistency that can support asset valuations and risk assessments. But the path towards generating those standards

will be neither linear nor smooth. Subtle shifts in language will signal material shifts in risk for investments in various economic sectors as well as individual issuers.

Capital markets need not wait passively while latent risks expand on their balance sheets and portfolios over the next 18-24 months. Dynamic, daily policy risk quantification enables portfolio managers and strategists to conduct course

corrections via pricing and risk model parameters. Research and strategy professionals that additionally incorporate language data feeds related to our quantitative data will also achieve considerable efficiency gains and informational advantages as they connect the dots faster across publicly available policy developments before those items materialize within the media cycle.

Every position within the climate finance context today, and probably every position in a traded security today, is exposed to considerable risk related to shifts in public policy associated with climate change. It is

crucial that investors adopt a systematic approach to measuring and managing their exposures to that risk.

"We know that the physical risks related to climate change will grow over time, while the transition risks will depend in part on how abruptly policy, technology, and behavioral changes take place. Since financial markets are forward looking, a change in expectations regarding climate-related risks could lead to a sharp repricing of assets at any time."

--Federal Reserve Gov. Lael Brainard (Oct. 2021)

"ESG-related risks may drive conventional financial risk categories, such as credit, market and operational risk, through a number of transmission channels...(including) transition risks derived from the impact through policies and consumer activism intended to achieve a greener and more sustainable economy."

--Joint Committee Report on Risks and Vulnerabilities in the EU Financial System (March 2022)

Understanding the scale and scope of embedded public policy risk within a given fixed income or equity portfolio begins with an awareness on any given day of whether (or not) policymakers are taking action regarding specific issues (e.g., greenwashing, GreenQE, green bond issuance standards, climate-related disclosures).

Pairing quantitative data with related structured verbal data speeds access and visibility regarding the momentum and trajectory of policy formation regarding that issue.

We believe that including quantitative data derived from the public policy process is crucial to good decision-making at this juncture because the normative process regarding climate-related risks is a key driver for private sector decisions. Public policy decisions impact entire economic sectors in a horizontal manner. They can create considerable regulatory compliance/operational risk as well as credit and market risks:

- Significant increases in climate-related disclosures can create operational and compliance risks for issuers of publicly traded securities if they do not make the appropriate or correct disclosures.
- Failing to provide appropriate disclosures or take into account specific kinds of climate-related risks increasingly creates the risk that obligors will attract higher risk premia during the credit pricing process.
- Financial regulators increasingly are exploring whether and how regulatory capital requirements for banks could be

crafted to capture and internalize embedded climate-related risks within bank loan book.

- As central banks increasingly discuss the possibility of adjusting monetary policy frameworks to incorporate climate risks, financial firms face the prospect of mispricing price credit and market risks if they fail to take into account the looming role that climate considerations play when central banks set interest rates, adjust asset purchase program parameters (“Green QE”) and shift the focus of their monetary holdings to address climate change mitigation efforts.

- As governments increase the issuance of green sovereign bonds and increase official sector purchases of those bonds, fixed income investors face new kinds of market risks associated with new kinds of competition between green trading assets, “brown” trading assets, and vanilla trading assets for which previous time series data regarding pricing and market behavior may no longer be relevant.

Failing to measure exposure to unanticipated shifts in public policy creates implicit and unnecessary financial risks, particularly in contexts like climate change and cryptocurrency regulation where the policy framework is actively under revision.

The patented process that generates PolicyScope data provides them the toolkit to make those risk assessments, particularly when paired with the other data sets important to assessing climate-related risks.

HOW POLICY RISK MEASUREMENT ACCELERATES INSIGHT

Quantifying public policy risks provides perspective on momentum and volatility in the public policy process. It provides users with the capacity to conduct information triage and drill down quickly into technical issues as they arise in the public policy discussion. It also provides the capacity to compare how much media coverage has been devoted to an issue over time.

Spoiler Alert. Most technical shifts in climate-related financial and economic policy are under-reported, except the carbon border adjustment mechanism under discussion in Europe.

Consider the global PolicyScope data regarding ESG Disclosures for 13 April 2022 in the chart below. Measurable activity occurred regarding only three out of fifteen lexicon terms. Moreover, no media-related activity (rhetoric, leaks) were detected.



Climate activists, enthusiasts, and risk professionals may be surprised to see the dearth of media coverage even though our media inputs include data mining licenses from Dow Jones and ThomsonReuters. PolicyScope data does not measure all media references to climate-related issues. To generate rhetoric and/or leaks scores, a fact-checked and responsible media outlet needs to reference official sector activity. We apologize in advance to our friends and colleagues who are thought leaders and advocates. *The patented PolicyScope process only captures when the mainstream media notices that government or a policymaker have acted.*

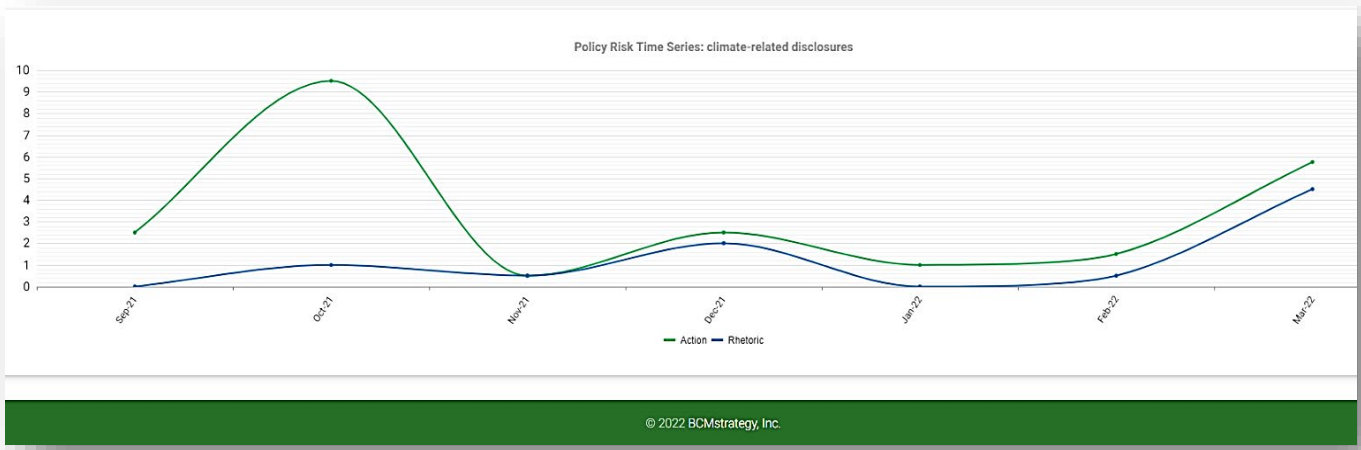
PolicyScope data thus delivers an immediate informational advantage by showing users that policymakers are actively delivering cues to the market about intended decisions...before journalists have had an opportunity to publish a story. Since most market participants, advocates, and analysts currently concentrate their policy input processes on media feeds, data users acquire an additional informational advantage because they can spot which issues are generating the most activity, freed from the noise of the news cycle. Our preliminary backtests indicate the informational advantage can be as large as 10 days to 22 days.

The data buys users time to focus on strategic policy shifts as they occur. Rather than chase the news cycle, users chase the policy cycle which ultimately will generate news. They catch the wave of public policy using publicly available information using the data generated by our patented process.

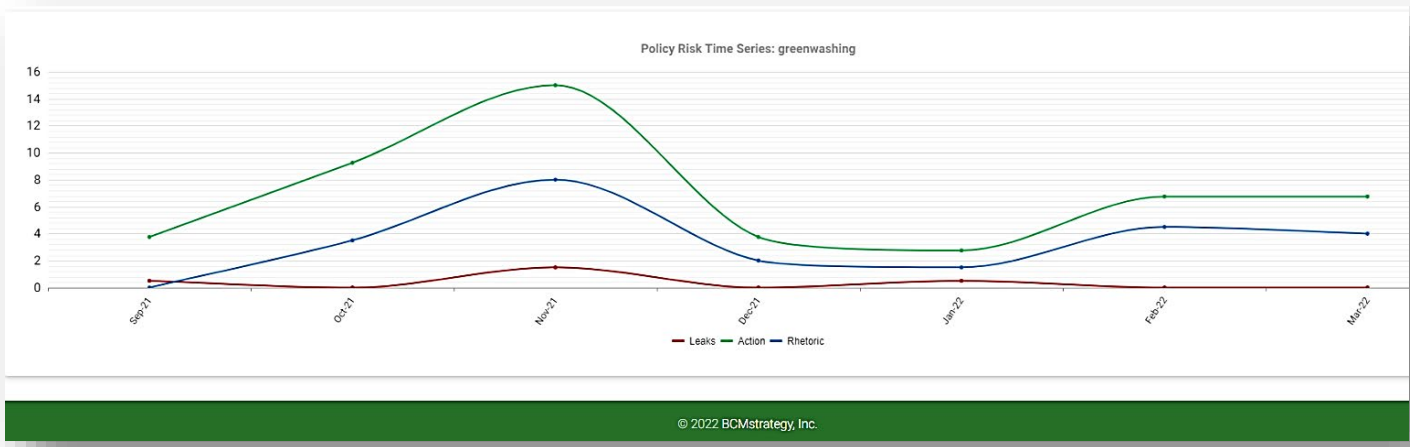
Data feed users can configure alerts to notify them of activity regarding even the most technical terms. Alternatively, they can see daily momentum data on dashboards fed by the PolicyScope API. Users can also prioritize which tags generate alerts. The example below focuses on lexicon terms. Additional display options include: country, policymaker, and activity type.

Because all PolicyScope data has been timestamped automatically, the resulting multivariate time series data delivers advanced insights regarding the pace, rhythm, and relative volume of policy activity over time for any given issue.

Compare the time series data for two different but related lexicon terms: "climate-related disclosures"



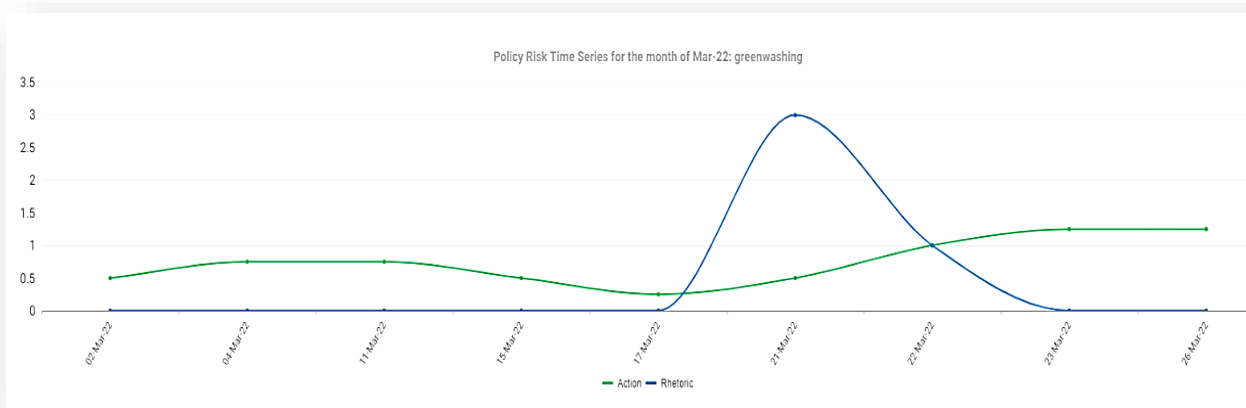
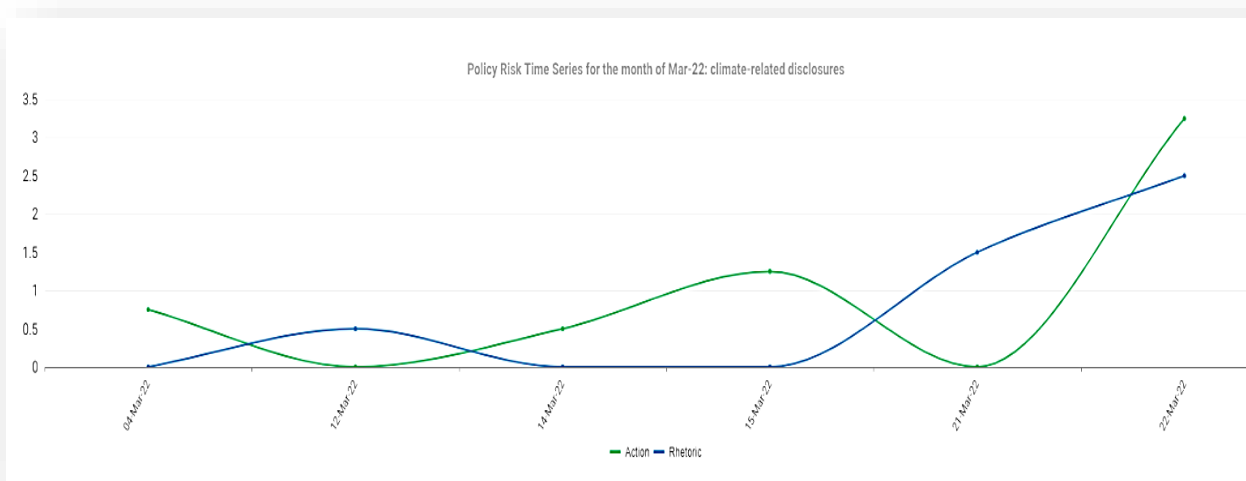
and "greenwashing"



Policymakers to date have spent far more time and energy addressing greenwashing issues than climate-related disclosures. Moreover, the spikes in activity levels during 2021 were not aligned.

Intuitively, the distribution of activity makes sense. High level meetings in October (IMF/World Bank/FSB/G20) generate activity related to strategic direction (climate-related disclosures) and more technical work addressing greenwashing ensues the following month using existing regulatory capabilities. Because greenwashing implicates existing investor protection and disclosure standards, it also makes sense that more action could be undertaken regarding this issue relative to climate-related disclosures for which new rules need to be written. Note that the dynamic changes dramatically in February and March 2022, coincide with Russia's invasion of Ukraine as the green revolution acquires a geopolitical overlay.

The monthly distribution of activity also generates insights regarding relative policy priorities before we even look at a single line of text:



The global standard-setting process regarding climate-related disclosures kicked in to high gear during March 2022, with the U.S. Securities and Exchange Commission, the U.S. Treasury Department, the Bank for International Settlements, the World Bank, the European Central Bank and the European Securities and Markets Authority all issuing proposals, reports, speeches, statements, and studies. The preceding month, the

EU legislative process took another step towards finalizing the corporate sustainability directive, with the Council adopting a final position. Targeted activity regarding greenwashing registered low but steady activity.

Measuring policy momentum thus delivers an additional layer of insight regarding policy reaction functions and the focus of activity. Advanced users can identify correlations and covariances in activity levels in order to accelerate their ability to anticipate policy outcomes and measure their risk exposures to those outcomes.

Factor model parameterization is now possible using concrete, objective data for a key transition risk: the shift in public policy. Risk models can incorporate factors for individual issues (e.g., greenwashing) or entire categories of issues (e.g., climate disclosures).

The concept and operational implementation will be familiar to volatility traders. Just as in the financial markets, often the most important piece of information is that momentum is building behind an activity. Measuring public policy momentum in notional volume amounts delivers important insights regarding the pace of change. This is especially important in technical regulatory areas where media coverage can be sparse in the early stages of decision-making.

Quantifying momentum paired with the underlying, structured language data provides additional, powerful perspectives on policy trajectories. The language enables domain experts to connect the dots across ideas and issues faster. Whether delivered in machine-readable form as an add-on institutional news feeds or as PDFs with keywords highlighted for human readers, the efficiency gains are the same.⁴³

BCMstrategy, Inc. will be conducting research and development on its three years of highly structured text data in the coming 12 months. The curated data lake paired with the quantitative momentum data provides a promising foundation on which to being automating trend projections. But portfolio managers and analysts/strategists do not need to wait for the research in order to extract value from the verbal data.

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undertaken by a number of U.S. agencies, including as outlined in the U.S. Financial Stability Oversight Councils Report on Climate-Related Financial Risk. In particular, participants provided an update on the development of **climate-related financial disclosures** and the management of Climate-related financial risks, consistent with their respective mandates. In that regard, participants discussed ongoing work undertaken in the UK and United States on Climate-related scenario analysis and supervisory expectations, noting the importance of continued international cooperation in these areas.

Both sides exchanged views on the financial sector outcomes of the UKs Presidency of COP26, including on the future work of the International Financial Reporting Standards Foundations International **Sustainability Standards Board**. Participants reflected positively on the private sector finance commitments for net-zero through the work of the Glasgow Financial Alliance for Net Zero. In that regard, participants reiterated the importance of credible, transparent, and high-quality transition plans.

In addition, participants discussed ongoing cooperation on international efforts to address climate change issues within the financial sector, including the **G20 Sustainable Finance Roadmap**, and the FSBs Roadmap for Addressing Climate-Related Financial Risk. They noted the positive and productive bilateral engagement on sustainable finance to date and will continue that engagement moving forward, including at a technical level.

On the topic of **crypto-assets** and CBDCs, U.S. participants provided a summary of the Presidents Working Group, FDIC, and OCC Report and Recommendations on **Stablecoins** and an update on the Federal Reserve Boards forthcoming paper on the future of money. UK participants discussed the UKs **crypto-asset** consultation, the Bank of Englands Discussion Paper on new forms of digital money, and the UKs ongoing exploration of a potential **CBDC** through its **CBDC** Taskforce. Participants acknowledged the importance of maintaining and further engaging in multilateral discussions on these topics.

Participants took stock of ongoing efforts in relation to the **LIBOR** transition, market developments,

PolicyScope data feeds provide users with access to the underlying structured verbal data either in machine-readable/tagged form or, for human readers, as a PDF with highlighted keywords. Whether the words are read by client machines or by human subject matter experts, again the outcome is the same: accelerated insight formation.

⁴³ "...a 'sophisticated' reader could infer GDP growth projections based on the text of the reports, somewhat beyond what is told in just the numbers, condensing as well the "forward-looking) risks assessment." *The Narrative About the Economy as a Shadow Forecast: An Analysis Using Banco de Espana Quarterly Reports*, Banco de Espana Working Paper 2042 (2020).

Conclusion: The Climate Finance Data Frontier

Capital markets are only starting to develop frameworks for pricing climate-risks at scale. Policymakers during 2021-22 have initiated a robust effort in parallel to safeguard financial stability from risks associated with rapid or disorderly asset pricing dynamics.

Demand for alternative data providing perspective on climate-related risks can only increase as a consequence.

The climate context is unique for many reasons. For purposes of this paper, one of the most unique elements is that the policy process itself has been identified by leading official sector entities as a *driver* of risk rather than as a remedy for unacceptable risks.

Markets exist for the purpose of setting prices for risk assets. They measure and assess all components that contribute to risk profiles in order to set prices. When public policy risks present as an explicit, identifiable risk class, markets must price for that risk using mechanisms more robust than personal opinion which is prone to bias and incomplete information.

We believe the patented PolicyScope data generation process provides the optimal quantification mechanism for measuring public policy risks related to climate change (among other issues). The quantitative data generates a measure of momentum. The structured, curated language data enables users to identify policy trajectories daily and globally.

The sources and amount of alternative data available to market participants regarding climate-related risks will increase exponentially over the next 2-3 years. A new class of data will soon be issued by the official sector. The second White Paper in this series addresses the frontier of climate-related risk data.