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ENVISIONING THE FUTURE OF
NON-STATE CLIMATE ACTION DATA AND ACCOUNTABILITY

Acknowledgements

About Data-Driven EnviroLab

The Data-Driven EnviroLab (DDL) is an interdisciplinary and international group of researchers, scientists, programmers, and visual designers. The DDL uses innovative data analytics to distill signals from large-scale and unconventional datasets and develop policy solutions to contemporary environmental problems. The DDL is based at the University of North Carolina Chapel Hill and is a joint initiative between the Department of Public Policy, the Environment, Ecology, and Energy (E3P) Program, and the Institute for Environment at UNC.

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Glossary of Acronyms and Abbreviations

AI	Artificial Intelligence	NAZCA	Non-State Actor Zone for Climate Action
CAD2.0	Climate Action Data 2.0 Community	NDC	Nationally Determined Contribution
CAMDA	Community of Climate Action Methodologies Data and Analysis	NGO	Non-Governmental Organization
CDP	formerly known as Carbon Disclosure Project	NLP	Natural Language Processing
COP	Conference of Parties	NPA	Non-Party Actor
CSR	Corporate Social Responsibility	NSA	Non-State Actor
CSV	Comma-Separated Values	NZDPU	Net-Zero Data Public Utility
DOI	Digital Object Identifier	PACT	Partnership for Carbon Transparency
DLT	Distributed Ledger Technology	PID	Persistent Identifier
ECF	European Climate Foundation	PPP	Public-Private Partnership
ESG	Environmental, Social, and Governance	PRI	Principles for Responsible Investment
FAIR	Findable, Accessible, Interoperable, and Reusable	RAF	Recognition and Accountability Framework
GCAP	Global Climate Action Portal	RtZ	Race to Zero
GHG	Greenhouse Gas	SBTi	Science-Based Targets initiative
GRI	Global Reporting Initiative	SEC	Securities and Exchange Commission
GST	Global Stocktake	SME	Small and Medium-Sized Enterprises
HLEG	High-Level Expert Group	RtZ	Race to Zero
ICI	International Cooperative Initiative	SBTi	Science-Based Targets initiative
ICIEI	formerly now as international Council for Local Environmental Initiatives	SEC	Securities and Exchange Commission
ICT	Information and Communication Technology	SME	Small and Medium-Sized Enterprises
IETA	International Emissions Trading Association	TCFD	Task Force on Climate-related Financial Disclosures
IFRS	International Financial Reporting Standards	TCR	The Climate Registry
IoT	Internet of Things	UN	United Nations
IPCC	Intergovernmental Panel on Climate Change	UNFCCC	United Nations Framework Convention on Climate Change
ISSB	International Sustainability Standards Boards	WBCSD	World Business Council for Sustainable Development
ISO	International Organization for Standardization	WMBC	We Mean Business Coalition
JSON	JavaScript Object Notation	WMO	World Meteorological Organization
LEI	Legal Entity Identifier	WRI	World Resources Institute
LLM	Large-Language Model	XBRL	eXtensible Business Reporting Language
MRV	Measurement, Reporting and Verification		

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Executive Summary

This report sheds light on the pivotal but often overlooked role of non-state actors (NSAs) such as businesses, financial institutions, and civil society in driving the objectives of the Paris Agreement. While their significance is undeniable, the impact of NSAs' contributions to climate action often remains obscured due to insufficient data accounting practices. Unlike the more established reporting norms for national climate targets, NSA accounting falls behind, inviting the risk of greenwashing and eroding the authenticity of their environmental pledges. This is a critical concern given the heightened international scrutiny of NSAs' climate actions within international processes such as the UN Framework Convention on Climate Change's Recognition and Accountability Framework.

Highlighting the existing data gaps and accountability challenges NSAs face, this report aims to uncover the root causes of ineffective data accounting practices and suggest practical solutions.

Key Findings

By conducting in-depth interviews with a range of organizations and stakeholders engaged in the non-state actor data collection and accountability sphere, this report identifies four primary factors that impact quality and limitation application of NSA climate data:

- Lack of standards to counter greenwashing: Current reporting practices are based on voluntary self-reporting. Varied methodologies and lack of unified standards compromise credibility of supplied information and enable misleading claims. Credible reporting requires transparent, universal standards and definitions for climate actions, such as net-zero climate pledges.

- Fragmented data exchange for climate action tracking: Climate action data is compiled and shared inconsistently by NSAs. Different accounting tools, software platforms, and data formats make it difficult to unify and merge data to track bigger-picture progress.

- Resource constraints impacting emissions accounting: Capacity constraints significantly impact smaller entities, especially those in developing countries, limiting their ability to conduct thorough emissions accounting. The scarcity of unbiased third-party verifiers further complicates data verification.

- Lack of regulatory alignment: While setting standards is critical to improve data accountability, it is equally important to ensure that these standards are universally adopted and consistently applied by national regulatory bodies. In addition to standard setting, regulators must also address challenges related to data sharing, ownership, and accessibility.

Executive Summary

To address these four obstacles, this report proposes a future digitally-enabled climate action accountability system

In the future, a climate accountability system should unite the NSA institutions, stakeholders, and processes outlined in this report under one umbrella. Such coordination aims to synchronize efforts and foster alignment on digitally-enabled, collaborative, open, and consistent data-driven accountability.

Digital innovations, such as Internet of Things (IoT) sensors, earth observation data from satellite remote sensing, machine learning, and distributed ledger technology, have potential to further improve existing data collection to improve future accountability systems.

To achieve this vision, the system should adopt the following four principles:

- **Openness, traceability, and machine readability:** Climate data comes from different sources, in various formats and qualities. Interoperability, which is essential, can be achieved through uniform metadata standards and open data structures. Emphasizing openness and traceability and adopting machine-readable data formats are required.

- **Clear data governance protocols:** Effective data governance is crucial for maintaining high quality data that complies with legal and ethical standards to improve its reliability for facts-driven decision-making.

- **Soft infrastructure for coordination, capacity and community engagement:** The ability of businesses and governments to collect, process and use high-quality data hinges on capacity. Active community involvement and co-creation, aided by institutions like the UNFCCC, are fundamental to facilitate continuous engagement among technology providers, governments, and end-users broadening the overall data accounting capacity.

- **Embrace of digital innovation:** New technologies can help us gather better data. Satellites and smart devices can supply real-time information about emissions, new advances in machine learning can aid data analysis and discoverability, while AI models can help process textual data like transition plans and corporate reports to unlock new insights and scale up learning and sectoral benchmarking.

In addition to creating a digitally-enabled climate action accountability system, this report proposes seven complementary actions:

- Fostering improved coordination and linkages between regulatory frameworks and voluntary standard setters, supported by the UNFCCC's facilitative role;
- Developing a comprehensive data accountability model encompassing global requirements and sector-specific expectations for data quality;
- Promoting transparent data governance principles to ensure consistency and reliability in data management;
- Advocating for standardized machine-readable data formats and metadata standards to enhance interoperability and AI utilization;
- Embracing digital approaches and innovations to expedite climate accountability practices;
- Exploring decentralized data governance models adaptable to evolving data sources and needs;
- Elevating the Global Climate Action Portal to encompass robust data, establishing standardized definitions, verification criteria, and stakeholder support for credible net-zero commitments and transition plans.

These recommendations, crucial amidst current momentum, aim to create open and scalable systems, empowering climate governance and enhanced ambition.

Report Overview

This report focuses on both the data accounting and the data accountability processes needed to develop relevant inputs and solutions to the evolving climate data accountability space.

Section 1   provides an introduction to the context for heightened scrutiny of NSA accountability

Section 2   maps relevant actors, institutions, initiatives, and organizations in the NSA climate action data and accountability landscape

Section 3   identifies the accountability wielders, including standard setters (both voluntary and regulatory), data reporting platforms, verifiers, and watchdogs

Section 4   takes stock of current accounting and accountability gaps, drawing from a wealth of first-hand perspectives from key stakeholders in NSA climate action

Section 5   discusses the design of a future digitally-enabled climate accountability system that requires openness and machine-aided interoperability, embracing advances in digital technology and artificial intelligence

Section 6   gives recommendations and charts a path forward.

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01 Introduction

Introduction

As the first Global Stocktake (GST) moves from technical assessment to political implementation, it is an opportune time to assess the future of accountability for global actors under the Paris Agreement. While focused primarily on the Parties to the United Nations Framework Convention on Climate Change (UNFCCC), the GST's consultative and technical dialogues sought to include a range of perspectives from non-Party actors, including businesses, financial institutions, civil society, international organizations and subnational governments, also referred to as non-state actors or NSAs. These non-state and subnational inputs were primarily reflected through roundtable sessions and dialogues as well as just over 1,000 submissions to the UNFCCC's official Global Stocktake Portal, an online repository where Parties and organizations with observer status submit documentation of actions taken on mitigation, adaptation, implementation, finance, response measures, and loss and damage (UNFCCC, 2023d).

Simultaneously, the number of NSAs that are pledging largely voluntary efforts to tackle climate mitigation, financing and adaptation has expanded to nearly 30,000 at the time of writing (UNFCCC, 2023c). Notably, the number of NSAs declaring "net zero" or decarbonization targets have proliferated in recent years (Race to Zero, 2023a). The latter trend, in particular, has been scrutinized for greenwashing and credibility, leading the UN Secretary General Antonio Guterres to convene a High Level Expert Group (HLEG) to develop guidelines for NSAs' net-zero pledges. The HLEG produced a report (HLEG, 2022) for the mission to advance "zero tolerance for net-zero greenwashing – misleading the public to believe that a company or entity is doing more to protect the environment than it is." Greenwashing concerns also culminated in the need for "credible, accountable and transparent actions by non-Party stakeholders […] to strengthen efforts for systems transformations," a key finding of the UNFCCC's synthesis report for the first Global Stocktake's Technical Dialogue (UNFCCC, 2023a).

Most recently in June 2023, the UN Climate Secretariat announced the Recognition and Accountability Framework (RAF) for Non-Party Stakeholder Climate Action (UNFCCC, 2023f).

The RAF seeks to improve the transparency of NSA action, following and building on the UNFCCC's Global Climate Action Portal (GCAP). At the time of writing, however, it remains uncertain if and how the RAF would provide more stringent scrutiny, and require businesses and subnational governments to not only regularly report on progress, as national governments are required, but to also have their targets, plans, and progress third-party verified. While at the time of writing the UN Climate Secretariat had just launched a consultation period for the RAF, the timing of this effort alongside the GST's first conclusion is noteworthy, since it suggests a new era of accountability that places significant emphasis on data to effectively deliver on climate commitments. For this upcoming phase of NSA accountability to succeed, it is critical to understand the landscape of climate data and to identify key requirements for accountability mechanisms and processes to succeed in this next phase. Advances in digital technologies, specifically artificial intelligence and machine learning, could address persistent data gaps and broaden the scope of available data tracked.

This report aims to provide an overview of the diverse landscape of actors, institutions, processes, and initiatives involved in NSA climate action data and accountability. It identifies common challenges and gaps prevalent across all NSAs, from private businesses and financial institutions to subnational governments, with respect to data collection, reporting, and transparency. These issues adversely affect the capacity of both the public and policymakers to aggregate and make sense of collective progress. While both voluntary and mandatory regulation have slowly been converging, standards and definitions are often misaligned, resulting in heterogeneous reporting practices. The existing climate action data accounting landscape is therefore insufficient to meet growing national regulation mandating disclosure and to inform international climate policy processes like the UNFCCC GST and RAF.

Box 1. Essential Terms Used in This Report

Accounting

Accounting means measuring and tracking GHG emissions and removals as the result of an NSA's actions and activities. There are different types of GHG accounting for various purposes, including allocational GHG accounting, which seeks to regularly measure physical quantities of GHG emissions and removals allocated to specific entities, including facilities and organizations or jurisdictions; as well as performance GHG accounting, which strives to attribute emissions and impacts to facilitate management or policy objectives (Brander, 2022; Gillenwater, 2023a). GHG accounting by NSAs is conducted for a variety of goals, including managing climate risks and identifying mitigation opportunities; participating in voluntary programs (see Section 2.4: International Cooperative Initiatives) as well as complying with mandatory disclosure laws, accessing carbon markets, and recognition for early action (Gillenwater, 2023b).

Accountability

Accountability refers to the process by which an entity is held responsible for the consequences of its actions against a set of expectations or commitments. Broadly speaking, accountability is comprised of two components, where a set of actors (i.e., accountability wielders) demands justification from accountability holders in line with established standards, with the ability to confer positive or negative sanctions (Kuyper et al., 2017). Kuyper et al. (2017) define institutional accountability as an additional dimension required to understand how NSAs are held to account within international frameworks like the UNFCCC, where NSAs can employ institutional rules, norms, or procedures derived from horizontal networks (e.g., voluntary initiatives) in conjunction with exit, voice, and loyalty to foster new modes of accountability. Higham et al. (2021) further define accountability systems as requiring four key features: obligations, accountable relationships, assessment of compliance, and consequences for non-compliance.

Disclosure

Disclosure in relation to climate actions refers to the process of publicly reporting GHG emissions and climate-related risks and opportunities.

Transparency

Transparency as it relates to NSA climate action data means that "the data and methods used to produce GHG emissions information are publicly available and traceable," including primary and key supporting data sources, in addition to the underlying methods and models used. The U.S. National Academies of Science, Engineering and Medicine (NASEM) in a 2022 synthesis report that developed a framework for GHG information for decision making extends transparency to include data "definitions, version numbers, documentation, funding sources, and open access (i.e., freely available, not behind a paywall)" (NASEM, 2022), reflecting specific open and transparent data generation and access requirements.
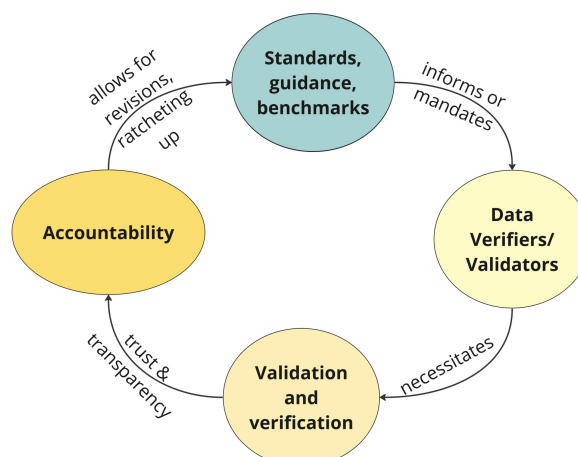
Figure 1. Relationship between key terms used in the report.

02 The Ecosystem of Non-State Actors (NSAs) and Institutions

Key Messages

- The NSA climate action data and institutional landscape is diverse and expanding, and while there is a general recognition of the importance of NSA action, roles and responsibilities remain unclear.

- NSAs are not yet fully included in national and international [transparency] processes stipulated by the Paris Agreement, like the GST.

- To enable effective NSA contributions, advancing and maturing NSA orchestration is crucial to avoid duplication of efforts and even counteract increasing fragmentation between actors and groups.

The Ecosystem of Non-State Actors (NSAs) and Institutions

> **"Non-state entities — businesses, financial institutions, cities and regions — play a critical role in getting the world to net-zero emissions no later than 2050"**
>
> **(United Nations, n.d.)**

The NSA data and institutional landscape is diverse and expanding. NSA climate data is heterogeneous, scattershot, and fragmented since individual NSAs and cooperative initiatives use different standards and reporting schemes that may not be consistent and harmonized with each other. Consequently, it is challenging for policy actors and decision-makers to easily obtain a complete and aggregate picture of NSA contributions collectively and how they contribute to or exceed national government efforts (Kuramochi et al., 2021). A few studies, summarized in the 2018 UN Emissions Gap Report special chapter on non-state actors (Hsu et al., 2018) and the IPCC's Sixth Assessment Report (Intergovernmental Panel On Climate Change, 2022), have assessed NSA contributions to mitigation, finding that subnational governments and private businesses often pledge voluntary emission reduction targets that exceed those of national governments (Kuramochi et al., 2020; NewClimate Institute et al., 2021).

However, these studies primarily reflect NSA efforts in developed countries, namely Europe, and fail to capture efforts from developing countries and small island states. Furthermore, NSA initiatives should also include and support stakeholders and groups that are often marginalized, including women, youth, and Indigenous Peoples, for effective participation and contribution to climate efforts (UNFCCC, 2023a).

This section provides an overview of the different types of actors, networks, initiatives, and institutions that comprise the landscape of NSA data and accountability. As illustrated below, the array of NSAs and the diverse institutional configurations that both constitute them and oversee their operations collectively result in a fragmented data environment, characterized by differing degrees of transparency (Figure 2). As concerns over the adequacy of NSA data propagate in critiques of the first GST, it is important to examine the status of present reporting platforms and governing institutions to

2.1 UNFCCC, the International Orchestrator

> **The UNFCCC has stepped into a new role as an orchestrator of non-state action through the Marrakech Partnership and coordination initiatives like Race to Zero and utilizing platforms like the Global Climate Action Portal and the Race to Zero Data Explorer to foster accountability.**

Since the adoption of the Paris Agreement, the UNFCCC Secretariat's focus has transitioned from a role focused chiefly on facilitating the implementation of its various climate accords to serving as an international orchestrator of global climate initiatives (Abbott et al., 2015). This shift acknowledges the increasing involvement of non-state actors (NSAs), a growing polycentric governance landscape, characterized by multi-level, and cross-sectoral participation within its operational sphere and beyond.

Since 2015, the UNFCCC has been instrumental in synchronizing climate action across diverse layers of governance, including national governments, cities, businesses, and other NSAs. Under its revised mandate, the UNFCCC appoints two Global Climate Champions, representing the incumbent and subsequent Conference of the Parties (COP) presidencies. One pivotal initiative that exemplifies this is the Marrakech Partnership for Global Climate Action, unveiled at COP22 in 2016 (UNFCCC, 2023e). This initiative catalyzes voluntary collaborations between state Parties and NSA stakeholders, aiming to expedite the implementation of the Paris Agreement. The work of this Partnership was later incorporated into the GCAP (detailed in Section 3.2: Data Reporting Platforms) and the Race to Zero (RtZ) campaign (UNFCCC, 2023c). Over 11,000 non-state members have

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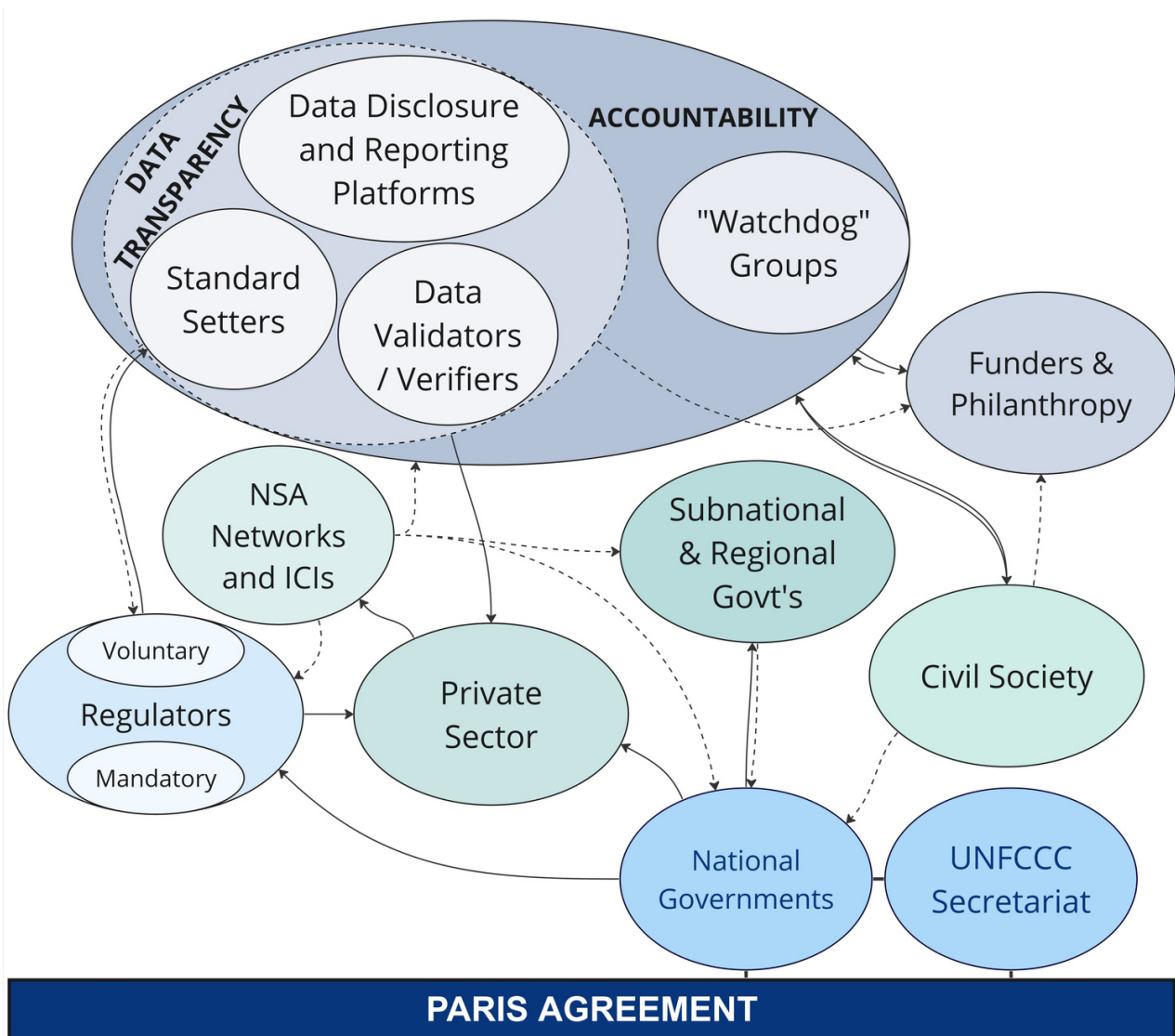
Figure 2. The climate actor and institutional landscape as of 2023. The arrows between ecosystem groups signal direct interaction (full lines) and second-order interactions (dotted lines). Source: authors.

joined RtZ, representing 8,307 companies, 595 financial institutions, 52 regions, 1136 cities, 1,125 educational institutions, 65 healthcare institutions and 29 other organisations, to set greenhouse gas reduction targets to halve global emissions by 2030 towards net-zero by 2050 (as of October 2023) (UNFCCC, n.d.-a).

Through the Marrakech Partnership, the UNFCCC is granted an official mandate to engage NSAs via International Cooperative Initiatives (ICIs) and support technological and data tools like the Global Climate Action Portal. This portal serves as a comprehensive repository that collects, showcases, and tracks NSA initiatives. Furthermore, the UNFCCC leverages intermediary entities, including partnerships and networks, for external

monitoring to assess the efficacy, progress, and compliance of NSA-driven actions. We further detail these actors, initiatives and their roles in the section titled "NSA Supporting Actors."

The UNFCCC's role in orchestration—specifically its capacity to signal and spur higher levels of climate ambition among NSAs—became evidence with the June 2020 launch of the Race to Zero (RtZ) campaign. Representing a "network of networks," RtZ rallies networks and actors to commit to achieving net-zero carbon emissions by 2050 or earlier. The campaign operates under criteria established by the High-Level Champions. RtZ participants are required to adhere to a framework built upon five pivotal pillars:

setting science-based pledges to limit global warming to 1.5°C by 2050, formulating detailed action plans, initiating the procedures for implementing these plans, generating publicly accessible progress reports, and advocating for the alignment of external policies with climate goals. To track the 500 largest participating companies' progress on these '5Ps,' the RtZ campaign released a Data Explorer (Race to Zero, 2023b).

2.2 National Parties

National policies are pivotal in directing NSA climate initiatives, yet while mandatory reporting is on the rise, comprehensive regulations for net-zero pledges are lacking, leading to a reliance on voluntary standards.

National governments and policies provide the regulatory context for NSA climate actions in the form of voluntary and mandatory standards. Voluntary reporting standards, discussed further in Section 3.1: Standard setters, are self-imposed frameworks that NSAs elect to follow, having the latitude to innovate and operate beyond the legal confines, by developing and adopting standards proactively. In contrast, mandatory climate reporting standards are legal requirements set by governmental bodies.

They compel organizations to report specific climate data, ensuring a minimum level of disclosure to create a level playing field. The primary difference between voluntary and mandatory standards lies in their enforcement and adaptability. However, while NSAs can proactively adopt voluntary standards, they are still fundamentally anchored to national policy baselines and regulatory frameworks. Often voluntary standards are formalized into mandatory standards over time. As an example, the proposed EU Corporate sustainability due diligence directive (CSDDD) states that while corporates have adopted voluntary tools for value chain due diligence, "voluntary action does not appear to have resulted in large scale improvement across sectors and, as a consequence, negative externalities from EU production and consumption are being observed both inside and outside the Union" (European Commission, 2022). As a response, the CSDDD aims to "create a level playing field

for companies within the Union and avoid fragmentation resulting from Member States acting on their own" to advance respect for human rights and environmental protection. Table 1 provides several country examples that show how voluntary and mandatory regulation currently evolves and influences NSA data reporting.

In summary, these examples illustrate how the current global regulatory landscape is on track to cover jurisdictions close to 50% of global GDP (Net Zero Tracker, 2023a). Both developed and developing countries are embarking upon legislation to mandate NSA environmental and climate reporting. While some countries, including the UK, US, and India are taking direct aim at NSA data disclosure standards, others like Brazil and South Africa have developed regulatory mechanisms to align efforts with private actors increasingly engaged in climate actions. These regulations, however, fall short of more comprehensive regulatory frameworks that go beyond disclosure and include specific guidelines for net-zero commitments increasingly being pledged by NSAs.

The emergence of voluntary standards and approaches, including the HLEG Recommendations, Science Based Targets Initiative guidance, and the ISO net zero guidelines, is currently filling this gap. These initiatives include recommendations for regulators to require the largest firms to publicly disclose their pathways to net zero to create additional transparency and advance national climate objectives and that advertising products and services, or describing corporate performance as 'net zero' should be subject to transparent and rigorous standards. With the rapid proliferation of voluntary NSA report standards, there is a risk of further misalignment with national regulatory guidelines and greater fragmentation, as well as a widening gap between the net zero plans and the delivery of progress.

To attempt to strengthen the link between voluntary NSA data reporting and disclosure frameworks, CDP released 10 High-Quality Mandatory Disclosure principles, which aim to assist policymakers and financial regulators in creating robust and effective mandatory environmental disclosure systems. The Principles emphasize the need for

The Ecosystem of Non-State Actors (NSAs) and Institutions

Table 1. Country examples of regulation establishing NSA reporting guidelines for climate action data. Source: authors.

Country	Description
Australia	**Formalizing Net Zero** In 2023, the country established the National Net Zero Authority, an institution designed to steer the nation toward its ambitious net-zero emissions targets (Prime Minister, Treasurer, Minister for Climate Change and Energy of Australia, 2023). The Authority's multifaceted mandate encompasses assisting investors and companies in identifying and capitalizing on net-zero transition opportunities and orchestrating policies and programs to nurture new clean energy industries. It also plays a pivotal role in supporting workers from emissions-intensive sectors by offering resources and opportunities for skill development, thereby facilitating their transition to greener industries. Complementing the efforts of the National Net Zero Authority is Australia's National Greenhouse and Energy Reporting (NGER) Act. Established before the Authority, this act furnishes a comprehensive framework for the reporting of greenhouse gases, including carbon emissions, energy production, and consumption. Since 1 July 2008, entities deemed to have high greenhouse gas emissions, termed "liable entities," have been mandated to annually disclose their Scope 1 and Scope 2 emissions. The liable entities must submit their energy and emissions data to the Department of Climate Change and Energy Efficiency, which, in the spirit of transparency, makes this crucial data accessible to the public via its website (Wedari et al., 2021).
Brazil	**National Climate and Ecological Transition Plans** In Brazil, the government has announced national ecological transition plans that prioritize climate change as a key focus area. The Brazilian Development Bank (BNDES) has launched a series of green bonds aimed at financing sustainable projects and promoting environmentally responsible behavior in the private sector (BNDES, 2021). Moreover, Brazil's National Policy on Climate Change (PNMC) outlines specific greenhouse gas reduction targets and provides a framework for public and private actors to align their efforts in mitigating climate change (Presidency of the Republic of Brazil, 2023). These various initiatives showcase Brazil's commitment to influencing NSAs to adopt sustainable practices and transition toward low-carbon development.
European Union	**New directives to Advance Corporate Behavior** The Corporate Sustainability Due Diligence Directive (CSDDD) and the Corporate Sustainability Reporting Directive (CSRD) are EU initiatives designed to integrate human rights and environmental considerations into corporate operations, both within and outside Europe. The CSDDD focuses on mitigating adverse corporate impacts through due diligence practices for human rights and environmental protection. Meanwhile, the CSRD, revising the earlier Non-Financial Reporting Directive (NFRD), expands its scope to include all large and listed companies, requiring them to audit and standardize reported sustainability information. This directive mandates companies to conduct due diligence by identifying, preventing, and accounting for adverse human rights and environmental impacts in their operations and value chains. A key feature of the CSRD is its requirement for companies to disclose plans for aligning their business strategies with the Paris Agreement's objective of limiting global warming to 1.5 °C, thus complementing the NFRD's efforts to promote sustainable corporate governance.

The Ecosystem of Non-State Actors (NSAs) and Institutions

Country	Description
France	**Pioneering Climate Disclosures** In France, Article 173 of the 2015 Energy Transition Law serves as a landmark policy, setting a precedent by mandating climate-related disclosures from institutional investors and companies (Ministry of Environment, Energy and Sea (France), 2015). The regulation mandates that these entities disclose not only their climate impact but also how environmental, social, and governance (ESG) considerations factor into their strategic decision-making. In 2019, the legislation was revised and expanded to include considerations such as biodiversity and natural resources, thus broadening the ambit of non-financial disclosures. These regulations align with and expand upon the European Union's 2014 Directive on Non-Financial Reporting (European Parliament, 2014).
India	**Corporate Environmental Responsibility and Climate Disclosure** India's Ministry of Corporate Affairs introduced guidelines for Corporate Social Responsibility (CSR) in 2014, which include provisions related to environmental sustainability (Ministry of Corporate Affairs, Government of India, n.d.). These guidelines encourage companies to undertake projects that aim to reduce carbon footprints, conserve natural resources, and promote renewable energy. Although not mandatory, 185 entities have voluntarily disclosed their business responsibility and sustainability report, which replaced the previously mandatory business responsibility report in May 2021 (Balanced Framework for ESG Disclosures, Ratings and Investing, 2023). India also launched the Perform, Achieve and Trade (PAT) scheme in 2008, targeting energy efficiency improvements in large energy-consuming industries (Bureau of Energy Efficiency, Government of India, Ministry of Power, 2023). This scheme not only mandates energy-saving measures but also facilitates the trade of Energy Saving Certificates, providing a financial incentive for corporations to adopt more sustainable practices. Additionally, the Securities and Exchange Board of India (SEBI) has expressed interest in enhancing Environmental, Social, and Governance (ESG) disclosure requirements, which would impact a broad array of NSAs, including public companies and mutual funds (Balanced Framework for ESG Disclosures, Ratings and Investing, 2023).
South Africa	**Carbon Tax and Mandatory Reporting** South Africa introduced a Carbon Tax Act in 2019 to provide economic incentives for reducing greenhouse gas emissions (Carbon Tax Act, 2019). It requires companies emitting more than a specified threshold to pay a carbon tax. Additionally, the Department of Environmental Affairs has implemented a National Climate Change Response Policy that mandates greenhouse gas emission reporting for significant emitters (Department of Environmental Affairs, Republic of South Africa, 2011). This legislation has a ripple effect on NSAs by affecting investment decisions, compelling technological upgrades, and necessitating disclosures related to climate impacts and adaptation plans.
United Kingdom	**Financial Disclosures and Climate Risks** In 2020, the UK government established mandatory climate risk reporting, effective in April 2022, for around 1,300 of its largest companies and financial institutions (UK Government, 2021). The directive is led by the financial industry and aligns with the Taskforce on Climate-related Financial Disclosures (TCFD). The UK was the first G20 nation to implement such a mandate, potentially setting a standard for global policy. The Financial Conduct Authority and the Bank of England are also engaging in ongoing work to expand the scope of entities to include asset managers, life insurers, and pension providers (Financial Conduct Authority, 2021). In addition, the Transition Plan Taskforce released a disclosure framework in September 2023, which provides a set of recommendations to support companies across the economy to communicate high-quality, consistent and comprehensive information on their transition plans to investors (Financial Conduct Authority, 2023).

Country	Description
United States	**Forthcoming SEC Regulations** The U.S. Securities and Exchange Commission (SEC) plans to finalize its 534-page proposal to "Enhance and Standardize Climate-Related Disclosures for Investors," by year-end (SEC, 2022). Targeting public companies with market capitalizations exceeding $250 million, the proposed regulation seeks to impose rigorous climate-related disclosure requirements. Under the guidelines, companies would be obligated to report not only their direct and indirect emissions (Scope 1 and Scope 2) but also those from their supply chain (Scope 3). It further requires companies to conduct formal risk assessments on their exposure to climate-related risks. If approved, the rule would significantly raise the bar for and reshape corporate environmental accountability. There is an expectation that these requirements could then serve as a blueprint for other regulatory agencies, including state-level organizations and international bodies, thereby influencing global practices.

comprehensive and reliable mandatory environmental disclosure systems, covering aspects like consistency, scientific grounding, inclusivity, transition plans, external assurance, and enforcement mechanisms, while fostering innovation in disclosure practices (CDP, 2023c).

2.3 Non-State Actors

While non-state actors emerge as a driver that surpasses national ambition, such ambition also reinforces the need for robust accounting.

Non-state actors encompass the private sector (e.g., businesses and investors), subnational and regional governments (e.g., San Francisco to California), and civil society (e.g., 350.org) groups that have increasingly participated and pledged a range of climate actions, ranging from mitigation and adaptation, to financing and capacity building. In committing their own climate actions or participating in voluntary cooperative initiatives (see below: NSA Networks and International Cooperative Initiatives), NSAs frequently collaborate with each other or with national governments (Hsu et al., 2018).

They may voluntarily set their own emission reduction targets, report their emission inventories, and disclose climate risks and actions through voluntary disclosure platforms like the CDP (formerly known as the Carbon Disclosure Project) (see Section 3.2 on NSA data reporting platforms) or through self-publication of climate action plans or corporate responsibility reports online. Some national governments, including Denmark, the United

Kingdom, Slovakia, and France (Reckien et al., 2018), require subnational governments to formulate their own climate action plans. Figure 3 provides an overview of the global distribution of such subnational action plans, specifically for cities and regions, and their varying levels of ambition.

Aside from setting mitigation targets and reporting inventories, NSAs pledge a range of climate actions, showcased on the UNFCCC Climate Action Portal (see Section 3 on NSA Accountability), including renewable energy or energy efficiency commitments, conducting research and disseminating knowledge on industry-specific or global climate issues, setting and enforcing best practices, advocating for better climate policies or facilitating their implementation, providing training and education on greener practices, or fundraising for mitigation and adaptation measures (Climate Initiatives Platform, n.d.; UNFCCC, 2023b).

Several studies have demonstrated the potential for NSA emissions reduction commitments, if fully achieved, to help reduce emissions beyond countries' Nationally Determined Contributions or NDCs (Hsu, Brandt, et al., 2020; Hsu et al., 2015; Kuramochi et al., 2020; Lui et al., 2021; Roelfsema et al., 2018). Because of this estimated potential, data regarding progress is critical to demonstrate the delivery of results and a greater understanding of how NSA actions are contributing to global mitigation goals.

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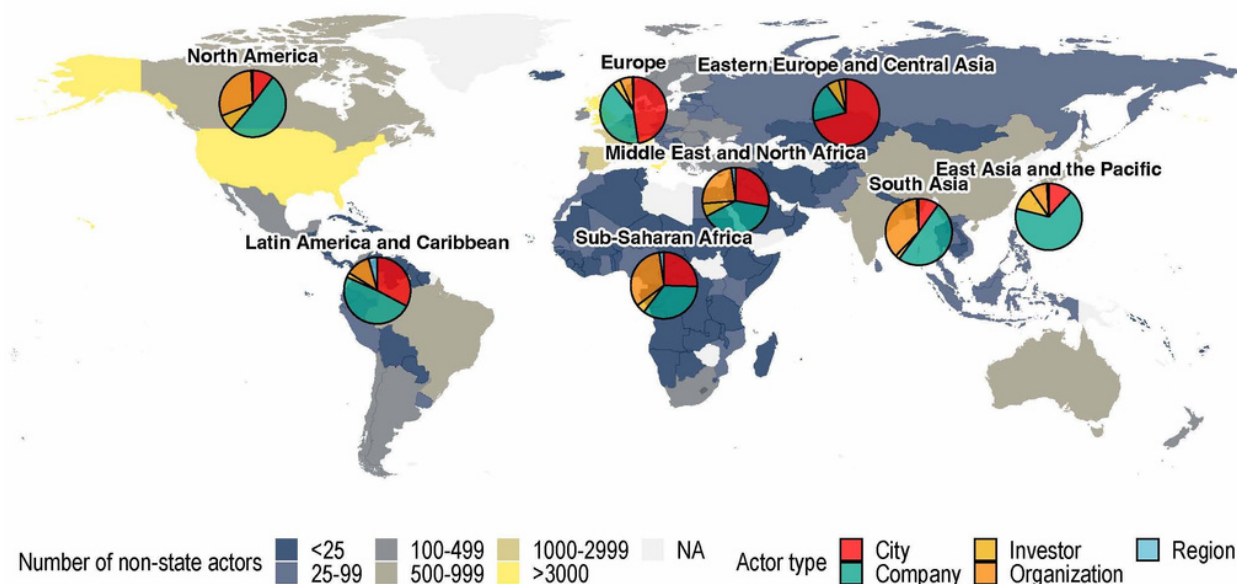
Figure 3. Global distribution of the over 32,500 NSAs recording on the UNFCCC's Global Climate Action Portal (GCAP). Pie charts show the proportion of NSA actor types (e.g., City, Company, Investor, etc. as classified on GCAP for each geographic region. Data as of August 2023. Source: (Hsu et al., 2023)

2.4 NSA Networks and International Cooperative Initiatives (ICIs)

NSA networks and ICIs advance collaborative efforts, though their potential is hindered by gaps in accountability, varied efficacy, and a need for comprehensive reporting protocols.

Beyond individual NSA climate action, many NSAs have teamed up to form larger networks, often in the form of international cooperative initiatives, or ICIs, also referred to as "transnational climate initiatives'' (Bulkeley et al., 2014). These networks amplify the impact of individual actors by aligning them towards shared goals, serving as laboratories for policy experimentation, facilitating knowledge transfer, and recognizing and rewarding climate action (Hsu et al., 2018). ICIs also provide platforms for sharing best practices and methodologies, standardization, coordinating action, and pooling resources. They also perform diverse governance roles by setting rules, standards, and benchmarks, thereby complementing, supporting, and enhancing the efficacy of national government climate policy and regulation efforts (Bulkeley et al., 2014; Iozzelli, 2023).

In this way, NSAs and ICIs may bridge gaps where national policies may fall short. For example, businesses and industries often adopt sustainability practices or invest in renewable energy projects that go beyond national regulatory requirements. Through such actions, NSAs exert influence on policy by engaging with governments and international bodies. Many ICIs are public-private partnerships aimed at co-creating solutions, offering a model for how governance, finance, and expertise can be pooled to accelerate action. The We Mean Business coalition, for instance, brings together companies to advocate for policies and provide funding to facilitate the transition to a low-carbon economy. Similarly, the World Business Council for Sustainable Development (WBCSD) is currently finalizing the Pathfinder framework to support corporate performance and accountability (Pathfinder Framework Version 2.0, 2023). Finally, cities are increasingly taking the lead in implementing locally tailored climate action plans aimed at reducing emissions and enhancing resilience (Rivas et al., 2022).

ICIs have traditionally established their own reporting and transparency mechanisms to ensure NSAs follow through on pledged commitments. Many initiatives produce toolkits, guidelines, and reporting frameworks that may complement or even exceed national reporting

guidelines and policies. Some, like the Business Environmental Leadership Council, have no regular reporting requirements for participating businesses, while others specify annual reporting according to a specific methodology, such as the Greenhouse Gas Protocol Corporate Standard. Others, like the EU Secretariat of the Global Covenant of Mayors for Climate and Energy (GCOM, formerly known as the EU Covenant of Mayors for Climate and Energy), have required members to submit climate action plans along with baseline and regularly monitored emissions inventories, which are then reported on specific city pages to allow for publicly-accessible progress tracking (Bertoldi et al., 2018). As Section 3.2 describes, many of these ICIs, including GCoM, C40 Cities for Climate Leadership, and Science-Based Targets Initiative, encourage their members to report to CDP, which is de facto the largest and most centralized reporting platform for NSA climate data and information.

In theory, when coordinated with national government action, ICIs can help promote "upward convergence" by consolidating good practices and codifying them into regulation (Hans et al., 2023). This "conveyer belt" (Hale, 2021) process, whereby voluntary ICIs may both raise ambition and provide critical scrutiny of national regulation to ratchet the stringency and content of disclosure standards and practices, is more challenging in practice. The case of the EU CSDDD outlined in Section 2.2 highlights that despite voluntary action, substantial sector-wide improvements haven't been observed, leading to noticeable negative consequences from EU production and consumption within and outside the Union (European Commission, 2022). This concern is compounded by the variable performance levels of 289 ICIs listed on the UN Environment Programme's Climate Initiatives Platform as of August 2023 (Chan et al., 2022). Notably, Chan et al. (2022) found initiatives focusing on mitigation and featuring a secretariat tend to perform better than those focused on adaptation. There is an observable gap in accountability, as Iozzelli (2023) points out that only 30% of the 56 regulatory ICIs they reviewed had disclosed sufficient information for evaluation. This raises questions about the efficacy and accountability of these ICIs, underscoring the need for robust monitoring

and reporting mechanisms. While these networks have proven effective in certain contexts, there remains a need for better alignment with national priorities and for robust systems to measure and report their contributions to global climate goals. The often informal and diverse nature of these networks can sometimes lead to fragmented, rather than coordinated efforts, and make it challenging to quantify their collective impact. Many ICIs further lack appropriate financial and human resources to actually implement actions to achieve their intended aims (Widerberg & Pattberg, 2015). Nevertheless, there is certainly potential for ICIs to raise the bar (Lui et al., 2021) for national climate ambition and build NSA capacity, while fostering alignment and coordination with national regulations. Voluntary standards and guidelines related to corporate net-zero target setting, for example, have exhibited a high degree of convergence in guiding principles (McGivern et al., 2022).

2.5 Philanthropy and Funders

Philanthropies and funders can act as catalysts for NSA climate data collection and accountability by contributing financial support and leadership to the harmonization, development, and implementation of transparency processes, platforms, and tools.

Philanthropic organizations have historically served as the primary financiers for and drivers of NSA data and accountability efforts (other initiatives receive member funding or have their own data-based business models). Specifically, they have been instrumental in financing initiatives that collect, organize, and disseminate data on both NSA and national government climate commitments and actions. Below a few initiatives are detailed as examples of how private philanthropy has been playing an active role in supporting efforts aimed at NSA data and accountability:

Bezos Earth Fund: Launched in February 2020 with a $10 billion grant commitment, the fund aims to combat the climate crisis and promote a nature-positive future. Targeting to disburse its funds by 2030, the Fund has already allocated $1.84 billion through over 190 grants. The Fund emphasizes collaboration
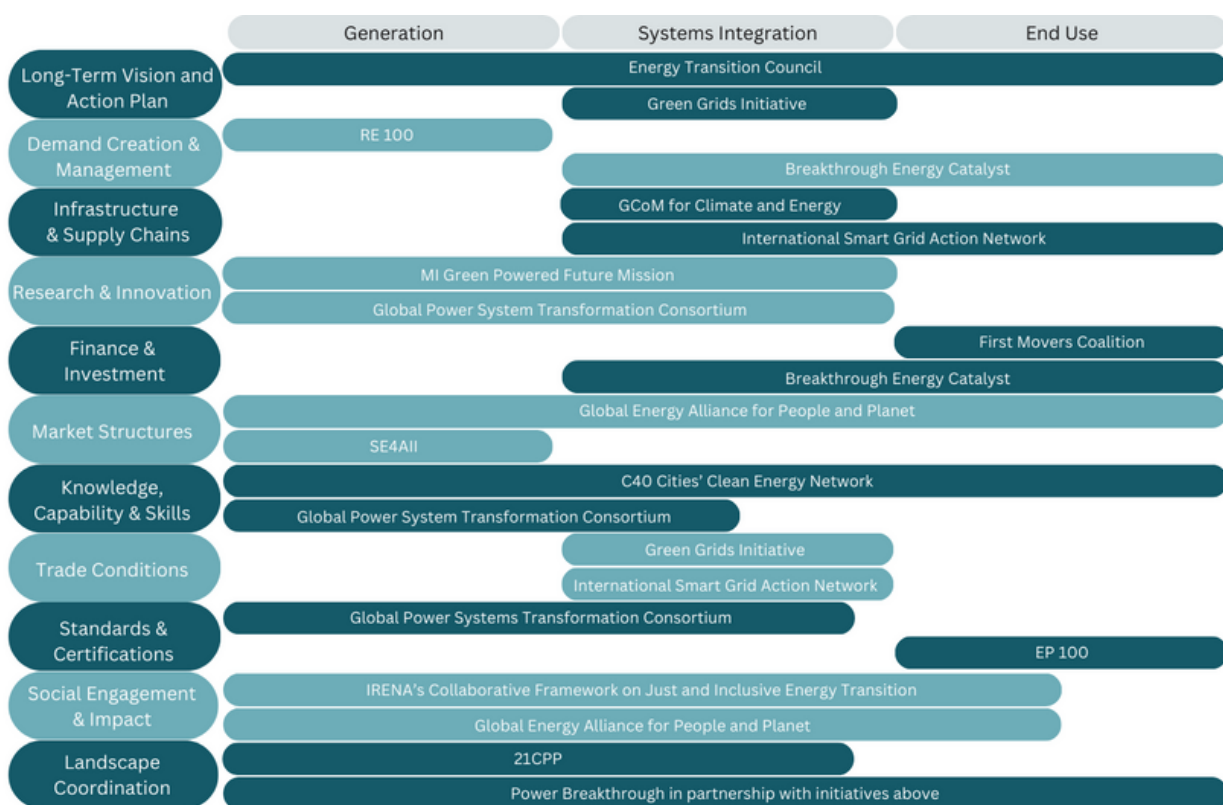
The Ecosystem of Non-State Actors (NSAs) and Institutions

Box 2. Breakthrough Agenda - Bringing together NSAs, National Governments, and International Coordination

The Breakthrough Agenda, established during COP26 in 2021, comprises a coalition of 45 world leaders representing over 70% of global GDP (UNFCCC, n.d.-b). This international initiative aims to reduce global emissions by 50% before 2030 and achieve net-zero emissions by the mid-century mark. It fosters collaboration among nations, corporations, and civil society within high-emission sectors. The agenda's focus is to enhance the affordability and accessibility of clean technologies and sustainable solutions, combining governmental, business, and financial efforts to make these options the primary choice globally by 2030.

At COP26, leaders committed to an annual progress review and exploration of crucial international actions to expedite progress towards the Breakthroughs. These decisions will be influenced by an annual independent expert report from the International Energy Agency (IEA), International Renewable Energy Agency (IRENA), and UN High Level Champions. The inaugural report highlighted concerns about an "international collaboration gap" that poses a risk of delaying net-zero targets by several decades.

The Breakthrough Agenda (2022) report utilized landscape maps to evaluate gaps across Power, Road, Steel, Hydrogen, and Agriculture sectors. The aim is to collaborate with international initiatives and countries to develop activities towards progress in that sector. Figure 4 below depicts the sectors and initiatives used to map and pursue Breakthroughs within the Power sector.

Figure 4. . Breakthrough Agenda mapping of verticals and initiatives for the Power Sector. Adapted from: (Breakthrough Agenda, 2022)

across governments, NGOs, communities, and the corporate sector, driven by science and a commitment to justice. Recognizing the critical importance of data in environmental decision-making, the Bezos Earth Fund focuses on investments in projects and coalitions that leverage technology to collect, organize, and disseminate data on crucial environmental challenges and solutions. This approach aims to inform and shape decisions across various sectors, including governments, corporations, local communities, and broader society. For example, the fund awarded a $9.25 million grant to the Greenhouse Gas Protocol, which is co-convened by World Resources Institute and the WBCSD (Greenhouse Gas Protocol, 2023).

Bloomberg Philanthropies: With a nearly $2 billion USD distribution in 2022, Bloomberg Philanthropies is the philanthropic organization of billionaire businessman and former New York City Mayor, Michael R. Bloomberg (Bloomberg Philanthropies, 2023a). It provides funding support for a range of NSA climate actions, including supporting NSA ICIs such as C40 Cities for Climate Leadership and Global Covenant of Mayors for Climate and Energy (GCoM), as well as the UNFCCC GCAP (Bloomberg Philanthropies, 2023b).

In collaboration with French President Emmanuel Macron, the philanthropy also established the Climate Data Steering Committee (CDSC) in June 2022 (Climate Data Steering Committee, 2023). Through the announcement of the Net-Zero Data Public Utility (NZDPU), the CDSC is designed to advance the UN's climate objectives by creating a foundational, high-quality climate dataset aimed to deliver "key climate transition-related data, commitments, and progress of businesses and financial institutions toward those commitments" (Net-Zero Data Public Utility, 2023).

ClimateWorks Foundation: Granting over $1.7 billion to over 750 grantees in over 50 countries since its founding in 2008 (ClimateWorks Foundation, n.d.), Climateworks Foundation is a regranting organization for six notable philanthropic foundations, including the Oak Foundation, Energy Foundation, Hewlett Foundation, David and Lucile Packard Foundation, Doris Duke, among others,

and has been active in supporting early efforts to make NSA climate actions accountable. As an early funder of the Camda (see Section 3 below) community, Climateworks provided early philanthropic support in the development of methodologies to quantify NSA impact, including the first Global Climate Action of Cities, Regions and Companies report that was the first to quantify the aggregate mitigation contributions of companies and subnational governments, compared to current national policies (Data Driven Yale et al., 2018). The foundation also plays a significant role in funding and supporting various platforms and tools designed to increase transparency and accountability in climate actions.

In 2022 Climateworks partnered with Microsoft to initiate the "Carbon Call," which aims to strengthen the reliability and interoperability of greenhouse gas accounting, thereby ensuring that data is accurate, up-to-date, and exchangeable across multiple levels —from corporations to governments (The Carbon Call, 2022). The Carbon Call brings together a range of stakeholders including scientific experts, corporate leaders, philanthropic organizations, and intergovernmental entities. It was formed with the purpose of ensuring more consistent disclosure of data and the flow of data into relevant platforms, enhancing the reliability, comparability, and availability of climate data.

As a grantmaking organization and convener, **Climate Arc** is an initiative aimed at embedding climate science into financial decisions. Their goal is to connect the financial sector with real-world companies to more efficiently direct capital towards climate solutions. They are a major funder of the Science Based Targets Initiative's efforts in collaboration with the Net Zero Insurance Alliance (NZIA) to guide the insurance industry to set their own targets for near and long-term alignment with global climate goals (Climate Arc, 2022). Most of their re-granting is focused on corporate and financial institution efforts to decarbonize, enabling the development of tools and metrics that ensure these efforts are credible and science-based.

03 Holding NSAs Accountable

Key Messages

- Different actor types, standard setters, data reporting platforms, data verifiers/validators, and watchdog groups, need to interplay to enable and ensure transparency and accountability.

- Verification is critical for ensuring data quality and reliability, and there's a need to increase the capabilities of auditors and establish clear requirements for the verification process.

- Data quality and verification are critical to achieve effective climate accountability.

> **Given the burgeoning diversity of climate actors and their commitments, there exists a pressing necessity to establish a robust system that offers dependable data, enabling the enforcement of accountability for their set targets amidst existing challenges in tracking, verification, and the prevalence of voluntary, self-regulated initiatives.**

The increasing diversity of climate actors and their commitments present challenges for tracking, verification, and accountability. As of July 2023, the business landscape reached a stage where, for larger and publicly-listed companies in the Global North, setting voluntary climate targets and announcing strategies to reduce emissions have become standard practice (Hans et al., 2023). Over 23,000 companies disclose environmental data through the CDP (CDP, 2023b), more than 5,600 have set targets validated by the SBTi, and over 8,300 are part of the UNFCCC's Race to Zero campaign (Hans et al., 2023). However, despite this proliferation of voluntary and self-regulated initiatives, the current ecosystem suffers from a lack of transparency and effective accountability (Bäckstrand & Kuyper, 2017; Hsu et al., 2023). The system is replete with ambiguities about how these diverse initiatives and actors complement each other and which accountability functions they serve. Recent studies, such as the NewClimate Institute's Corporate Climate Responsibility Monitor, have revealed that companies often exploit these systemic flaws to obscure inadequate climate action (NewClimate Institute & Carbon Market Watch, 2022, 2023). In national contexts with stronger climate change regulation and compliance monitoring, research has demonstrated a lower probability of companies engaging in greenwashing behavior (Mateo-Márquez et al., 2022).

In this complex NSA accountability ecosystem (Figure 5), standard setters, data verifiers, and data reporting platforms underpin the core functions of standards and benchmark-setting, as well as the validation, verification, and auditing of NSA climate commitments and actions (adapted from and inspired by Hans et al., 2023). Standard setters delineate the benchmarks and guidelines for assessing actions, data verifiers authenticate and uphold the integrity of reported data, and data reporting platforms consolidate this information into accessible repositories for analysis. We elaborate on each key set of actors in this accountability framework: standard setters, data reporting platforms, verifiers, and finally, watchdog organizations. Together, these entities must align their objectives, standards, and processes to efficiently generate data required for effective accountability mechanisms.

3.1 Standard Setters

> **The role of standard setters in enhancing NSA accountability is to provide comprehensive methodologies, benchmarks, and guidelines for climate data reporting.**

Standard setters play an essential role in NSA accountability by providing four different types of standards, i.e. data assurance (carbon accounting), target setting, data exchange, and disclosure. They have been instrumental in developing methodologies and guidelines for voluntary GHG disclosure: the World Resources Institute (WRI) and WBCSD developed the Corporate Standard for Greenhouse Gas Accounting and Reporting (referred to as the Greenhouse Gas Protocol or GHG Protocol) in the early 2000s as a voluntary standard and has since been one of the leading approaches companies adopt. In 2006, the International Standards Organization (ISO) adopted the GHG Protocol as the basis for its 14,064 guidelines for greenhouse gas management. In 2014, WRI, in collaboration with city networks like GCoM and ICLEI, developed the Global Protocol for Community-Scale Greenhouse Gas Inventories to provide more specific guidance for city-level accounting. Currently, the WBCSD is driving standardization of companies Scope 3 emissions reporting and how companies access that information across their supply chain through the new PACT (Partnership for Carbon Transparency) initiative (PACT, 2023). These standards have been instrumental in developing a common terminology for NSAs to assess and report their GHGs; for example, the emission "scope" terminology delineating direct from indirect and supply chain/consumption-based emissions. Given the significant heterogeneity of climate

Holding NSAs Accountable
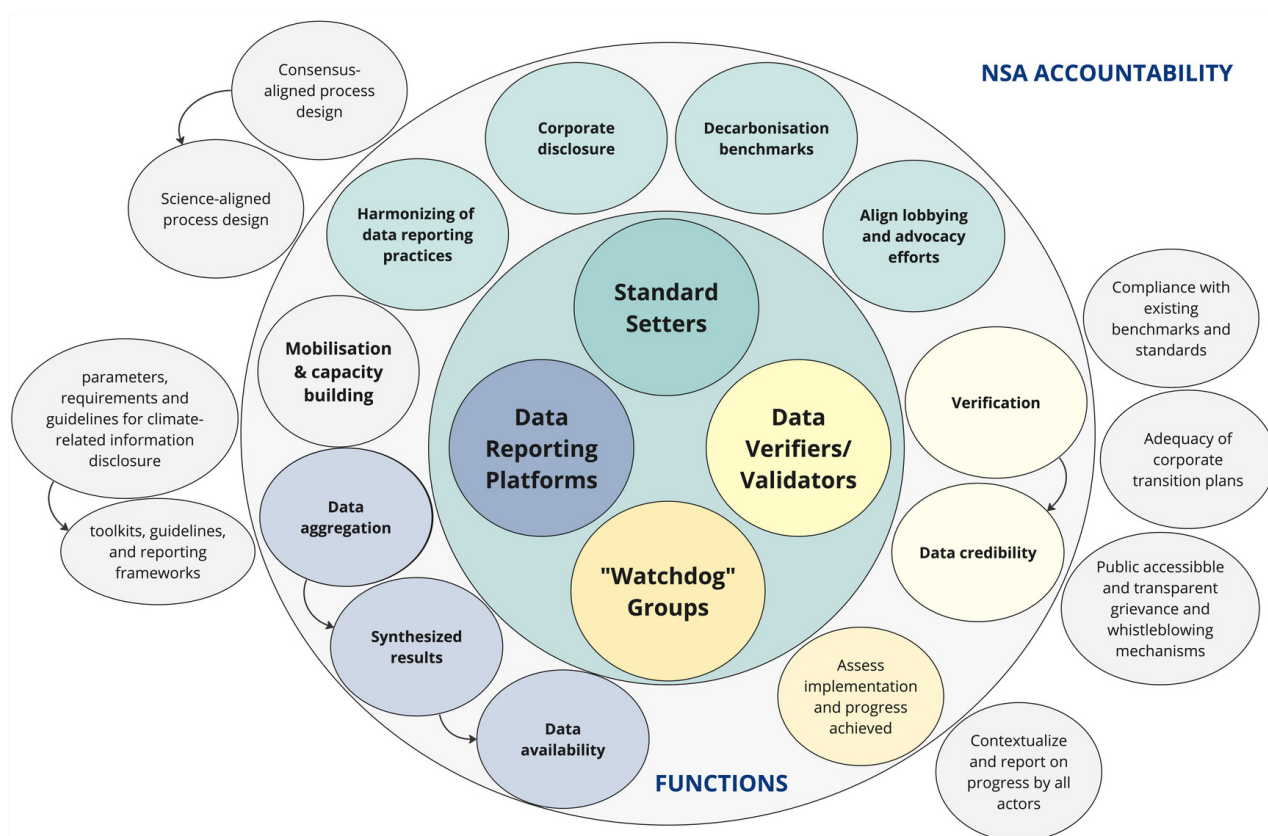
Figure 5. Overview of the NSA Accountability ecosystem, the ecosystem functions, and their outputs toward NSA accountability. Source: Authors, inspired by and adapted from (Hans et al., 2023).

data reporting, standards also are crucial for harmonizing data reporting practices and making data available, thus elevating transparency and accountability across NSAs (Jia et al., 2023).

Second, standard-setting organizations have delineated benchmarks and guidelines for NSAs to set rigorous climate targets. For example, standards elaborate on how corporations can set short-, medium-, and long-term targets, aligning them with 1.5°C-aligned sector-specific decarbonization benchmarks and broaden considerations of equity (Hans et al., 2023). They can also provide guidance on how corporations' can ensure that their external lobbying, advocacy efforts, and contributions to fair and just transitions are consistent with overarching climate goals. Areas such as corporate governance, reporting mechanisms, due diligence, and adaptation targets also fall under their purview.

Third, standard setters play an important role in ensuring cohesiveness and unified direction at the intersection of corporate climate reporting and financial reporting. Traditionally, the segregation between climate reporting and

financial reporting reinforces a false dichotomy that suggests that environmental and financial performances are mutually exclusive domains. This separation inhibits a comprehensive understanding of a company's overall profile. Environmental risks can have financial repercussions, and financial strategies can impact environmental outcomes. The siloed approach can lead to decision-making that doesn't account for the interconnectedness of these factors. As the business world recognizes the intrinsic link between environmental sustainability and long-term financial viability, the convergence of these two reporting methodologies has become increasingly significant.

Recognizing these challenges, standard setters are playing a crucial role in bridging the gap. By promoting standards that encourage the integration of financial and climate reporting, they are paving the way for a more holistic view of corporate performance. Initiatives such as the Task Force on Climate-related Financial Disclosures (TCFD), the Global Reporting Initiative (GRI), and the International Sustainability Standards Board (ISSB) have been instrumental in this regard (Table 3).

- The TCFD, for example, emphasizes the importance of businesses disclosing their financial risks associated with climate change. By doing so, it not only sheds light on companies' environmental footprints but also on the potential economic repercussions that can arise from climate-related risks and opportunities. Such insights are invaluable for investors, stakeholders, and regulators alike, ensuring that financial decisions are made with a comprehensive understanding of both immediate economic factors and long-term environmental considerations.

- Another standard setter is the GRI, which provides a globally recognized framework for sustainability reporting, covering a range of economic, environmental, and social issues. Unlike the TCFD, which specifically focuses on climate-related financial disclosures, the GRI offers a more comprehensive perspective on sustainability, emphasizing the interconnectedness of various dimensions of sustainable business practices. Moreover, by providing a common language for reporting, the GRI aids businesses in communicating their sustainability performance to stakeholders, ranging from investors to consumers, in a standardized manner.

- Similarly, the ISSB works towards a global alignment of sustainability reporting, ensuring that these reports are consistent, comparable, and reliable across jurisdictions. The ISSB is currently folding the TCFD into its standards in a move toward increased integration. By aligning corporate climate reporting with universally recognized financial reporting standards, the ISSB aids in creating a holistic understanding of a corporation's performance, integrating both its economic and environmental facets.

3.2 Data Reporting Platforms

The role of data reporting platforms is to incentivize transparency, while facing challenges due to heavy reliance on self-reported, often inconsistent data, and issues around data access and proprietary.

NSA climate planning, action, and performance data are primarily self-reported. A major shift in corporate attitudes, from climate inaction to regulatory fear and then to opportunity via carbon markets and trading, opened the first avenues for corporate climate reporting (Kolk et al., 2008). Following the logic of sustainability reporting frameworks like the GRI and other voluntary, private governance efforts, initiatives like the CDP (as discussed below) and the Investor Network on Climate Risk harnessed investor apprehension about the business ramifications of climate change to compel companies to reveal a wide array of climate-related risk and opportunity data (Kolk et al., 2008). These efforts ushered in an "institutionalization of standardized information disclosure" as a way of providing stakeholder accountability and corporate benchmarking (Kolk et al., 2008). For cities and subnational governments, the origins of sustainability and climate disclosure are more closely linked to ICIs like C40 Cities and ICLEI, which played key roles in promoting cities to report carbon emission inventories (Sulkowski, 2015).

The heavy dependence on self-reported voluntary disclosure presents a range of obvious challenges. Data are often inconsistently or inaccurately reported, and individual NSA actors can often cherry-pick or determine what to include or exclude from disclosures. They also lack interoperability, resulting in the inability to easily aggregate and synthesize across data platforms (Hsu et al., 2023; Luers et al., 2022; Schletz, Hsu, Mapes, et al., 2022; Widerberg & Stripple, 2016). They may also narrowly reflect the priorities of the data collectors or program designers, which could result in failing to collect necessary data to appropriately and comprehensively track progress towards a wider range of climate goals and to understand underlying conditions and drivers for their success and failure (Hsu et al., 2023; Luers

Table 3. Examples of standard setters aligning corporate climate and financial reporting. Source: authors.

Type	Initiative Name	Founding Year	Users & Endorsements	Description
Data assurance (carbon accounting)	Global Reporting Initiative (GRI)	1997	78% of the largest 250 companies (G250) and 68% of the leading 5,800 companies (N100)	GRI's framework consists of a set of universal standards along with topic-specific standards, which companies can use based on their individual operational contexts and stakeholder requirements. These standards capture sustainability metrics, including but not limited to, carbon emissions, water usage, labor conditions, and corporate governance. Adopters contribute to a global data pool that allows for industry benchmarking and cross-sectoral analyses.
Data assurance (carbon accounting)	Greenhouse Gas Protocol (GHG Protocol)	First edition of the Corporate Standard, published in 2001	Developed jointly by the WRI and the WBCSD. In 2016, 92% of Fortune 500 companies responding to the CDP used GHG Protocol directly or indirectly through a program based on GHG Protocol.	The GHG Protocol is an internationally recognized framework for measuring and managing GHG emissions. For business and organizational GHG accounting, it offers a comprehensive suite of standards, including the Corporate Standard for organizational emissions, the Scope 3 Standard for value chain emissions, and the Product Standard for product lifecycle emissions. These standards guide businesses and governments in accurate GHG accounting and reporting, ensuring transparency and uniformity in climate-related disclosures globally. In 2006, the International Standards Organization (ISO) adopted the GHG Protocol as the basis for its 14064 guidelines for greenhouse gas management. In 2014, WRI, in collaboration with city networks like GCoM and ICLEI, developed the Global Protocol for Community-Scale Greenhouse Gas Inventories to provide more specific guidance for city-level accounting.
Disclosure	International Sustainability Standards Board (ISSB)	2021	The ISSB, established in 2021 under the IFRS Foundation, is an autonomous body responsible for developing and endorsing worldwide sustainability reporting standards, and it operates under the same organization that supervises the International Accounting Standards Board.	reporting that enable consistent and comparable disclosures, cater to common investor data needs, align with specific requirements of different regions, and facilitate comprehensive sustainability information sharing by companies across global markets. In June 2023 the ISSB released its first two International Financial Reporting Standards (IFRS), the IFRS S1 General Requirements for Disclosure of Sustainability-related Financial Information and the IFRS S2 Climate-related Disclosures. The two standards are based on the TCFD's four-pillar approach, encompassing governance, strategy, risk management, and metrics/targets. IFRS S1 provides guidelines for identifying and disclosing material sustainability-related risks and opportunities. IFRS S2, a thematic standard building on IFRS S1, focuses specifically on climate-related disclosures. It mandates identifying and disclosing climate-related risks and opportunities that could impact the entity over different timeframes. Industry-specific disclosure topics and cross-industry metrics, such as GHG emissions and internal carbon prices, are to be considered in these

Category	Organization	Year		
Target setting	Science-Based Targets Initiative (SBTi)	2015	SBTi is utilized by 2,253 companies that represent $38 trillion USD in global market capitalization as of 2022 (George, 2023)	SBTi offers tools, guidelines, and verification mechanisms that help companies quantify their emissions across their value chain (Scopes 1, 2, and 3) and set targets in line with the Paris Agreement's goals. Moreover, SBTi provides sector-specific guidance, enabling companies in different industries to tailor their targets to their unique operational realities, thereby increasing both feasibility and effectiveness.
Disclosure	Task Force on Climate-related Financial Disclosures (TCFD)	2015	The Task Force consists of 31 members from across the G20, representing both preparers and users of financial disclosures	Under the TCFD, companies are to disclose their governance around climate-related risks and opportunities, the actual and potential impacts of climate-related risks and opportunities on the business, and how the organization identifies, assesses, and manages such risks. These pillars guide organizations in disclosing financial information related to climate risks and opportunities, enabling investors and other stakeholders to make informed decisions. Non-compliance could lead to legal repercussions and impact investor relations and stock value.
Data assurance (carbon accounting)	International Financial Reporting Standards (IFRS) Foundation	2001	Founded in 2001, IFRS Foundation is an independent, not-for-profit organization that continues the work of the International Accounting Standards Committee established in 1973.	IFRS aims to standardize sustainability information and disclosures by providing IFRS standards that enhance transparency, accountability, and efficiency in global financial markets, all in the public interest, fostering trust, growth, and long-term financial stability in the global economy. The organization also oversees the International Accounting Standards Board (IASB), which develops IFRS specifically to address how financial information should be recognized, measured, presented, and disclosed. They created the ISSB in 2021 to develop the IFRS for sustainability disclosure information, to ensure alignment with IASB disclosure regulations.
Data assurance (carbon accounting)	International Organization for Standardization (ISO)	1947	Over 1,400 standards related to the United Nations' Sustainable Development Goal 13, which focuses on Climate Action (ISO, 2022). In 2022, ISO released its Net Zero Guidelines, with inputs from 1,200 experts from over 100 countries.	ISO has progressively broadened its mandate of setting technical standards to encompass environmental and energy management standards. It has produced ISO launched initiatives like the London Declaration and "Our 2050 World" to spur global efforts toward achieving net-zero emissions (ISO, 2021; Our 2050 World, 2023). ISO's Net Zero Guidelines specifically set a common path for (ISO, 2022): • definition of "net zero" and related terms (greenhouse gas removals, offsetting, value chain, etc), clarifying the differences in scope between direct emissions, indirect emissions from purchased energy, and other indirect emissions arising from an organization's activities • high-level principles for all actors who want to achieve climate neutrality, • actionable guidance on getting there as soon as possible, by 2050 at the very latest, and • transparent communication, credible claims, and consistent reporting on emissions, reductions, and removals.

et al., 2022; Schletz, Hsu, Mapes, et al., 2022; Widerberg & Stripple, 2016). In addition, data reporting platforms often grapple with criticisms around commercialization, licensing, and restricted data access.

CDP is the largest and arguably most central NSA climate data reporting platform. Since it started operation in 2000, more than 23,000 companies encompassing 66% of global market capitalization reported to the platforms (CDP, 2023b). CDP dispatches annual sector-specific surveys to companies, cities, and regions, seeking detailed data and information such as greenhouse gas emissions, energy usage, water consumption, and other environmentally relevant metrics. Based on the information provided, CDP has a scoring system, which grades organizations on their disclosure, awareness, management, and leadership in environmental matters (Lino et al., 2022). This system serves to incentivize better disclosure and more robust environmental practices among participating entities and offers a valuable tool for investors, policymakers, and other stakeholders seeking to assess the environmental performance of organizations. CDP also promotes third-party verification, mandating that verifiers adhere to selected standards or provided verification guidelines (CDP, 2023d). CDP provides disclosure data from cities, states, and regions freely from its website, but corporate data beyond a few large actors, such as the Global500 companies, requires a paid license, and its website blocks web scraping or automated search and retrieve methods to collect more data points beyond a limited number of free access points. To address the challenge of reporting redundancy and fatigue, CDP has emerged as a central data reporting platform for subnational government climate initiatives, with ICLEI, C40, and GCoM consolidating reporting with CDP and ending maintenance of their own independent reporting platforms. Corporate initiatives like SBTi also encourage its members to report to CDP.

Alongside increasing NSA data reporting convergence to CDP, the UNFCCC Secretariat launched the first high-level, intergovernmental platform to showcase the breadth of NSA climate actions and ICIs in the lead-up to the 2015 Paris climate negotiations (United Nations Environment Programme, 2023). Originally called the Non-State Actor Zone for Climate Action (NAZCA) and launched at COP-20 in 2014, the UNFCCC's GCAP influence was instrumental in bolstering climate momentum for an ambitious global agreement by demonstrating the widespread "all of society" support for climate action. As of August 2023, over 32,500 actors are registered on GCAP, including 15,590 companies, 11,354 cities, 1,654 investors, 3,443 organizations, 282 regions, and 194 countries (UNFCCC, 2023c). A noteworthy enhancement to the platform came in 2019 when the UNFCCC, in collaboration with Camda, integrated advanced tracking metrics primarily sourced from CDP data (UN Climate Change News, 2019). These metrics, emphasizing ambition and robust target-setting, have enriched GCAP's analytical depth, offering a granular view of emission trends and specific climate actions undertaken by its registrants, although the availability of progress metrics is predominantly limited to Global North actors based on data availability.

NSAs and ICIs do not directly report to GCAP, instead, it represents a "platform of platforms," to which various data providers report, such as:

- CDP supplies GCAP with environmental data disclosed by companies, cities, states, and regions, which encompasses greenhouse gas emissions, energy consumption, water usage, and other pertinent environmental metrics. ICLEI, C40 Cities for Climate Leadership, GCoM, and the European Commission, which stands as the secretariat for the EU Covenant of Mayors for Climate and Energy, have all consolidated reporting directly to CDP in recent years, and selected data is featured for a subset of these initiatives' members on GCAP. In 2023, 1,100 cities, states and regions in close to 100 countries made disclosure reports to CDP (CDP, 2023b).
- Climate Bonds Initiative: This initiative is centered on financial instruments designed to support climate-related projects. The data supplied to GCAP includes detailed information about the bonds issued, the amounts raised, and the specific climate-related projects they're intended to fund.
- The Climate Group's Under 2 Coalition, which coordinates climate efforts of nearly 200 state and regional governments,

originally had their members report to CDP, but they have since 2020 opted for independent reporting to better suit their own reporting needs. They regularly survey their members on information related to their baseline and monitoring emissions inventories, targets, and progress on self-declared commitments to align efforts with under 2-degrees C pathways.

- Climate Initiatives Platform: A collaborative platform managed by the UN-Copenhagen Climate Centre that contains information on ICIs, many of which are coalitions of NSAs partnering with intergovernmental and national entities. The data it provides to GCAP includes specific commitments, targets, actions, and progress reports of these initiatives.

As previously discussed, while most recent NSA data platforms such as the NZDPU and RtZ's Data Explorer rely on CDP data, there are other self-disclosure platforms emerging. One example is the Climate Registry (TCR), which launched a Net Zero Portal and plans to allow entities to self-report net-zero related pledges and plan information as early as winter 2023 (The Climate Registry, 2023). This public, online platform is designed to track and compare net-zero greenhouse gas pledges and the strategies employed to achieve them on a global scale. The portal seeks to bolster climate ambition by offering a comprehensive source of information related to net-zero pledges, research, standards, and field leaders. Entities, irrespective of their TCR membership status, can make pledges on the portal. These pledges denote commitments to realize and uphold net-zero emissions across operations, communities, and entire value chains. OpenEarth Foundation also launched the OpenClimate Network, which coalesces climate target, pledge information along with other emissions data, including allowing subnational governments to self-report emissions data (Hsu & Schletz, 2023).

3.3 Data Verifiers/Validators

> **While data verification is essential for the credibility of climate reporting, open questions exist regarding who should perform these verifications.**

Data verification is a cornerstone in the climate transparency and accountability space, ensuring the accuracy and reliability of disclosed information. In the initial draft of the UNFCCC's RAF for Non-Party Stakeholder Climate Action, validation and verification procedures are mentioned in several contexts, from businesses and financial institution stakeholders seeking "independent evaluation of their annual progress reporting and disclosures" (UNFCCC, 2023f) (e.g., ex-post pledge and plan verification, see Box 1) to emphasizing the importance of credible climate action plans and transition plans (e.g., ex-ante validation, see Box 1). For example, since the HLEG emphasizes in its first recommendation the need for credible net-zero pledges, the UNFCCC secretariat proposes a working group of "pledge verification entities" to ensure consistency and standardization of best practices (UNFCCC, 2023f). The UNFCCC Executive Secretary Simon Stiell has emphasized the need for strengthened verification and accountability processes within the UNFCCC and (UNFCCC, 2023f), and the preliminary RAF consultation documents include more than a dozen mentions of "verification." While these international frameworks refer to verification and validation largely in the context of plans and target setting, this section focuses specifically on data verification - processes that provide assurance regarding the accuracy and credibility of NSA data disclosures to support ex-post validation of climate action.

Within this context, a crucial question arises concerning the identity of potential data verifiers who can provide independent, "third-party" evaluation of NSA climate data and actions. The "Big Four" accounting firms—Deloitte, Ernst & Young (EY), PricewaterhouseCoopers (PwC), and KPMG—have emerged as major players in climate data verification. Traditionally specializing in accounting, auditing, tax, and consulting services, these firms have expanded their

portfolio to include services related to environmental, social, and governance (ESG) disclosures, particularly in the realm of climate and emissions. Deloitte, for example, offers robust climate data assurance services that focus on reviewing NSA data quality (Deloitte Global, 2023). KPMG also provides quality assurance policies aimed at validating and verifying NSA emission reduction initiatives (KPMG, 2021). PwC offers a bifurcated approach that includes both external and internal solutions for climate reporting, while EY concentrates on comprehensive climate disclosures and assurance that include various facets of ESG reporting (PricewaterhouseCoopers, 2023). This expansion of roles is occurring at a pivotal moment, as ESG disclosure standards are being redefined in regions such as the U.S. and Europe.

Although the Big Four aim to capitalize on this market, they face challenges, including cost-related disparities and questions about sector-specific expertise. According to data from 2021, only 6% of S&P 500 companies contracted an accounting firm for ESG verification, compared to 47% that opted for non-accounting firms, often due to lower costs and specialized expertise (Maurer, 2022). Smaller consultancies generally charge less for their services than do the Big Four and other large accounting firms. There is also the question of expertise. Some accounting firms have called for greater regulatory scrutiny and clarification on the type of firms allowed to provide ESG verification services. Engineering and certification consultancies have meanwhile attested that they are indeed the ones with the appropriate expertise to provide ESG assurance, as these firms employ technical, sector-specific experts to conduct their reviews and assessments.

As illustrated in Table 1, the shift towards mandatory corporate disclosure of emissions data, climate actions, and green claims may produce new troves of valuable public data, yet additional verification requirements will add new costs and complexities to businesses performing climate change disclosures. These trends may also lead to consolidation among the firms providing third-party assurance of these disclosures. The Big Four are all in the midst of carrying out multi-year, multi-billion

dollar plans to enhance their organizational climate literacy. Smaller, non-audit firms may not have the capital to broaden their services to meet the US SEC's expansive guidelines and some could be left to fill niche roles in climate disclosure assurance. Greater demand for third-party assurances spurred by the new regulations, however, will likely float all boats in the near-term, allowing audit (i.e., accounting) and non-audit firms to expand their roles in climate-related information disclosure. Regardless, there is currently a gap in the availability and capacity of firms to provide needed independent verification of implementation and actual progress, since most verifiers perform ex-ante validation of corporate climate action plans (Hans et al., 2023).

3.4 "Watchdog" Groups

Watchdog groups play a crucial role in enhancing climate action accountability by filling data gaps, providing critical analysis, and developing tools and methodologies for assessing the adequacy and credibility of climate actions.

In the complex terrain of climate action accountability, "watchdog" groups, such as academic research units, and non-profit organizations have emerged as indispensable stakeholders, significantly enhancing transparency and filling critical data collection gaps. These entities contribute by scrutinizing NSAs climate actions, particularly in a landscape where uniform data management infrastructure and universal verification schemes are barely existing. Independent analysis by think-tanks, universities, and non-profit organizations have provided needed translation of complex NSA climate data and information for citizens and decisionmakers. A well-known and oft-cited example is the Climate Action Tracker, developed and maintained by a consortium of independent analysis groups including Climate Analytics and the NewClimate Institute, a website that provides regular evaluation of countries' nationally-determined contributions (Climate Action Tracker, 2023). Importantly, the Climate Action Tracker assesses the sufficiency of each country's actions and their alignment with the

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1.5°C pathways, allowing advocacy groups and decisionmakers to compare efforts both between governments and globally. In a similar vein, the Net Zero Tracker is an analogous tracking tool aimed specifically at deciphering the credibility of more than 4,000 entities, including countries, net-zero and decarbonization efforts.

Within the NSA realm, various academic and non-profit watchdog groups banded together to develop specific datasets and methodologies for evaluating NSA climate actions. In 2016 a group of organizations, including Data-Driven Yale (now known as the Data-Driven EnviroLab at the University of North Carolina at Chapel Hill), NewClimate Institute, PBL Netherlands, Oxford University, University of Maryland, WRI, among others convened a collaborative working group to survey the existing landscape of NSA assessment methodologies and coalesce on common definitions and approaches for aggregating NSA climate impact (Weinfurter, 2016, 2017). In 2019 the group published the results of these discussions in a research methodology roadmap for assessing NSA climate action in the prominent climate science journal Nature Climate Change (Hsu et al., 2019) and publishing the first Global Climate Action of Cities, Regions, and Companies report at the 2018 Global Climate Action Summit held in San Francisco. Simultaneously, in partnership with the UNFCCC and Marrakech Partnership for Climate Action, the initiative was rebranded as Camda—the Community of Climate Action Methodologies Data and Analysis - in response to a call from the UNFCCC Executive Secretary in 2016 (UN Climate Change High-Level Champions, 2021). As mentioned in Section 3.2: Data Reporting platforms, Camda collaborated directly with the UNFCCC Climate Champions and Global Climate Action team to develop a set of progress tracking metrics that were directly incorporated into GCAP (UN Climate Change News, 2019). Camda was also a partner, along with Data-Driven EnviroLab and the OpenEarth Foundation, in the Climate Action Data 2.0 Community (further discussed in Section 5), to identify opportunities for digital technology innovations to improve NSA climate data and tracking. Climateworks Foundation funded the Camda secretariat until the end of 2022 when the Data-Driven EnviroLab took over the duties as secretariat for Camda. The organizations publishing the Global Climate Action of Cities, Regions, and Companies annual reports in 2023 co-branded these publications with the Camda logo and banner to signify the continuation of NSA tracking and aggregation research, funded by the Ikea Foundation (Utrecht University & Data-Driven EnviroLab, 2023).

DATA DRIVEN ENVIROLAB

04 Accounting and Accountability Gaps

Key Messages

- Data accounting gaps are currently leading to greenwashing concerns and an inability to hold NSAs accountable.

- Such gaps stem from a lack of standardization and methodological consistency, as well as a lack of data, systems, and governance interoperability that limit the flow of data and data comparability.

- Regulatory cohesion is increasingly important to level the playing field globally and across actors and sectors to increase data reporting and enhance data accounting practices.

Accounting and Accountability Gaps

The landscape of NSA climate data and accountability is rife with challenges that influence the efficacy and credibility of efforts. In this section, we discuss the most notable and pressing gaps that our research and interviews identified. We spoke with a range of experts from the Science Based Targets Initiative, WRI's Greenhouse Gas Protocol, International Sustainability Standards Board, WBCSD's PACT Initiative, the International Sustainability Standards Board, Climateworks Foundation, Carbon Call, the UNFCCC, Oxford Net Zero, and the GHG Management Institute to form our analysis and conclusion.

These experts identified the following primary gaps in NSA accounting and accountability:

- Greenwashing concerns due to a lack of standardization and methodological coherence challenges: While some alignment on methodologies exists, disparities remain, and standards lack clarity. Communication gaps persist, and the need for standardized, objective reporting is a key concern. These conditions allow for both intentional and unintentional greenwashing, which risks genuine efforts and a lack of effective climate action. The future roles of dominant voluntary standard setters, such as GHG Protocol and Science-based Targets Initiative are uncertain, and alignment with intergovernmental frameworks varies based on actors' own incentives.

- Data, systems, and governance interoperability: The proliferation of climate data standards has caused data fragmentation and interoperability issues, including challenges in data, systems, and governance interoperability. Achieving interoperability is crucial for seamless data sharing, but it depends on clear standards and an open data model. These challenges stem from fragmented efforts across sectors and governance levels.

- Capacity constraints and data quality and verification: Accurate data is crucial for trust and accountability. However, capacity and resource limitations are major challenges for NSA data accounting and reporting, especially for small and medium-sized enterprises (SMEs) in developing countries. These capacity constraints include a lack of technical expertise necessary for precise climate data measurement, limited financial and human resources, and inadequate access to accurate information and training in reporting standards. Additionally, technological barriers, such as the high cost and limited availability of efficient monitoring technologies, further impede their ability to monitor emissions. At the same time there is an increasing complexity in reporting due to the growing emphasis of Scope 3 emissions, while many SMEs struggle to report quality data on Scope 1 and 2 emissions.

- While technology offers solutions, adoption is hindered by capacity gaps and complexities of exhaustive inventory requirements. Verification, done by independent auditors, is essential for data quality, but challenges like conflicts of interest and resource limitations need attention. Balancing the need for verification with accessibility is important.

- Overcoming corporate voluntarism through regulatory cohesion: creating synergy between corporations and regulatory bodies faces challenges due to the predominant voluntary data disclosure approach. To enhance accountability and transparency, government regulation and mandatory disclosure is needed particularly where economic incentives are crucial.

4.1 Greenwashing Concerns from a Lack of Standardization and Methodological Consistency

Greenwashing can occur due to persistent discrepancies in goals, ambiguous standards, communication and implementation gaps, as well as the credibility and potential conflicts of interest of standard-setting bodies.

While advocating for regulators to take decisive action by developing regulations and standards, the HLEG recommends an initial focus on high-emission corporate entities, including private and state-owned enterprises and financial institutions (McKenna, 2022). The HLEG also suggests a collaborative approach involving regulators from various jurisdictions and regulatory fields, along with key participants in voluntary and standard-setting initiatives and independent experts. This collective action is aimed at reshaping the fundamental rules of the global economy to ensure alignment with the goals of the Paris Agreement. Such collective coordination is critical because, while methodologies and standards are generally converging, misalignment still exists.

As voluntary standards and initiatives continue to proliferate, concerns about greenwashing and a lack of accountability have increased (UN News, 2022). The HLEG report (McKenna, 2022), for example, warns that unchecked greenwashing, particularly through questionable net-zero pledges, risks undermining genuine efforts, leading to confusion, cynicism, and a lack of effective climate action. The severity of these greenwashing practices is highlighted in a recent survey of about 1,500 executives from 17 countries across seven industries, which found that 74% believe greenwashing is pervasive in their industries, and that many organizations would likely be implicated if subjected to thorough investigations (Toplensky, 2023).

Greenwashing risks stem from three challenges:

- Definitional consistency: due to the lack of standardization and methodological consistency at various levels in sustainability and climate-related reporting. This challenge ranges across the four different areas, from data assurance/calculation, target setting, data exchange, and disclosure (Table 3). The ambiguity and variations in defining sustainability standards and net-zero goals create fertile ground for greenwashing, especially concerning the precise definitions of net-zero and the accurate reporting of Scope 3 emissions.

- Diverse approaches to defining key accounting and disclosure concepts, including determining materiality, defining organizational boundaries, and establishing reporting criteria. Variation in whether to report on targets, how to report on greenhouse gas emissions, and other key aspects contribute to the challenge of achieving methodological consistency and comparability across diverse reporting entities. This diversity in approaches and practices poses obstacles to effectively assessing and addressing greenwashing risks, as well as to harmonizing sustainability disclosures on a global scale.

- Alignment with regulatory frameworks: An essential aspect of addressing greenwashing risks lies in achieving greater standard consistency and alignment with regulatory frameworks. Notably, alignment initiatives like the TCFD aim to harmonize approaches across entities such as the EU, SEC, and ISSB. While substantial progress has been made in certain areas, disparities persist, particularly in defining the materiality of information and specifying targets and timelines for sustainability objectives.

Accounting and Accountability Gaps

We further elaborate on each point below, drawing from the recurring issues highlighted by our interviewees regarding the challenge of greenwashing.

Definitional Consistency

On the other hand, despite this coalescence, disparities persist, rooted both in overarching goals and around a unified and credible baseline that defines NSA climate actions for specific actors and sectors. Some of the issues related to standardization are more fundamental, as mentioned by several respondents who pointed out a general absence of problem or goal identification. McGivern et al. (2022) found that 85% of net-zero initiatives, although mandating a decarbonization strategy or transition plan, fall short of detailing the requisite benchmarks. This problem stands to be further exacerbated by increasing regulatory calls, including the UNFCCC's RAF, for climate transition plans detailing how an organization plans to pivot its assets, operations, and profit models to align with science-based climate goals. In fact, a recent CDP report on corporate climate plan disclosure revealed that only one-third of disclosing organizations met their criteria for a credible transition plan, with an overwhelming majority of organizations lagging on financial planning, target, and net-zero strategy indicators (CDP, 2023a).

Methodological Consistency

Although there is emerging agreement on methodologies and standards towards net zero (Net Zero Tracker, 2023a), significant differences remain. A study by Oxford NetZero scrutinized 33 such voluntary initiatives and discerned a broad consensus about the essential elements that underpin a robust net-zero pledge (McGivern et al., 2022). However, at the same time the same study finds "[o]utright contradictions between voluntary initiatives are uncommon, and variation is often due to differences in focus (e.g., some cover measurement while other cover target setting" (McGivern et al., 2022). Similarly,

interviewees noted a broad methodological convergence on emissions measurement and reporting approaches, such as the widespread use of the GHG Protocol Corporate Standard, the Global Protocol for Community-Scale Greenhouse Gas Inventories, and the HLEG recommendations for net-zero target setting. However, most interviewees simultaneously emphasized significant differences in terms of information reporting requests, regional reporting requirements, scope of reporting (e.g., spanning from product level, corporate level, to target tracking), or the reporting venues.

Additionally, even converging voluntary standards often retain ambiguities, causing inconsistencies in data reporting. For instance, the PACT Pathfinder Framework (World Business Council for Sustainable Development, 2023) on Scope 3 reporting highlights and seeks to address the ambiguities surrounding product emission accounting due to the discretionary space in prevailing standards. Interviewees pointed out the difficulty stemming from the absence of uniformity in the interpretation of standards and the flexibility in choosing methodologies, which naturally leads to increased discrepancies as more NSAs become involved.

Even though the majority of companies currently adopt the GHG Protocol as the main standard, interviewees noted the need for more industry-specific standards and methods. This critique often directly conflicts with NSA membership organizations we surveyed, which noted that members frequently desire standard and methodological simplification. There is also a notable dearth of guidance on how entities committing to net zero should contemplate and address broader impacts, encompassing aspects like biodiversity and climate justice.

Accounting and Accountability Gaps

Regulatory Alignment

The lack of alignment among these different components in the sustainability reporting landscape further complicates the issue. It becomes increasingly evident that governments play a pivotal role in addressing this complexity by making disclosures mandatory. For instance, the UK has taken a pioneering step by mandating TCFD disclosures for listed companies (UK Government, 2022). This regulatory move sets a precedent and emphasizes the role governments can play in streamlining and aligning sustainability reporting practices across the corporate landscape.

While the importance of national regulations in shaping sustainability reporting practices cannot be overstated, it remains uncertain how international initiatives like the HLEG and RAF will fit into this landscape, particularly when national regulations may take precedence, especially for corporate actors. HLEG and RAF may exert minimal influence for actors whose primary concerns are tied to local, or national regulatory frameworks. For other NSAs, such as state or local government actors, where national reporting guidelines and regulations are not as advanced compared to those for private-sector actors, aligning target-setting, particularly for net zero, and transition plans with international frameworks appears to be of a more relevant concern. The Global Covenant of Mayors for Climate and Energy, in partnership with WRI, initiated an "Integrity Matters" working group aimed at subnational networks. This group's purpose is to assess the HLEG (McKenna, 2022) recommendations and offer detailed guidance for their members on implementing critical aspects such as defining boundaries, phasing out fossil fuels, and comprehensively addressing emissions coverage (Global Covenant of Mayors, 2023). In this scenario, international frameworks might offer valuable guidance in the absence of clear national standards.

Communication gaps also exist between scientists, standard developers, and private actors, such as businesses. Some interviewees identified a clear tension between private actors and the entities involved in developing standards, conveying a sense of moving goalposts and constantly updating guidelines, often which contradict recent and previous iterations. For example, debates include issues like market-based accounting for offsets and renewable energy certificates, scope 3 reporting, and the role of organizations like SBTi and GHGP in moderating these debates. The evolution of GHGP and SBTi centers around if and how they can address the needs for standardized, objective, and comparable reporting effectively.

SBTi, in particular, has been criticized for potential conflicts of interest in maintaining dual roles in standard setting and for-profit consultation for companies on how to achieve the benchmarks it sets (Morse, 2023). In September 2023 SBTi announced it would separate its non-profit arm, which oversees standard-setting, and its consultancy roles (George, 2023). When the same actors wear the hats of both standard-setters and verifiers, with corporate influence shaping, executing, or even financing these roles, the sanctity of the process is compromised (Hans et al., 2023). Bjørn et al. (2022) also critiqued the SBTi for allowing too much leeway in lax target-setting.

For better or worse, some of our respondents noted some companies' reluctance and skepticism with SBTi's leading role in the voluntary standard-setting space, and whether the standards and guidelines it sets are sufficiently rigorous.

4.2 Data, Systems and Governance Interoperability

> **The challenges in achieving efficient climate data management are largely due to the current state of interoperability across data, systems, and governance structures.**

The proliferation of various standards, guidelines, and tools within the climate action data assurance space has led to significant data fragmentation and inconsistency, commonly referred to as the challenge of interoperability. Interoperability, in this context, involves multiple dimensions, including data interoperability (e.g. data definitions and methods), systems interoperability (e.g. software and platforms), and governance interoperability due to differences among stakeholders. Data interoperability refers to the ability of different systems, datasets, or tools to seamlessly exchange and integrate data across diverse sources and platforms. It ensures that data from various sources can be accessed, understood, and utilized cohesively, enabling more efficient data sharing and integration, which is crucial for harmonizing diverse datasets for aggregate analysis. Data interoperability relies on uniform definitions and guidelines for data collection, reporting, and formatting, as discussed in detail in 4.1: Greenwashing Concerns Due to Lack of Standardization and Methodological Coherence. At the same time, it is crucial that the effort to create interoperability does not result in a race to the least common denominator, but that the level of interoperability is increased to the highest existing levels. To achieve this goal, the capacity of currently lagging actors needs to be elevated by addressing the prevailing accountability gaps (see Section 4 and 4.1).

Systems interoperability, on the other hand, refers to the ability of different technological systems, software applications, and platforms involved in data management and reporting to interact with one another and operate in conjunction. Interoperability does not singularly

rely on data itself but the underlying systems that process, store, and transmit this data. In the context of climate data accountability, systems interoperability is critical for ensuring that the diverse technologies and platforms used by various stakeholders can work together without compatibility issues. Software plays a vital role in facilitating data management, analysis, and reporting processes. The WBCSD PACT Pathfinder Framework (World Business Council for Sustainable Development, 2023) underscores that the emergence of novel GHG accounting technology and data exchange platforms has been met with an interoperability deficit in both the way that data is exchanged (specifically at the product level Scope 3) and how systems (data platforms and technology solutions) connect to each other. Consequently, businesses can only tap into each other's data reservoirs if they employ compatible technological solutions. This limitation effectively stymies the free flow and exchange of essential information. Recognizing the data collection, reporting, and interoperability gap, there has been a recent proliferation in data solution providers, with CarbonCall identifying more than 20 carbon reporting software systems. At the same time, PACT is aligning with around 25 carbon accounting tools, platforms, and initiatives. This evolving software landscape is promising given the recognition that accelerating transparency and data sharing is critical, the buy-in from corporate, and the interest in collaborating to solve these transparency and accountability challenges. While interviewees reacted positively to the evolving software landscape, there was also hesitancy regarding lock-ins and path dependencies with various software platforms.

Governance interoperability refers to the ability of different governance systems, organizations, or entities to collaborate, exchange information, and align their operations effectively to achieve common goals and objectives while maintaining coherence and consistency in decision-making and governance processes. Regulatory entities, such as the US SEC, European Commission, and International Sustainability Standards Board, alongside

corporate players, have been charting their own course with respect to data accounting and reporting requirements. While industry-centric associations strive to address the immediate concerns of their affiliates, the broader ecosystem, through efforts led by the UN and UNFCCC, is carving out its role. This fragmented approach has created a discernible lack of harmonization and integration, posing a substantial barrier to needed governance interoperability for accountability. Interviewees expressed concern regarding the lack of interoperability between different levels of actors: how NSA efforts will inform future GST and the next round of NDCs, how various voluntary NSA initiatives link together, and relate to the UNFCCC. Yet there is an opportunity to facilitate needed governance interoperability, particularly in the context of "double materiality" to establish standards and guidelines that align environmental and social impacts and risks with financial disclosures across multiple jurisdictions and reporting frameworks (Täger, 2021).

4.3 Capacity Constraints and Data Quality and Verification

Data quality is currently limited by capacity and resource constraints of NSAs that are aggravated by increasingly complex accounting requirements. The legacy reporting approach is not scalable and a re-think and re-design is essential to transform the accountability landscape to be more inclusive.

Accurate and reliable data are preconditions for transparency and accountability (NASEM, 2022). Our interviewees confirmed that data accuracy is fundamental for data trust, particularly for corporate actors who may not immediately perceive a benefit to data reporting and transparency (see 4.5 Corporate voluntarism). Instilling trust in the data handling process, preventing misuse, and ensuring data go where it's intended are all key components to incentivizing businesses to invest in high-quality data reporting.

However, many NSAs are capacity and resource-constrained, particularly for small and medium-sized enterprises and NSAs in developing countries, posing a significant challenge to the provision of accurate and reliable data. These constraints are exacerbated by more complex reporting requirements. Several of our interviewees honed in on the example of Scope 3 - supply chain and consumption-based accounting for NSAs. Scope 3 emissions accounting and reporting is considered integral for net-zero integrity and credibility (McKenna, 2022), yet to date, only a fraction of NSAs disclose these emissions to CDP (Utrecht University & Data-Driven EnviroLab, 2023). Even in Europe, where an overwhelming majority of emissions (92%) fall into Scope 3 categories, only a third of them are covered by climate targets (CDP & Capgemini Invent, 2023). Out of 18,600 companies reporting to CDP, only about 23% of companies, or 4,220 in total, included information on their Scope 3 emissions, a crucial element for achieving net-zero emissions (CDP, 2023c). The overemphasis on Scope 3 reporting, while crucial for comprehensive climate accountability, often leads to difficulties due to the lack of unique and consistent standards. This complexity is exacerbated by ongoing updates to reporting frameworks like the GHGP and SBTi, with Scope 3 remaining a focal point of concern.

The lack of clear proposals and guidelines for Scope 3 reporting further complicates matters. One proposed solution to alleviate these challenges is to streamline reporting and move away from the exhaustive inventory concept, particularly regarding consumption-based accounting, which involves complex modeling exercises. Instead, a more pragmatic approach involves selectively addressing specific aspects of Scope 3 emissions, focusing on lowering the accounting burden while maintaining a serious commitment to addressing them. This balanced approach, which also emphasizes understanding and addressing Scope 1 and 2 emissions, can help overcome capacity and resource constraints in the pursuit of effective climate data accounting and reporting. Other interviewees emphasized the potential of AI to improve data sharing, which could substantially reduce the burden of data collection and modeling.

Verification is critical for ensuring data quality and reliability. To enhance these aspects, there's a need to increase the capabilities of auditors and establish clear requirements for the verification process. Third-party validation plays a vital role in providing an independent assessment of data accuracy; however, identifying who and which organizations should be tasked with this critical role was another challenge interviewees identified. Potential conflicts of interest could arise due to the compensatory and for-profit nature of third-party verification, potentially exacerbating issues of transparency and undermining the entire accountability process (Hans et al., 2023). Other respondents noted the financial resource limitations of small and medium-sized enterprises and Global South NSAs that may not be well-positioned to engage third-party verifiers - a gap where digitally-enabled solutions discussed in Section 5 may play a role. Some individuals highlighted the importance of balancing the need for verification with ensuring that it doesn't create overly burdensome barriers for well-intentioned participants who wish to engage in responsible action.

Technological advancements have the potential to reshape the reporting and verifying resource requirements (e.g. Belenky et al., 2022; Hsu & Schletz, 2023; Schletz et al., 2022). However, while they are maturing, their adoption and integration into transparency systems remains lagging. The reason behind this laggard adoption is clear: the absence of technological capacity and the requisite economic incentives. This creates a significant challenge among NSAs and various countries with limited resources: even with access to modern technology and data, many lack the expertise to effectively develop and deploy these technologies. Initiating such technologies requires a substantial upfront investment in both technological and social structures. However, once established, scaling these technologies becomes notably more manageable than operating within current, less transparent systems. It is evident that the traditional manual and analog methods of transparency and accountability are insufficient and obsolete, given their inability to scale to the magnitude required. Moving away from these outdated approaches to more innovative, scalable solutions is essential for creating a foundation for climate accountability. Addressing this upfront investment challenge is thus crucial to establishing a more accessible and inclusive system in the future. International coordinating bodies, alongside philanthropic and funding organizations, should prioritize this area, as their support can enable broad-scale transparency and accountability transition.

4.4 Overcoming Corporate Voluntarism through Regulatory Cohesion

> **While voluntary disclosure is an important driver towards net zero, regulators need to provide mandatory standards and coherent policies at the international level to level the playing field and avoid further fragmentation.**

Driving the net-zero transition requires voluntary corporate leadership, as it inspires confidence among policymakers who are in the process of developing standards, policies, and regulations to ensure a fair competitive environment and economy-wide adoption (HLEG, 2022). Nonetheless, an overreliance on voluntary initiatives poses the risk of further increasing fragmentation and, consequently, a potential rise in greenwashing due to the absence of unified action and standards. This necessitates a concerted effort from regulators across various levels of governance and jurisdictions to mitigate this fragmentation and align ambitions with concrete actions. According to the HLEG (2022), transitioning from voluntary initiatives to regulated requirements is essential for ensuring consistent compliance with net-zero objectives.

Addressing fragmentation necessitates the introduction of mandatory standards and consistent, reliable data requirements for corporate reporting. Interviewees indicated that such standards could create a "conveyor belt," increasing demand for data providers and consultants, and catalyzing a chain reaction of compliance and engagement as described by

Hale (2022). As per interviewees' perspectives, progress is impeded by the dearth of economic incentives rather than the absence of technology. Once mandatory standards are in place and economic motivations, especially for sectors like insurers, become evident, an ensuing demand for data providers, consultants, and the like will naturally emerge, propelling the entire process forward. By doing so, the impulse for corporates is to not fall behind their competitors, ensuring continued adherence to data reporting and accountability norms. As our interviewees noted, the key is to establish clear rankings – when everyone has a hiding place, complacency sets in. Once established, this momentum could be self-sustaining, exponentially fostering transparency and accountability.

However, there is an evident disparity in commitment levels, especially among larger NSAs, including private companies and state-owned enterprises, many of which have not pledged to net zero, leading to concerns about competitive fairness. Although the landscape is evolving rapidly, it underscores the need for governments and regulators to level up the global playing field. The HLEG (2022) proposes the establishment of an international Task Force on Net Zero Regulation to unite regulators from various jurisdictions to create coherent regulation targeted at large corporate emitters, encompassing verification of their net zero commitments and mandating annual reports on progress. This collective would work in tandem with leading voluntary initiatives, standard-setting bodies, and independent experts to realign the fundamental principles of the global economy with the Paris Agreement's objectives.

As shown in Table 1, mandatory disclosure and cohesive regulatory strategies are pivotal in addressing the current limitations of voluntary NSA data reporting. Nonetheless, several challenges persist. Many NSAs, particularly businesses and financial institutions, consider data proprietary. In addition, increasing policy and regulation only considering the national setting can also increase the fragmentation and dissonance due to competing rules (HLEG 2022). Existing and emerging accountability frameworks, such as the RAF, might fall short of compelling businesses to elevate their disclosure or reporting practices. Interviewees pointed out that while private entities recognize the value of international acknowledgement, their primary accountability lies with direct regulation and shareholders. Thus, issues concerning data ownership, sharing, and accessibility should be tackled cooperatively by regulators, NSAs, and the broader climate action community.

05 Designing a Future Digitally-enabled Climate Accountability System

Key Messages

- Emerging technologies, such as earth observation, artificial intelligence, and distributed ledger technologies have potential to reduce the reporting burden and create (open) access to high quality data, especially for resource limited actors.

- To leverage the potential of emerging technologies, soft infrastructure (collaboration, co-creation, community engagement) and data governance considerations are crucial.

- Creating open and transparent digital platforms to enable data flows and interoperability between existing and evolving data systems is crucial.

The HLEG (2022) states the creation of "a global central digital repository of climate disclosures that encompasses all reporting data points is needed (such as efforts to create the net zero Data Public Utility (NZDPU)." It further describes the need for such a repository to be "open-source" with the following key elements:

- Accommodation of diverse reporting capacities, ensuring inclusivity regardless of the varying capabilities of reporting entities;
- Universal accessibility, granting all users, especially non-state actors globally, the ability to freely upload information. This process would be facilitated by an agreed-upon electronic format optimized for efficient bulk data extraction;
- Inclusion of data quality metrics and validation checks, a step that is indispensable for maintaining a repository replete with information that is not only reliable but also actionable;
- Adherence to the HLEG's recommendations, ensuring consistency down to the template and record levels;
- Oversight by a credible body such as the UNFCCC, thereby ensuring alignment with global climate initiatives and contributing directly to GCAP.

These suggestions point to a future climate accountability system that is digitally-enabled, collaborative, open, and consistent. In open-source projects, the source code or data is made available to the public, allowing anyone to view, use, modify, and distribute it freely (Red Hat, 2023). This open and inclusive framework fosters innovation, as a global community of developers, researchers, and users can collectively improve, customize, and build upon the original software or data. Open source promotes a culture of sharing and collaboration, which often leads to higher quality, secure, and cost-effective solutions, extending beyond software to these broader values that are based on open exchange, transparency, collaboration, community-oriented development, meritocracy, among other values (Red Hat, 2023).

As previously described, existing NSA climate data platforms fall short of this open source ethos, despite their predominantly digital nature. CDP, as the largest self-disclosure data platform among NSAs, does offer a standardized format for data reporting and often involves the public in shaping their questionnaire. Their digital platform, however, relies on closed-source software, and they do not make all their data freely and openly accessible. The UNFCCC's GCAP portal, functioning as a "platform of platforms," depends on data reporting initiatives such as CDP to collect data, and it does not enable direct public data submissions. Although the site features an application programming interface for backend data management, it does not grant public access to this API. While the NZDPU mentioned in the HLEG (2022) report at the time of writing is still under development, its website lacks mention of the site as open source, although foundational data for approximately 400 "high-impact companies" are initially slated to be primarily drawn from CDP (CDP, 2023b). None of these three examples leverage advances in digital technology, including earth observation and satellite remote sensing, machine learning and artificial intelligence, or decentralized data storage and protocols such as distributed ledgers, that may serve as game changers to address many of the critical data shortcomings described in Section 4. In short, there is still a significant journey ahead to establish an NSA climate accountability system that fully realizes the HLEG's (2022) vision.

Figure 6 provides an overview of several key digital innovations with the potential to transform the climate data and accountability landscape. These innovations include digital data collection technologies, notably Internet of Things (IoT) sensors, such as smart meters, that play an increasingly crucial role in real-time environmental and climate data monitoring. Additionally, it encompasses earth observation data obtained through satellite remote sensing, facilitating the monitoring of emission sources and carbon sinks from a spatial perspective. Leveraging such data technologies is particularly valuable in regions where access to data is limited and can

significantly enhance data capacities by enabling broad-scale coverage and advanced analytics to collect and process data efficiently to overcome resource constraints.

Furthermore, machine learning and artificial intelligence are highlighted for their capability to enhance the efficiency of data analysis by reducing barriers associated with processing large datasets. These technologies are rapidly advancing, particularly in text and natural language processing, enabling the development of large language models and chatbots designed for advanced data interpretation. These technologies can aid in data harmonization and assurance by enabling secondary checks of self-reported data ensuring accuracy and reliability, which is particularly valuable for resource-constrained actors, helping them minimize costs and enhance access to carbon markets and climate finance through more credible data. Lastly, distributed ledger technology is introduced as a potential solution for traceability through immutable ledgers and the promotion of decentralized data governance via open source data protocols. These aspects are discussed in Section 5.4. We first explore other vital components of a future digitally-enabled data accountability system, encompassing factors such as openness, traceability, machine readability, governance, and the softer infrastructure elements of community co-creation and coordination.

5.1 Openness, Traceability, and Machine Readability

The growing diversity of climate data providers presents both challenges and benefits, emphasizing the need for consistency in open data practices and processes.

The landscape of data providers involved in climate accountability is expanding, with a diverse array of stakeholders adopting various approaches to data collection, management, and reporting. This trend can be perceived both as a challenge and an opportunity. The increasing diversity of data providers adopting various approaches may lead to greater fragmentation and potential confusion in the climate accountability landscape. On the other hand, the proliferation of data providers may not necessarily be detrimental to accountability, since a decentralized system could offer certain advantages. A decentralized system could be more inclusive, since it allows a broader range of actors to contribute their own data, thereby promoting diversity and reducing the risk of overreliance on a single source. By promoting redundancy and enabling data comparison and triangulation from various sources, the quality and credibility of the data would be enhanced, particularly if multiple independent data sources are
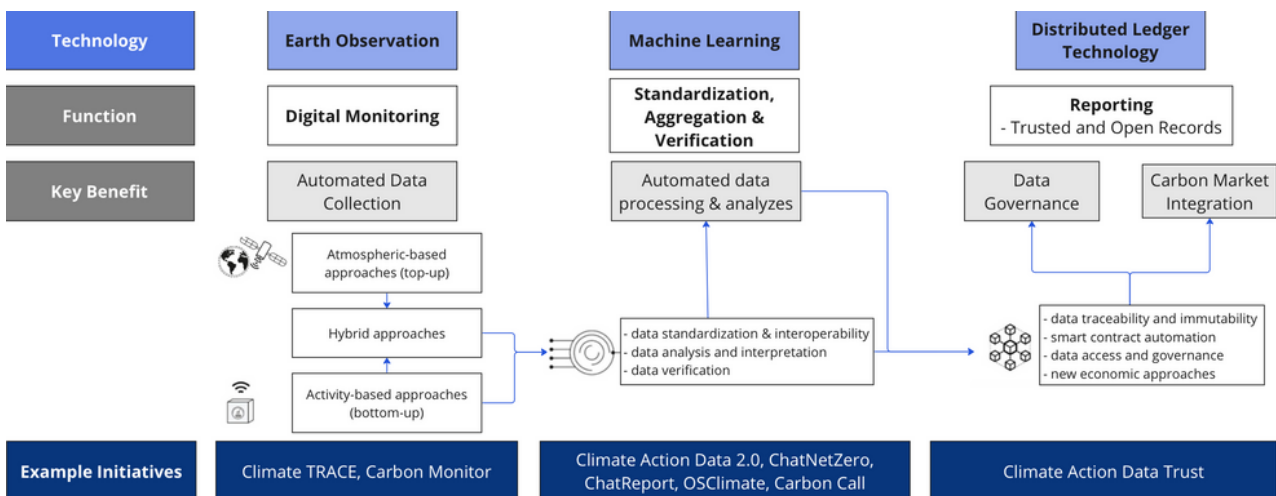
Figure 6. Applications of digital technologies, their roles, potential benefits, and technological requirements. Source: Adapted from (United Nations Environment Programme, 2023)

compared. This decentralization reduces dependence on single data providers and mitigates potential conflicts of interest, as frequently discussed in interviews.

At the same time, a more decentralized data architecture increases the complexity due to more heterogeneous data from a wide range of actors, formats, and qualities. Therefore, a critical aspect is the development of systems that ensure interoperability, or the ability of diverse data sources to work together seamlessly. For a consistent and efficient data integration across platforms, organizations should adopt consistent metadata (i.e., data "about the data") standards (NASEM, 2022). Uniform metadata standards are a defined set of guidelines and specifications that outline the creation and utilization of metadata. Some notable examples in the climate science space including the Climate and Forecast (CF) conventions. These conventions encompass a standardized set of naming rules for climate and forecast data, ensuring that data from diverse sources can be readily comprehended and compared (Eaton et al., 2022). Aside from the external reporting and harmonization benefits, consistency in metadata that allows for external interoperability enhances internal data management processes critical for internal decision-making.

As a complementary component to consistent metadata standards, interviewees identified the need for an open data model (i.e., schema). Such a data model would constitute a structured framework that defines how data is organized, stored, accessed, and manipulated within a database or information storage system, to improve data interoperability. An example is the OpenClimate data model, which provides standardized definitions for key variables necessary to identify climate-pledging entities and their related climate emissions, pledges, and action information (Open Earth Foundation & Data-Driven EnviroLab, 2022/2023). Similarly, the PACT Framework is currently an open data model for Scope 3 emission reporting and obtaining information across the value chain. This could involve the use of AI and other digital technologies to facilitate data collection, analysis, and reporting (see Section 5.4).

However, as identified in 4.1: Greenwashing Concerns Due to Lacking Standardization and Methodological Coherence, a data model is contingent upon having clear, objective standards for what is being measured and reported.

Ensuring data interoperability heavily relies on maintaining consistent metadata standards and an open data model. Furthermore, fundamental principles of openness and traceability play a vital role in this context. Data, alongside its associated methodology, should be available for scrutiny and traceable to its origin to aid in verification and quality assurance. Regulators worldwide are increasingly emphasizing the adoption of structured, open-source, and machine-readable data and standards for company reporting. This shift reflects a growing consensus on the importance of transparency and accessibility in financial and non-financial disclosures. One prominent example of this trend is the use of standardized identifiers to facilitate the authentication of legal identities for financial transactions. Legal entity identifiers (LEIs), for example, are standardized 20-character alphanumeric codes that serve as unique identifiers using corporate registration records as a primary source to validate entities' identifying information (Treacy & Okrent, 2023). Combined with XBRL (eXtensible Business Reporting Language), an international open-source and royalty-free data standard tailored for digital reporting, the use of standardized identifiers and reporting formats have demonstrated to vastly streamline corporate financial reporting while providing traceability and source verification. XBRL is specifically designed to enable structured, consistent, and machine-readable presentation of various types of company information, including financial performance, non-financial disclosures, and compliance reports. The adoption of XBRL ensures that financial and sustainability data is not only presented in a structured format but is also easily accessible and interpretable by both human users and automated systems. By providing a unique machine-readable tag for individual disclosures within statutory reports, XBRL enhances data integrity, comparability, and facilitates data aggregation and analysis (IMA, 2020). Expanding to the ESG reporting domain, CDP, along with other initiatives like the Climate Disclosure Standards Board (CDSB) and the Global Reporting Initiative (GRI) have developed an XBRL taxonomy

based on the CDP questionnaire and the CDSB Climate Change Reporting Framework to allow electronic systems to process and communicate climate change data (CDSB, 2022).

Balancing the need for open data with data privacy and protection poses a significant challenge in designing an effective accountability architecture. There is a need for an accountability architecture to provide options for safeguarding proprietary data, while ensuring credibility and accountability. By enabling verification without revealing specific data, DLT-enabled methods like Zero-Knowledge Proofs, decentralized identifiers, and verifiable credentials, offer a potential solution with verification and data protection (Schletz, Hsu, Mapes, et al., 2022). Another decentralized data governance application is the JLINX project, which offers organizations control over data sharing and decision making since each entity maintains control own data "node" that contains all data (Fournier et al., 2022). In addition, since data is becoming an increasingly valuable resource in the global data economy (Gigler, 2023), data ownership is an important consideration. Both companies, especially those with data-based business models (e.g., CDP) and countries often are hesitant in surrendering their primary data sovereignty, even if it would benefit collective coordination and action (Beck et al., 2023).

5.2 Data Governance

Data governance refers to the framework of policies, procedures, and practices that organizations put in place to ensure high data quality, protect data, and comply with data-related regulations. Simply put, it refers to the "exercise of authority and control over the management of data" (Abraham et al., 2019). With the advent of artificial intelligence, recognition of the need to include the entire algorithmic lifecycle into this process, since data changes as algorithms are applied and intermediate products are produced (Janssen et al., 2020). Organizations are adopting data governance as a strategy to maintain command over data quality and ensure compliance with legal and ethical standards, ensuring the reliability of their decision-making

processes (Janssen et al., 2020). Although there is no single, agreed-upon definition of data governance, Abraham et al.'s (2019) synthetic review of the data governance literature reveals six common dimensions of data governance: cross-functional collaboration, serving as a framework for structured data management, focusing on data as a strategic enterprise asset, specifying decision rights and accountabilities, developing data policies, standards, and procedures, and monitoring compliance. Data governance distinguishes itself from data management, which relates to the day-to-day execution of decisions made within data governance policies.

In this context, the EU has initiated several pieces of complementary legislation aimed to promote open data and facilitate data sharing(European Commission, 2023). The Open Data Initiative, a voluntary initiative launched by the European Commission in 2011, encourages governments, private companies, researchers and citizens alike to share open datasets to foster innovation and economic growth across the region. In 2019 the Open Data Directive was adopted as a legally binding instrument that establishes common rules for public authorities to make information available for re-use in a machine-readable format, free of charge or at minimal cost. It stipulates the publishing of dynamic data and the uptake of Application Programme Interfaces (APIs) and the strengthening of transparency requirements for public–private agreements involving public sector information to avoid exclusive arrangements (European Commission, 2023). The Directive focuses on so-called "high-value datasets," which constitute thematic categories like geospatial, earth observation and environment, meteorological, statistics, companies and company ownership, and mobility. The EU also tests innovative DLT-applications as part of the European Blockchain Services Infrastructure (EBSI) (European Commission, n.d.) that enables all EU member states to share data through a shared infrastructure to support cross-border services between governments, businesses and citizens with the goal of improving the efficiency and trust of EU-wide transactions. The EU also adopted a Data

Governance Act in 2022 that requires organizations to adhere to certain standards when managing their sensitive or confidential data.

By articulating how data should be handled, governance structures facilitate the development of systems and tools that enable data-informed decision-making. They also determine practical rules governing how information is collected and shared in climate accountability, particularly regarding the Paris Agreement. These rules, known as "rules in use," encompass various aspects, such as who gathers the information, why it's collected, what kind of data is needed, and who receives the information (Ostrom et al. 1994). These rules can be either formal (like laws and policies) or informal (like social norms and customs) and have a substantial impact on climate actions (Hsu & Schletz, 2023). Notably, there are significant differences in these rules between NSAs and national governments. For instance, a corporate or NGO actor may operate under its self-defined rules, such as relying on voluntary data disclosure that might align with particular communication or advocacy aims. In contrast, a government agency, as a representative of a country's obligations under the Paris Agreement, is subject to formal rules and regulations that dictate data collection, reporting requirements, and international compliance standards. The variations in these rules influence the scope and depth of climate actions. Even so-called "open data portals" are not immune to these informal or formal rules in use for data governance, as they frequently have established terms of use, access policies, and usage guidelines to govern their data resources. The UNFCCC's GCAP also involves procedures to decide which data providers among NSAs are chosen, which specific entities are selected from these data sources, and what information is presented, as well as what remains undisclosed. These decisions often involve negotiations with the data source providers to determine the final content and presentation of data. Data governance regulations are often not disclosed and lack opportunities for public input or consultation.

5.3 Soft Infrastructure: Coordination, Capacity, and Community Engagement

The transition from voluntary reporting into regulatory cohesion as a collaborative effort between NSAs, ICIs, and orchestration entities like the UNFCCC, to ensure standardized compliance with net-zero objectives.

"Soft" infrastructure components, notably human resources and institutional capacity, are essential for creating the enabling conditions for data, and in particular new data collection systems and processes, to support accountability mechanisms and policy. This capacity, often referred to as informational capacity, describes a system's ability to assimilate, process, and utilize technical and scientific knowledge and data (Cuevas, 2016). Besides data collection itself, informational capacity also requires the "ability to apply statistical methods, applied research methods, and advanced modeling techniques" (Howlett & Cashore, 2009). Without considering the analytical capacity of actors to utilize data and information, "overloading" users' capacity can also lead to environmental management failures (Dietz et al., 2003), thereby defeating the advantages of informational and evidence-based governance approaches (Hsu et al., 2015). Currently, a substantial skills deficit exists, emphasizing the importance of capacity building for data literacy to help individuals understand data's value, generation, and application. To achieve this need for upskilling NSAs on a broad scale, digital data technology can help bridge gaps and facilitate capacity expansion. Soft infrastructure, therefore, can be thought of as connective tissue that binds data collection, analysis, and policy implementation together, ensuring a seamless and effective flow of information and knowledge across the climate accountability landscape.

Community input and co-creation, in harmony with UNFCCC orchestration, can help realize shared policy objectives (Nasiritousi & Grimm, 2022). Strengthening community co-creation of a future digitally-enabled climate accountability system necessitates active orchestration from entities like the UNFCCC and financial backers, driving sustained interaction among technology communities, governments, and end-users in the climate data sphere. This continuous, iterative exchange of information and ideas ensures that technological advancements are not only developed but also effectively deployed to meet the specific needs and challenges faced by governments and organizations. It allows for feedback loops that improve learning and capacity on the users' end, as well as the usability and relevance of technology solutions, ultimately leading to more effective climate action. Moreover, promoting collaboration and understanding among these stakeholders can help bridge the gap between technical innovations and practical implementation, ensuring that the benefits of advanced technologies reach the forefront of climate accountability efforts.

An illustrative initiative is the Climate Action Data 2.0 (CAD2.0) community that is co-convened by Camda, the Data-Driven EnviroLab, and the OpenEarth Foundation, and funded by the Carnegie Corporation of New York. This initiative, which ran from 2021-2023, focused on data integration, technology, and infrastructure to address climate accountability. With the collaboration of over 80 organizations, CAD2.0 emphasized three work-streams: data harmonization, digital infrastructure, and policy applications. To advance in these areas, CAD2.0 established partnerships with organizations in climate data disclosure and investigates technologies such as blockchain, satellite imagery, and artificial intelligence. CAD2.0 facilitated co-creation between these partners and relevant stakeholders and end-users, including the UNFCCC Secretariat, philanthropic donors, industry representatives, academics, and civil society groups. A key goal of the CAD2.0 community was to enhance knowledge and awareness building around digital technology

and amplify understanding and advocacy for the role of digital technologies towards open data and interoperability, to enhance NSA accountability.

5.4 Potential of Digital Data Innovation

The transformative potential of advanced digital technologies, including earth observation, machine learning, in enhancing and revolutionizing NSA climate data accountability.

Advances in digital technology have the potential to revolutionize the climate data accountability system. These technologies can be interconnected to automate Digital Monitoring, Reporting and Verification (D-MRV) at a global scale (Figure 6) (United Nations Environment Programme, 2023).

5.4.1 Earth Observation

Earth observation tools and satellite remote sensing are providing temporal and spatial coverage of a wide range of greenhouse-gas emitting activities, providing alternative data sources compared to existing self-reported data (Hsu, Khoo, et al., 2020; Skovgaard et al., 2019). Besides Earth observation data, the digital realm of the Internet of Things (IoT), which encompasses interconnected devices and sensors, holds the potential to offer highly detailed, real-time data across vast geographical areas. These data sources can significantly enhance services and diagnostics related to source-specific emissions. For instance, a network of IoT sensors placed on manufacturing equipment can continuously monitor and report on emissions in real-time, enabling timely interventions and more efficient emission management (Chen et al., 2015; Tsai et al., 2014; NASEM, 2022). Employing both Earth observation and IoT data has the advantage of reducing the burden on entities regarding modeling and data collection, enabling the gathering of real-time and primary data.

Table 4. Examples of NLP-based AI initiatives in the climate accountability space.

Initiative	Description
ChatNetZero (beta)	A fine-tuned Language Model (LLM) aiming to clarify net-zero integrity and credibility that relies on data verified by the Net Zero Tracker and recognized experts. It uses advanced algorithms to ensure accurate outputs without misinformation specifically tailored for climate policy and action questions related to net zero. The beta version was launched in September 2023. Planned updates include real-time internet access and user report analysis capabilities.
ChatClimate/ChatReport	Utilizes an LLM to streamline corporate sustainability report analysis, allowing users to upload corporate social responsibility reports to see how well-aligned they are with TCFD principles. It focuses on response traceability to counter inaccuracies and misinformation. These tools were developed with the involvement of domain experts to ensure technological robustness and domain-specific accuracy. Offers open access to methodology, datasets, and analyses of 1,015 distinct reports.
Climate Policy Radar	Employs data science and machine learning to facilitate climate law and policy research by converting climate-related documents into a structured, accessible database. They combine data from diverse sources to create a repository for detailed analysis, utilizing machine learning algorithms to extract relevant information and identify trends.
OSClimate and CarbonCall	Aims to apply machine learning to enhance interoperability between climate data structures (i.e., schemas). They aim to develop structured data models to standardize climate-related data organization, storage, access, and manipulation; and promote clear and consistent data definitions and guidelines for improved data integration and understanding among diverse stakeholders.

By integrating data from such a multitude of sources, including satellites and ground-based sensors, initiatives like Climate TRACE and Carbon Monitor seek to detect emissions from a range of on-the ground activities and sources, which includes industries and natural occurrences like deforestation and wildfires (Climate TRACE, 2023). Climate TRACE uses high-resolution Earth observation data and activity-based methods to estimate emissions by sources. For instance, using multispectral satellite imagery, it breaks down national-level steel emissions to specific production sites through satellite detection of heat production from steel plants. In November 2022, Climate TRACE claimed to provide estimates for over 70,000 individual sources worldwide (Climate TRACE, 2022). Other examples include Environmental Defense Fund's MethaneSAT, set to launch in 2024, which will provide global, high-resolution measurement of methane emissions from oil and gas sources, to better estimate this powerful yet undermeasured source of greenhouse gas emissions. There is also great potential for earth observation data to assist countries in developing forest biomass and carbon stock inventories, particularly as technologies continue to advance and provide increasingly accurate and high-resolution data that can significantly enhance the precision and comprehensiveness of such inventories.

While the potential for earth observation data to supplement self-reported inventories is clear, a major question that looms is how to effectively integrate these alternative data sources with decision-making processes and end-users (NASEM, 2022). Similarly, Hegglin et al. (2022) found that the translation of Earth observation data into information for policymakers and other stakeholders remains unclear. This challenge is exemplified in Climate TRACE's partnership with Carbon Yield, a company that assists farmers in reducing greenhouse gas emissions from agricultural sources (Mckenna et al., 2023). Carbon Yield has been collaborating with

Climate TRACE to better detect and measure methane emissions from cattle production facilities, an emissions source underregulated in the state of California, due to difficulty in accurately measuring sources. While Climate TRACE's method has demonstrated an accurate way of measuring methane emissions from these unregulated sources, hesitancy still policymaking and management policies and practices (Howlett, 2009; Hsu et al., 2015).

5.4.2 Machine Learning for Text-based Data and Generative Artificial Intelligence

Emissions data represent just one facet of the data necessary for NSA accountability, and a significant source of information frequently comes in the form of qualitative textual data, including law and policy documents, websites, corporate reports and press releases, and other media. As a result, Machine learning aided natural language processing (NLP) is enhancing data discoverability, search, and analysis. Machine learning, a subset of artificial intelligence, encompasses the creation of algorithms and models enabling computers to learn from data, make predictions, and inform decisions through pattern recognition. NLP involves developing algorithms to comprehend, interpret, and generate human language, enabling tasks like translation, analysis, and summarization. In the area of climate science, NLP has been applied for meta-analyses as seen in Callaghan et al., (2021), coordinating climate action (Debnath et al., 2023), and for dissecting financial climate disclosures, as highlighted in works by Bingler et al. (2022) and Luccioni et al. (2020). Others like Stammbach et al. (2023) have used it for detecting environmental claims and fact-checking climate assertions as demonstrated by Diggelmann et al. (2020). These techniques facilitate data interoperability by standardizing data formats, understanding data semantics, transforming data, integrating across platforms, linking related data, matching schemas, and automating validation.

Recently, generative artificial intelligence (AI) and specifically Large Language Models (LLMs) like ChatGPT and Bard are expanding the possibilities through improved understanding of complex climate change concepts. Generative AI refers to a class of models that are trained on large datasets and use probability distributions to create new, original content, often in the form of text, images, or other media. LLMs are advanced generative AI models that are capable of understanding context and producing coherent and contextually relevant responses to generate human-like text and perform language-related tasks, such as translation, summarization, and question-answering. These new technologies are particularly relevant and transformative in the NSA climate data and accountability space since they hold the potential to better understand and develop credible climate action plans, facilitate data analysis and reporting, and enhance public engagement with climate issues by providing accessible and contextually relevant information through natural language understanding and generation. For example, tools described in Table 4, such as ChatNetZero and ChatReport, may allow companies to benchmark their own climate action and net-zero transition plans with others in their sector or identify best practice. For the public and regulators, these tools have the potential to significantly reduce the time needed for the public and regulators to perform rapid trend analysis and pattern recognition across a multitude of diverse documents, offering timely, human-like responses to essential inquiries to enable evaluation of their credibility.

5.4.3 Distributed Ledger Technology

Distributed Ledger Technology (DLT), commonly known frequently referred to as blockchain, is a decentralized system for recording, verifying, and sharing transactions across a network of computers. It operates on a distributed ledger, which is a tamper-resistant digital record of transactions, ensuring transparency, security, and trust among participants without the need for a central authority. In this way, DLT can facilitate data access and governance while safeguarding data transparency and accountability across the different data sources and methodologies (Schletz et al., 2020; Schletz, Hsu, Mapes, et al., 2022). The

Climate Action Data Trust (previously World Bank Climate Warehouse) is an innovative approach to counteract the fragmentation in carbon markets and enhance interoperability (Climate Action Data Trust, 2023). Conceived as an open-source metadata system, it employs distributed ledger technology to aggregate and harmonize scattered carbon market information. This approach was orchestrated to address pressing concerns such as double counting, and to instill renewed trust in the carbon market. The prototype of the Climate Warehouse, which was originally overseen by the World Bank's Carbon Market and Innovation unit, subsequently transitioned its ownership to the Climate Action Data Trust in December 2022. The Trust is collaboratively governed by the World Bank, the International Emissions Trading Association (IETA), and the National Climate Change Secretariat Singapore. With its foundation anchored to the principles outlined in Article 6.2 of the Paris Agreement, the Trust aspires to bolster the transparency, robustness, and integrity of internationally transferred mitigation outcomes. By crafting a unified taxonomy of carbon project data, the Trust bridges data heterogeneity among various registries, rendering them interoperable through the creation of a single meta-registry.

The implementation of digital innovation, specifically DLT, necessitates considerable upfront investments in both social and technical infrastructures (United Nations Environment Programme, 2023). The risk of centralization also emerges during the creation of such infrastructure. Thus, there is a need for new business models that foster an inclusive approach, facilitating participation from resource-constrained actors in the creation and governance of these infrastructures. In addressing this complex technological challenge, dynamic prototyping approaches are recommended (Schloesser et al., 2017), which are characterized by the iterative development of functional system increments. The technology architecture must be created dynamically, following a bottom-up and co-creative approach with all relevant participants included, to accurately reflect the climate data ecosystem's needs. Blockchain applications utilizing energy-intensive Proof-of-Work

processes within DLTs have faced criticism for their impracticality in climate-related contexts. However, recent innovations in alternative consensus and validation mechanisms present less energy-intensive approaches similar to other digital applications (Schletz, 2021).

Many developing countries currently lack the necessary technologies, ranging from basic necessities such as broadband internet access to more advanced technologies such as smart meters and sensors (Belenky et al., 2022; Global Environment Facility, 2019). The establishment of the required digital infrastructure will ultimately rest on governing bodies within these countries, though financial, organizational, and technological support will likely be necessary (Organisation for Economic Co-operation and Development, 2019). While digital innovation has the potential to streamline and economize climate data accounting over time, it also introduces increased complexity and demands significant upfront investment. Financial mechanisms to cover the upfront costs for developing countries and scaling digital systems will be important to make the technologies available.

DATA
DRIVEN
ENVIROLAB

06 Conclusion

Conclusion
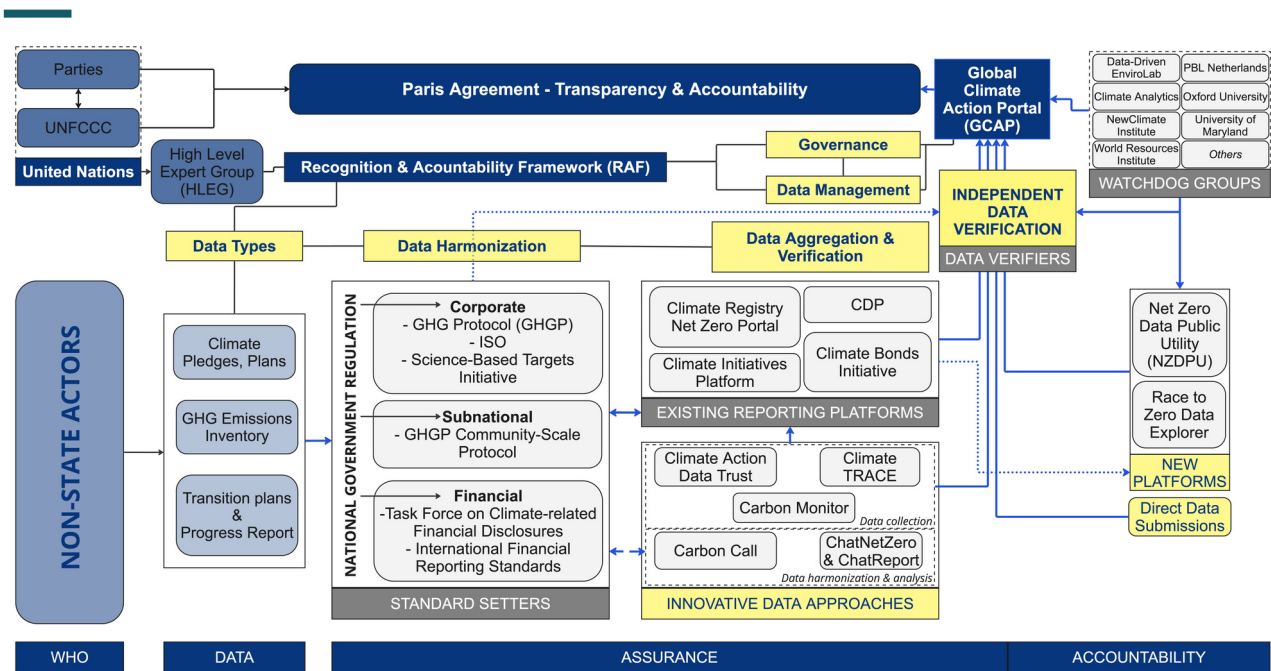
Figure 7. Summary of a future climate accountability system that integrates actors, components, institutions, and initiatives discussed throughout this paper. Yellow boxes highlight components of the accountability systems that are new or are at the center of needing expansion. Initiatives and organizations listed are meant to be illustrative and definitive. Source: authors, adapted from OpenEarth Foundation and the CAD2.0 Community.

The non-state actor climate accountability landscape presents both opportunities and uncertainties. The need for concerted efforts in data governance is evident, wherein voluntary actors inform standards and regulations at national and international levels. Challenges arise from increasing fragmentation as individual stakeholders aim to address climate issues, often missing opportunities for collective action. The absence of international regulation and doubts about its incentivizing power further complicate the accountability system.

Figure 7 illustrates a future NSA climate accountability framework that highlights collaboration of critical stakeholders to generate needed data streams, reporting platforms, and mechanisms for accountability. The framework provides specific information about who is involved, what their roles and activities entail, and how data is created, harmonized and managed. The framework provides specific information about who is involved, what their roles and activities entail, and how data is created, harmonized and managed. Key elements for NSAs include creating climate pledges, inventories of greenhouse gas emissions, and reporting on transition plans and progress. These activities are then integrated into a larger system of recognition and accountability, which emphasizes the importance of diverse data types and harmonization. For data harmonization, standard setters play a critical role in ensuring data consistency and comparability. Data collection and management is facilitated through existing legacy reporting platforms, as well as innovative approaches incorporating machine learning, earth observation and Internet of Things (IoT) sensors. Finally, independent watchdog groups and new platforms contribute to the verification and scrutiny of the reported data to enhance transparency and accountability.

Conclusion

Towards an improved NSA accountability system, we provide several recommendations for next steps:

- **Develop a data accountability model:** A clear and comprehensive data accountability model that draws from existing data protocols, platforms, and disclosure standards is needed to clearly communicate global requirements and expectations. This model should outline key elements and expectations for data, particularly in the context of net-zero and transition plans. It should offer guidance to NSAs regarding data quality, accuracy, and sector-specific requirements, outlining their responsibilities in detail. Creating a unified model and its associated schema, which provides a clear structure describing how data elements relate within the data model, will prevent redundant and duplicated efforts in data reporting. NSA standard setters, ICIs, and national regulators should collaborate to ensure that data definitions and standards are aligned.

- **Promote clear and transparent data governance rules:** Encourage the development and dissemination of a set of clear, transparent data governance rules. These rules should emphasize cross-functional collaboration, the framework for structured data management, the strategic importance of data, decision rights and accountabilities, data policies, standards, and procedures, as well as compliance monitoring. Ensuring that data governance principles are well-defined and widely understood is critical for creating a cohesive and accountable data ecosystem. By adhering to these principles, organizations, regulators, and Non-Party actors can harmonize their efforts in data management, fostering greater consistency, reliability, and trust within a climate accountability framework. The UNFCCC could encourage the adoption of standardized governance principles across the entire climate data landscape, promoting a shared understanding of data management responsibilities and accountabilities.

- **Establish clear data format and metadata standards:** Standardized data formats that are machine readable, including metadata and templates are needed to ensure interoperability between data and systems. AI can automate tasks, uncover insights, and enhance data quality control, offering improved accuracy and efficiency in climate accountability, but its potential can only be fully realized if data inputs are machine readable, high quality, and consistent. Standard setters and regulators should take the lead in coordinating to ensure open and transparent data formats and metadata. Encouraging a data governance framework that takes into consideration AI and the algorithmic data lifecycle is crucial for modernizing and streamlining climate accountability systems.

- **Embrace digital approaches and innovation:** A future climate accountability system must embrace digital innovation and emerging technologies, such as large-language models and generative AI, for expediting the understanding of best practices in climate accountability. These tools can help decisionmakers, regulators and the public more easily access and efficiently analyze climate action plans. AI-driven solutions for rapid trend analysis and pattern recognition in diverse documents can facilitate credible evaluation. In this domain, corporations are currently driving rapid innovation. However, it is essential that these technologies are developed and applied in consultation with communities and governments to really address the core problems and also abate the risk of increasing centralization and commercialization of climate data through open governance (Schletz, Hsu, Robiou du Pont, et al., 2022).

Conclusion

Towards an improved NSA accountability system, we provide several recommendations for next steps:

- **Explore decentralized data governance models:** The feasibility of decentralized data governance models that harness machine learning and AI interoperability to leverage diverse data streams should be explored. These models should be designed to adapt and grow as emerging needs and data sources evolve. By embracing flexible and decentralized governance, the climate accountability ecosystem can benefit from the agility of AI technologies to integrate a wide range of data inputs while ensuring the system remains responsive to emerging challenges, without reinventing wheels or relying on lengthy consensus-building processes required for standardization.

- **Elevate GCAP to encompass the most ambitious data**: As a global benchmark and critical component for inputs to future GSTs, GCAP should establish clear and standardized definitions of credible net-zero commitments, target setting and transition plans across all NSAs. A unified approach must include a transparent process for defining credibility criteria and identifying essential verification data, ensuring consistent evaluations to bolster confidence in commitments. A phased expansion of the RAF should incorporate a broader range of metrics, including nature-based assets. To achieve this more extensive and ambitious data collection, the UNFCCC should prioritize capacity building and stakeholder support for robust data verification and quality assurance.

As the climate data landscape continues to evolve, scalability and flexibility are pivotal in shaping a robust accountability framework. The increasing number of climate actors and the exponential growth of data production necessitate adaptable systems that can accommodate diverse formats, methodologies, and user requirements. This adaptability ensures interoperability among a variety of stakeholders and facilitates a comprehensive and evolving approach to climate accountability. While this report in no way can exhaustively cover this rapidly evolving data landscape, it has attempted to provide a broad overview of the entities, organizations, institutions and initiatives that comprise the NSA climate action data accountability landscape. It identifies common gaps and challenges across various NSA communities and sectors to surface priority areas for needed investments and collaboration to drive data-driven accountability. Amidst the current momentum and political emphasis on enhancing non-state actor accountability for climate change, now is the time to seize the opportunity to design future systems that can prevent potential future constraints and challenges.

Conclusion

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