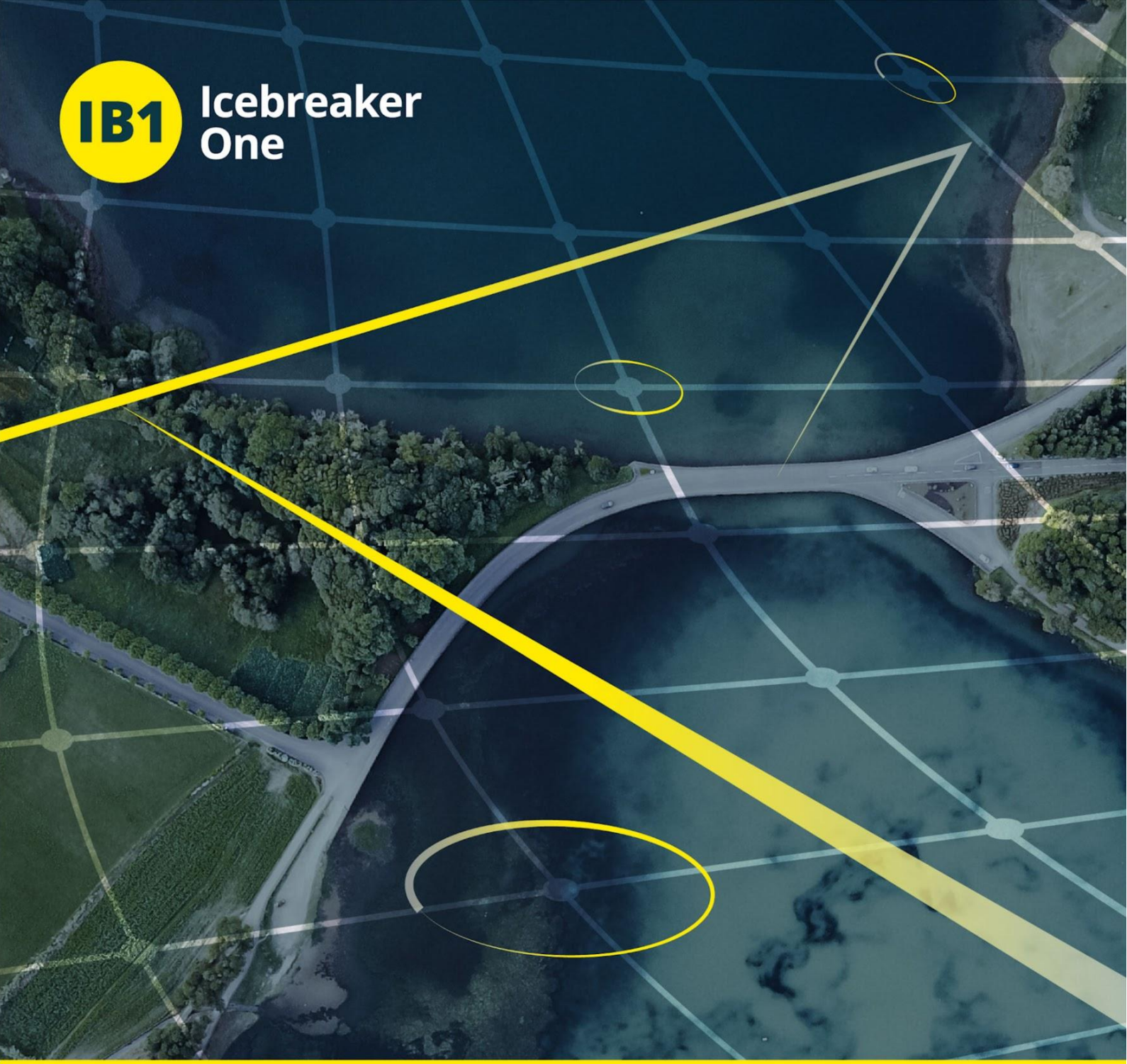

DATA INFRASTRUCTURE

Enabling secure and scalable non-financial reporting and data flows

Icebreaker One

**Formal consultation on this document,
as part of a development process, closed on 31st Mar 2021**

It remains open to comment by anyone by default via https://bit.ly/ib1-nfdf

For more context, please see https://icebreakerone.org/report-nfdf/

Enabling secure and scalable non-financial reporting and data flows

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eit Climate-KIC
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Icebreaker One

Contents

“Governments must deliver the transformational change our world needs and that people demand, with much stronger ambition – ambition on mitigation, ambition on adaptation, and ambition on finance. Every city, region, bank, pension fund and industry must completely reimagine how they operate to keep temperature rise to 1.5 degrees.”

António Guterres, Secretary-General of the United Nations[1]

“It is a fact that unless sufficient capital is mobilised we will fail to deliver the Paris Agreement. Better data won’t deliver the Paris agreement by itself, but delivery will be impossible without it. Access to trusted data is fundamental to the mobilising of capital that will deliver a credible net-zero future.”

Steve Waygood, Chief Responsible Investment Officer, Aviva

“By the end of 2020, all active portfolios and advisory strategies will be fully ESG integrated – meaning that, at the portfolio level, our portfolio managers will be accountable for appropriately managing exposure”

Larry Fink, CEO, Blackrock[2]

“We call on policymakers and the financial sector to…collaborate to bridge the data gaps to enhance the assessment of climate-related risks”

Governor of Bank of England Mark Carney, Governor of Banque de France François Villeroy de GalhauChair of the Network for Greening the Financial Services Frank Elderson[3]

“Digital technology is embedded in our daily lives and in every sector, so it has a critical and growing part to play in delivering a net zero future.”

Professor Andrew Hopper CBE FREng FRS, Chair, Digital Technology and the Planet Working Group, and VicePresident, The Royal Society[4]

[1] https://www.un.org/sg/en/content/sg/speeches/2020-01-22/remarks-general-assembly-priorities-for-2020
[2] https://www.blackrock.com/corporate/investor-relations/blackrock-client-letter
[3] https://www.bankofengland.co.uk/news/2019/april/open-letter-on-climate-related-financial-risks
[4] https://royalsociety.org/-/media/policy/projects/digital-technology-and-the-planet/digital-technology-and-the-planet-report.pdf

1 Foreword

Goals of this document

In the context of environmental information, comprehensive financial and non-financial reporting by organisations, we aim to demonstrate opportunities that could reduce effort and complement ongoing international initiatives. We present the scope and complexity of data sharing across markets, supply and value-chains. We highlight challenges that create friction, inertia and inhibit action in delivering goals, including hard-programmed habits and underlying presuppositions and premises. We highlight solutions that can reduce friction in data-sharing and propose levers of change that can help unlock innovation (e.g. policy and regulatory, perception shifts, behavioural changes).

Intended audience(s)

Our primary audience includes decision-makers and their advisors who wish to understand the transformative potential of data, and how its usage can be unlocked at scale to enable it to act as a flow of evidence that informs action. While it covers ‘technology concepts’ it is not ‘about’ technology. Rather, it addresses designing the conditions for success that would enable millions of experts, practitioners and organisations to better discover, access and use the data they need to make informed decisions.

This includes, but is not limited to: policy makers and regulators working on Sustainable Finance, Corporate Reporting and Value Chain Due Diligence; experts working across Environmental, Social, and Corporate Governance (ESG), Corporate Social Responsibility (CSR) and related reporting frameworks (e.g. TCFD, SASB); Chief Data Officers and related leaders working on data strategy and policy; solution providers seeking to improve scenario modelling; business leaders optimising efficiency and reducing risk in decision-making.

Sources

The ideas, frameworks and recommendations presented in this document have been distilled from dialogue with over 320 organisations over a two year continuous development process. These include multilateral organisations, national governments, environmental and statistical agencies, regulators, global financial organisations (including banks, asset managers and insurance companies), energy and technology companies. Individuals include government ministers, CEOs and C-Suite (e.g. Chief Data Officers), policy leadership, academics, risk management and environmental reporting experts.

These include, but are not limited to: UNEP, World Bank, WMO, CDSB, CDP, Defra, Lloyd's Register Foundation, Aon, Arup, Bank of England, UK Financial Conduct Authority, Climate Financial Risk Forum, UKRI, UK Cabinet Office, BEIS, NZ Ministry for Environment, OBIE (Open Banking Implementation Entity), Ofgem, CDBB (Center for Digital Built Britain), Climate KIC, Schneider Electric, DWS, Geneva Association, Spatial Finance Initiative, Coalition for International Platform on Climate Finance, Refinitiv, ANZ Bank, Aviva, Willis Towers Watson, Brit Insurance, Google, Apple, Microsoft, Scottish Power, University of Cambridge, University of Oxford, University of Edinburgh, University College Dublin, Ordnance Survey, Cambridge Institute for Sustainability Leadership, Grantham Institute, UK Office of National Statistics, OS Climate, Oasis LMF.

2 Executive Summary

The wealth of data we have, and that is becoming available, must now be made usable to help us address climate and environmental risks, and to radically improve our investments in, and planning and management of our global infrastructure. While there is an ocean of available capital, the lack of comprehensive, trusted and quality data-flow is leading to a misallocation of resources, missed opportunities and is creating catastrophic risks on our global balance sheets. Our infrastructure for accessing this data is as important as our physical infrastructure in averting our climate, biodiversity and related crises, but it is being dangerously neglected.

Data for non-financial reporting is, and will increasingly be, required across global value chains. Global cooperation will be needed, ensuring timely, trusted coordination to enable data to flow in ways that all value-chain partners can engage with, align with and accept. Data sharing will, therefore, require an industry-neutral, geography-neutral and context-neutral trust framework and governance to underpin sharing in a non-partisan manner.

Today, the majority of corporate environmental sustainability data published are delivered ‘somewhere online’, often in a PDF format, often inconsistently, in ways that are then aggregated into portals or commercial services that then attempt to translate them into value or risk assessments. There are substantial gaps in the materiality of much of this data, it is often incomplete or not ‘actionable’. The process of data collection, access, sharing and usage are, at best, not fit for purpose.

Fortunately, there are many initiatives addressing the issues of what data may be material (e.g. TCFD, SASB, GRI, CDSB, GHG Protocol). Given that element of the challenge is well understood, our focus is on how to make the information more accessible, usable and impactful.

The opportunity exists to directly affect two parts of the data value chain. Firstly, we can enable better discovery, access and usage of the ‘outputs’ (e.g. TCFD reports). Secondly, and significantly, we can enable better discovery, access and usage of the ‘inputs’ (e.g. the energy consumption of a factory that generates emissions).

There is a bold but achievable route to deliver access to the environmental data with the quality and scope that will be needed for the success of Sustainable Finance, corporate environmental reporting and multinational corporate management of Science Based Targets for GHG emission reduction. This solution can overcome the significant political and cultural barriers and challenges to the current situation of access to suitable data for corporate reporting, financial disclosures and systemic risk modelling.

The proposed solution builds on the proven potential of existing shared data standards development (e.g. currently deployed in Open Banking) and those that lie at the core of the EU’s Digital and Data Strategies, including the Green Deal Dataspace.

Open Banking has already used this approach with great success. Open Banking is used by two million consumers in the UK, and Open Banking practices are now in development across over twenty countries, including Australia, Bahrain, Europe, Hong Kong, India, Japan,

Mexico, Malaysia, New Zealand, Rwanda, Singapore and the USA and beyond. The Open Banking market is projected to grow to over $40B by 2026.

Our direct experience shows that the key features of the creation of data flows are not technical ('ICT'). Therefore, rather than a focus on 'which data', 'which technology' or 'what data standards' (many exist), instead the solution requires addressing the processes and practices that enable data flows that can unlock continuous improvement — using data as material evidence that drives decisions. In order to achieve this at scale, across industries and borders, we need a functioning data ecosystem of users and suppliers of data, and the best way to achieve this is to adopt common, open standards for data sharing. To deliver this requires a governance framework for data access that creates trust.

At the heart of the architecture is a federated approach to data sharing, namely that the data is not centrally stored, it is left with the data owner or controller and consent managed to allow those with permissions to access with conditional rules that have been agreed by the market.

A data governance trust framework addresses three foundational issues. Firstly, it helps align the discovery and access of data in a manner that can scale to millions of use cases. Secondly, it aligns the actors in the system around a secure and trusted environment from which they have a direct benefit to participate (as either a supplier or a consumer of data). Thirdly, critically, a trusted framework can help align organisations around legal, IP, liability and rights issues in a manner that can unlock data sharing between organisations and across borders.

Practical experience in Open Banking, and development of 'Open Energy', shows that implementation can grow organically, with strong leadership, appropriate governance, starting small around core use cases, and expanding progressively. Implementation strategies can build on existing experience.

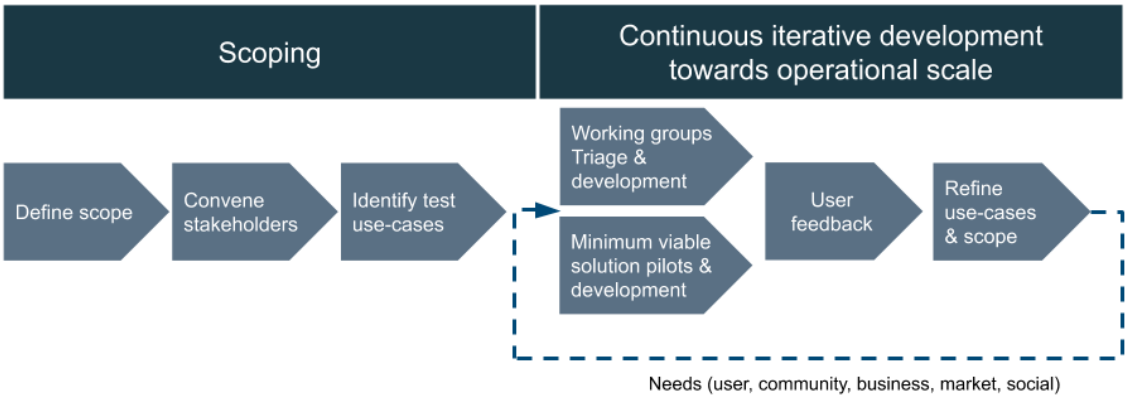
The approach needs organisations to take forward development together. To satisfy all needs, it is best co-designed by the future participants, with that process facilitated by an independent, neutral body. Whilst there are various international, sectoral and regional initiatives attempting to align data standards (for example around taxonomies and ontologies such as the EU taxonomy for sustainable activities[5]), there is a significant (and unnecessary) gap in initiatives to facilitate data discovery, access and usage. Yet, success in this area is essential and can also resolve or reduce some of the most difficult problems around the alignment of data.

A roadmap for this work would include a 3-6 month process of planning, stakeholder curation and engagement, and scoping of test use-cases. Implementation can be delivered through a continuous development process that combines multi-disciplinary working groups to triage, prioritise and work through specific issues linked to the use-case. In parallel, the use case is developed in an active sandbox environment to test the recommendations and identify material blockers. The solution is tested with users and the outcomes fed back into the scoping process for refinement. This process can be run on a continuous 3 or 6-month loop until viable solutions have been identified, tested and proven.

[5] https://ec.europa.eu/info/business-economy-euro/banking-and-finance/sustainable-finance/eu-taxonomy-sustainable-activities_en

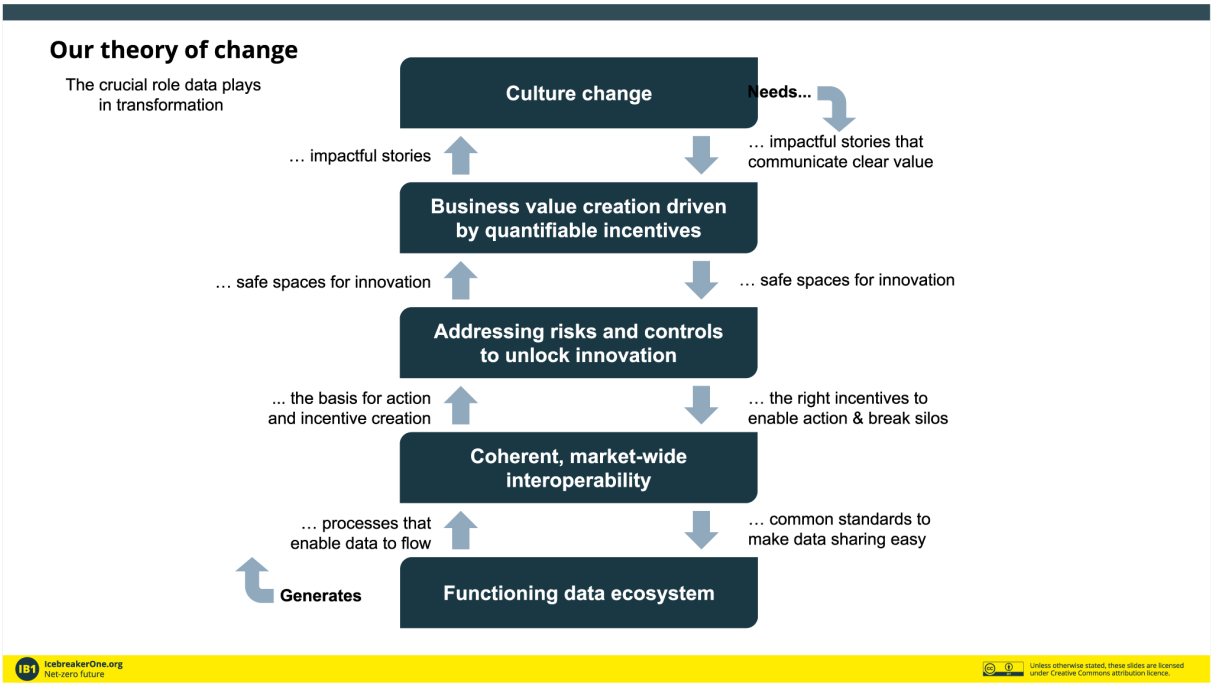
Icebreaker One

Roadmap to operational delivery



3 Sustainable finance and corporate sustainability need new data solutions

Both Sustainable Finance and corporate value chain sustainability transformations require significantly improved flows of data to analysts, decision makers and policy makers.



To internalise externalities, our economy needs to integrate its whole-system impact into the definition of capital. Financial communities require non-financial information to make robust, timely decisions about their financial investments. To fully comprehend, quantify and model cascade and systemic risk[6] requires data to flow from myriad sources. Access to data is highlighted across markets as critical to address issues ranging from the climate crisis[7] to biodiversity collapse.

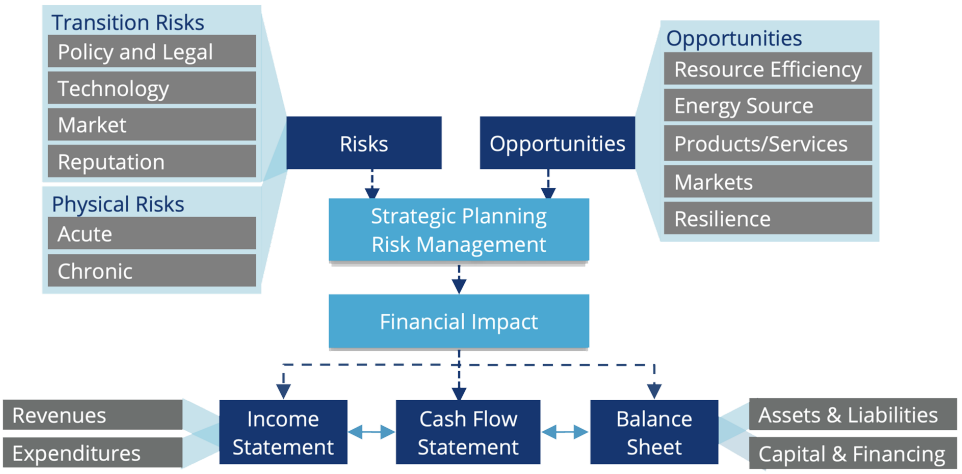
In the context of the EU Sustainable Finance frameworks there are recognised needs to support all actors in the international integration of environmental impacts, and dependencies into Sustainable Finance practices besides climate.

Similarly, current recommendations from the Task Force for Climate Related Financial Disclosures (TCFD) cover a range of diverse and connected data needs ranging from resource efficiency to energy sources.

[6] https://gar.undrr.org/
[7] https://www.fca.org.uk/transparency/climate-financial-risk-forum

Figure 1

Climate-Related Risks, Opportunities, and Financial Impact



Increasing demands for sustainability-aligned decisions will drive the diversity, volume and frequency of reporting, interpretation and analysis will only increase in complexity and burden to all stakeholders.

This has already led to a proliferation of standards, schemes, models and reporting requirements to improve the visibility of risk and the transparency of business operations to society. In future, all frameworks and standards will need to dynamically and continuously evolve and change over time, probably adding complexity to the system.

Concurrently, the volume, variety, velocity, veracity and value of data is increasing exponentially[8]. The complexity and diversity of global data value chains is fragmented and can be divergent, unreliably and costly for organizations to address. Consequently investors and corporations struggle to fully understand what is material, what to report and how to react to demands.

The Future of Sustainable Data Alliance[9] (FoSDA) highlight that new datasets must be made available ranging from geospatial data (Earth observation, spatial reporting), asset-level, benchmarking to financial and non-financial data. Such data must be made 'market ready' to enable the integration of non-financial data into financial practice to manage sustainability related risks, opportunities and impacts[10]. Additionally it highlights that we must define and create a path to filling ESG data gaps and data holes, map data to sustainability taxonomies, and develop ESG data talent[11].

[8] https://en.wikipedia.org/wiki/Big_data
[9] https://solutions.refinitiv.com/futureofsustainabledata
[10] https://www.asifma.org/wp-content/uploads/2020/09/asifma-fosda-interim-report-esg-and-data-needs-in-asia-v20200907.pdf
[11] https://solutions.refinitiv.com/futureofsustainabledata

However, stakeholder discussions reflect that:

1. Access to the data people need to make decisions is often not shared, or it doesn't exist, or it is shared in ways that are not fit for purpose[12], or in a manner that does not scale, or it cannot be trusted[13].
2. There are material risks and threats to non-financial reporting, including that data is not matched to the user-needs of financial decision-makers[14] and that the lack of demonstrable, traceable and provable impact may represent a systemic threat to the development of 'Sustainable Finance'.

The problematic impact on corporates is manifold:

- Increased burdens on reporting (not only annually but continuously)
- Lack of alignment on information requests to investors
- Multiple requests for different information in different formats from different actors (e.g. ratings agencies such as MSCI, ESG consultancies and investors such as Blackrock)
- Requests for information from their supply-chains and across value-chains
- Increased investment in (and fatigue from) data sourcing, collection, verification, processing, analysis and reporting[15]

The efficacy of the information is fragmented in quantum, format and mode of delivery

- data is not provided in a consistent manner and is often incomplete or not 'market-relevant'
- non-comparable information compounds confusion, leads to complexity in analysis, errors in benchmarking, inaccurate ratings and poorly informed decisions
- corporates typically pack non-financial information into a 'sustainability report' on an annual basis that has minimal impact on behaviours
- reported information and data often lack materiality: they are not used substantially in decision-making by the market
- increasing awareness of environmental risks to financial performance is driving the need for smoother integration of data flows, but these currently result in diverse and non-standardised approaches. PDF files and spreadsheets are still the mainstay of information delivery.

We must also recognise that, today, most non-financial reporting is done on spreadsheets. It is often incomplete, 'gamable', post-event (i.e. not 'operational') and not provided in a machine-usable way. Combined, this undermines trust and results in a poor 'product to market fit', does not provide actionable insights and is not used in decision making in an ongoing, material manner. This is unacceptable from the perspective of both the scale of the challenges we are trying to address, and in nature of the digital age.

[12] https://viewpoints.reedsmith.com//post/102gj4u/is-data-broking-broke-unpicking-the-ico-s-recent-investigation
[13] https://nic.org.uk/app/uploads/Data-for-the-Public-Good-NIC-Report.pdf
[14] Via interviews with asset managers, insurers, banks as well as large corporate CSR leadership,
[15] WBSCD count over 1600 various data points requested from corporates https://docs.wbcsd.org/2019/10/WBCSD_Reporting_Matters_2019.pdf

Data—**as a continuous flow of evidence that informs action**—can easily become contested, and in terms of governance needs to be understood and addressed as such.

The consequences of these problems are inhibiting our ability to instrument environmental protections, address circular economy resourcing in a financially material framework, inhibit the design and implementation of policy interventions, misallocate pricing signals and undermine political action.

Studies indicate future growth of ESG investment are inextricably linked to data[16] and highlight over 50% of respondents saw 'data inconsistencies' as a critical blocker.

To paraphrase one interviewee: "garbage-in, garbage out. If the data provided into our AI is not robust or comprehensive they will be mistrained and lead to poor outcomes". Similarly, being able to robustly track the provenance of data supply is only useful if we are gathering genuinely actionable data along the chain.

There are primary 2 areas of solutions to these challenges:

1. Alignment of content
2. Facilitation of data generation and access.

Both need taking forward. This paper primarily investigates the second solution area, noting that success in this area can also resolve or reduce some of the most difficult problems around alignment of content.

4 Data Requirements

Underpinning the EU's Green Deal approach, Sustainable Finance, corporate SBTi goals[17] and corporate sustainability reporting is the need for accurate, well-controlled data on climate change, climate risks, the impact of firms' activities on the climate and their exposure to climate risk. This includes the interdependent drivers and multiple-contexts underpinning the manifestations of these risks, in addition to design and operational data from implementations. The global nature of financial markets, and the high degree of interoperability and interdependence between market participants, means this data must be subject to standardisation wherever possible.

Further, data is of little use unless it can be exposed to and accessed by those who require it for policy-making, supervisory and investment decision-making purposes: policy-makers, regulators, investors such as asset managers and pension funds, and other financial institutions including banks and insurers.

Needs for environmental data in corporate value chains match the diverse uses that the data will be used for.

[16] https://perspectives.eiu.com/sites/default/files/sustainable_and_actionable_report_2.pdf
[17] https://sciencebasedtargets.org

There are five broad user-groups for environmental data:

- **Financial asset owners and managers**, including large portfolios and those impacted by climate change
- **Financial markets**, including investment, insurance; financing; pensions and savings
- **Corporates**, their advisors, suppliers and customers
- **Policymakers**, including market regulators
- **Non-profit users**, including academic researchers, NGOs and charities

For corporates this includes:

- **Data for corporations and investors to align their activities with Paris goals (e.g. science-based targets), biodiversity targets and circular economy goals;** and
- **Data to deliver on environmental (non-financial) corporate reporting**

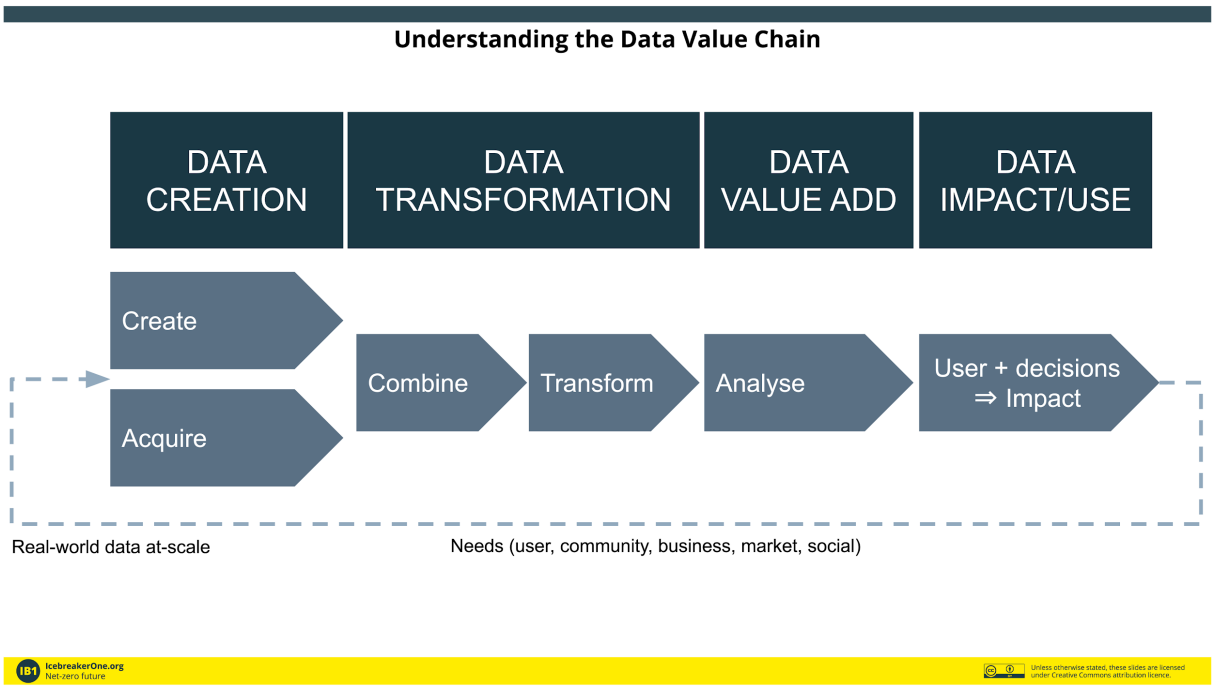
For asset owners, financial markets and their regulators, this includes:

- **Data to assess material financial risk;** and
- **Data to assess systemic risks**

Systemic risks to financial markets, or for specific supply chains, from environmental change are now at the forefront of markets and regulators' attention. The nature of these risks and the corresponding needs for data are described in detail in the Appendix.

Understanding the data value chain

To understand how to improve environmental data for decision-making, we need to understand how the **flow** of data works, from creation to usage, and how in a digital age, there is no 'end point'—it is a continuous feedback loop.



1. Data is **acquired** or **created** by something (e.g. a satellite, a drone, a sensor) or someone (e.g. some research)
2. It is then **combined** and **transformed** into a useful form. This is often underestimated in terms of the amount of effort required
3. It is then **analysed** using a combination of machines (e.g. algorithms, machine-learning, AI, etc.)
4. It is then **used** by humans and/or machines to make decisions that have an **impact** on the issue that people are trying to solve. Data is also generated from use and impact, feeding back into point 1

This view is independent of technologies, organisational boundaries and/or governance structures. The activities may happen wholly inside a single organisation. However, it is far more likely that a range of internal and external data are used to help inform outcomes. Addressing Shared Data will make it easier to access both internal (by increasing interoperability of internal processes and systems) and external data (through collective action).

Almost all decision-making taking place is based on aggregated data that has been collected, interpreted or extrapolated from context specific measurements (for example, the energy use in one production process in one manufacturing plant in a global value chain).

Specifying the needs for Environmental Data

Market needs are often articulated as 'bring us the data and we'll innovate'. The obvious question is 'which data, how, and why?'. What data are needed to support innovation that spans finance, policy, and science in practical and actionable ways? How can we design for humans and machines in the process, to make data findable, usable and reusable?

The data needs across users are increasingly wide ranging in scope and depth. For example, the identification of a specific component of a specific asset in a specific location at a specific time, and its temporal risk profile (where there is a change in risk over time).

Simplified, the underlying raw data needs for assessing environmental dependencies, risks and impacts - on which the quality of all other higher-level data rest—fall into these categories:

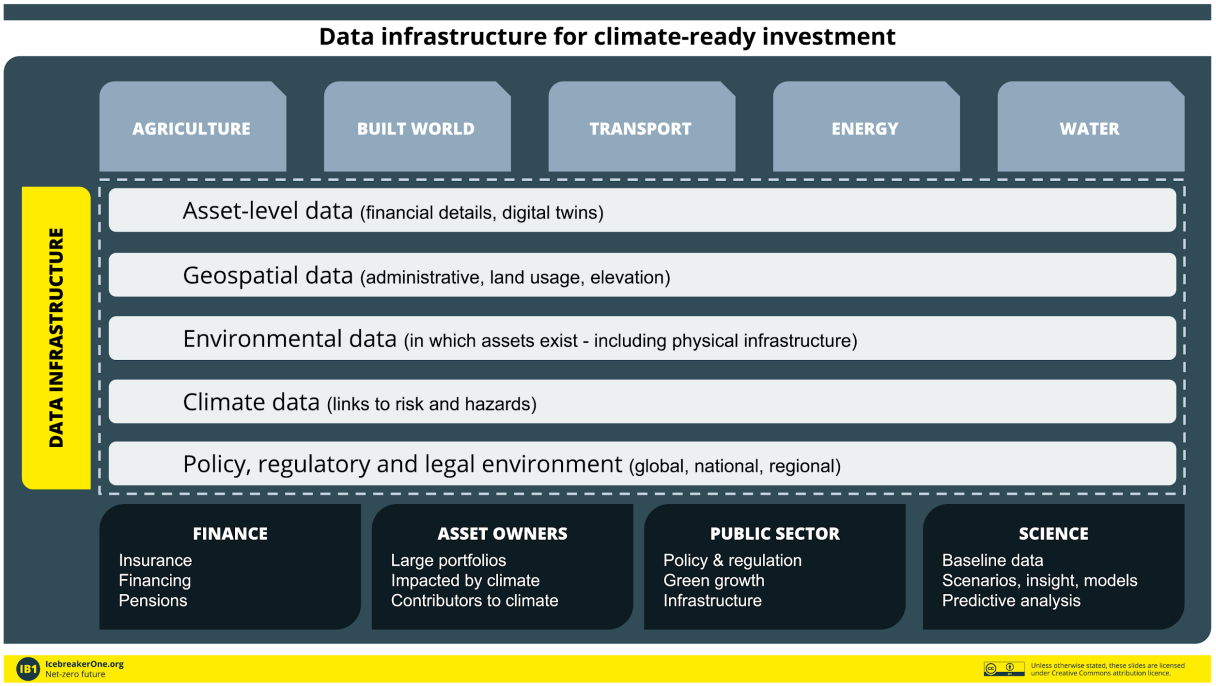
- **Asset-level data** (operational details, process inputs-outputs)
- **Geospatial data** (administrative, land usage, elevation)
- **Environmental data** (in which assets exist)
- **Climate data** (its links to risk and hazards)
- **Policy, regulatory and legal environment** (global, national, regional, local)

Interpreting the meaning of specific data relies on a combination of skills: environmental science, data science, scenario modelling, risk analysis, modelling, predictive analysis, financial modelling and communication. Experts need better access to baseline data, raw

(instrumented data) as well as collated and interpreted data, across different parts of the data value chain.

For example, the schematic below demonstrates the huge variety and applicability of non-financial data that impacts our environment. It spans agriculture, the built world, transport, energy and water. While this may seem complex, there are mechanisms to enable market-scale cohesion and interoperability.

The data infrastructure (the framework allowing data to be supplied, discovered and used[18]) spans the five categories listed above. These data are used across a broad range of stakeholders in finance, asset management, the private and the public sectors, as well as the scientific community who are modelling the measured impact we are having on the environment. Each of the stakeholders listed at the bottom of this chart are both consumers of data, and producers of data: there is no 'line' from one end to the other, it is a data value chain network that has no 'center'.



When reading this document it can be useful to hold in mind an example such as 'asset-level' data (e.g. data about a ship, a power plant, substation, a railway, a farm, a factory, a water treatment plant, a bridge). There are many other examples that are relevant, but given the abstract nature of 'data', thinking about a physical asset can help 'bring the data to life' and make the link to the material world.

Qualities of Environmental Data

Data has many characteristics. Some of the most relevant ones for users of environmental data include:

[18] https://icebreakerone.org/2019/05/13/discussion-paper/

- **Granularity**: specifically to enable the analysis of interdependencies across value chains, the 'scope' of granularity can include spatial, temporal and structural elements (e.g. to enable parametric insurance[19]).
- **Content scope**: extremely wide-ranging including emissions, biodiversity, water, ecosystems, materials, land and marine environments. Scope needs to cover both critical and non-critical infrastructure assets.
- **Content type**: measured (e.g. via sensors, satellite) vs modelled data
- **Provenance**: material and product traceability
- **Verification**: levels of authentication ranging from 'assured' to 'audited'
- **Confidentiality**: issues around sensitive data ranging from commercial secrets to privacy concerns

Additionally, the nature of data presented to users is dependent on the characteristics of:

- **Analytics and modelling**: both regression and predictive analytics and their modelling, including unknown or unknowable interdependencies (e.g. energy mix, cascade systems collapses, catastrophic risk modelling)
- **Reporting formats and aggregation choices**: which reporting frameworks[20], methodologies and metrics are being used for assessment
- **Science**: what scientific methods, models are being applied and in what manner

Stakeholder discussions over the last two or more years have pointed to a list of the specific qualities of the environmental data that is or will be required from global value chains. These include, but are not limited to, data that is:

> Relevant, Outcome-related, Comparable, Context Specific, Granular, Trusted, Confirmed, Timely, Forward-looking, Reliably-estimated, Whole value-chain, Business-specific, System-located.

Planning now for future needs

Going further into the future, to deliver the transformational change in the global economy called for by the EU Green Deal, non-financial data—as a continuous flow of evidence that informs action—needs to be usable for many different purposes, by many people at different times and different levels of granularity and scales: to drive different decisions.

Numerous reports and articles have highlighted the need for a step-change in how we handle data if we are to address the pressing climate and ecological crises we face (Jensen and Campbell, 2019; Coalition of Finance Ministers for Climate Action, 2019; UNEP, 2019; Brown, 2019; NGFS, 2019). A common theme is that non-financial reporting must go 'beyond the annual report' and be usable as a continuous operational lever for change.

> *"The EU can become a leading role model for a society empowered by data to make better decisions – in business and the public sector"*[21]

[19] A type of insurance that does not indemnify the pure loss but makes a payment upon the occurrence of a triggering event such as a catastrophic natural event https://en.wikipedia.org/wiki/Parametric_insurance
[20] For example, https://www.cdsb.net
[21] https://ec.europa.eu/info/sites/info/files/communication-european-strategy-data-19feb2020_en.pdf

As Jensen and Campbell (2019) emphasised, “Now is the time to reimagine and supercharge environmental governance and public-private partnerships by using big data, frontier technologies and data analytics to target our action and investments.”

More recently, investors overseeing over $9tn in assets have asked their portfolio companies to ensure their financial statements reflect the implications of the Paris Agreement, including “adjustments to critical accounting assumptions and estimates to ensure they are consistent with achieving so-called net zero carbon emissions by 2050… [asking that] board directors explain whether they had room to pay dividends if investments were needed to meet environmental goals.”[22]

Driving towards sustainability will increase the demands on non-financial reporting, which are growing exponentially. Such reporting, at its core, requires the sharing of timely, relevant, actionable data upon which people can have sufficient trust to make decisions. Equally important is that this same data be usable in holding to account the delivery of objectives.

5 Required features of a system for delivering this data

To meet the demand for data with the qualities specified above, the set-up for generating, collection and accessing data will need to include the following characteristics:

> User-friendly, searchable, accessible, confidential, rewarded, international, secure, uncorrupted, high-volume, progressively expandable, public interest, free-market, citizen participation, state-guaranteed.

Unpacking some of the most important of those:

1. **Reduce the burden of information gathering** and analysis by those requiring non-financial reporting data. Collecting information from global facilities and supply chains is highly complex and subject to numerous commercial and related constraints.

2. **Reduce the burden of reporting** from organizations across reporting frameworks, jurisdictions and scopes. The diversification and proliferation of reporting is increasingly complex and requires dedicated resources to collate, analyse and produce reports.

3. **Unlock access to sensitive information** by addressing legal, liability and consent management issues. Much of the more material information that is relevant to financial decisions is considered sensitive and requires restricted access.

4. **Unlock access to non-sensitive information** so that such access is commoditised. Access to data that could, or should, be considered Open must be provided in structured, machine-readable[23] formats in order to optimise for discovery and use.

[22] https://www.ft.com/content/dd01aacd-85a0-4577-9700-26f1d6fb26b3
[23] See Appendix for examples of machine-readable formats

5. **Reduce the risk of delivering quality, timely data to the ecosystem** by enabling better change management practices to be implemented in a scalable, operational framework

6. **Reciprocity:** Everyone thinks their data is valuable. It is. But how we measure and exchange value is something we need to explore. Value comes in many forms. Here, we talk about it in terms of reciprocity; do we feel as if there is a fair value exchange. If there is reciprocity then value flows in both directions; even if it's not a direct 1:1 exchange, there can be broader benefit to the market in which we are operating and that can improve operational efficiency, risk management or opportunity generation.

We make decisions that the 'value exchange' in making certain data open that has been funded by the taxpayer should be open because, as taxpayers, we've already paid for it.

6 Meeting data needs—technology is no longer the primary blocker

Technology innovation over the past 5-10 years has led to a radical transformation of what is now possible. Data from diverse sources are now connected to the web: from the 'internet of things' (IoT) to sensors and earth observation satellites, through to individual accounting packages for small businesses and national company registries. This means they are already able to be connected;this is no longer an 'ICT' challenge and technology is not an inhibitor to rapid implementation.

The resultant technical challenges that do remain include (a) alignment and (b) ubiquity. It is possible to create the framework for the required flows of environmental data through value chains today if (a) relevant stakeholders engage and 'lean in' to the collective action challenge and (b) the sufficient investment is made to ensure that no one is left behind in this implementation of the Data Revolution[24].

One area of data innovation that has revolutionised what is possible is 'interoperability'. Interoperability is defined as 'the ability of computer systems or software to exchange and make use of information.' In practice, this allows any number of services to share data seamlessly in a consistent fashion. The resource owner always maintains control of authorisation: they define who is able to interact with what data.

Examples of this approach at sector-scale already exist. An exemplar implementation is the implementation of Open Banking in the UK.

6.1 Open Banking as proof of concept

Open Banking is a regulated standard for access and sharing of sensitive data across the banking sector. It has facilitated the uptake of the technical possibilities of interoperability by addressing issues around consent, access rights, security, operating principles, technology architecture, dispute and redress rules.

More than two million organisations and individuals now use it on a continuous basis to manage financial data sharing. American Banker magazine described it as

[24] https://www.worldbank.org/en/data/statistical-capacity-building/data-revolution

“one of the biggest changes in financial services in a generation”.

The design of Open Banking was launched in the UK in 2016, regulated and implemented across the whole of the UK market by 2019 (in under five years).

The principles and practices of Open Banking are now in development across over 20 countries, including Australia, Bahrain, Europe, Hong Kong, India, Japan, Mexico, Malaysia, New Zealand, Rwanda, Singapore and the USA and beyond.

The pace of change has been extremely rapid, with projections that Open Banking is going global with 87% of countries and over 10,000 financial institutions following its approach[25]. The Open Banking market is projected to grow to over $40B by 2026 with a 24% growth rate (CAGR)[26].

“The evolution from a closed model, where each financial institution retains and controls the information it collects about its customers, to an open model, where customer data is shared, referred to as open banking, has the potential to change competition in the sector and see the creation of new products and services based on that data.”
Deloitte[27]

Open Banking is a data sharing approach designed to help companies and regulators design and **develop new financial products and services**, with a **shared set of principles and practice** aligned with regulatory best-practice and common goals.

The range of use its possibilities are put to is impressive:

> Saving for financial resilience, budgeting tools, affordability checking for those with thin credit files, cash flow forecasting and integrated accounting for business, low-cost overdraft alternatives, lower cost payments, even alerts on unusual spending patterns for those caring for others.

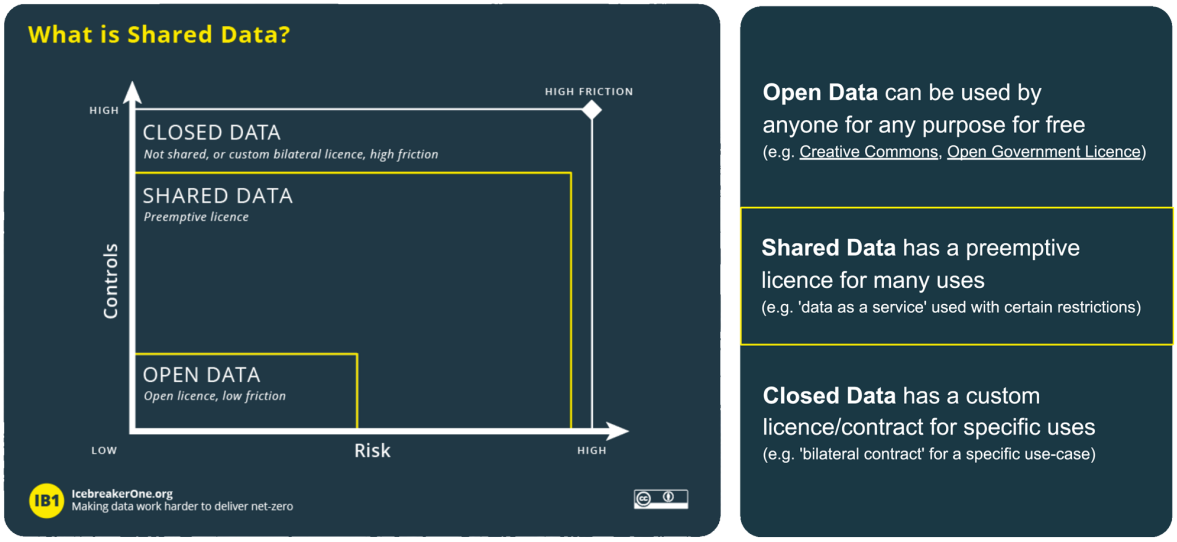
As a result of its implementation, there is greater competition, a far more level playing field for new entrants, and as a result the benefits sought by the Competition and Markets Authority (the UK’s competition regulator) are becoming evident. The Open Banking approach is now being trialled in other sectors, such as energy.

See the Appendix for more detail on Open Banking UK and the ongoing development in Open Energy[28].

[25] https://www.finance-monthly.com/2019/11/open-banking-is-going-global-with-87-of-countries-having-open-apis/
[26] https://www.globenewswire.com/news-release/2020/04/13/2015104/0/en/Open-Banking-Market-Size-to-Reach-43-15-Billion-by-2026-at-24-4-CAGR.html
[27] https://www2.deloitte.com/content/dam/Deloitte/au/Documents/financial-services/deloitte-au-fs-open-banking-seismic-shift-180118.pdf
[28] http://energydata.org.uk/

6.2 Understanding Closed, Shared and Open Data

The possibilities of data flows hang on the differentiation of access rights to data and the understanding that some data is Closed, some Open and—crucially— the rights around data that can be called Shared (see diagram).



Open Data

Open Data can be used by anyone for any purpose, for free (e.g. under a Creative Commons licence). Examples include public data such as the human genome, a bus timetable or any of the 55,000 data sets here (you may be surprised that it took quite a bit of effort to get bus timetables to be open in the UK).

Creative Commons defined a step-change in thinking. It enabled us all to say “it’s okay to use this image for free” **in advance**. As of May 2018, there were an estimated 1.4 billion works licensed using a CC licence.

Society has defined that personal data is **not** Open Data—for many reasons—and that data is now covered by regulations such as GDPR in the EU.

Closed Data

Closed Data is either data that you don’t want to share outside of a specific group (e.g. people contracted to work for your company), or that is only shared using bilateral contracts, where each contract needs to be unique.

For example, a bilateral contract for a specific project, or access to information enabled via an employment contract.

Shared Data

Shared Data is data that is accessible under a predefined set of rules (e.g. on who can access it, for which uses, under which conditions).

With **Shared Data**, if stakeholders publish their data descriptions and their licensing options per type of use (aka 'preemptive licensing'), then other stakeholders can just access it — compliant to their respective licensing requirements. This can enable people to create different types of value exchange, including granular payment structures for different types of use.

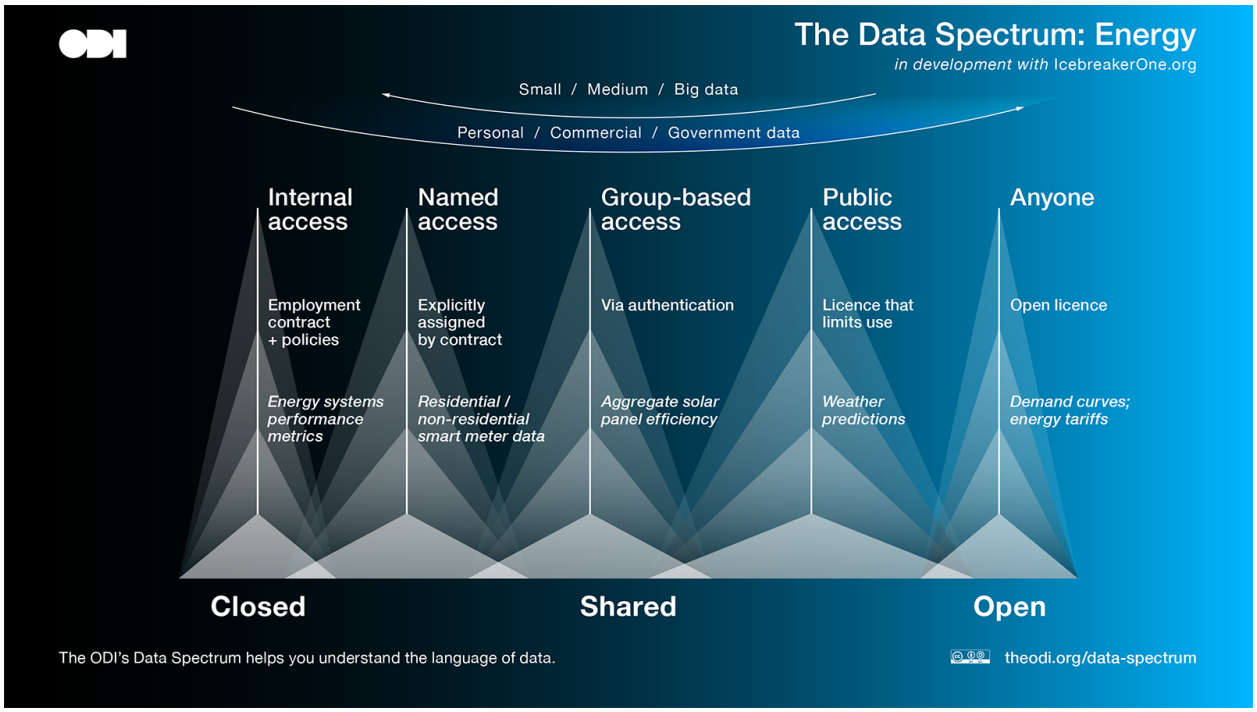
Shared Data can be discovered by publishing an (open data) description of it (e.g. meta-data), that enables search engines (and therefore you) to find it. If the licensing is clear, then the friction between discovery and usage is reduced.

Doing this **increases the size of the observable dataverse** and helps to unlock innovation while protecting the interests of individuals, organisations and countries to use it for both **public** and **private** good.

The example of Open Banking provides some insight: the regulator mandates that financial data (e.g. business or personal financial statements) can be transferred between banks by the customer without a financial cost. This data is not open and it's not 'free'.

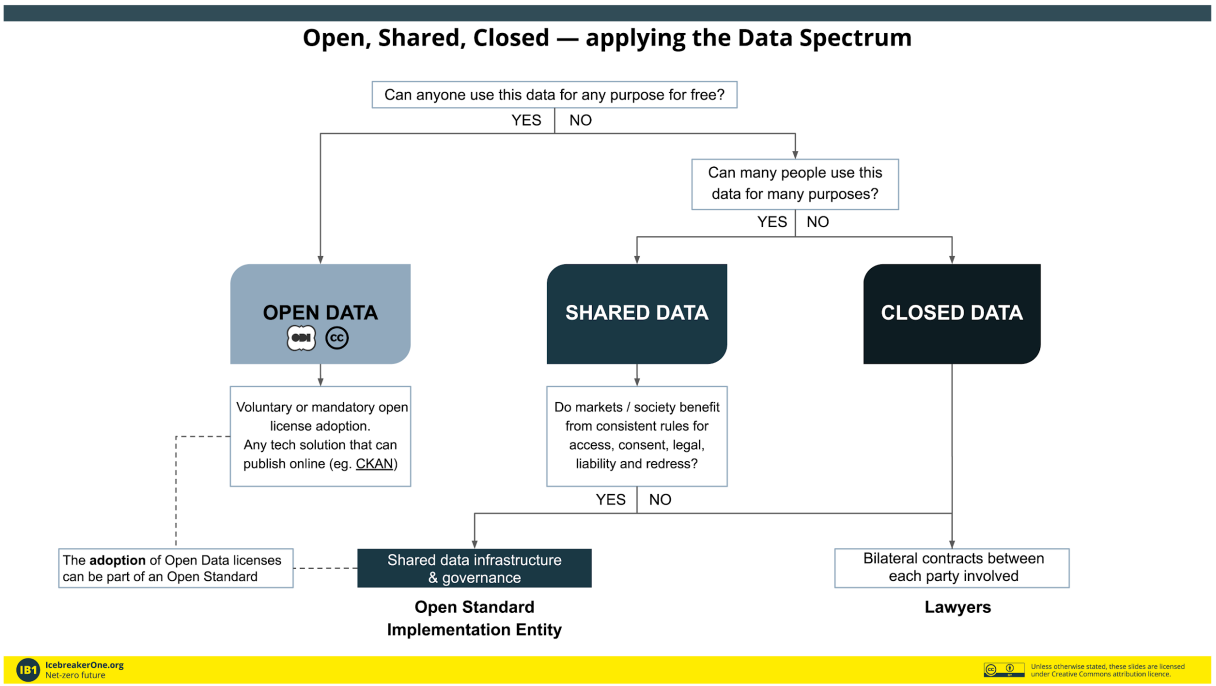
Firstly, it is either personal or commercially sensitive data, so it cannot be open. Secondly, it is not free as there is a material cost to provide that scale of data management. However, retail banks have collectively agreed to bear this cost, because there is a mutual benefit (and it is regulated). The market as-a-whole benefits, the costs all 'balance themselves out'—there is **reciprocity**.

The diagram below illustrates the Data Spectrum[29] for energy[30]:



[29] Data Spectrum, https://theodi.org/about-the-odi/the-data-spectrum/
[30] Energy Data Spectrum co-developed by Icebreaker One and the ODI

To consider whether any piece of data is to be closed, shared or open, the flow-chart below is helpful. It is based on the question “how can a piece of data be used?”.



6.3 Policy support for new data systems

The European Commission’s 2020 Data Strategy is clear that the future of data in the EU lies in the creation of the frameworks for shared data. The strategy calls for “[a] cross-sectoral governance framework for data access and use”, which is to be applied to a very wide range of uses for data across the scope of EU policy interests; for industry, health, agriculture, and the achievement of the Green Deal.

Specifically, the Data Strategy plans for:

> “cross-sectoral (or horizontal) measures for data access and use should create the necessary **overarching framework for the data-agile economy**, thereby avoiding harmful fragmentation of the internal market through inconsistent actions between sectors and between the Member States. Such measures should nonetheless take into account the specificities of individual sectors and of the Member States.
>
> The Commission’s approach to regulation is to **create frameworks that shape the context, allowing lively, dynamic and vivid ecosystems to develop**. Because it is difficult to fully comprehend all elements of this transformation towards a data-agile economy, the Commission deliberately abstains from overly detailed, heavy-handed ex ante regulation, and will prefer **an agile approach to governance** that favours experimentation (such as regulatory sandboxes), iteration, and differentiation.
>
> In line with this principle, a first priority for operationalising the vision is to put in place an enabling legislative framework for governance...**such governance structures should support decisions on what data can be used in which situations, facilitate cross-border data use, and prioritise interoperability** requirements and

standards within and across sectors, while taking into account the need for sectoral authorities to specify sectoral requirements."

At least part of this governance structure is proposed in the Data Governance Act[31] adopted by the European Commission on 25th November 2020. Amongst other things, the proposed Data Governance Act aims to:

- Increase trust in data sharing.
- Create new EU rules on neutrality to allow novel data intermediaries to function as trustworthy organisers of data sharing.
- Facilitate the reuse of certain data held by the public sector.
- Give Europeans control on the use of the data they generate, by making it easier and safer for companies and individuals to voluntarily make their data available for the wider common good under clear conditions.

The Data Strategy plans for development of the governance of EU Dataspaces[32] in: health, the Green Deal, energy, agriculture, mobility, finance, manufacturing, public administration and skills.

Of these, Green Deal dataspace aims to facilitate the transition to an environmentally sustainable economy outlined in the EU's Green Deal policy, including aligning financial and corporate decision making with sustainability.

The EU has set aside funding of €2 billion for the development of the data processing infrastructures, tools and governance mechanisms that would underpin these dataspaces. Much of this activity is likely to build on five years of work undertaken by the International Data Spaces project[33] and subsequent GAIA-X project. The International Data Spaces Association has recently defined a standard for creating and operating data spaces[34].

At national levels, data is now being considered as a part of national infrastructure[35].

Future proposals for a cross-sectoral governance framework for non-financial environmental data appear to fit closely with the potential of the Green Deal Dataspace to deliver on the EU's Green Deal policy agenda, especially where they fit with current data policy goals.

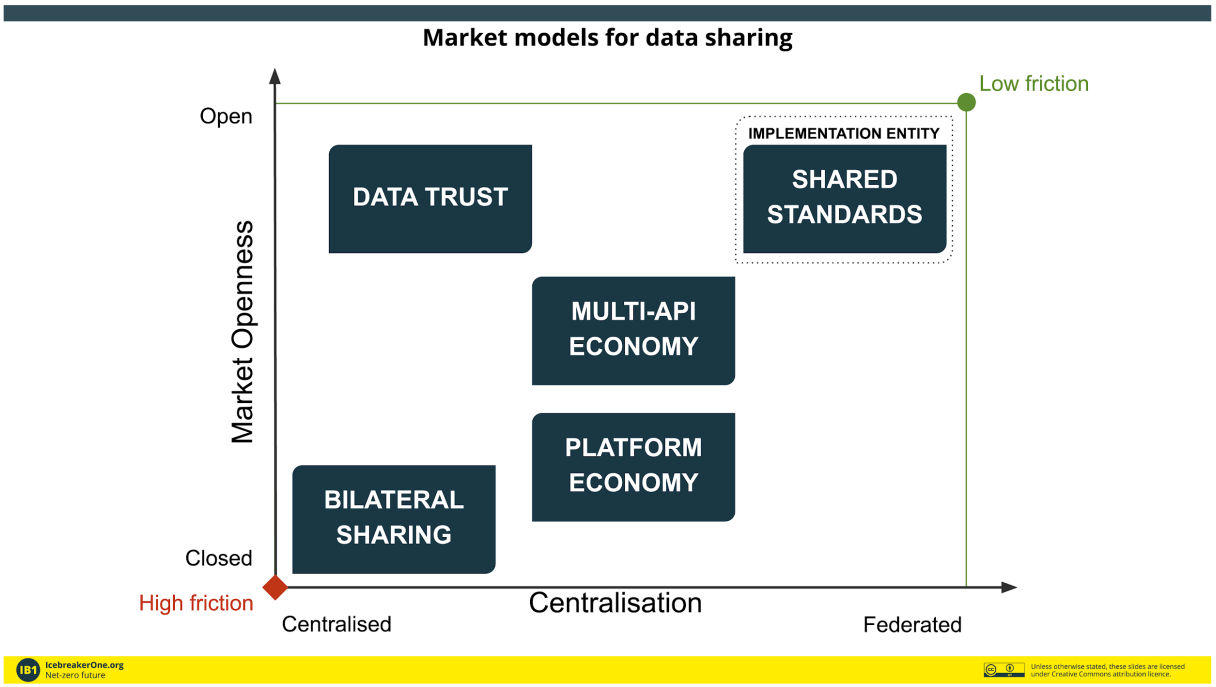
For instance, these include avoiding conflicts of interest in new data sharing services and a desire for data-sharing entities known as 'data intermediaries' to be set up as a means to act as a go-between for exchanges between data producers and acquirers. Such bodies will be subject to strict conditions as a means to ensure 'trust' in the new framework.

It should be possible, to build upon these requirements in a manner that is commensurate with both the requirements of structural separation but also in a manner that can embrace and enable cross-border data sharing between the bloc and the rest of the world—given the immediately global nature of supply-chain reporting, and that this is a critical requirement for the Green Deal and all forms of non-financial data.

[31] https://ec.europa.eu/digital-single-market/en/news/proposal-regulation-european-data-governance-data-governance-act
[32] https://ec.europa.eu/digital-single-market/en/european-data-governance
[33] https://www.dataspaces.fraunhofer.de/en/InternationalDataSpaces.html
[34] https://www.internationaldataspaces.org/idsa-horizons/
[35] https://nic.org.uk/studies-reports/regulation/

7 Market approaches and options that unlock data flow

Below, we consider six models that enable better flows of data. These are different models for data sharing. Our axes are **market openness** (how easy is it to enter, participate or collaborate) and **centralisation** (how does the market design influence data flows).



7.1 Bilateral Sharing

The current default is Bilateral Sharing: one organization sends data to another based on a request. This is simple to understand and execute. It is often achieved using a bilateral contract to address legal terms.

However, it is a high effort and cost and is not easily scalable. The requesting body usually has to create a contract, a set of requirements and manage a relationship with each reporting organization. Each organization has to review terms and meet the needs of that specific report. There is little or no framework in place to enable reuse of the organizational data for other requesting bodies. Reports are often not machine-ready (e.g. unstructured PDF files). The process is costly in time and effort and therefore inhibits innovation (e.g. increasing reporting frequency from annual to quarterly or more granular detail is impractical).

It may be considered reasonable and practical to continue with this process. Our opinion is that to maintain this approach would both materially limit trust in the market and inhibit innovation.

We consider Bilateral Sharing as an inevitable component of an overall market solution.

7.2 Platforms

Platforms are core to most organizational strategies. A platform economy[36] enables the aggregation of data, services and markets under a single umbrella (e.g. Amazon) and can generate significant value for the aggregator. It can also unlock huge value for the surrounding ecosystem(s) by removing transactional friction.

Such platforms can reduce costs, reduce inefficiencies and help create entirely new markets. They can provide 'turnkey' solutions that can provide shortcuts to organizations looking to share data. They can also create substantial monopoly positions and place substantial power (real or soft) in the hands of private sector actors.

Platforms are an essential part of the web of data. They are structurally attractive as they can often reflect bureaucratic structures and can appear easier to govern.

However they also present material challenges to data sharing as they may be acting in direct competition to those wishing to share sensitive data. Platforms can also be brittle: subject to technology innovations, market shocks or regulatory interventions, they require continuous innovation, development and redevelopment, and are prone to 'feature creep' that may or may not be aligned with the needs of the market as a whole.

Challenges include:

1. **Scalability**
   Organizations can find it burdensome to submit data to many places in different report formats.
2. **Confidentiality**
   Organisations are reluctant to send any sensitive data to any third party especially if it relates to any competitive, privacy or security-related matters.
3. **Continuity funding**
   Funding can be uncertain and can often end up 'competing' with other organizations in the ecosystem.

Some vendors are proposing that encrypted solutions or distributed ledger-type approaches are solutions to these challenges. However, we believe that the complexity of such approaches is both a barrier to entry and does not provide a robust cost-benefit outcome.

When assessing the needs of the whole market around non-financial data, we must be cognisant of the social vs economic vs environmental balance. This is especially important in the context of cross-border data sharing where there may be substantial differences in legal frameworks, skills and capabilities.

We consider Platforms an essential component of an overall market solution.

[36] https://en.wikipedia.org/wiki/Platform_economy

7.3 Multi-API Economy

Much of the web today operates within the frame of a 'multi-API' economy.

APIs allow different software applications to communicate with each other and exchange data directly, without the need for human input each time. They have become the de facto standard for sharing data, and have enabled organisations that hold large amounts of data to become platforms for third party innovation.

Organizational APIs enable the sharing of data between entities in a relatively low-friction manner (e.g. Software-as-a-Service models). They are quick-to-market and are competitive at all levels in the data value chain. They embody an open market approach. Conditional access controls are defined by the organisations who host them.

Without regulatory intervention, they also result in multiple approaches, rules and create scalability issues. For example, prior to the existence of the UK Open Banking Standard, an organization would have to create a custom integration with every other service. Now there is a single way of creating cohesive interoperability within a trusted framework.

Multi-API economies present challenges to effective definition and protection of rights, modes of redress and dispute resolution are complex and imbalanced. The latency between market capabilities and regulatory control are lengthy and can enable asymmetries, monopolistic behaviours and undermine trust. For example, GDPR now exists to try and address these issues for personal data. Open Banking addresses challenges for personal and business financial data. There is currently no robust, scalable framework for non-financial reporting.

We consider a Multi-API economy a critical component of an overall market solution.

7.4 Data Trusts

More recently, the concept of a Data Trust[37] has emerged to address these challenges.

Data Trusts steward data on behalf of communities. They involve one party assuming a fiduciary duty to stewarding the data (acting with impartiality, prudence, transparency and undivided loyalty).

Data Trusts build on many of the challenges we have described herein and specifically aim to address governance, impartiality and centralised data aggregation so that data may be shared and analysed within a trusted environment. The model can simplify contracting and integration around specific use-cases and provide a narrow and comprehensive focus for action around that use-case. For example, GOFCoE (Global Open Finance Centre of Excellence[38]) is a university-hosted national data observatory for granular financial data across the UK that could be considered an exemplar for a data trust type of solution.

However, at the scale and diversity envisaged around non-financial reporting, Data Trusts can also present anti-competitive challenges around cross-border sensitive data (e.g. due to

[37] https://theodi.org/article/what-is-a-data-trust/
[38] https://ddi.ac.uk/case-studies/gofcoe/

state interests around data about critical national infrastructure). One interviewee shared an experience about what can happen when data trusts go wrong—where competitors utilised the data trust to gain an advantage over each other through asymmetric provision of data. They may also struggle to rapidly adapt to diverse user needs.

We consider Data Trusts a potential component of an overall architectural solution.

7.5 Shared Standards

Shared Standards are standards that facilitate data sharing (e.g. Open Banking standards).

They can help align public and private sector organizations around a governance framework that does not hold any data itself, but rather defines the rules for sharing, and present a solution to unlocking data sharing at scale. Such frameworks can be voluntary or mandatory.

They represent a **foundational component** of an overall architectural solution that can help the whole market address its diverse challenges and opportunities. It is aligned with the EC recommendation for a “cross-sectoral governance framework for data access and use”[39].

[39] EC ‘A European strategy for data’ https://ec.europa.eu/info/sites/info/files/communication-european-strategy-data-19feb2020_en.pdf

7.6 Summary of pros and cons of solutions in creating data flows

These approaches outline modes of addressing data governance for access to Shared Data and can provide a framework to standardise access to Open Data.

	Pros	Cons
Shared standards	Open marketplace Shared integration / interoperability framework Close regulatory linkage & feedback loops Enables market-participants to self-organise Low transaction cost (common approach) Makes clear what should be 'competition' Multi-point, whole-system value creation Fast to integrate once in-place (adherence standards) Builds on architecture of the web	Higher initial effort to reach consensus Requires cultural alignment Requires cohesion between regulation and market actors
Data trusts	Centralised administration Governance a key focus Single integration point Single contracting point	Lack of willingness to share into it Hard to address diversity of needs May struggle to meet diverse user needs Difficult to adapt in an agile manner/brittle
Multi-API	Market-driven Quick-to-market Competitive at all levels	Multiple rules & integrations Complex High cost to enter Monopoly-gating points emerge easily
Platform economy	High single-point value creation Centralises control Faster-to-market Structurally attractive to reflect existing bureaucracies	Lack of willingness to share into it Value flows easy to skew to monopolies Doesn't scale long-term Commercial friction on data value Not a 'web-first' strategy (reflects legacy thinking not 4th industrial revolution)
Bilateral contract	High single-point value creation Centralises control Faster-to-market Structurally attractive to reflect existing bureaucracies	High friction process (repeat for each relationship) Low/no reuse (unique to each use) Market inhibiting High cost Slow (3-9 month contract cycle)

8 System design options

“The convergence of the solutions... that’s the piece that I’m really interested in... because treating them individually and trying to figure out a solution separately hasn’t brought us very far.”,*Christiana Figueres, Outrage and Optimism podcast, May 2020*

It is tempting to see ‘data’ as a technology problem, whereas technology is merely a tool by which we can choose to implement policy decisions. Our response, therefore, considers the market design to best deliver robust data sharing that will meet the needs of policy and business, governments and citizens, after considering all the alternative available modes for addressing that.

When considering the whole-of-market design for data-sharing, we propose the ideal design outcomes include:

- Maximising for interoperability and cohesion (between private sector and public sector)
- Reducing friction in the system to enable data flow (legal, technical, cultural, regulatory)
- Open markets that drive trust, transparency, cooperation and competition

Challenges include addressing data as infrastructure[40], challenging the ownership of data[41,42], and exploring market-specific interoperability issues for sectors such as energy[43], and building on existing practice in the financial sectors[44].

We will continue to see the rapid and diverse increase of data supply and demand, and this will require many-to-many governance across a diversity of use-cases. To ensure that any of our technologies have the best potential to be useful we need to instrument the provision of reliable, robust data ‘into the systems’. We further anticipate rapid and continuous expansion and refinement of data provision requests to enable it to be ‘market ready’ and actionable.

Further, given the global, cross-border and multi-stakeholder nature of non-financial data, the politics and practice of the data sharing challenge will almost certainly need to be distributed and ‘web-scale’ (for current needs, and as looking into the future, it will need to involve many millions of connections on a continuous basis).

We will describe five potential market models that apply to data sharing in the digital age. Our recommendations are that, in cases where many-to-many data sharing is required, a *Shared Data Governance* approach is the most effective option to deliver the objectives for standardisation and efficiency. This would deliver consistent governance rules and legal frameworks for access, consent, liability, redress, structure, technology approaches and support.

[40] https://www.nic.org.uk/wp-content/uploads/Data-As-Infrastructure.pdf
[41] https://theodi.org/article/who-owns-our-data-infrastructure
[42] https://blogs.worldbank.org/climatechange/hydromet-services-public-sector-domain-or-private-sector-business
[43] https://es.catapult.org.uk/reports/energy-data-taskforce-report
[44] https://thebusinesscouncil.ca/wp-content/uploads/2019/07/Data-Driven-Issues-Paper-July-2019.pdf

Together, these serve to reduce structural barriers, mitigate potential monopolistic behaviours and address the previous collective-action challenges identified to create an open, competitive marketplace for non-financial data.

Given the complexity of most of our systems, a 'web of data' approach is more effective, efficient, resilience and scalable than an approach that tries to 'aggregate everything into one place' (which many big-data lakes have attempted to do over the last decade).

We can learn from the architectural approaches utilised by both the web (the most successful information architecture in history) and its governance approaches. We can also build upon the more recent codification of domain-specific policy which reflects decentralised data ecosystems, such as Open Banking.

So a distributed approach to Shared Data[45] facilitated by Open standards is cheaper and more robust in the long-term and may require an independent governance process to help manage trust relationships across the ecosystem[46] and address data across the Data Spectrum[47]. Adopting this removes two major barriers.

- Firstly, the need for bi-lateral data sharing agreements is removed, as participants adopt a preemptive licencing regime appropriate to their requirements.
- Secondly, there is no need for the unique technical integration often required to access datasets securely.

It is a service that, once onboarded and integrated, can be deployed many many times with low marginal cost. As a result, it makes data sharing much faster and cheaper than we see in the current fragmented landscape.

"Open Standards will help support delivery of our legally binding net-zero targets and enable regulatory interventions across sectors"
Baroness Worthington, UK House of Lords

While much of the promise of jargon-led technology (e.g. big data, blockchain, artificial intelligence, machine learning, etc) can excite and engage in the short-term, their impacts will not be felt for some time. Equally, when the pace of change in digitalisation 'connects' with a sector, we have seen substantial creative destruction. Thirty years into the development of the web we are arguably at the 'end of the beginning'—we have connected the majority of the world's humans and machines. We cannot underestimate the impact of digital innovation.

"[W]e overestimate the impact of technology in the short-term and underestimate the effect in the long run", *Amara's Law*

Open standards can enable data portability across digital services, making data available to a wider marketplace for users and competitors[48], offering benefits to organisations and

[45] https://medium.com/@agentGav/what-is-shared-data-20f6a7233887
[46] Mapping Data Ecosystem, https://theodi.org/article/mapping-data-ecosystems/
[47] https://icebreakerone.org/understanding-data-sharing-applying-the-data-spectrum/
[48] "There is a highly competitive market for the provision of data networks based on open standards in almost all countries" https://www.gsma.com/publicpolicy/wp-content/uploads/2018/06/GSMA_Data_Value_Chain_June_2018.pdf

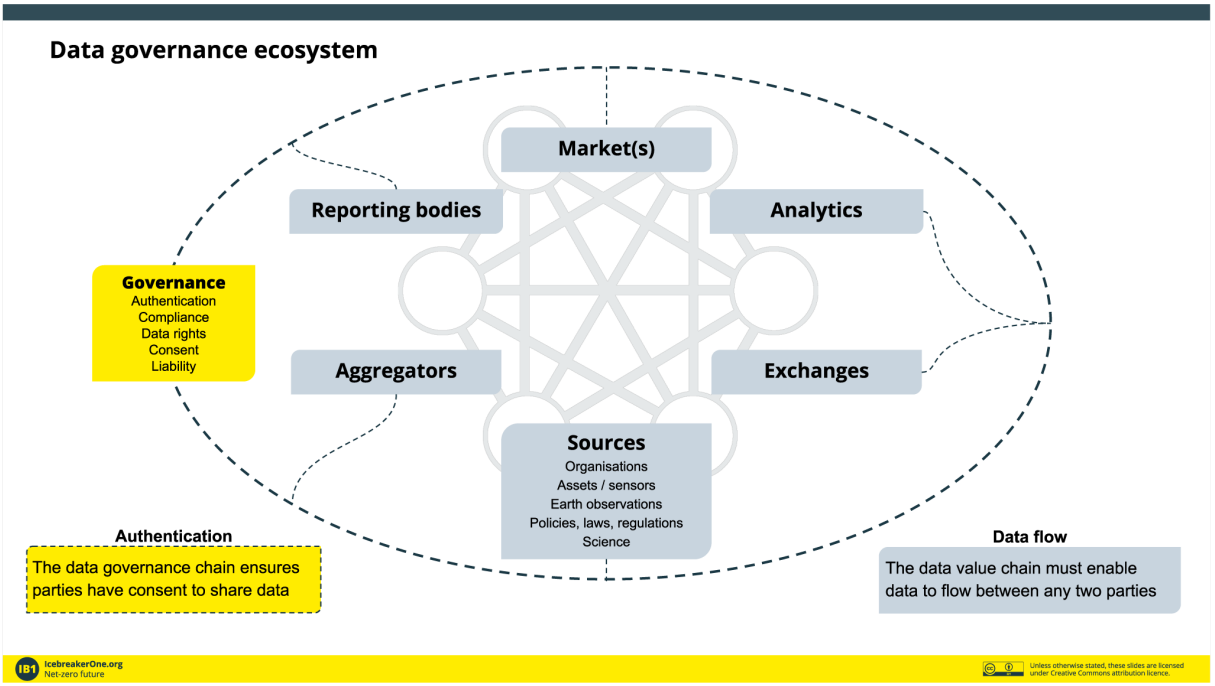
facilitating the entry of new businesses. Implemented effectively, this approach could be a more flexible, manageable and timely strategy than current approaches.

Recent evaluation of the suitability of the approach used in Open Banking for a shared data approach to the energy system in the UK has demonstrated that this approach can be adopted across other sectors and for data sharing of non-financial information more widely.

"Building on Open Banking and Open Energy frameworks will help us deliver a robust data infrastructure and provide a blueprint for cross-sector data sharing. This will help us improve efficiency, meet our net-zero targets as well as stimulate innovation to enable companies to scale up." **Irene Graham OBE, CEO, Scale Up Institute**

We unpack data value chains from the perspective of those attempting to use data, as transformed into actionable information and insights. The users are manifold and the data value chain should be seen as cyclic and interwoven, not linear.

These possibilities are sufficient to create an outcome that is an ecosystem for data exchange, which creates the appropriate relationships between the key actors, for effective, easy data generation, exchange and use - as illustrated below.



In this diagram, there are many data suppliers and many data users (in fact most organisations will be both suppliers and consumers of data in a web of data ecosystem). The diagram illustrates the fact that the flow of data can be treated as a separate component to the flow of authentication.

All organisations inside the data governance ecosystem (or 'trust framework') agree to common rules for data sharing. These rules are overseen by the Governance body which, working as a neutral provider, oversees the collective needs to both **define** and **operationalise** authentication of the actors in the system (this is at the heart of a trust framework), data rights (who is allowed to do what, when), consent and consent

management (who gives permission and how is this applied), liability rules (how does liability flow across the system) and dispute management (independent oversight).

For example, a city planner might need access to regional data about energy consumption. The data will sit across many vendors and systems. It will not be (and should not be) Open Data, so gathering it would require approaching each vendor individually, or via a third party aggregator.

With a common framework for trusted sharing, data can be easily requested by the planner, and all the vendors can easily *pre-authorise* consent for that use case (which is linking private, confidential and sensitive data to a public good and may require a non-commercial fee).

Equally, an engineering firm may request access to the same data for modelling. Access can be similarly *pre-emptively* granted, the parties authenticated and a commercial fee agreed. Open Banking facilitates precisely these forms of interaction between hundreds of fintech companies and all retail banks in the UK, underpinning millions of transactions.

This can allow data flows through global value chains for all use-cases to shift the operational mechanic of corporate reporting from **'push'** to **'pull'**, for instance to create an open, competitive market for non-financial reporting data that can evolve incrementally, on a continuous basis.

The shared-data principles can **enable the creation of new impactful incentives & levers of change** in data generation, access and flows and could lead to:

- Automate data provision to a closed, trusted ecosystem (from authorised entities)
- Automate reporting (authorised entities **pull** data — not pushed by the end user)
- Automate federated verification (via machine-ready data flow)
- Automate decentralised, verifiable audit (via third-parties)

By way of comparison with a current example, the combined impact of both digitalisation and Open Banking approaches has shifted VAT reporting for millions of companies from what was an onerous and complex task to a 'single click' or automated process in jurisdictions that have fully embraced data sharing.

For example, Xero, the widely used accounting software programme, has made open banking a core part of its proposition. As you'd expect it makes the core features such as a bank reconciliation much easier, but Xero has adopted a partnering approach where other third-party solutions can link to the Xero "platform". This opens up the benefits of a wider range of solutions for the small business user that are driven by deep understanding of that particular business.

Cashflow forecasting tools are useful, but newer services are able to benchmark, contextualise and help guide decisions about the way a business is funded. A loan may not be the answer: invoice discounting or further equity investment may actually be better options. This is important, because there's been a long term trend for SME business banking to be provided through account managers in regional offices.

Whereas a generation ago the local bank manager would typically have a personal contact and a relationship with the business owner, and therefore a good insight into the needs of the business and the circumstances of the owner, this is not as prevalent today.

Therefore, new services through this type of accounting platform can be invaluable in stepping into this gap. The process of digitalisation is not about 'technology-first' solutionizing or 'a database'. It must be considered through the lens of market design that can operate in a digital era at web-scale.

9 Design needs

Overcoming Challenges to Data Flows

We have witnessed the impact of the web, over many decades, fundamentally alter the nature and scale of information interoperability and data exchange. Many of its benefits have yet to be embraced by the non-financial reporting community. Equally importantly, many potential harms must be mitigated. Robust data sharing, at web-scale, must address a range of challenges, some familiar and some new, to governance.

Commercially Sensitive Data

Specific decision-relevant information that can affect market behaviours is often highly sensitive (e.g. intellectual property, competitive, relevant to system security) and can be considered 'high friction' in terms of the willingness of participants to share it.

This is particularly relevant to supply-chain, value chain and Scope 3[49] information where these sensitivities are codified in legal confidentiality clauses that prohibit the sharing of data about suppliers and customers.

Other sensitive data

Data about assets can be highly sensitive, are often covered under national security[50] guidelines as critical infrastructure, all the way through to non-sensitive data such as the total power output of a national grid.

Data is not innocent nor neutral, and openness can be a problematic and contentious issue, used for strategic or manipulative purposes. Governments will have national security concerns and might be reluctant to share information about certain infrastructural conditions; companies will have commercial concerns around sharing data that might affect their business models; communities will be vulnerable to exploitation or other action by malicious actors and have concerns about justice, privacy and security.

Attitudes around data are broad, ranging from concerns of surveillance capitalism, to being a "social infrastructure that must be public in order to ensure common well-being"[51], to being an asset for competitive advantage.

[49] https://ghgprotocol.org/standards/scope-3-standard
[50] https://www.cpni.gov.uk/system/files/documents/78/7c/CPNI%20-%20Open%20and%20Shared%20Data.pdf
[51] https://www.barcelona.cat/digitalstandards/en/data-management/0.1/_attachments/barcelona_data_management_0.1.en.pdf

Governance must ensure the health and security of our nations, businesses and societies. Increased exchange of information and knowledge in relation to our place within, and our impact on, the environment must also take into account national security concerns, commercial interests, and respect for individual and community privacy. There will be a balance to strike here when we consider the governance of data with planetary relevance and its implications: is the attitude towards data nourishing of the vitality of life, including human life?

Problems with Platforms

It is not uncommon to see data solutions proposed that try to create a 'central repository' or 'hub' to which all data must be sent in order that consistency may be achieved. This is a high-risk approach for three reasons.

Firstly, it doesn't scale: organizations see it as burdensome to have to submit many reports to many places. Secondly, organisations are reluctant to send any sensitive data to any third party. Thirdly, the funding model for the 'hub' can be uncertain and it can often end up competing with other organizations in the ecosystem.

For data sharing to succeed, we will need to articulate pathways that establish trust, collaboration and willingness to share - as well as ensuring that the different needs of stakeholders in different countries and contexts are taken into account.

System Innovation

Additionally, creation of a new framework for data is a dynamic, collective transition of multiple, diverse actors to a new set of norms, practices and opportunities. Businesses may feel they cannot move alone in becoming more 'Open or open access by default', even though when a whole market moves, the new norms can bring benefits to all players. So achieving a new equilibrium in data flows needs careful design so that it incentivises and aligns voluntary actions and regulation over time to identify and advocate for voluntary and regulatory initiatives to improve the availability of critical datasets.

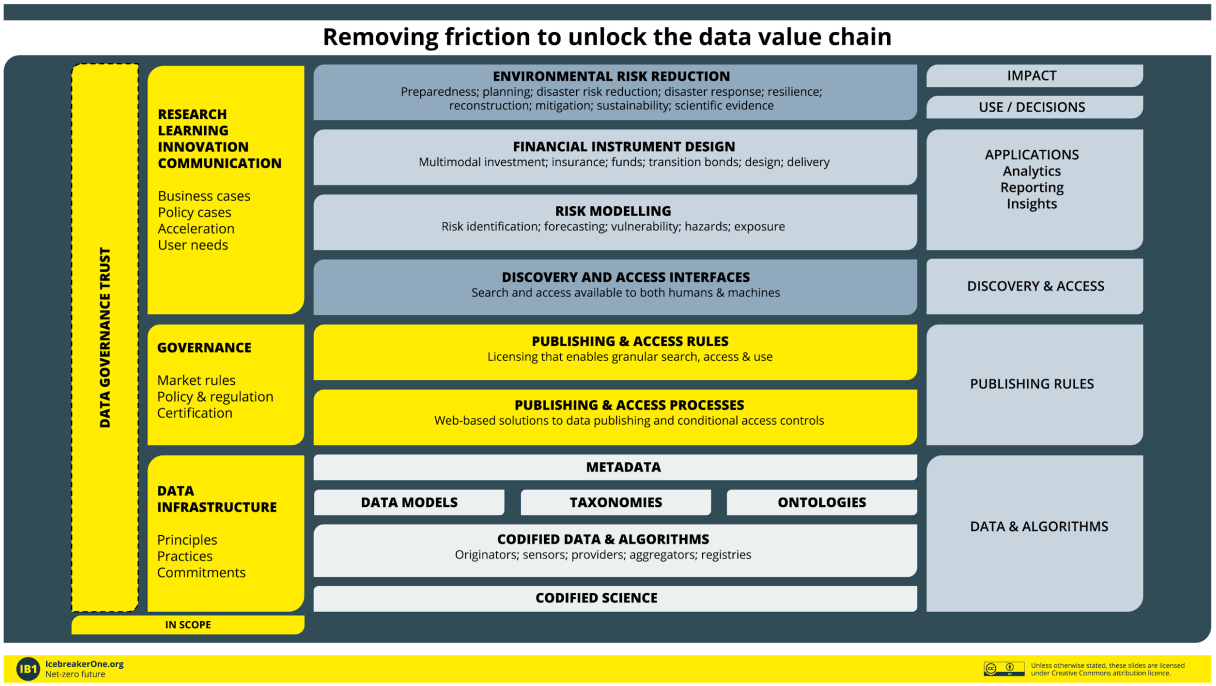
For example, the insurance and reinsurance industries are currently grappling with the need to better understand environmental systemic risks, and recognise the need to coordinate across multiple different actors (PwC, 2014). However, because each stakeholder has different interests in the status-quo, securing a shift is difficult. Work on governance can identify opportunities for voluntary coordination to shift to a new default, securing commitments from key stakeholders, monitoring progress, and coordinating the shift.

9.1 Specific design needs

The schematic below[52] illustrates what could lie within the remit of data infrastructure governance, what does not, and how this fits within the broader context of user needs. Specifically included are the Publishing Rules. Specifically excluded are the origination of new taxonomies, modelling, ontologies and schemas.

[52] https://icebreakerone.org

The approach narrows the scope of work for the data governance organization so as not to compete with the rest of the value chain. It helps bring together organisations across the data value chain to understand their needs; to understand through collaborative research what the business cases and policy frameworks are that can address specific user needs; to define and implement the market rules, policy and operational rules; to certify and manage compliance with collective commitments agreed; to operationalise the principles and practices that support data publishing and access rules and the supporting processes that enable them.



From the top down, the value chain in this illustration begins with a requirement for environmental risk reduction (enabling delivery of resilience, adaptation and mitigation strategies). Such strategies are affected through financial instrument designs that fully internalise external risks and properly price environmental and social values. These instruments are informed by risk models that identify and forecast risks.

In turn these models are fed by data. It is at this point in the value chain that the supply of poor quality, incomplete, untimely or erroneous data will lead to systemic issues in the rest of the chain. As one interviewee commented “garbage in, garbage out. If we train our AI with the wrong inputs it doesn’t matter how good the models are”.

Accessing trusted, complete, timely data is therefore essential.

From the bottom up, the value chain begins with raw data (whether from a smart meter or a weather satellite) and can pass through many intermediaries who collate, clean, modify, augment and process the data into usable information. Each of the actors in the data supply value chain can also benefit from a trust framework to help perform their tasks, improving trust and reducing friction in interoperability. There are many existing solutions that can ‘present’ data (describe what data is using metadata): the trust framework helps everyone agree which ones are most useful for their purposes.

Ultimately, the data governance approach (in yellow) removes transactional friction from across the system by agreeing common approaches and rules. It then codifies these in ways that can be scaled across entire sectors, with many thousands of organisational participants and millions of end users.

For data that may be classified as Open Data (non-sensitive information that can be used by anyone for any purpose for free), governance can focus on addressing

- Which data should be made available
- Which licenses are appropriate for publishing
- What publishing mechanisms are most relevant

For data that is classified as Shared Data (data that cannot be Open Data and required some mode of access control) there are 3 priorities, to deliver a cohesive and interoperable data infrastructure:

1. **Design for search—the foundation for discovery and access**
2. **Address data licensing policies—the foundation of access and usage**
3. **Address data governance—the foundation of open markets**

1. Design for search—the foundation for discovery and access

Data must be usable by machines, not just humans. Policies **must** mandate that data be **machine-readable** in order that it may be collected and used in an efficient manner.

As important is the ability to discover that the data exists, what it is, where it is from, and how it may be used. This 'metadata' is a priority to make available so that data may be found and information about it accessed. Policies **must** mandate the production of meta-data that will aid discovery.

This first priority is independent of the specifics of any taxonomy, ontology or other structural design. Such designs are numerous and domain-specific. However, the guiding principle that, whatever the data or its taxonomy, is that it be machine-readable, fundamentally addresses a foundation of interoperability by enabling discovery and creates scope for interoperability.

2. Address data licensing policies—the foundation of access and usage

To achieve these priorities, questions that must be addressed include, but are not limited to:

1. **Mandating the publishing of Open Data**
2. **Address Shared Data licensing policies**

Licensing can determine how data may be used. To unlock the value of Priority 1, policies **must** mandate the publishing of meta-data under an open license[53]. This is essential to enable large-scale, many-to-many discovery that the data exists.

Policies **should** mandate the publishing of any non-sensitive data under an open license (this mirrors the open-by-default policies of many countries).

[53] The EU INSPIRE project recommends License to be distributed as "Machine readable License"

Policies **should** mandate the publishing of sensitive non-financial reporting data under a Shared Data infrastructure framework.

To achieve these priorities, questions that must be addressed include, but are not limited to:

- **Triaging what licenses should apply to which data**
  For example, which data should be Open Data and what is 'sensitive' (including cross-border issues) and must be considered Shared Data?
- **Defining and managing data rights**
  For example, who should have access to data and for what purposes (whether data flow from an electricity substation to the scope 3 emissions in a supply chain)? GDPR represents a global benchmark evolved for personal data. What equivalents exist for non-personal data that determine fair-use and address public and private sector needs?
- **Addressing consent and consent management for access to data**
  How will the data owners, or data controllers, manage giving and restricting permission to different parties, and for what purposes?
- **Implementing security protocols (physical and digital)**
  How can we ensure that data is only shared with those authorised? Data can represent a vast range of things, ranging from physical assets that are part of national critical infrastructure to commercially sensitive digital models to public information.
- **Defining the role of regulation and regulating where required**
  Balancing the needs of our society, environment and economy has never been more critical. Voluntary measures have not succeeded in addressing our systemic risks and there will be a greater role to both mandate access to data, and equally protect the exploitation of data in a manner that is commercially viable and socially acceptable.

3. Address data governance—the foundation of open markets

Data increases in value the more it is connected. A focus on systemic cohesion and interoperability reduces the burden of sharing by creating common rules and frameworks for sharing that address good data governance.

It ensures data is used appropriately for the purposes intended, addressing questions of security, liability and redress.

To achieve these priorities, questions that must be addressed include, but are not limited to:

- **Managing liability transfer**
  How is liability handled between commercial and non-commercial parties when they are given permission to access and share sensitive data?
- **Identifying and managing risks & controls**
  How do we apply controls and processes to manage risk? For example, in building information modelling, digital built environments and smart asset management there are information security standards[54] to minimise potential harms.

[54] BS EN ISO 19650-5:2020 https://shop.bsigroup.com/ProductDetail?pid=000000000030377794

- **Identifying, responding to, and adapting to unintended consequences**
  Who is responsible for monitoring and identifying risks, and enabling and managing the process of adaptation and redress?
- **Avoiding the creation of accidental monopolies that inhibit innovation**
  How can we ensure that better access to data can be maintained in an open market context that can drive competition and minimise the potential for monopolistic behaviours?
- **Creating modes of redress when data is used inappropriately or illegally**
  What is the process for organizations to claim, process and manage disputes?
- **Defining business cases for the ecosystem and engaging with them**
  How should the data flows be paid for? For example, where there is a public good, or reciprocal value exchange, a closed network can shift the cost of data supply to a marginal cost model. Where an imbalance in value exchange emerges, the ability to charge for access to data is critical.
- **Addressing the business model for the governing entity(ies)**
  Long-term financial stability of governing entities is critical. The lowest risk approach is to encourage a blend of commercial and non-commercial income as this both addresses a balance of neutrality and focuses on both the market and social needs.
- **Defining and managing operational processes**
  Who defines the operational processes in the governance of systems, which communities must, or should, be engaged in the scope and details of operationalising data sharing at scale?

Taken together, robust data governance in a decentralized, international marketplace needs to bring together a number of services, which for maximum cohesion and interoperability must cover:

- recruitment of firms to participate
- liability models
- terms and conditions data
- dispute resolution
- consent and consent management
- data rights and access management
- authentication and identity management
- conformance & certification with standards
- legal frameworks
- regulatory permissions
- identification and accreditation of entities
- standardised security protocols
- logistic processes
- technology architecture (e.g. open APIs)
- operating principles, processes and practice
- performance (e.g. service level agreements)

Data infrastructure governance addresses both Open Data and Shared Data. For Open Data, a subset of the above requirements are needed. As Open Data is free for any use, it is less onerous on liability and does not require consent. However, for Open Data it addresses:

1. Which data should be Open
2. Under what license(s)
3. How it should be published to maximise for discovery and use

Shared Data requires a comprehensive approach, the above points address:

1. What market(s) actors are being addressed within a Trust Framework[55]
2. Which data should be Shared Data
3. Operational governance to instrument sharing

Trust Frameworks: Creating Trust around Access

Trust is essential to data sharing, and particularly so when there are many participants and data is widely distributed. In order to minimise barriers, participants can operate under a common preemptive licence regime to access data, removing the need for bilateral contracts, and working to a common set of rules. In this situation every party must have complete confidence in any other party with whom they transact. A data provider, for example, must be able to trust a service provider that is not known but requests access to data.

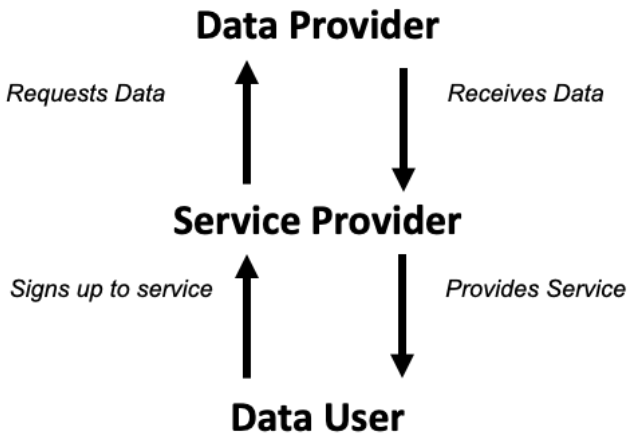
This therefore requires a “trust framework” which addresses the issues raised in the preceding section. It gives participants the ability to request and see the data, but it does not hold data itself.

The trust framework is an enforceable set of rules, agreements and specifications that provides the governance for data sharing. In practice this requires:

- That participants, whether data provider or service provider, must be vetted to ensure that they meet the conditions set for the trust framework. This is an “authorisation” process, for example this is undertaken by a regulatory body (the FCA, in the case of Open Banking in the UK);
- Authorised data providers must be able to check that the authorisation of a service provider requesting access to data is valid
- Participants must be able to prove who they are (authenticate their identity) to other parties in the trust framework
- Service providers must be able to prove what data they are entitled to access
- Service providers requesting access on behalf of a consumer, where the consumer owns the data that is held by a data provider (such as an Open Banking Third Party Provider requesting access to the consumer’s bank account data) must be able to prove that they have been granted the consumer’s consent to do so.

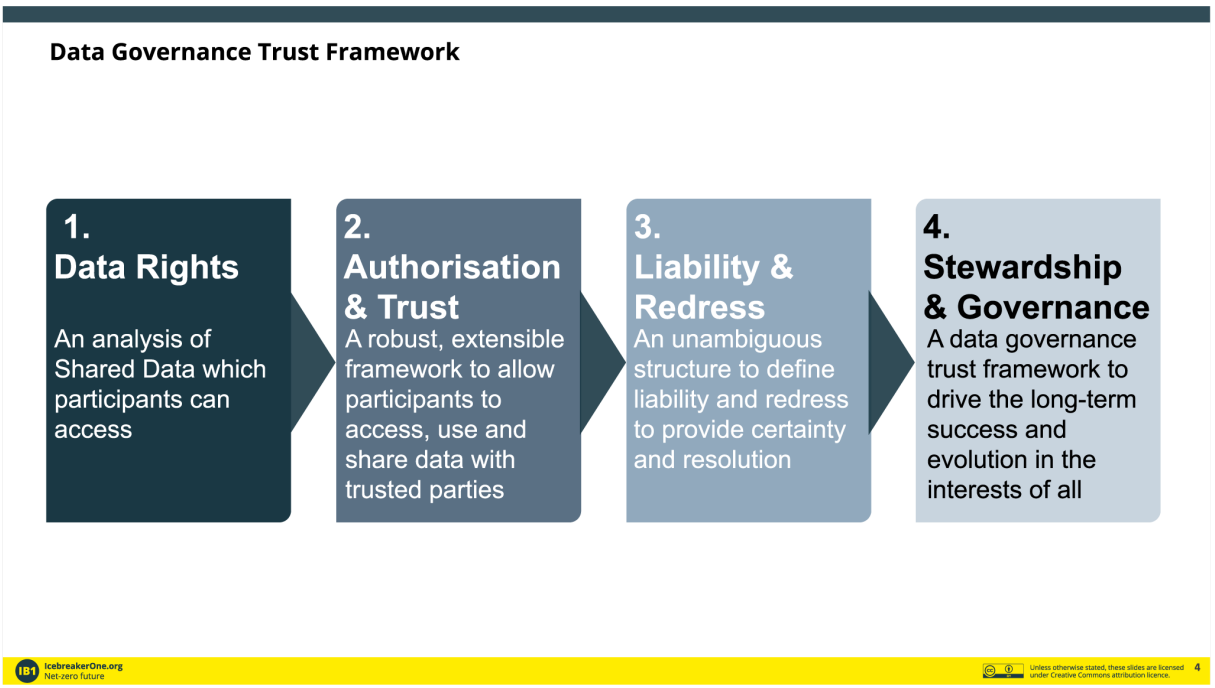
[55] A Trust Framework is a collection of policies, technical specifications, and interoperability criteria that are accepted by multi-organizational participants to satisfy a particular need.

An example of data transfer is shown in a basic data flow below.



The trust framework is provided by a Governance Platform, (sometimes referred to as a Directory because it maintains the list of authorised participants and provides access control). It checks against the factors described above and ensures that both the data provider and the service provider requesting data have met their obligations.

Only if these are satisfied will access to data be allowed, and such are the controls built in that the data requested can be tightly controlled, for example to meet the principle of data minimisation under GDPR.



Fit with existing and on-going Initiatives

There are several existing initiatives and organisations working towards Open Data for environmental data useful to finance, corporate and policy making.

Ways forward need to analyse how far these, and other initiatives, make up part of the data ecosystem that appears necessary (as described above). Each initiative has particular scope and characteristics. In brief:

- Oasis LMF and OS Climate provide modelling and software under an open license, similar to many open-source software projects.

- Cambridge Zero, as a research institution, aggregates data, creates and uses software and models to carry out research and analysis.
- Commercial vendor, Planet, produces data from its satellites on earth observation and makes both data and analysis available to the market on an open or a paid basis.

There are significant differences in how the word ‘open’ is used by these initiatives (and beyond) in relation to data, software, research, modelling (e.g. AI), analysis, markets and standards. The table below details some of the roles around which they operate, and how ‘open’ is defined by their approach.

Understanding the different uses of ‘Open’ across applications

OS-C OS Climate “will assemble several components into an open source public good, leveraging methodologies and models already tested and in use by asset owners on the cutting edge of climate-integration.” [including banking, asset mgmt]

OASIS LOSS MODELLING FRAMEWORK OASIS LMF provide open source software and an open framework for model and software development [specifically for insurance]

Icebreaker One Icebreaker One provide open source governance solutions and policy frameworks to enable both Shared and Open data flows [across sectors and finance]

		Holds or produces (primary function)							
Who	"Open" license approach	Data	Software	Research	Modelling (inc. AI)	Analysis	Policy	Governance	Standards
Icebreaker One	Y					Y	Y	Y	Y
MET office	Mixed	Y			Y	Y			
OasisLMF	Y		Y	Y	Y				
Blackrock		Y		Y	Y	Y			
Cambridge Zero	Mixed	Y	Y	Y	Y	Y			
Planet Labs	Mixed	Y				Y			
OS Climate	Y		Y		Y				
Open Banking	Y						Y	Y	Y
Public sector	Mixed (open by default)	Y		Y	Y	Y	Y	Y	Y
Private sector	Mixed (closed by default)	Y	Y	Y	Y	Y			

IB1 IcebreakerOne.org Net-zero future

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All of the approaches listed in the examples above are required: from software systems to data supply, from analytics to policy, investment to governance. Each address different components of the overall jigsaw that is required to complete the picture.

10 Making it happen

While current diversity in initiatives is understandable, initiatives which focus on specific needs act to add complexity to the broad landscape of non-financial reporting requirements and are missing an opportunity to create global, cross-border frameworks that could address the needs of the many while improving trust, reliability and provability of the underlying data itself. We expand on a potential implementation framework for this approach in the next section.

Technology solutions are typically developed in two main ways. They can be approached from the top-down through solution-first, typically the extension of an existing system, or from bottom-up, building on user needs. Solution development has evolved in the past 20 years.

The previously common “waterfall” approach (where requirements, design, build, test and deployment are delivered stage-by-stage) has increasingly been replaced by a user-needs driven approach which uses “agile” methodology and is highly iterative, responding to user

needs. This latter approach sets out to identify and deliver only the essential aspects of the solution, often referred to as the “Minimum Viable Proposition”. Once delivered, this is further developed iteratively through ongoing dialogue (a test and learn cycle) with users. This supports overall better understanding of user needs and more effective prioritisation of the solution’s capabilities, therefore tending to greater adoption, faster implementation and overall lower costs.

User needs first

The critical success factor for any product or service is how well it meets the needs of the end user, who will have a specific problem that they need to solve: the Use Case.

There is often a rush to technology-led solutions without considering the overall decision-making environment that will impact users. As a starting point to assessing the impact we encourage analysis of user needs, examining the whole system. This can explore potential risks and harms, security, privacy and assess the potential for redaction, differential disclosure, anonymisation, etc. to enable Open or Shared approaches.

Questions such as 'what data do we need in order to address the SDGs?' start from the wrong end of the data value chain: we must start with specific user-needs, then look at the broader architecture and design principles for realistic, scalable interventions. This requires a blend of bottom-up and top-down.

Questions for consideration include:

- What problems are we really trying to solve—based on current and predicted future user needs?
- How will data help these problems?
  (What data? when? what frequency is timely? what analysis? for whom?)
- Who should act to convene and lead: a sector, public body, both?
- When are solutions needed and what might be our MVP (minimum viable proposition) intervention? (Nb: this may not need **any** data at the outset)
- What single issue could act as an exemplar to focus everyone’s minds?
- What institutional memory, standards, principles and practices can be created as a legacy output and how will we make it discoverable?

The two, leading examples of developing a shared data standard, Open Banking and Open Energy (see example below) have been developed through a clear emphasis on understanding the customer needs, both the specific Use Case and the way in which it is addressed (i.e. WHAT needs to be done, and HOW to do it). The same will be true of data sharing for Non-Financial Reporting.

A Use Case example, relating to “Automating non-financial reporting (e.g. TCFD) with cross-border data-sharing” describing the needs and uses for improved environmental data in financial decision making is in the Appendices.

This process enables a foundation to build from. The focus on a specific Use Case allows development of a Minimum Viable Proposition (MVP) which validates the product and the customer needs. The emphasis is on learning at low cost and with low risk, testing, thereby validating the hypothesis. It's a test and learn approach that ultimately ensures that the solution does exactly what is necessary.

In order to break into this and identify the core requirements, a core Use Case should be chosen, out of a range of possibilities. This choice can be achieved by discussion with key stakeholders who will describe the problems they face and the outcomes that they are looking for. If this stakeholder engagement exercise is done effectively it will reveal a range of Use Cases, which can be filtered through a scoring process.

The Open Energy process interviewed 200 Stakeholders and identified a range of Use Cases before settling on a representative Use Case to bring the concept to life. This ensures that the issues faced are well understood and provides context for the core Use Case.

Once this core Use Case is confirmed, development moves into an iterative phase where adjacent Use Cases can be considered and incorporated. This iterative process begins to add features to the underlying solution, but only once the needs have been fully understood. Ultimately this provides a richness to the solution that meets a wide range of end user and market needs well.

So, for example, with Open Banking the initial payment proposition was a single Payment Initiation solution with very limited functionality. This has now evolved into far more sophisticated functionality to support Variable Recurring Payments, but only after deep consideration of the market needs and a testing phase which involved solutions running in the FCA's regulatory sandbox. The full breadth of the Open Banking Standard has developed according to this iterative approach, and has resulted in a holistic approach that considers not only functionality, but, having listened carefully to end users and the market, extends to compliance, operational and customer experience guidelines.

This process can run at pace. For example, in the initial stages of Open Banking there was a continuous feedback loop between the "Customer" team and the "Build" team. This enabled customer/market requirements to be assessed technically, and proposed solutions to be tested back to the market. This was a complex task yet ultimately ensured that Open Banking was delivered satisfactorily to a demanding regulatory deadline.

A critical factor with this process is effective governance of the development process. As with all development projects, it is essential to maintain very clear focus in order to deliver. To this end, a series of gateways throughout the process are essential; governance decision points at which the solution can proceed, be "parked" temporarily while more information is sought, or stopped. The key objective of these points is to ensure only validated requirements that effectively meet end user needs are delivered.

There are five main Policy/Regulatory areas for consideration and design when developing a data ecosystem governance approach and the conditions for preemptive licences that enable participation in the data sharing ecosystem.

1. **Authorisation**. Who can access what data, and how is this controlled. This requires defining participants: who provides, receives or facilitates data flows as well as identifying, authenticating and authorising data shares between participants.

2. **Data rights**. What data is shared and what obligations are there on data providers? Defining data: what is open, shared or premium, what is static or dynamic; raw or derived insights. Defining purpose, value, sensitivity and limitations of data.

3. **Trust framework**. What other tools are there to ensure safe and legal data sharing? Mechanisms for trust: governance directory, levels of authorisation and authentication, consent (where applicable) and consent management.

4. **Liability**. What structures are in place to resolve issues if things go wrong? Identifying roles and responsibilities; risks and liabilities; ensuring traceability in data chains and data protection requirements.

5. **Standards stewardship**. How is the ecosystem governed and the standard enforced? Governance roles and responsibilities; regulatory or scheme based approach; implementation requirements, enforcement and sanctions.

10.1 Lessons from Open Banking and Open Energy

The key features of the Open Banking regulated standard that addresses the sharing of sensitive data across the banking sector, by looking at:

- Rights
- Liability models
- Dispute resolution and redress
- Consent
- Security
- Legal frameworks
- Usability
- Logistics
- Technology architecture
- Operating principles

Open Banking was created by convening teams to develop common principles and practice for sector-wide data sharing. They included existing and challenger banks, trade bodies, fintechs, Treasury and regulators. In the UK, this led to the creation of an independent non-profit (funded by the banks) to develop and take the standard to market, with a directory of accredited organisations using it that now numbers in the hundreds.

A similar approach is currently being used to develop an Open Energy Standard[56] in the UK, building on and re-purposing the investment already made in Open Banking. This has enabled a deep understanding of how cross-sector data infrastructure can be built with a

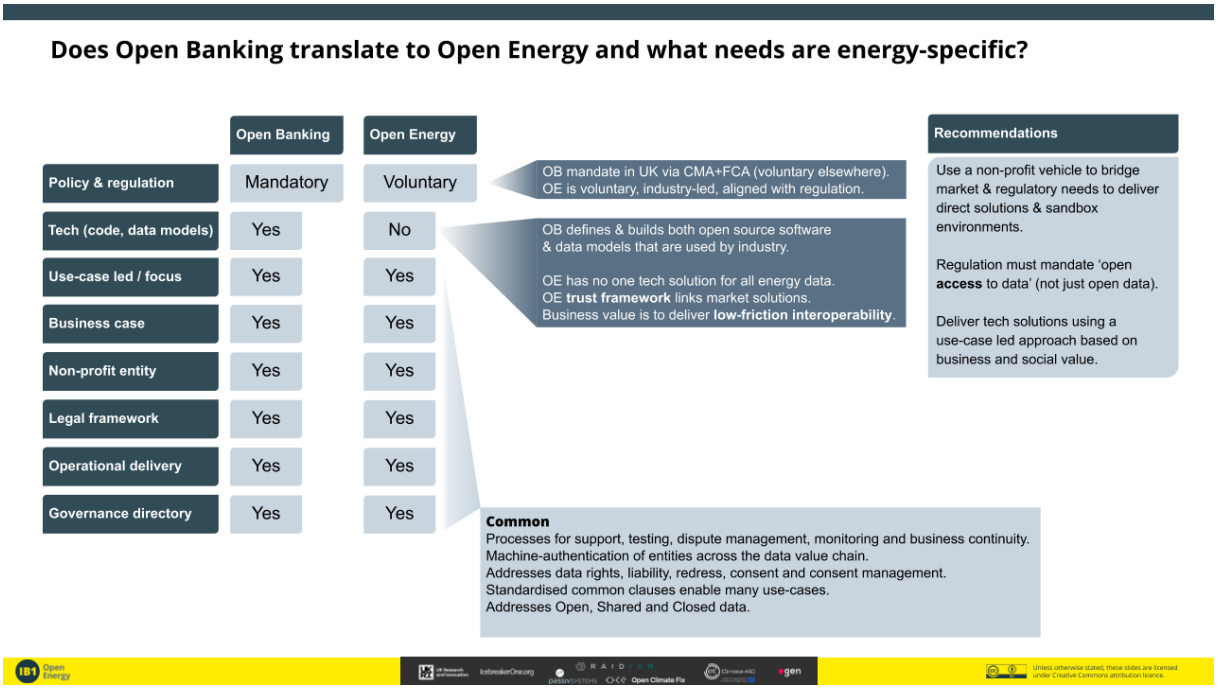
[56] energydata.org.uk

common underlying approach. This work has confirmed that the major areas to be addressed are not technical, but lie in establishing common cross-sector policy, adapting to sector regulation, and industry specific operational requirements.

The lessons from Open Energy prove the adaptability of this decentralised approach, which can therefore be applied to opening up other sectors, including the data that will enable robust, scalable Non-Financial Reporting.

The evidence from work undertaken is that the approach can be applied across sectors. The underlying architectural approach and infrastructure can be adapted to meet the needs of not only energy, but are sufficiently flexible to be repurposed for data sharing across the private and public sectors. It is the policy, regulatory, legal and operating requirements that must be contextualised for Open Energy. This work also applies to UK Smart Data Initiatives[57] and with both Ofgem, the sector regulator, and BEIS (Department of Business, Energy and Industrial Strategy) to inform their thinking in relation to the UK's national data strategy[58].

Looking deeper, this work has clarified the similarities and differences.



[57] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/915973/smart-data-consultation-response.pdf
[58] https://www.gov.uk/guidance/national-data-strategy

Lessons from Open Banking - success factors in the approach

There are a number of factors that have contributed to this success in the UK.

- Regulatory imperative. Open Banking was mandated by the CMA as a remedy following the financial crisis of 2008/2009. It applies to the nine largest UK retail banks (the “CMA9”) in order to open up greater competition and its objectives are closely aligned to those of the EU’s Second Payments Services Directive (PSD2). Because the Standard was adopted by these major banks, the rest of the UK market followed suit.
- Establishment of the Open Banking Implementation Entity (OBIE). As OBIE is both a Standards body and has responsibility for implementation, it provides a strong coordinating body and platform for development of the Standard.
- Funding. The OBIE is funded by the CMA9 as part of the market remedy - in effect a fine on these large banks. This approach has ensured that the organisation has been appropriately funded to deliver on its mission.
- Collaborative approach. The Open Banking Standard has been shaped by the market, based on a deep understanding of end user (consumer and small business) needs. It has adopted a highly collaborative and consultative approach, paying particular attention to the TPP community and consumer groups.
- Decentralised architecture.The architecture has only the minimum required centralised components, removing a single point of failure and allowing rapid and low-cost system evolution. This approach has the major benefit that the data is maintained only by the holder, so requires no curation and is always up to date.
- Directory. This is the critical enabler for the decentralised architecture as it provides a secure, trusted environment with strong governance. It enables account providers, such as banks, building societies and payment companies, to verify the identity of regulated third party providers. It therefore provides a gateway to the Open Banking ecosystem ensuring that only authorised third-party service providers that have been approved by their National Competent Authority (in the case of the UK, the FCA) can access data. These third-party providers can manage the digital certificates and software statements they need to connect to account providers. It signposts the API endpoints for data, and enables granular control over the specific data that is being accessed.
- Comprehensive Standard. The Open Banking Standard comprises the Data Standard, the associated API specifications, the Security Profile, Customer Experience and Operational Guidelines. In taking this approach, it both addresses ‘what’ and ‘how’ to build to the Standard. Furthermore, compliance tools are provided in order to ensure a high quality of implementation.
- Ecosystem development. Support for both banks and TPPs in implementing and testing the standard has been paramount from the start, with ongoing outreach to the market to understand and respond to needs as the Standard develops. Further, two innovation challenges run by Nesta (the UK’s Innovation foundation) have brought specific focus onto innovative propositions for both small business and consumers.

The approach does have risks however.

- The balance between regulatory intervention and market-led initiatives must be carefully weighed. For example, Standards, although agreed, may be implemented slowly or ineffectively. Regulatory deadlines may be required. Further, the CMA has issued Directions on certain aspects of the Open Banking Standard (relating to consumer authentication) because these fell substantially short. The customer journeys for consumer authentication were judged to include unnecessary friction, seen as a barrier to adoption, which led to the imposition of Directions on the nine banks covered by the CMA Open Banking Order.
- Customer and market needs must take precedence over technically-led development. Where legacy infrastructure exists, data holders/providers may be biased to build what they can support, or solutions that have least impact or cost. This may result in a technical capability, but not implemented in a way that the market can easily use.
- Developing a successful Standard requires a collaborative approach. This can be viewed as time consuming and complex, and often requires careful navigation between the vested interests of the various parties involved. This means that it can appear complex to implement. However, once this has been achieved, the ongoing development, maintenance and scalability more than offset the initial investment.

Lessons from Open Energy

"Ensuring consistency and interoperability between the built environment and the energy sector with an Open Energy approach is essential to the development of our national data infrastructure",
Dame Wendy Hall, DBE, FRS, FREng, Regius Professor of Computer Science, Associate Vice President, Executive Director of the Web Science Institute

Open Energy is a blueprint for the implementation of secure, equitable and scalable data sharing that addresses a fundamental issue that sits at the heart of environmental impact reporting.

It is being trialled in other sectors such as energy where it has been comprehensively evaluated for the Innovate UK Modernising Energy Data Access Competition, and a functioning prototype has been developed that meets the requirements of the energy sector.

Open Energy involves Electralink, Scottish and Southern Energy, E.ON, Octopus Energy, Energy Systems Catapult, National Grid, Western Power, IBM, Ovo Energy, Piclo as well as observing government bodies the Department for Business, Energy and Industrial Strategy, Office of National Statistics and Office for Low Emission Vehicles.

The evidence from work undertaken is that the approach taken to development of Open Banking can be applied across sectors. The underlying architectural approach and infrastructure can be adapted to meet the needs of not only energy, but are sufficiently flexible to be repurposed for data sharing across the private and public sectors. It is the policy, regulatory, legal and operating requirements that must be contextualised for Open Energy.

This work also applies to UK Smart Data Initiatives[59] and with both Ofgem, the sector regulator, and BEIS (Department of Business, Energy and Industrial Strategy) to inform their thinking in relation to the UK's national data strategy[60].

Looking deeper, this work has clarified the similarities and differences. For example, in both banking and energy, a Third Party provides value to the ecosystem by integrating with multiple sources, then cleaning, categorizing and analysing the data, providing a range of different 'value add' services to other parties.

However, Open Energy has a wider variety of data providers and data types, both industrial data (such as asset performance) and personal data (such as patterns of home energy consumption), as well as greater potential volume of data and ways in which it can be used. This requires an amended approach that can facilitate these dimensions. Open Energy will therefore require different definitions for data sharing roles, actors, responsibilities and liabilities, plus authorisation levels appropriate to the data type.

This has been achieved through systematic analysis and discussion with four industry and public sector Advisory Groups, convened around the following focus areas.

1. User, market and societal needs
2. Policy & regulation (role of regulator, certification), legal (data rights, IP, liability)
3. Operational (access and consent management, redress, Service Level Agreements)
4. Technical (authentication, security, tech, data)

Advisory Groups consider best practice to develop a minimum viable Open Energy Standard that can unlock data sharing across a national energy sector (as Open Banking has enabled across the entire banking sector). Each group meets monthly, and comprises ~15 experts (over 60 total) which enable useful discussion with expertise across all dimensions of the project. Each Group has two experienced co-chairs with appropriate domain expertise, one being an energy expert, and one being a data sharing expert. The approach ensures a clear agenda, a focussed discussion and recognises the different perspectives held by stakeholders, with all meeting notes recorded, and shared. Importantly, all discussions in the forum are fully transparent. Advisory Groups are coordinated through a Steering Group comprising 12 experts, these being the co-chairs of the Advisory Groups, the Open Banking Implementation Entity, plus observers from BEIS and Ofgem. This Steering Group meets monthly.

Two important aspects of Open Energy are that it meets user and market needs, and a practical test that the repurposed infrastructure works as expected. Therefore, a well understood Use Case was identified through interviews with 200 stakeholders, which serves to develop the understanding of both end user and market needs. This informs the capabilities required from the technology, the policy, regulatory and legal implications, and the industry operational requirements. In this way, a comprehensive view of the requirements for the standard - well beyond the narrow definition of a data standard - can be formed. This is essential to success.

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[59] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/915973/smart-data-consultation-response.pdf

[60] https://www.gov.uk/guidance/national-data-strategy

The infrastructure can therefore be evaluated against a clear set of user needs and well understood market requirements. This includes the ability to search for and discover the required data, signpost the data (the API endpoints for access to specific datasets), recognise and authorise participants that hold and consume data, control access to data to a highly granular level, provide for consent (and meet the requirements of GDPR when appropriate) while ensuring that security is robust. In the case of the Energy market, this has demonstrated that the key areas requiring amendment are aspects of policy, regulation and the ability to meet pre-existing industry operational requirements.

Analysis undertaken by the Open Energy Advisory Groups to understand how Open Banking maps to Open Energy reveals that it is the Policy and Regulatory aspects that require most time and effort to amend. This can be achieved by voluntary agreement, such as a 'scheme' similar to those operating in financial services, or through regulatory mandate. There are some operational requirements that apply to the Energy market that must be taken into consideration, and the role definitions for the Governance Platform, but these are measures that can largely be developed through industry stakeholder consultation. Having undertaken this exercise, we believe that the same issues would require consideration for development of standards for other sectors, or for cross-sector non-financial reporting.

10.2 Operational Governance for a Data Standard creation process

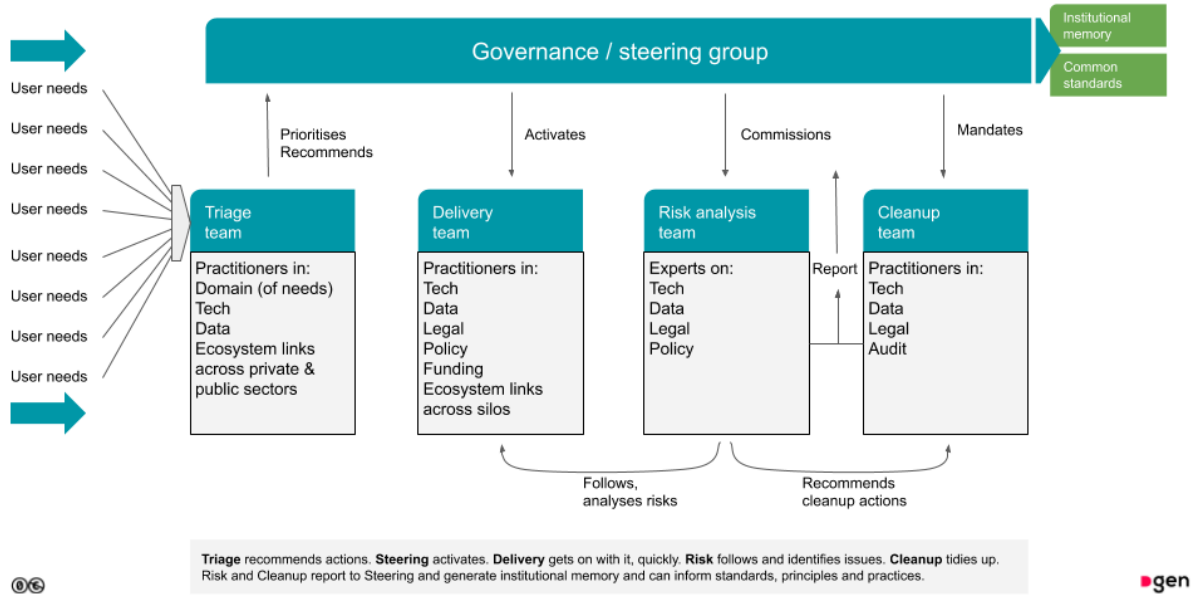
Based on the lessons learnt from development of Open Banking and Open Energy, the process for creation of a data standard for environmental data begin with building stakeholder engagement—it is critical to run open consultation processes. This should, ideally, incorporate a commitment to the creation of Advisory Groups to drive forward the future strategy while taking stock of successes and failures to both signal that there is a process to listen, adapt and report on outcomes, and to make such outcomes material.

Our proposed questions as part of an open consultation include:

- What are your perceived risks and opportunities around non-financial reporting?
- How can harmonisation, cohesion and interoperability best be achieved while maintaining pace?
- Which entities should be involved in both development and industry-specific implementation?
- Which areas should be prioritised?

Given the pace of development, and the challenges for the public sector, regulators and businesses to fully assess risks, a data innovation triage process can help build trust and address mitigation. A triage process[61] that combines practitioners across domains can consider user needs, recommend and prioritise responses for a 'Governance/ Steering Group' to approve.

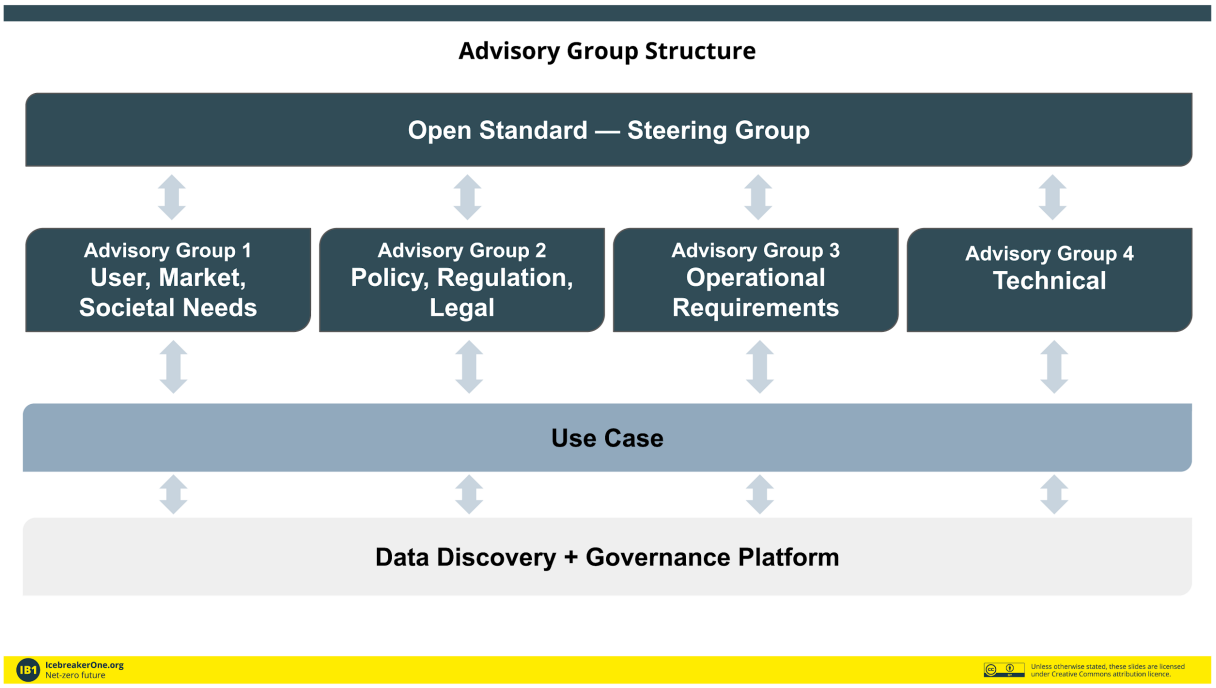
[61] http://bit.ly/data-triage



A triage process can be designed to be rapid and responsive, with fewer than 10-15 experts. Roles & responsibilities across the team can include:

- **Steering**: combined expertise to ensure decisions are timely, effective, comprehensive and address risk
- **Domain** experts: sector or topic specialism that is based on the user-needs
- **Tech**: understanding technology including coding, devops, infosec
- **Data**: understanding data analytics, data science and algorithmic modelling
- **Ecosystem**: connecting across silos (public, private and third sectors)
- **Legal**: expertise in the **Domain** and in data rights, IP, ethics
- **Policy**: expertise in the **Domain** and across relevant applications
- **Audit**: expertise across all of the above to ensure ‘clean up’ is comprehensive and that processes are fit for purpose.

During its initial scoping, Open Banking convened 150 people into a range of Working Groups, seconded from across industry, to create the draft standard. An equivalent team size (~120) were engaged through a dedicated non-profit vehicle over a 3-4 year period, to build and iterate to market launch. Open Energy convened 65 people in Advisory Groups over three months, seconded from across industry, as part of its initial consultation process.

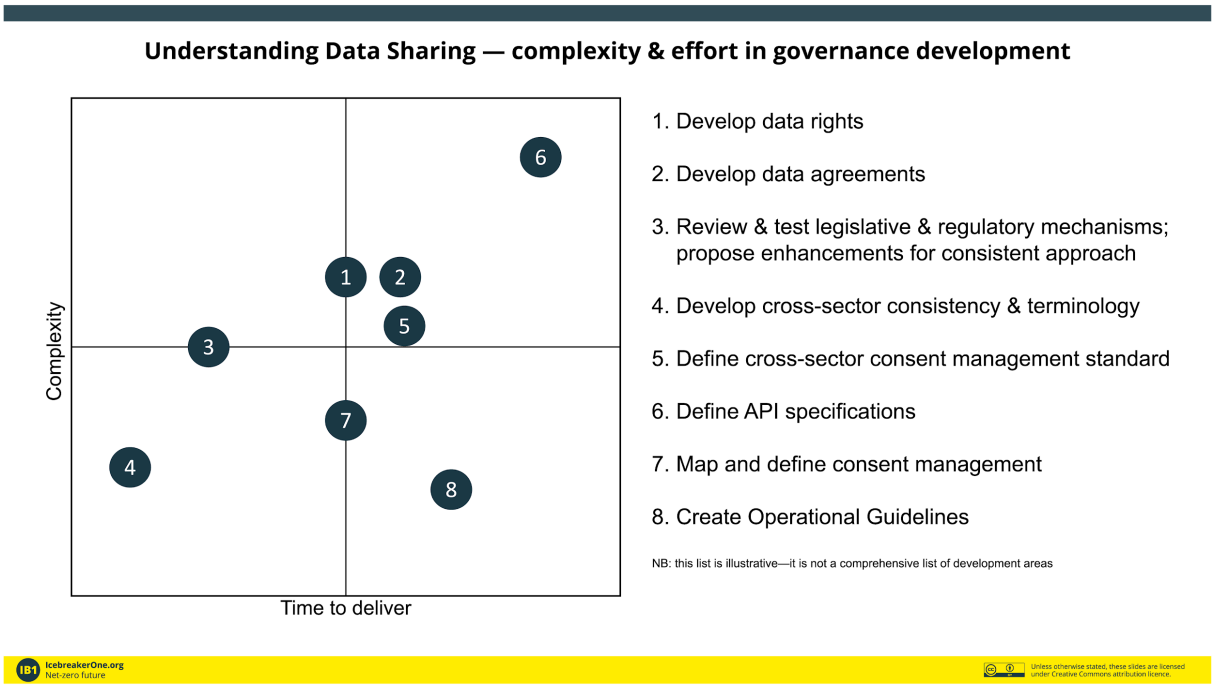


Multi-stakeholder, federated Working Groups can address sector-specific issues (e.g. TCFD and related reporting). We recommend exploring areas which may not have been explored before: this work is fundamental to the future of non-financial reporting and contains new questions, new threats and new opportunities. It is likely that areas which have not been considered before are looked at for the cross-border adoption of common standards. We recommend including diverse organisations in this exploration to ensure all tiers of market needs are met.

Resourcing, co-operation needs and timelines

To illustrate the types of areas for development in Data Governance we have produced a chart to visualise their relative complexity, and so resourcing needed. This is based on our direct experience[62] in developing the Open Banking Standard, generalising the approach for input into the UK's Smart Data strategy and applying this in multiple jurisdictions around the world.

[62] https://dgen.net/0/2020/08/15/designing-the-uks-shared-data-infrastructure/



For example, developing API specifications is more complex and takes more time than developing cross-sector consistency, or developing data rights. However, these can occur concurrently.

The Role of Policy and Public-interest Convening

While approaches to co-ordinating stakeholders to create markets in Shared Data can be voluntary or mandatory, our experience points to an often crucial role of public, or public-interest, actors in creating the motivation, coordination, convening and decision frameworks that engage stakeholders in collective action towards a common goal.

There is, at least, an essential need for a stable, accepted vision and a guardian of that vision, who is trusted to act in the collective interest. At national level, that can be played by a public, or quasi-public body.

For cross-border, trans-national initiatives in value and investment chains, arguably the potential friction between market-led solutions and regulation can play out individually in each of the national legislative jurisdictions. However, this may lead to fragmentation of solutions or delay. Fragmented approaches (e.g. many different organisations developing different mechanisms to achieve secure interoperability) will lead to poor competitive outcomes, poor consumer value, increase costs and risks, and not meet the needs of our digital economy.

As non-financial data will have increasing importance, and value, ensuring trust in data-flows will be an essential issue, and an agreed legal framework to create that trust across boundaries also appears a key element of success.

For flows of data along global value chains, international level coordination to create the rules governing that data ecosystem appears essential. For success in that task, the coordination would need to convene participation from across the world, under conditions in which the convenor was trusted to be neutral.

As the development of rules and standards for data flows must be an ongoing process, to adapt to new needs, and new possibilities for data, there appears to be a need for a public-interest convenor to hold the ring, to facilitate discussion between the various interests and stakeholders into the future.

There is an additional need for public policy coordination, as data flows and data access are high on the international political agenda. The possibilities of transformational use of data could be held back by rules designed to block access to data, for security or economic protection.

Some of these issues are already discussed in the G20, where common positions are possible. The leaders of all G20 countries very recently re-affirmed the challenges and priorities they give for cross-border data-flow:

> “We acknowledge the importance of data free flow with trust and cross-border data flows. We reaffirm the role of data for development. We support fostering an open, fair, and non-discriminatory environment, and protecting and empowering consumers, while addressing the challenges related to privacy, data protection, intellectual property rights, and security. By continuing to address these challenges, in accordance with relevant applicable legal frameworks, we can further facilitate data free flow and strengthen consumer and business trust.” Leaders' Declaration G20 Riyadh Summit (November 21 - 22, 2022)

Securing incentivisation to participate

The process should ensure openly licensed standards, shared and common processes, principles and practice are made de facto compulsory or strongly incentivised around cohesion and interoperability across the market.

It is possible to begin this process using voluntary, best-practice approaches, however without a compulsion to act in a cohesive manner, market fragmentation and monopolistic behaviours become the defining characteristics. For example, the reason GDPR and Open Banking exist is to balance social and commercial purpose.

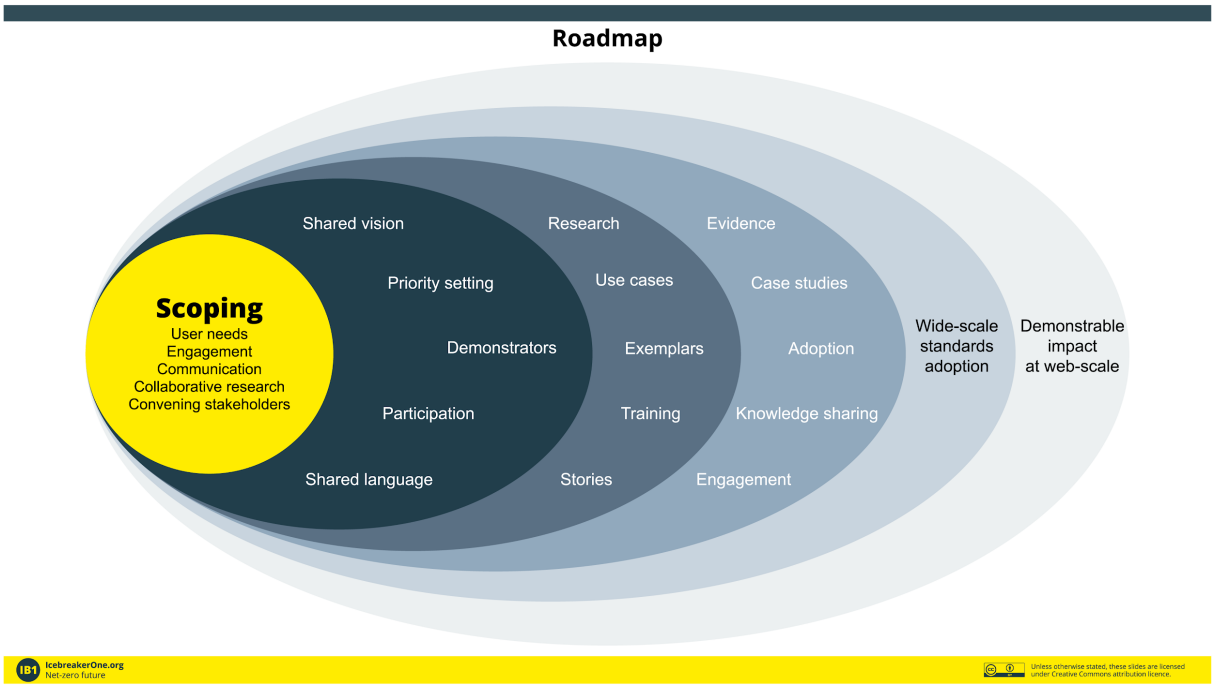
Yet, currently, we also need the right balance between permissionless innovation ('don’t ask permission' culture), a precautionary principle and the efficiency of coordinated effort. 2020 to 2030 will define the shape of the coming centuries, not just decades or years. How can we best unlock the potential for rapid transformation while providing robust safeguards?

> *"[W]hat should the goldilocks zone of regulation look like? How can we support fevered exploration while managing risks, especially systemic, run-away or existential ones?",* Azeem Azhar[63]

[63] https://www.exponentialview.co

10.3 Project planning for development of the data infrastructure

Using the Open Banking and Open Energy approach as a blueprint, the framework can be applied to non-financial data within five years. The medium-term roadmap for development should take the form below:



A user-needs based approach to governance design for environmental value chain data is an ongoing process, because the needs of users for the data is evolving over time, as data becomes available, capacity develops to interpret and work with it, and an increasing range of decisions start to be made with it.

So, governance design also needs to be built for evolving governance structures over time. The process must be adaptive to a rapidly changing landscape: there is no 'endpoint' to innovation in this area. The compulsion to adopt—and make accessible—standards should be on a continuous basis and to a predictable cadence (e.g. a six-month cycle). We recommend exploring areas that can (or should) be regulated as well as Guiding Principles that can be codified in a Code of Practice.

This design process will only be as successful as the inputs it receives - particularly around evolving user needs, and evolving capacities for data supply. Therefore, there is a need for a medium-term roadmap for robust data governance that incorporates and develops five strands of work in parallel: Strategy, Processes, Skills, Community and Finance. This approach can ensure cohesion at institutional levels as well as technical and legal cohesion and interoperability across stakeholder networks.

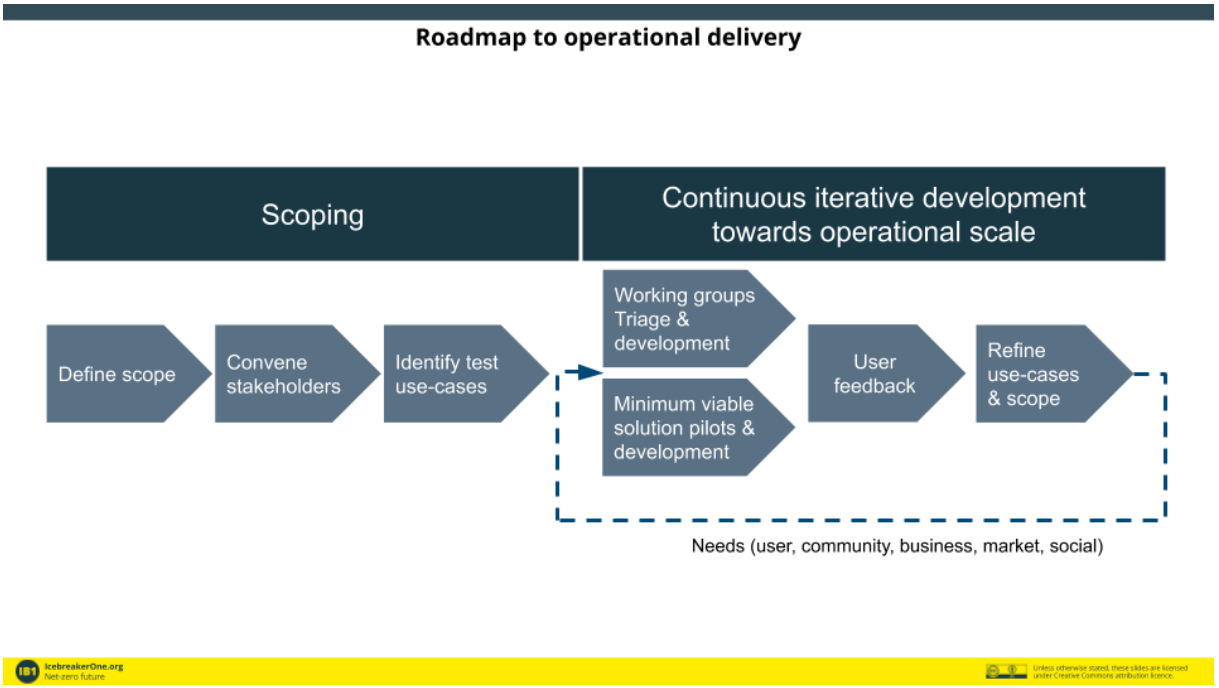
1. **Strategy**: Defining Key Performance Indicators (KPIs) for impact
2. **Processes**: Operationalising data publishing, standards development and reuse

3. **Skills**: Developing expertise, knowledge and continuous learning relevant to market and social needs as codified in policy and business rules
4. **Community**: Running engagement processes and gathering expert feedback; and
5. **Finance**: Budgeting, financial oversight and impact assessment of the data infrastructure construction process itself.

11 Recommendations

11.1 Developing a roadmap for non-financial data governance: needs and gaps

A sustainable data ecosystem can enable a highly diversified future—in which data is produced and consumed by all market actors in complex value chains that need to be adaptive to rapid and unpredictable change—while operating within a managed risk, control and costs structure.

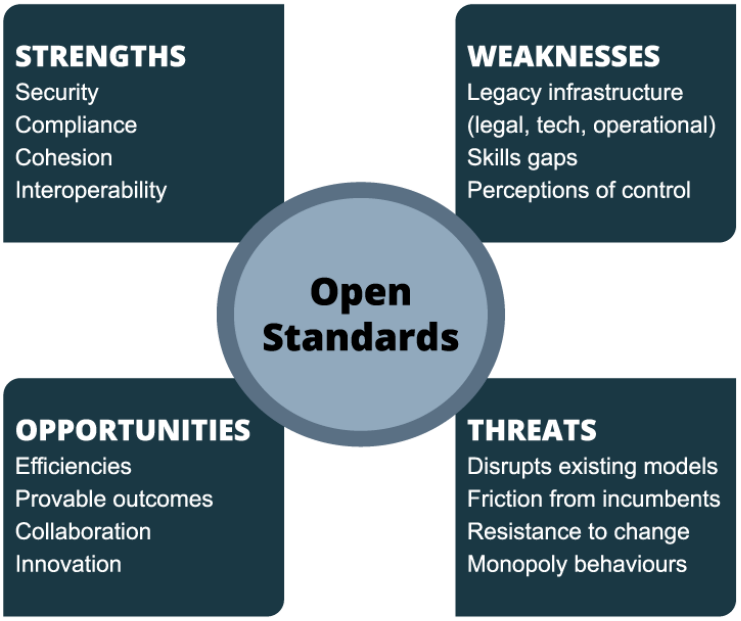


We recommend developing an implementation a roadmap that enables rapid development:

1. Secure a clear international sectoral, or regional mandate, to generate credibility for convening participation.
2. Recruit participation for overarching governance that guarantees public interest goals informed by multiple stakeholder viewpoints.
3. Recruit participation for small groups of users combining multidisciplinary skills across policy, operations, data, and use-case development.
4. To facilitate flows of data in global value chains, make sure to involve adequate global representation in the process.
5. Collect multiple potential starting use cases from key stakeholder groups, and select starting use cases. Select these use cases to include different global value chains and challenging parts of the value chain (e.g. end-of-use, Scope 3 GHG emissions).
6. Start small, basic sandbox tests and delivery on real and active use cases and iterate.

7. Collaborate widely to build on initiatives that constitute different parts of the future data-ecosystem, gather expertise, address skills and build capacity.
8. Design a dynamic, evolving process, for progressive, stepwise future development and improvement, with learning through experimentation.
9. Define impact metrics that make clear what success looks like for use cases and overall.
10. Progressively expand from initial use cases to additional cases, finding the common features of the data infrastructure.
11. Use the opportunities offered by the EU Digital Strategy to develop the data ecosystem that serves the needs of the EU Sustainable Finance agenda and corporate reporting of environmental impacts and risks in their global value chains.
12. Explore potential challenges to global environmental data flow (e.g. in China, India and public diplomatic-e.g. G20-solutions).
13. Engage in formal public international processes when sufficiently developed to offer solutions.

The potential strengths, weaknesses, opportunities and threats of the proposed approach are highlighted below.



12 APPENDICES

12.1 Data for Sustainable Finance - the role of shared data standards for TCFD and NFR implementation

Robust, credible data is critical to understanding financial exposure to risks.

The nature of the risks

From the perspective of policy-makers and regulators, climate change poses enormous systemic and financial risks to the financial system. A recent report[64] estimates that for US banks alone, more than half of all syndicated lending activity is exposed to climate risk, translating into up to what we consider a *conservative* estimate of $100B of exposure. This risk is overwhelmingly invisible at present, given it is not currently priced into either the credit ratings or share prices of corporate borrowers.

Once the exposure of stock markets to climate risk is taken into account, the impact for investors - including pension funds - is orders of magnitude greater. It is vital that businesses that are already considering the impact of climate risk on their activities (and factoring this into their strategy, planning, and the pricing of their goods and services) should not be unduly disadvantaged or disincentivised by the fact that others in their industry are not yet doing so. Conversely, those that have not yet taken steps should be incentivised to do so.

Comparable data, demonstrating exposure and predictive analysis will therefore be critical to a broad spectrum of users.

The exposure of firms to climate risk comes in five primary forms:

1. **Physical risks**: the impact of physical consequences of climate change. These can be either acute, arising from specific events such as wildfires and extreme weather events such as floods and hurricanes, or chronic, arising from longer-term changes in the environment and weather patterns, such as temperature changes, rising sea levels, and changes to water availability.
2. **Transition risks**: the impact of changing regulatory requirements, changing investor and consumer preferences, introductions of new carbon taxes and emissions caps, and other legislative responses such as bans on new coal-powered plants or sales of new polluting vehicles.
3. **Liability risks**: the risk that stakeholders or shareholders may take legal action against a firm for either its contribution towards emissions and climate change, or for not adequately taking into account these climate risks and factors when developing and implementing the firm's business strategy.
4. **Stranded assets**: particularly relevant for the oil and gas sector, this refers to the risk that these firms may not be able to extract the resources that are already factored into their share prices.
5. **Systemic, cascading and complex risks** - risk that is endogenous to, or embedded in, the system that is not itself considered a risk and therefore not tracked or managed, but which has the cumulative or latent potential to impact overall system

[64] https://www.ceres.org/sites/default/files/reports/2020-10/Ceres%20Bank%20Risk%20Report%202020%20FINAL.pdf

performance when some, potentially unrelated, characteristic of the system changes. The potential for a Minsky Moment is the climate-related systemic risk of greatest concern to central banks and regulators at present.

Needs for pricing Material Risks

The common theme across all of these risks is the need for greater transparency of climate and climate risk-related data, the ability to combine this with detailed information about assets, services, companies and the environments in which they operate—and the ability to incorporate all this data into pricing and investment decision-making. This represents an internalisation of the externalities; full incorporation of climate risk into the pricing and trading of loans, shares, bonds and other financial instruments associated with the activities and behaviour of a company.

A fundamental question is how do capital markets price climate exposure and risk into the financial instruments issued by a firm, or the financing extended to that firm, so that capital can be allocated in a manner that better recognises the impact of climate risk on the performance of those financial instruments? The intended uses and impact of data supplied cannot be underestimated and will/should carry material liabilities when incorporated into financial decision-making.

There are two ways to look at this:

1. **How do markets price the impact that a firm or activity has on the environment?**

   How do markets assess a firm's environmental and social footprint? This is at the core of ESG investing — internalising the externalities that firms create when undertaking their core activities. This is also referred to as environmental and social materiality, as characterised by the EU in its articulation of the scope of the Non-Financial Reporting Directive[65] (which also covers data having financial materiality). It has a wide potential audience, encompassing not only investors but also consumers, civil society, employees and other stakeholders impacted by the firm's activities.

2. **How do markets take the impact that climate change will have on a firm?**

   How do they incorporate it into the firm's credit rating, and the pricing of its equity and debt issuances? This is data having financial materiality, and is primarily of interest to investors. Are investors, conditioned to not seeing these impacts, able to perceive them (and act on them) even if information is provided?

The two are, however, inextricably interconnected given that a firm's ESG disclosures contain valuable information about the extent to which it is exposed to climate risk. A firm having a high negative impact on the environment will typically be exposed to a greater degree of transition risk. On the other hand, a firm's exposure to physical risk does not necessarily depend on whether or not that firm has a direct impact on the environment—but the impact of another firm's activities on the environment may have consequences for many others.

[65] https://ec.europa.eu/finance/docs/policy/190618-climate-related-information-reporting-guidelines_en.pdf

The availability of robust, high-quality, machine-readable, algorithmically-processible and accessible data is fundamental when considering these questions in any material form. **This data is, at present, simply lacking in the form required,** as both inputs to and outputs from the processes of evaluating and pricing in the climate risk to firms as well the environmental impact of firms' activities.

At present, asset managers and other investors are unable to use data in driving informed decision-making, because the models around climate risk and its pricing are flawed, due to inaccurate underlying assumptions (based in turn on a lack of solid data) and poor decision-making processes (due to the lack of standardised industry frameworks for managing climate risk). In practical terms, it is also very difficult for firms to prove that their actions produce desirable outcomes in terms of mitigating physical and transition risks, and demonstrating net-zero outcomes[66].

12.1.1 Data for TCFD Implementation

The leading international initiative to drive the collection and use of this data, is the adoption of the recommendations of the Task Force on Climate-Related Financial Disclosures[67]. As an initiative of the Financial Stability Board (FSB) it has international recognition and credibility. The involvement of representatives of the global accounting and finance communities in its design has helped to ensure its relevance and usefulness in practical application. Its flexibility and ability to integrate with other reporting requirements — in fact, firms are encouraged to embed TCFD in their annual reports, thus ensuring that it is also subject to the same oversight, governance and approvals — provides a realistic path to close integration with a firm's existing governance and reporting framework.

Although a universal obligation for TCFD is still some way off, many companies are already engaging and it is rapidly becoming the standard for mandatory regulatory disclosures. Mark Carney, the UN Special Envoy for climate action and finance and former Governor of the Bank of England, has recently called for[68] mandatory disclosures to TCFD standards, and is leading international coordination for widespread mandatory adoption in the lead up to the G2021 Glasgow UNFCCC COP.

Various countries have made TCFD recommendations mandatory: for example, New Zealand has become the first country to announce[69] that it intends to make reporting in line with TCFD standards mandatory for listed issuers and large financial institutions. It cites three main goals behind this requirement: promotion of greater transparency and more accurate pricing in the market, incentivisation of low-emissions investment, and creation of a level playing field for firms already incorporating climate change in their management of longer-term risks.

The recommendations of the Task Force on Climate-Related Financial Disclosures[70] focus on financial materiality — the impacts of climate change on a firm's activities. The TCFD framework, however, is intended to be both holistic and inclusive, providing a means of wrapping existing metrics and standards in a single report that also includes detailed

[66] Interviews with leading global asset managers
[67] https://www.fsb-tcfd.org
[68] https://expertinvestoreurope.com/time-for-mandatory-tcfd-reporting-says-mark-carney/
[69] https://www.mfe.govt.nz/climate-change/climate-change-and-government/mandatory-climate-related-financial-disclosures
[70] https://www.fsb-tcfd.org

information on a firm's governance, strategy and risk management policies and practices relating to climate risk.

Facilitating data flows for TCFD implementation

Before TCFD data can be used in a truly meaningful way for on-going risk assessment, it must be made publicly available to a high standard and in a consistent manner. In a 2019 report[71], S&P highlighted the challenges associated with consuming this data and incorporating into the credit rating analysis process, including insufficient uptake of the voluntary recommendations, and inconsistencies in making disclosures across firms.

There are various particularly challenging areas for firms to master:

Scenario analysis, in particular, continues to pose a challenge for firms seeking to report in line with TCFD disclosure recommendations. The recommendation is for firms to run scenario analyses against, at a minimum, the 2 degree scenario (in which average global temperature increases by two degrees above pre-industrial levels), and the 4 degree scenario where possible.

Firms currently rely on a range of sources and estimates for data on how these scenarios might materialise for their industries and sectors. Better availability of climate-related data is key to consistency across the climate outcome predictions that underpin scenario analysis. Even so, more consistent and clearly-communicated frameworks for undertaking scenario analysis are required in order for it to be of practical use in investment decision-making. As one asset manager interviewed for this report framed the challenge, "Data around scenario planning falls into a tragedy of horizons: data points used in scenario analysis are still based on historical data. Furthermore, the scenarios don't go out far enough - even the UK's Prudential Regulatory Authority only runs stress tests out to ten years, which is insufficient when assessing the true impact of climate risk."

Scope 1, 2 and 3 GHG Emissions data. TCFD, whilst primarily addressing financial materiality, does strongly recommend that firms disclose their environmental impacts in line with existing metrics and standards, with an emphasis on the importance of Scope 1, 2 and 3 disclosures of greenhouse gas emissions as per the Greenhouse Gas (GHG) Protocol. These metrics and standards will form an important basis for the publication of machine-readable non-financial data. However, firms are finding it extremely hard to deliver Scope 3 emissions data, even those committed to Science Based Targets including Scope 3 emissions, with serious challenges obtaining the appropriate data through global value chains.

To be used at scale, the industry cannot rely on the painstaking work of individual analysts in amalgamating multiple, partial data sources and applying them to risk assessments. If markets are to truly price in the climate risk associated with financial instruments, then the capability must exist for this to be done algorithmically and in an automated, real-time manner. And in order to be used in a meaningful manner by pricing and risk engines, data inputs must be highly standardised, accessible and machine-readable. Subjective TCFD

[71] https://expertinvestoreurope.com/sp-issues-warning-on-esg-credit-analyses/

disclosures, delivered in prose and attached to annual reports, are largely insufficient for this purpose[72].

Ultimately, investment decision-makers will incorporate this data into their risk models. Risk models must evolve to be dynamic-based approaches based on all of Earth's interrelated systems. They must incorporate our changing climate, weather and ecosystems data and bring in knowledge of temporal cycles and physical asset change as well as related social movement. They will need to be more explicit about the inherent uncertainties we all have to face. The consequence of not doing this will be a Minsky Moment (see below)— and ultimately detrimental not only to financial markets but also to their users and beneficiaries, in the form of pension funds, borrowers and others across both investors and those seeking access to capital.

Gaps and Barriers

Public and private initiatives to create common norms and requirements around Non-financial, or environmental, reporting to support Sustainable Finance[73] are key drivers for the supply of appropriate, reliable data. They comprise a complex set of requirements that span ecological and social assessment, business needs, policy requirements, the development of protocols, metrics and accounting principles - that all focus on winning alignment and commonality on the content of the data to be provided.

The process of 'reporting' itself is driven from diverse perspectives and can result in instruments that lack efficacy: they can be overly bureaucratic or burdensome for those reporting or, equally, not material to recipients using their data to affect decision-making. The current diversity and intransparency of global practice on ESG reporting is undermining the practical value of ESG reporting, whilst increasing the burden of reporting on companies.

What remains entirely missing at present is the infrastructure for and governance around the sharing of this data — with regulators, governments, investors, financial institutions and the general public — which this report seeks to address. Data, after all, is of no value to anyone if it is not accessible, and accessibility of data for decision-making is absolutely critical in the transition towards a green economy and a net-zero, sustainable future.

A robust data infrastructure can address these challenges, and can be built upon existing and proven technologies and best-practices. Using open standards, good data governance frameworks can address the secure and reliable sharing of asset-level non-financial data. This can unlock data at scale to address local, national and international assessments of environmental impact and risk on a point or cumulative basis.

Initiatives are just starting to address this need, of which a couple of examples follow:

Example: UK regulatory support for sharing environmental data for the finance sector and TCFD implementation

[72] Interviews with standards bodies and asset managers.

[73] "Sustainable finance generally refers to the process of taking due account of **environmental, social and governance (ESG) considerations** when making investment decisions in the financial sector, leading to increased longer-term investments into sustainable economic activities and projects"
https://ec.europa.eu/info/business-economy-euro/banking-and-finance/sustainable-finance/

As climate change, and society's response to it, presents financial risks and opportunities that are relevant across the whole financial sector. In the UK public sector response falls within the remit of the financial regulators - the Prudential Regulation Authority (PRA) and Financial Conduct Authority (FCA).

The FCA's Climate Financial Risk Forum: **Innovation Working Group**[74] (CFRF-IWG) are helping to shape potential areas for product innovation and the underlying data sharing that might enable it. The objective of the CFRF is to build capacity and share best practice across financial regulators and industry to advance our sector's responses to the financial risks from climate change. It has convened representatives from across the financial sector, including banks, insurers, and asset managers as well as observers to represent a broader range of firms and ensure the outputs of the CFRF are communicated.

> "While these risks may form in full over time, they are becoming apparent now. Firms are enhancing their approaches to managing these risks, but face barriers to implementing the forward-looking, strategic approach necessary to minimise the risks. The CFRF aims to reduce these barriers by developing practical tools and approaches to address climate-related financial risks." Climate Financial Risk Forum

In March 2020, the UK's Financial Conduct Authority published a consultation[75] in which they proposed that premium listed issuers on UK exchanges be required to disclose whether or not they have made disclosures in line with TCFD, and explain why if not. This 'comply or explain' approach is broadly viewed as sub-optimal by a range of stakeholder groups, including standards-setters[76] and investors, particularly given the limited proposed scope of application. The UK government had also previously signalled its intention[77] to make TCFD reporting more broadly applicable as part of its Green Finance Strategy, for listed companies and large asset owners. In November 2020, the UK's Chancellor of the Exchequer set out far more ambitious targets for disclosure in line with TCFD recommendations[78], aimed at a broad segment of the economy and on a fully mandatory basis from 2025, with phasing in due to begin in 2023.

This is a most welcome development on the part of the UK government. It will, however, reinforce the case for data standardisation, data accessibility and data infrastructure even more compelling. The challenges around accessing and processing TCFD and other non-financial data are well-known at present[79]. The documents in which this data is contained are often uploaded to company websites, and must first be located. Analysts must then scour the documents for relevant content, applying their own lens of subjectivity, and then extract the information, and apply any processing to make it consistent with other data sources. When applied to thousands, or even millions of firms (on a global scale), this process is clearly unsustainable and does not support the availability of robust, actionable data.

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[74] https://www.fca.org.uk/transparency/climate-financial-risk-forum

[75] https://www.fca.org.uk/publications/consultation-papers/cp20-3-proposals-enhance-climate-related-disclosures-listed-issuers-and-clarification-existing

[76] https://www.cdsb.net/listing-requirement/1019/cdsb-warns-comply-or-explain-approach-not-sufficient-reaction-uk-fca's

[77] https://boardagenda.com/2020/02/13/uk-government-set-to-implement-mandatory-tcfd-reporting/

[78] https://www.gov.uk/government/news/chancellor-sets-out-ambition-for-future-of-uk-financial-services

[79] Interviews with data standards bodies and data consumers (e.g. asset managers)

Example: The EU's Sustainable Finance and Non-Financial Reporting agenda

The EU's Non-Financial Reporting Directive, which encompasses both financial as well as environmental and social materialities, also recommends[80] that TCFD forms the basis for reporting on financial materiality when making mandatory non-financial disclosures related to climate change. For the purposes of this report, therefore, TCFD provides a useful basis on which to consider the impacts of climate-related disclosures, and the requirements these create for data sharing and access.

In this context, the work currently being undertaken by the European Financial Reporting Advisory Group (EFRAG) at the behest of the European Commission, in exploring potential and recommendations for mandatory non-financial reporting to be standardised and digitised [81], is a welcome development.

12.1.2 Meeting data demands for Sustainable Finance

Through a process of evidence gathering and discussion across public and private sectors, and based on experience with open standard development, we have arrived at a set of specific recommendations for how to move forward to provide the data infrastructure that can deliver on future needs (as presented in the main body of the report.) Stakeholders note the extreme complexity of the challenge of bringing together non-financial data in a meaningful manner to deliver financial impact.

We anticipate demands for both non-financial and financial data will grow in diversity, complexity and timeliness. We have investigated examples[82,83] of the environmental data which will be needed to assess financial and systemic risk.

Over time, an increasing number of stakeholders will require data to flow across organizational and country boundaries. This will range from emissions to energy flows, water and other commodity flows from sources and their supply-chains to the upstream climate science and environmental impacts themselves.

The complexity of many-to-many relationships and cross-border data sharing requires moving from a 'push' model and annual reporting to a 'pull' model at 'relevant-time'.

There is no geographic 'center' to this market—it is a fluid ecosystem with diverse and interconnected dependencies. Environmental changes in one country will affect the manufacturing capabilities of another, and will impact the share price of a company in a third country that relies on the other two for its supply chain and raw materials. These global interdependencies, the product of decades of globalisation, mean that consideration of the cross-border governance and operating model for data sharing is essential and must be at the core of any proposal to address these challenges. This requires a shift in perception.

Together, these will help inform macroeconomic, societal and planetary risks in a manner previously unknown and currently invisible. Given the highly competitive and political nature of these risks, it is imperative that an internationally-accepted **trust framework** underpin the

[80] https://ec.europa.eu/finance/docs/policy/190618-climate-related-information-reporting-guidelines_en.pdf
[81] https://www.efrag.org/Activities/2010051123028442/Non-financial-reporting-standards
[82] https://energydata.org.uk/phase-2-use-case/ (industry-led use case for net-zero planning by a local authority)
[83] https://icebreakerone.org/events/#lcaw-2020 (3 hours of video webinar summaries across innovation programme)

foundational data (the ‘facts’) that are informing risk assessment and decision-making around them.

“As we compete to stake out our respective bits of market turf, celebrating the incremental changes of businesses that support our platforms, we confuse the market. Are we calling for change-as-usual or for ‘breakthrough’?”, John Elkington[84]

This has been recognised in some international initiatives. For instance, TCFD calls for companies, regulators, governments and financial institutions to integrate voluntary and mandatory disclosure frameworks into development. To enable cross-border data flows, data protection with hard-wired accountability between nations will be essential and this will require prioritizing cybersecurity, connectivity, technical interoperability, data portability and data provenance.

12.2 Open Standards

‘Open’ Standards mean that the standards themselves are open; the policies are open, all research and other related outputs that help create an open marketplace are licensed under an open license agreement.

An Open Standard can enable regulators and industry stakeholders to mandate the delivery of Open Data, based on needs. For example, in Open Banking the Standard mandates that product information is made available as machine-readable, Open Data for use by anyone for free.

Equally, it mandates that confidential information, such as a bank statement, cannot be Open Data. Instead, that data must be made available to trusted third parties using open API technologies, within a trusted network. The open banking standard creates and manages the implementation of rules by which the whole market can operate safely and securely, through Shared principles and practice.

An open governance platform can underpin trust networks—enabling industry and regulators to define both the data and the rules, which will enable markets to flourish.

An Open Standard:

- Opens up the market around shared principles and practices
- Enables open interoperability and cohesion across ecosystems
- Is itself licensed openly (e.g. CC-BY[85], MIT[86] or equivalent): covering words, code and data
- Can help create a voluntary or mandatory requirement for Open Data publishing of specific data that should be public and free
- Can help create a voluntary or mandatory requirement for open access to Shared Data for private and confidential data
- Can help create a voluntary or mandatory requirement for open APIs as a shared and common technical implementation to sharing easier

[84] https://www.greenbiz.com/article/lets-uberize-sustainability
[85] https://creativecommons.org/licenses/by/2.0/
[86] https://en.wikipedia.org/wiki/MIT_License

- Addresses sector-wide or cross-sector challenges.

This approach is complementary to, and could provide an operating framework for the EC Strategy for Data and GAIA-X[87] programme.

12.3 Stakeholder map for shared data development

This section identifies the range of stakeholder groups who would be, eventually, actors to involve in the development of open standards for environmental data in global value chains.

"In our networked age, everyone is a data stakeholder"[88]

There are many hundreds of initiatives working across climate, environment, finance, infrastructure and data. These span the public and private sectors operating at local, national and supranational levels. These include, but are not limited to:

- Networks (coalitions, knowledge sharing, consortia) across technology, principles and practice, reporting initiatives, research, advice, awareness raising, policy and industry representation
- Data inventory, aggregators, hubs, portals and related services
- Data services including data processing and analysis tools
- Developers of disaster and catastrophe models, risk models and related modelling
- Grant and loan financing bodies (including insurance provision and risk pools)
- Consultancies and service providers
- Standards development agencies

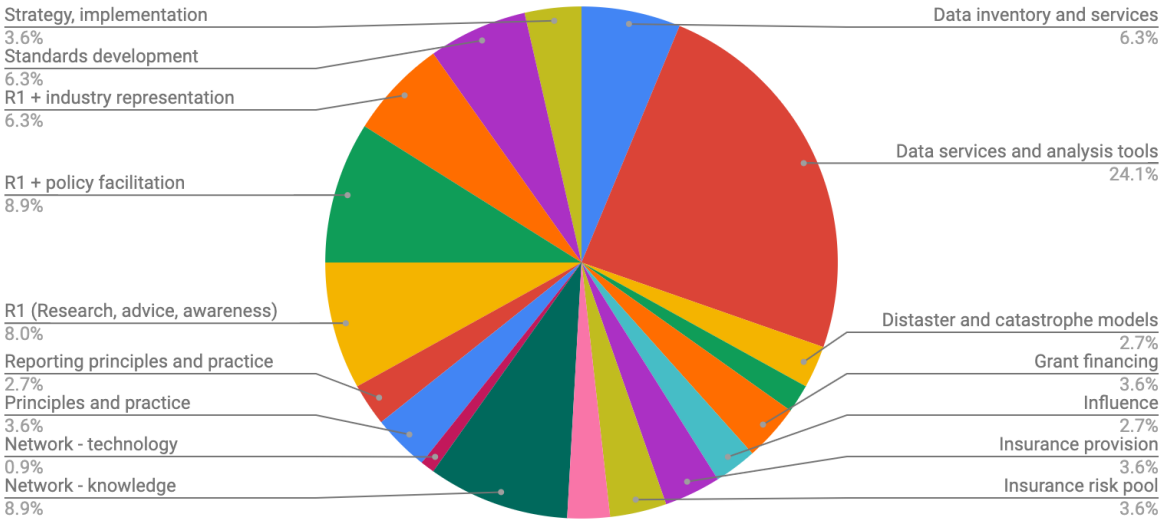
For example, stakeholders spanning financial[89] and non-financial data include

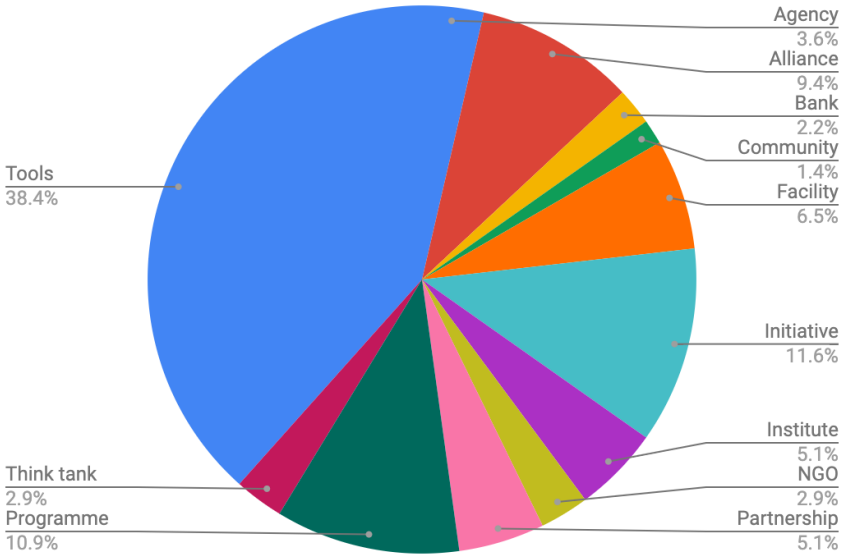
- The Financial Stability Board's Taskforce on Climate Related Financial Disclosure (launched in Paris at COP21 in 2015)
- The Network of Central Banks and Supervisors for Greening the Financial System (NGFS) launched at the Paris "One Planet Summit" in 2017
- The Coalition of Finance Ministers for Climate Action bringing together fiscal and economic policymakers from over 50 countries launched at the 2019 Spring Meetings of the World Bank Group and International Monetary Fund
- The Global Investors for Sustainable Development, a group of 30 private sector CEOs convened by the United Nations Secretary-General
- The United Nations-convened Net-Zero Asset Owner Alliance to help unite investor action to align portfolios with a 1.5°C scenario, an international group of 29 institutional investors Representing nearly $ 5.0 trillion assets under management (as of 3rd August 2020).
- The Climate Finance Leadership Initiative formed by Michael Bloomberg at the request of the United Nations Secretary-General António Guterres.
- The World Benchmarking Alliance, launched at the UN General Assembly in 2018 with support from the Governments of the UK, the Netherlands and Denmark.
- The Energy Transition Coalition, a diverse group of leaders from public, private and social sectors aiming to accelerate change towards low-carbon energy systems that

[87] https://www.data-infrastructure.eu/
[88] https://dgen.net/0/2018/10/28/can-government-stop-losing-its-mind
[89] with thanks to IPFC

enable robust economic development and limit the rise in global temperature to well below 2°C.

- In addition, the IMF has also recently developed Climate Change Policy Assessments for countries aimed at helping build a national economic policy framework that promotes a just transition.





12.4 What is Open Banking and why is it relevant?

Open Banking is an example of a shared data system created through Open Standards. Here, we describe some key features.

Firstly, it mandates that banks publish product information as Open Data. This makes it easier to find and analyse products that might fit customer needs. The value exchange (**reciprocity**) is that by making it easier for customers to find products that suit their needs, banks will get a better fit of customers-to-products which can increase the likelihood of having a happy customer. This is a win-win.

Further, while some banks used to feel that holding on to their customers' data was paramount, it's not the customer-value point that they should be competing upon. Furthermore, with GDPR, the data is controlled by the end customer.

The rules that govern this data exchange are encoded into the Open Banking Standard. It covers everything from the rights surrounding the data to the liability transfer as data flows. It is a **commercially-focussed framework** that allows **data-sharing**. These rules are now both common and shared across the whole market. It effectively defines the rules for sharing in advance.

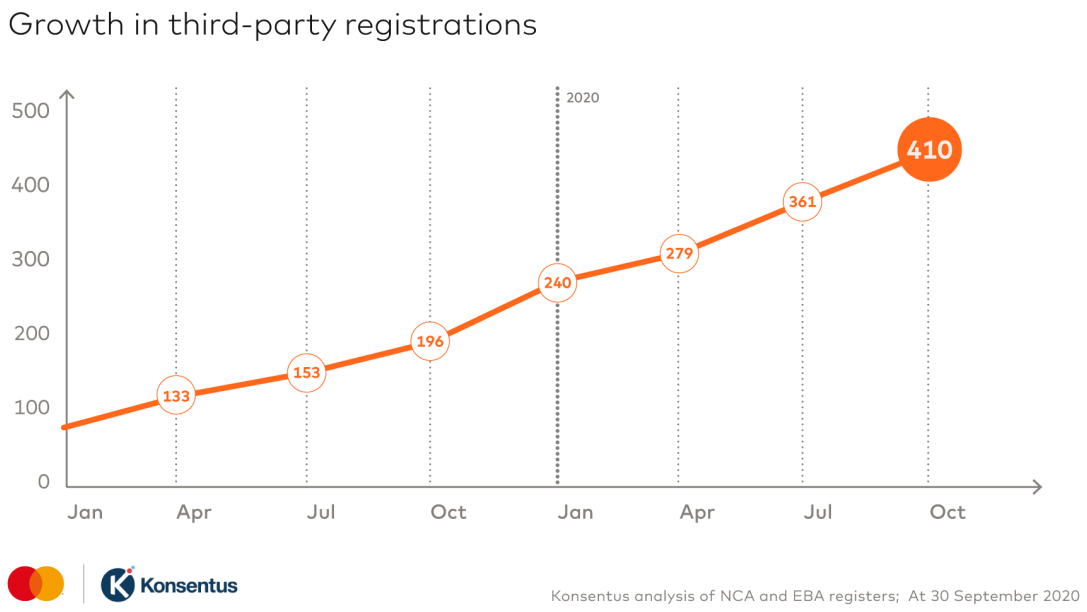
Open Banking was mandated by the CMA as a remedy following the financial crisis of 2008/2009. It applies to the 9 largest UK retail banks (the "CMA9") in order to open up greater competition and its objectives are closely aligned to those of the EU's Second Payments Services Directive (PSD2). Because the Standard was adopted by these major banks, the rest of the UK market followed suit.

Open Banking is a regulated instrument in the UK which covers all major banks (including AIB Group UK, Bank of Ireland (UK), Barclays Bank, HSBC Group, Lloyds Banking Group, Nationwide Building Society, NatWest Group, Northern Bank Limited, Santander UK) and over 300 companies in the broader ecosystem who provide services across the financial sector (including American Express, Experian, JP Morgan, Revolut, Sage, Starling Bank and Xero).

Open Banking went live in January 2018, now has 273 regulated providers, made up of 196 Third Party Providers (TPPs) and 77 Account Providers (i.e. banks). It reached one million live consumers in January 2020, and has gone on to reach two million live consumers in September. The approach described above has meant that all the UK retail banks have adopted the standard, and as a result a thriving ecosystem of TPPs has embraced innovation, redefining the consumer and small business relationship with their money.

Across Europe, at the end of June 2020, 361 third-parties had registered with a European 'National Competent Authorities'[90] (dedicated to Supervisory Disclosure such as regulators and banks), an increase of 30% on the previous quarter. By September there were 410 third-party registrations — a 13.6% in three months.

[90] https://eba.europa.eu/supervisory-convergence/supervisory-disclosure/competent-authorities



The standard was (and is) developed openly—as a result, it has helped to catalyse initiatives around the world. Similar initiatives now exist across Australia, Bahrain, Europe, Hong Kong, India, Japan, Mexico, Malaysia, New Zealand, Rwanda, Singapore and the USA.

It is important to note the difference between Open Banking and PSD2. The Open Banking Order forced the largest nine retail banks to adopt a common standard (these are commonly referred to as the "CMA9") whereas PSD2 only mandates that banks must open up data to third parties. So competing standards in Europe emerged (e.g. Berlin Group, STET, Polish API). Additionally, the CMA forced these nine banks to pay for implementation (effectively a fine on them).

So the UK has the Open Banking Implementation Entity, which is both Standards body and Implementation body. It has a quasi-regulatory role in that the Trustee can recommend an action to the CMA. Hence this has resulted in further directions on the nine banks covered by the Open Banking Order when their implementation of the standard is judged to have fallen short. An example of this is on the customer journey for authentication, where there was seen to be unnecessary friction when the consumer is redirected to their bank to confirm that they are making the request.

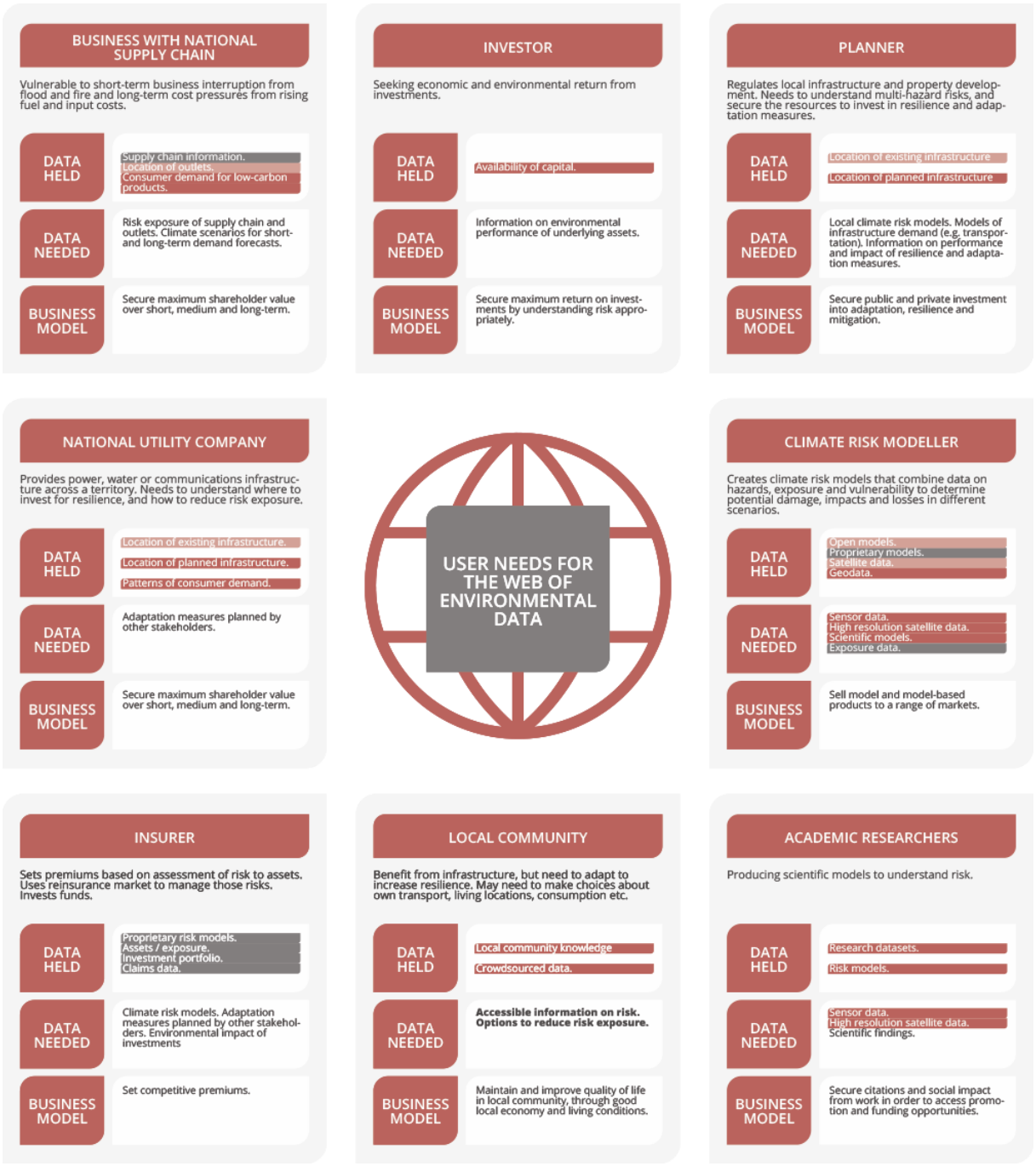
12.5 Use cases for Shared-data systems

In this Appendix, we describe 2 example ‘use cases’ to illustrate the nature of ‘use cases’ as conceived as the starting point for a market design process - the approach used in past UK Open Standard approaches to shared-data.

Overview

Below is an outline of the diverse connections between data assets and data needs across different stakeholders utilising non-financial reporting.

There are various use-cases in which stakeholders will use non-financial data within their programmes and projects. Understanding and processing real-time environmental risk data, and the impact of those risks on businesses, governments, and individuals is crucial information for many users and use cases.



Insurers and green investors need to understand and plan for the outcomes of their investments while minimising their costs. Urban planners and consultants must incorporate multi-risk modelling to inform infrastructure investment and build urban resilience against environmental shocks. Climate and disaster risk modellers need access to reliable and granular risk data to inform their models, while national disaster management offices can extrapolate their data to understand the risks faced by governments, businesses, and individuals.

For example,

- **Green Investors** want to understand the outcomes from their investments, minimising reporting costs while maximising the reliability of data. Long-term moves towards asset-level data, including through the use of 'Digital Twins'[91] has the potential to provide much more granular and real-time data on investment outcomes and the environmental performance of assets held. Over the shorter-term, the opportunity to align project level environmental reporting may assist investors in directing funds and ensuring promised resilience measures are enacted.

- **Urban planners** need access to multi-risk models that can allow them to plan infrastructure investment, and regulate private sector development. By lowering the friction to discovery and access to risk models, making it easier to import local information into modelling tools, and improving the transparency of risk modelling, Icebreaker One could support the creation of Universal Disaster Risk Modelling (UDRM) applications, tools and services, such as the proposed 4-dimensional topology of risk over time (UNDRR, 2019)[92]. When disaster risk models inform strategic planning, and when the results (in terms of more resilient infrastructure) are shared in forms that can also feed into insurer models, insurance premiums can also be reduced.

- **National Disaster Management Offices** oversee recovery and reconstruction efforts and need to overcome critical funding gaps that open up after immediate response operations are complete. They cannot progress without a better shared understanding of the risks faced by governments, businesses and individuals.

- **Catastrophe risk model developers** examining the costs inherent in developing country-specific models need to make use of non-financial reporting data from the private sector to customise the models and a network of local collaborators to help validate data points with ground surveys.

[91] A digital twin is a computer model which mirrors and simulates an asset or a system of assets and their surrounding environment. Digital twin models can help organise data and pull it into interoperable formats so that it can be used to optimise infrastructure use:
https://www.ifm.eng.cam.ac.uk/research/asset-management/research-projects/infrastructure-digital-twins/
[92] Global Assessment Report 2019, Chapter 2

12.5.1 Example Use Case 1: Automating non-financial reporting (e.g. TCFD) with cross-border data-sharing

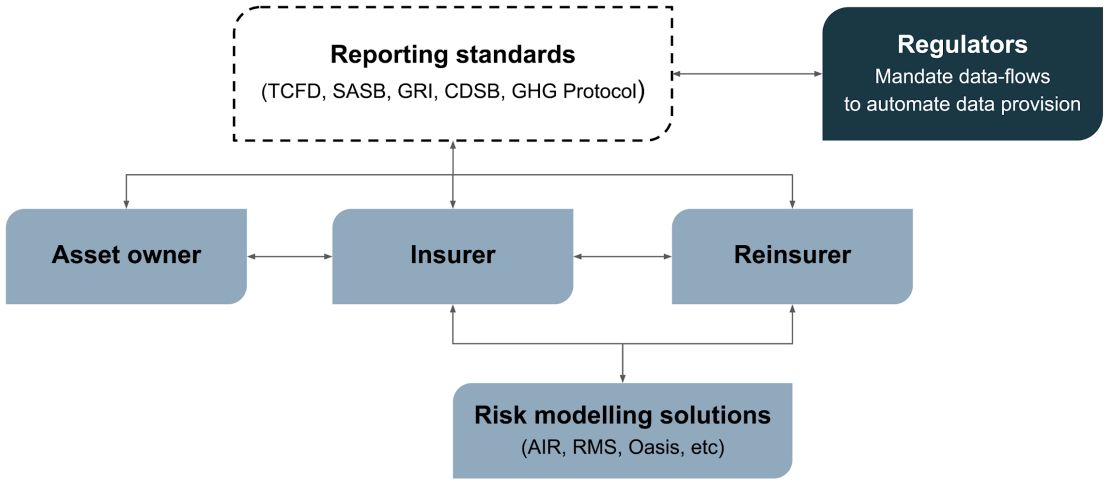
In this example, we address the use case around reporting of mandatory non-financial data by financial institutions, including banks, insurers and investors, to their regulators, as well as the consumption and utilisation of this data by internal risk-modelling software within these institutions. These firms are likely to be the first tranche, in most if not all jurisdictions, given both their essential role in managing the systemic risk posed by climate change, and their existing status as highly-regulated institutions having both the capacity and capability to undertake such reporting (New Zealand provides a case in point, with its introduction of mandatory TCFD disclosures for financial institutions).

These large regulated financial institutions are also typically of a global nature, having operations in multiple jurisdictions, and therefore subject to regulatory requirements having potential for both extraterritorial and cross-border reach.

Such disclosures, if mandated, will not only be required to be reported to regulators across multiple jurisdictions, but are also of potential relevance to a wider audience including investors and reinsurers.

From a regulator's perspective, they can also facilitate a greater and more complete appreciation of systemic risk, thus supporting the G20's post-2009 goals in terms of identification and mitigation of systemic risk. If exposed via a shared data infrastructure, they can be made accessible in a safe, secure and well-governed manner to other market participants and investors who will then be able to incorporate the data into the risk modelling processes and algorithms that underpin their own decision-making. This represents a significant step towards the internalisation of non-financial climate data within risk and pricing.

Links between regulators, reporting standards, market actors and modelling software



Data for financial and systemic risk modelling

This is not just about disclosure data. It is also about 'relevant time' data that is required for ongoing management of risks and exposures related to climate change and other environmental factors. Furthermore, TCFD reporting data, even if perfectly presented, is not fit for purpose in this context. It presents only climate risk, and a firm's response to climate risk. It does not show a firm's net-zero outcomes, or the collective impacts of many firms' activities and mitigation plans. This is the data that is so far missing, and sorely needed, when assessing the real-time emerging risk associated with issuers and issuances. This non-financial data has a multitude of sources: weather bureaus, satellite data, public and private databases, and non-financial reporting and disclosures on the part of individual firms.

Credit ratings — which embody the credit risk associated with an issuer or a specific issuance — can be impacted by the extent to which an issuer is exposed to transition risk or physical risk. This can change over time, so could be updated in line with periodic publication of TCFD reporting by the issuer. Specific aspects of TCFD reporting, namely certain metrics and standards, could also be included in the reference data associated with an issuer or an issuance, allowing market participants to make their own determinations of the impact that transition and physical risk exposure have on their portfolios.

There is then an ongoing need to understand how climate events might impact risk and pricing, for example, where a firm's share price might be impacted by the exposure of its supply chain to an acute physical risk event such as flooding. This where the combination of non-financial reporting on the part of corporates and other entities, and the availability of non-financial data, becomes critical. In order to fully ascertain such risks and their impact on pricing, it is necessary to understand both the firm's exposure to the risk *and* the nature of the risk itself (including the underlying, interdependent contexts and drivers of the risk) —meaning, the associated climate data around the risk.

Price-makers— the investment banks, market makers and brokers who provide pricing and execution services to asset managers and other investors—price assets based on the best available risk information that they have. This includes data about where the market is, the liquidity available, and the likelihood of being able to hedge their risk. Highly bespoke trades or instruments might be priced manually, or via spreadsheets. For more liquid instruments, however, prices are generated frequently (sometimes in near real-time) and automatically via pricing engines, which consume market data, reference data and other sources of risk data as inputs and generate two-way (buy and sell) prices as outputs.

There is a distinction to be made between the types of inputs to the pricing process. Company fundamentals, market analysis and peer performance benchmarking are all key to understanding the true value of an issuer. More 'relevant-time' data, on the other hand, is the input to day-to-day fluctuations in asset price which encompass the real-time risks associated with holding the asset.

For a single issuer, the prices associated with different issuances and tenors, for example, equities, short term notes and long term bonds, can vary significantly because of the different risk profiles of each tenor. The risk looking out to one year might be very different to the risk looking out to 30 years. In this context, climate-related risks and exposures on the part of a

firm have a clear and direct impact on the pricing of different issuances and tenors. An oil or gas company might be able to raise short-term finance relatively cheaply, but this should change as the maturity increases and the transition risk and risk of stranded assets are taken into account. On the other hand, acute physical risks such as flooding or wildfires, can have an immediate impact on that company's share price and short term debt.

Taken collectively, disclosures of environmental impact across firms in a given industry can help to build a picture of that industry's predicted impact on the environment.

Avoiding Minsky Moments

Unquestionably, the incorporation of climate-related risk into pricing of financial assets will lead to the crystallisation of some losses, as the extent to which firms have so far ignored both the impact of their activities on the environment, and the risks posed by climate change on their business models.

If these losses are realised suddenly, and at a systemic level, then global markets are in danger of a "Minsky Moment": a sudden collapse in asset values, following a period of unsustainable and bullish market optimism.

The role of data in decision making can help to ensure that a Minsky Moment is not reached—that climate-related risks are identified and appropriately managed in such a way as to smooth out the decline in asset values as climate risk is priced in. This will also give more time for firms to adapt their business models and to identify new and innovative means of surviving and thriving in a net-zero future.

Better and more accessible data, of both a financial and non-financial nature, can help us manage this transition more effectively, smoothing the curve and avoiding sudden market shocks. For:

- asset managers and pension funds, this includes investment decision-making;
- banks, brokers and market-makers, this includes decision-making in pricing, lending and trading (including pricing-in climate and related data);
- insurance companies, this includes risk management, pricing & avoiding coverage gaps.

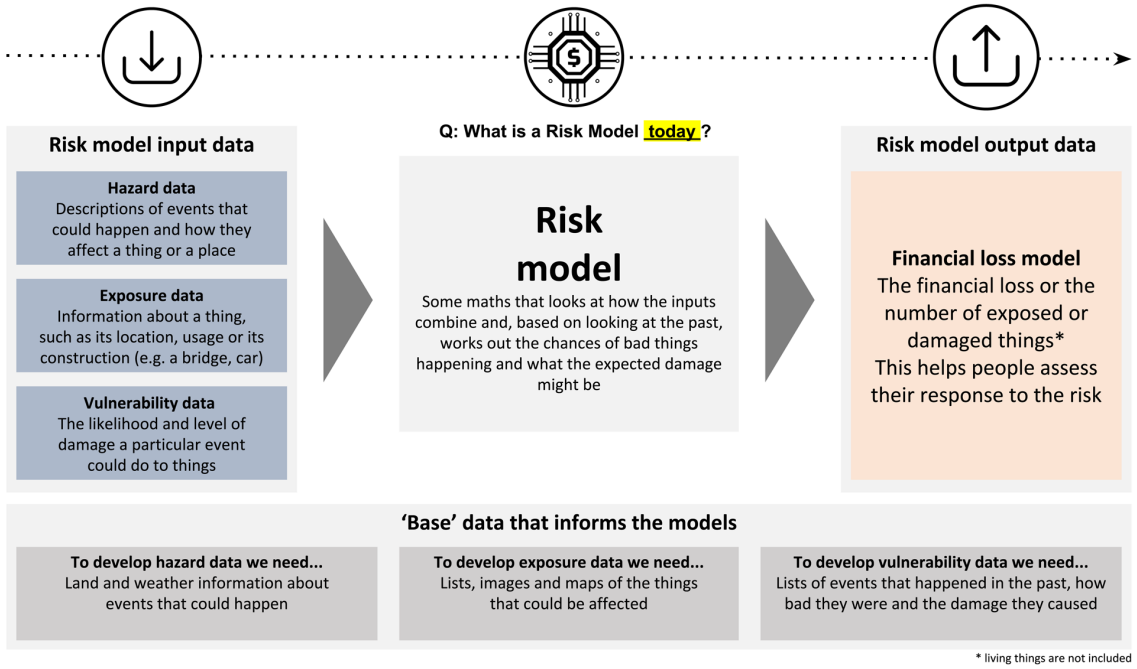
We would argue that markets have gone as far as they can without large-scale regulatory intervention. Their current, as-yet-undetermined exposure to climate risk arises not from a single market failure, but from thousands of market failures. Failure on such a systemic scale requires corresponding systemic levels of intervention. Prudential regulation needs to be updated so that, just as liquidity risk was incorporated to a greater extent following the global financial crisis of 2007-2008, climate risk is priced into financial institutions' capital adequacy buffers. Conduct regulation - such as MiFID II for capital markets, and Solvency II for insurance markets - must take into account the investor, issuer, buyer and end user disclosures required to enable financial institutions to fully assess these risks. Investors (both institutional and retail) need the ability to understand with certainty the environmental impact that their investment is having, as well as the climate risk to which it is exposed[93]. Finally, new regulation is required to mandate the sharing of relevant non-financial data in an accessible, machine-readable format.

[93] Interviews with leading global asset managers.

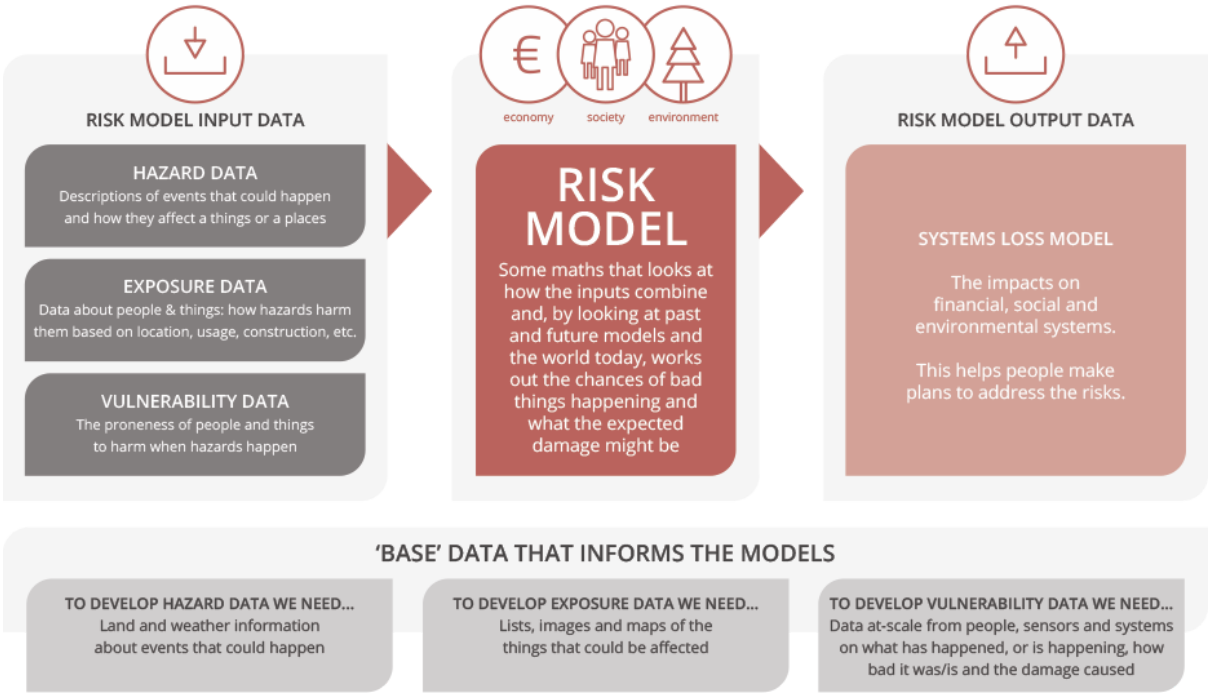
A transition in risk modelling

Within the insurance sector, there is a potential transition to the manner in which risk is modelled, from a financial loss model to a systems loss model - a transition that would be driven by, and require a parallel, possible, transition in the provision of data.

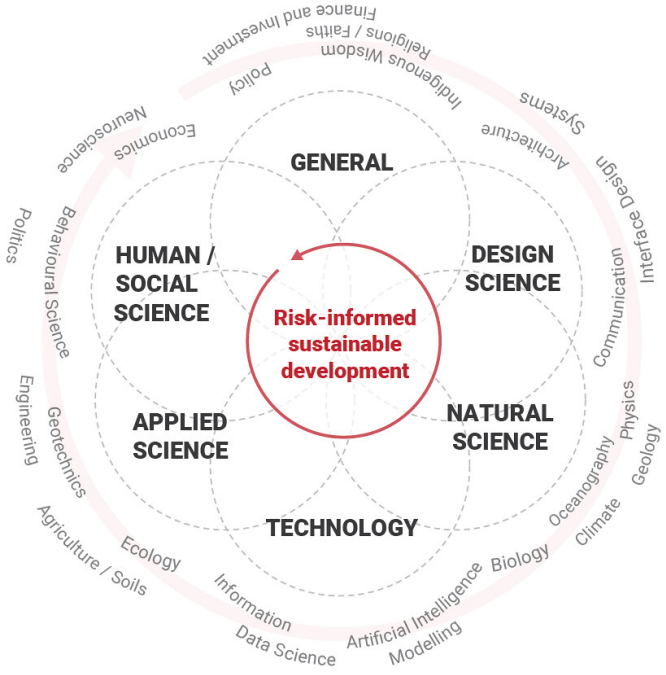
Simplified view of risk modelling today:



Potential evolution of risk modelling



The GAR[94] takes this yet further to include the underlying drivers and contexts, including cultural, historical, political, technological, financial, social and environmental factors to move beyond 'force majeure'-type perceptions of risk, rather than the perception of risk as a choice: an accumulation of our choices (of which information to include/ exclude, where to build, how to build, where to live, where to grow, what to grow, how to value, what to value, how to research, what to research etc). Choice is a critically important foundational component in the understanding of the systemic nature of risk.



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12.5.2 Example Use Case 2 - Local authority planning on energy use data

Local Authorities delivering a Local Energy Plan must be able to understand the impact of Low Carbon Technologies (LCTs) and whether retrofitting, or new installations to properties in a community would be achievable without investment by the local Energy Distribution Network Operator (DNO). With the rapid pace of change and decentralisation of the energy system currently underway, understanding how a specific retrofit project sits within an overall regional plan, or where investment will be required over time, is critical both for the Local Authority and the Energy DNO.

However, because the current energy data ecosystem is fragmented, accessing this data to assess the impact of planning decisions is not straightforward. Data must be accessed through multiple bilateral engagements, which is time consuming and inefficient. It is not easy to find data, to set up access, to use data, or to link to other related data.

This challenge causes significant delays to the rollout of retrofitted LCTs, delaying the significant benefits that can be achieved. These benefits are multi-faceted and include:

- Health, through improvements in air quality
- Economic, through greater fuel efficiency
- Environmental, through a reduced carbon footprint for the community.

[94] https://gar.undrr.org/
[95] https://gar.undrr.org/infographics

Systems thinking is required to unravel the complex inter-relationships between energy and LCTs, health, and the environment and economy, and therefore gain a true understanding of the overall cost-benefit associated with transitioning to low-carbon energy sources. Better air quality will reduce healthcare costs and improve worker productivity. Reduced fuel and transport costs through improved fuel efficiency can drive both local economic growth, reduce fuel poverty and improve consumer financial resilience. Environmental improvements contribute to mitigation of climate change risks such as extreme weather or flooding, with wider societal and financial benefits. As significant consumers of energy across their portfolio of properties, Local Authorities who make a switch to LCTs also exert an influence on market forces, making positive signals towards LCTs and signalling away from use of carbon-emitting energy sources.

The lack of easy access to data is therefore a pressing issue. Solving this enables the Local Authority to understand the variables and impact on DNO available capacity at the local substation, and any transmission constraints, as they roll-out solar arrays, public electric vehicle charging points, etc. These impact the available capacity both positively and negatively. More granular data availability can also help Local Authorities to manage the transition process, with the ability to run proof of concepts and test cases, and to access clear metrics on utilisation, performance and additional infrastructure requirements around these, which can then feed into the business cases for larger-scale roll-outs.

For example, a solar array on an apartment building will have the effect of reducing the energy required from the DNO, while the installation of charging points for electric vehicles may require more energy than the DNO substation can provide, hence triggering a need to invest further. If the Local Authority has the data that allows these variables to be accurately modelled and understood, this will inform their prioritisation and decision-making process.

An Open Energy Standard, supported by a Governance Platform, solves this problem of data sharing. Taking the same distributed approach as that successfully used in Open Banking, it ensures that only authorised service providers can access data, provides the control point over the specific datasets, signposts the API endpoints, and allows the data provider to recognise a legitimate request to access the data being held.

This approach has significant benefits.

- Energy data is centrally locatable, searchable and linked
- Permissions to access data are established on a one-time basis
- Data is secure and shared only within the trusted ecosystem
- Encourages a competitive ecosystem to develop, stimulating innovative solutions
- Allows rapid and low-cost system evolution - and avoids a single point of failure - through its decentralised architecture.

This is visualised below, with an ‘Energy Data Service Provider’ acting as the Third Party that enables access to the data that the Local Authority requires, and packaging the service so that it can be easily used. This approach is analogous to an Open Banking/PSD2 ‘Account Information Service Provider’ that takes data from multiple bank accounts and packages this information into a personal finance management service, where all the information is easy to access, understand, and act upon.

12.6 Examples of machine-readable data[96]

Machine-readable (MR)	Human-readable (HR) but not machine-readable
Structured data - in a format that can be automatically read and processed by a computer	Unstructured data; non digital data (but also some digital data)
HTML - HR and MR	PDF documents - digital HR but not MR
CSV on the Web - CSV and linked metadata in JSON format	Printed or handwritten documents - not digital
JSON - can describe complex data structures, popular for data interchange between programs and systems (is independent of programming language) and highly MR, reasonably HR	Scans or photographs of text and images - not digital
XML - Extensible Markup Language, a simple and powerful standard for representing structured data.	MS Word documents
RDF - describes linked data (where every identifier is a URL)	MS Excel documents - tabular but not structured for machine readability
ASCII, or plain text file in a structured format	
CSV - most common format for data but typically does not have metadata attached to describe contents and fields	
KML, GML, GEOJSON - MR formats for geospatial data	

[96] For further definitions see: http://opendatahandbook.org/glossary/en/terms/machine-readable/