

LAYING FOUNDATIONS FOR SCALABLE MARKETS IN TRUSTED & GRANULAR GREEN DATA REPORTING

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Executive summary

The need for trusted, verifiable, and granular green data and ESG indicators is driven by forces beyond regulation: data is essential for business intelligence, optimisation and new business models that enable firms to differentiate themselves and their offering to partners, providers, investors, regulators, and customers. This 2024 Point Zero Forum Roundtable brought together stakeholders¹ to share progress, provide insights, and focus on the challenges to forging a more open and interoperable market for green data, while creating mechanisms that

- (i) enable us to establish and track provenance of,
- (ii) trust the integrity of, and
- (iii) control access to

data across different organisations, geographies and value chains. Stakeholders specified the root causes of poor data quality hindering reporting efforts and shaped a preliminary proposal for trusted, scalable market arrangements to mobilise granular, machine-issued data for ESG indicators and financial market innovations.

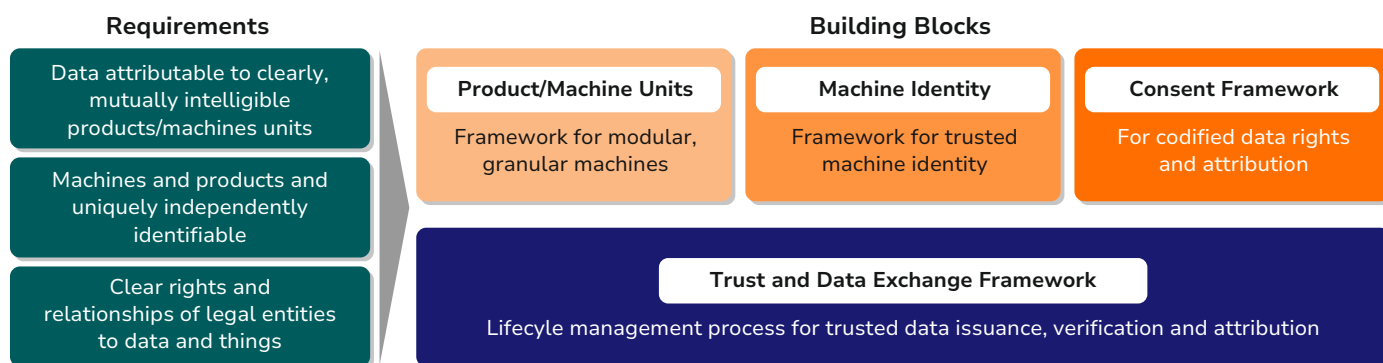
Building blocks are gradually coming into place

The stakeholder engagement led us to review the existing practices in other industries such as Digital Public Infrastructure and Legal Entity Identifiers and establish that these building blocks can be repurposed for the development of a trusted, verifiable and granular green data reporting.

What is missing?

1. Trusted interoperable identities for machines and devices that originate and manage data, and
2. Protocols and standards that use that identity chain to verify authenticity, track access and control, to enable actors along segments of value chains to collect and share data within a decentralised, scalable trust ecosystem.

Figure 1: Framework of requirements and building blocks for trusted machine issued-green data





This document presents **key insights** and considerations raised in the roundtable, outlining approaches discussed by participants to **shift ideas into actions** through a pilot in trusted machine level data for green data reporting.

Background & context

Stakeholders from the investment community, industry, government and specialised actors in digital infrastructure assembled at the Point Zero Forum 2024 in Zurich to discuss how innovations in decentralised identity, data sharing and legal frameworks can enable the provenance and authenticity of 'green' data¹ to be verified and traced along key sections of supply chains². Attention also focused on governance arrangements and market incentives needed to enhance engagement and support transformation of companies and other stakeholders especially in large and emerging middle-income markets that play a key role in global supply chains.

The roundtable was part of a series of public-private forums and initiatives – hosted by the Global Finance and Technology Network (GFTN, formerly known as Elevandi) – that seek to boost collaboration and innovation, ultimately to transition towards a carbon neutral economy and pursue related Sustainable Development Goals. The preceding Point Zero Forum (in 2023) considered the needs for interoperability, access and verification to track and finance net zero ambitions, which deepened into an examination of Project Savannah, a global initiative by the United Nations Development Programme (UNDP), the Monetary Authority of Singapore (MAS), and Global Legal Entity Identifier Foundation (GLEIF), at the Singapore FinTech Festival. The Japan FinTech Festival, held in March 2024, continued the consideration of the value of a global common for climate data.

The roundtable brought together stakeholders to

- share progress, insights and challenges from diverse initiatives in green reporting;
- specify the root causes of poor data quality and ability to tap machine-sourced data; and
- shape a proposal for trusted, scalable market arrangements

to mobilise granular, machine-issued data for ESG indicators and financial market innovations. Attaining granularity in data collection and consistency in reporting can drastically reduce the cost of assuring the integrity of disclosed ESG indicators, increasing information usability for strategic decision-making, financial products and data markets while reducing the reputational and financial risks that arise from opaque or low assurance reporting.

1 For instance machine or object level emissions, energy usage, inputs or other base level data that can be used to derive data required for scope 3 or other ESG reporting

2 Discussants attended from institutions including City Developments Ltd, Esatus, Giesecke + Devrient, GLEIF, GSMA, Momenta VC, the World Business Council for Sustainable Development, the Monetary Authority of Singapore, and Swiss Re.



Catalysts & opportunities

Regulatory and financial pressures to gather data are growing, not just to comply with reporting requirements but to induce behavioural change. Reporting requirements have a direct impact on financial markets. Investors are increasingly incentivised or required to consider the performance of a business on social, environmental, and governance metrics in their decision-making process. The credibility as well as authorisation of green financial products hinges on the quality and robustness of data that is used to substantiate compliance with disclosure rules and principles such as the Green/Social/Transition Bond Principles from the International Capital Market Association (ICMA), the UN Principles for Responsible Investment (PRI) and an increasing number of non-financial disclosure regulations.

As a participant noted:

“As financial institutions, re/insurance companies sit at the top of the carbon data pyramid. Their clients are people, companies, insurance companies, and governments, covering a wide variety of industries and countries. Understanding the risks in their books, as well as leveraging the opportunities to drive decarbonisation and, more broadly, sustainable industries, requires trusted bottom-up data from entities downstream.”

Increasing resilience across markets and industries is at the core of the reinsurance industry's effectiveness. To increase insurability, it's vital that data flows through the value chain. As perils arise or intensify – such as growing extreme weather or cyber threats – we need accurate and timely data to recalibrate models and provide forward-looking scenarios that help us price risks accordingly and develop effective risk sharing solutions that capture the value and material impact of new approaches such as climate-resilient rooftops or energy-efficient buildings and products.”

The time is right for creating scalable data markets for green reporting

Participants of this roundtable agreed that most of the necessary conditions for setting up scalable, interoperable data markets for green reporting are now present. There is demand from regulators and the financial reporting community to enhance the integrity of and ability to prove claims, potentially through more granular data instead of just indicators. Data standards and methodologies have made progress in some areas, including the harmonisation and operationalisation of data frameworks, methodologies, and semantics; stakeholders are building interoperable infrastructures to share and aggregate data. And with a growing understanding of the value of carbon reporting, companies along the value chains – those at the source of emissions, monitoring technologies and data are increasingly willing to share the data, at least if they have the means to reliably collect it, have a stake in its value and address legitimate concerns about control, security and proprietary knowledge.



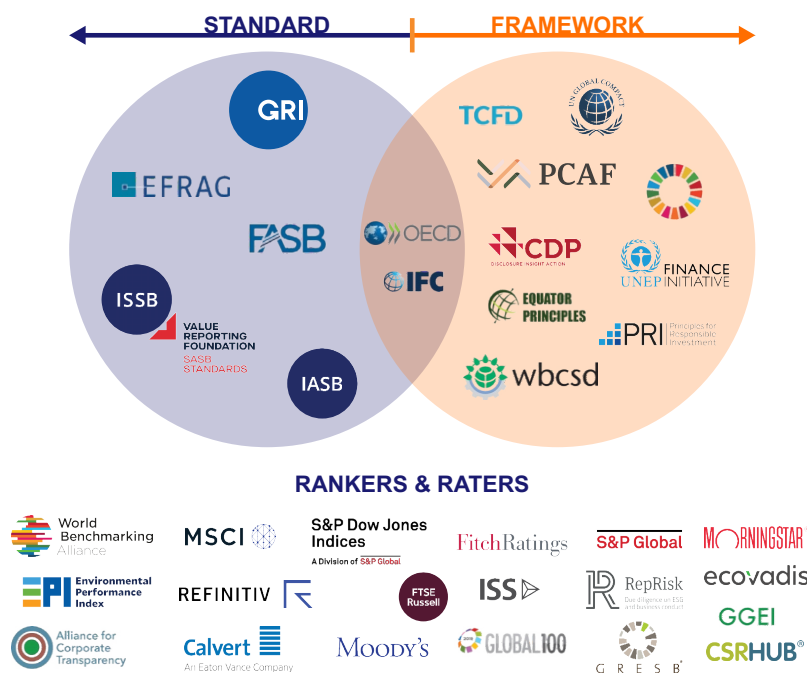
Building on progress to date but also facing rising expectations

The proliferation of regulatory, voluntary and market-led sustainability reporting standards and frameworks across the globe generates demand for granular data and indicators of many variables, including energy consumption, GHG emissions, waste, pollutants, nature, and social metrics. These frameworks often require the reporting entity to measure and report on the footprint of their own activities (scope 1 & 2) and those of upstream and downstream business partners, users and suppliers (3). Scope 3 is particularly challenging because it requires extensive coordination between diverse parties. Materials, production processes and end products blend multiple inputs, making it difficult to untangle and trace back to source level emissions and carbon footprint data. Achieving the overall goals of scope 3 reporting requires data of potentially different standards, granularity and levels of assurance to be combined by reporting entities or intermediaries across value chains, countries and companies and materials with different capabilities.

Maturing reporting standards

Most reporting requirements align with or complement market-led initiatives like ISSB, TCFD, and the latest TNFD. The emergence of regulatory requirements and consolidation efforts of voluntary frameworks under the IFRS brings more standardisation and clarity for all stakeholders. In this continuously evolving complex environment, with still many differences in standards, frameworks, and methodologies, investors and corporations will increasingly be concerned with the accuracy, comparability, and legal trust that can be placed in the data they use to report on or monitor compliance with legal and financial commitments.

Figure 2: reporting standards ecosystem



Significant progress in translating standards into technical systems

As standards are being refined and rolled out, incumbent financial institutions and start-ups are finding ways to create reporting from available data and transform it into indicators and metrics. This digitalisation is fostering collaboration across ecosystems for measuring, tracking and reporting carbon emissions in a uniform manner



and have led to market-led initiatives as well. Two such initiatives include the World Business Council for Sustainable Development's Partnership for Carbon Transparency (PACT) and the Net Zero Data Public Utility (NZPDU), both of which are also open to collaborate with other policy, regulatory and technical initiatives.

Technical infrastructure and tools for machine sourced data exist, and are proliferating

Independent of green reporting requirements, sophisticated and precise measurement, monitoring and analysis technologies are being adopted – at least by larger companies. Many companies that design or operate machines or infrastructure, or deploy materials from agriculture to buildings are advanced in collecting, monitoring and using data for their own business purposes. Property companies are systematically installing smart metering and monitoring devices not only to report on but also control, charge for and optimise energy consumption. Logistics companies carefully track fuel consumption, track shipments, plan loads and routing to optimise operating and transport costs, and manage finances. Manufacturers and infrastructure companies are deploying IoT devices to monitor their energy, water and resource utilisation to improve their operational efficiencies. The hyper-scalers have introduced scalable cloud-based platforms that are accessible globally. Telecom companies are rolling out high speed 5G internet that reduce the coverage gap between the developed and developing markets. Application of artificial intelligence is becoming a common business practice to harness new data sources for business optimisation and efficiency.

Growing strategic value of data driven business models

Smart manufacturing with mobile, IoT, and 5G already supports the ambitions of the manufacturing and industrial sector as it allows for the removal of wires, which delivers agility and flexibility for the factory floor, freeing up opportunities to launch new products. It also supports critical IT through low latency and high reliability that enables autonomous machines; plus, it allows the handling of massive amounts of data in real time, which enables predictive maintenance and planning.

Challenges

There are operational, business, and governance challenges to overcome to enable robust and inclusive markets in green and other business data to scale. Trust and provenance in data moving across ecosystems need to be preserved and the capacity and interests of the long tail of smaller firms and markets on which global and local value chains rely on – where emissions are still often unchecked and growing – need to be addressed. Machines, measurement and monitoring devices can be set up as reliable sources of at least some of the data needed to track environmental impact and business operations. But devices need to be deployed, connected and plugged into an ecosystem that enables the source, scope, integrity and control over data to be established and verified.

Many companies lack incentives and capacity to collect data

Many vital stakeholders are spread across emerging and developing markets. With fast-growing economies, these markets are critical to climate and sustainability objectives. Many of these entities' scope 1 & 2 emissions are the scope 3 emissions of companies downstream and in advanced markets where business and regulatory requirements are most stringent. However, capacity constraints and underdeveloped engagement with global



policymakers and industry leaders have not helped these stakeholders prepare to comply with reporting obligations outside their jurisdictions and support broader transformation goals. Poor data quality upstream will undermine the reliability of the reporting down the value chain. Access to data is a critical constraint for SMEs' ESG assessment.

As a participant noted:

“80% of emissions – and many vital stakeholders – in the value chain emanate from MSMEs spread across emerging and developing markets with fast-growing economies that are critical to climate and sustainability objectives. However, these MSMEs do not have the same resources as incumbents and often focus on the survival of their businesses, not compliance with green directives. Yet, considering the scope 1 & 2 emissions of upstream entities are the scope 3 of downstream entities, the lack of reporting practices and poor data quality for this category leads to a poor understanding of scope 3 emissions for the corporation downstream. When considering that with the use of proxy data, carbon emission estimates can be off by as much as 1,000 to 3,000%, the need to build MSMEs' ESG reporting capacity and increase the granularity of scope 3 measurement is unquestionable, but the challenge is sizable.”

Another participant highlighted:

“We launched an initiative which offers support to 100 of our top SME suppliers to set up a platform to start measuring their carbon and taught them how to do carbon accounting. Even with this support, the participation from the suppliers was less than 10%. Demystifying sustainability for MSMEs, such as explaining scope 1, 2, and 3 and what it means for their business, is a challenge. It's not only about money; they don't even have half a person to learn about carbon accounting; their focus is on cash flow. Allocating time and resources to activities that don't have a clear upside on the business bottom line is not possible.”

Even where devices are deployed, only a fraction are connected

Despite the technological progress of the last 15 years and efforts of manufacturing industry and startups, over 85% of industrial assets are still dark; they are unconnected, usually unmonitored, and most sit at the SME level. This is the single largest hindrance to green reporting. It also creates business challenges. Although these issues are less acute in advanced markets, there are more than 100 countries in 2023 without, with 80% being low or middle-income countries, which overlap with most of Scope 3 countries, as noted by one roundtable participant.

As another participant of the roundtable noted:

“Much data is still untapped – however, we can only help surface this under-utilised asset if we address the root causes e.g. control, interoperability, market incentives”.



Sustainable business models needed to deploy technology

The technical ability to monitor and measure climate impact of production processes is not being deployed. Re-tooling of machines, deployment of new production facilities and equipment as well as the training of staff all generate expenses and consume management time. But they may not lead directly to increases in revenue to fund the corresponding investment. New business models for deploying devices are emerging. Some entail monitoring as a service, through which devices and deployment costs are borne by third parties and recouped through variable fees. But more coordination may be needed to combine the power of public funding, VC investments and green finance to expand adoption and deployment of smart manufacturing approaches. The investment community needs to be mobilised to help companies join this process of IoT adoption for the sake of greening industry.

Where it exists, data interoperability is low

The environment of devices is currently heterogeneous and unstandardised. Interoperability of devices across technical, organisational, and industry boundaries is required. Environmental regulations increasingly require companies to report on their impacts (known as "double materiality"), including carbon, and climate transition plans supporting their countries' decarbonisation targets. Countries also need to report on their progress towards the broader Paris agenda, including the UN's Sustainable Development Goals (SDGs) signed by all 193 UN member states in 2015, and serves a universal framework for companies and countries to report on progress. This requires common metrics and impact accounting standards that allow us to aggregate data at product, company, industry and country level to help companies and governments measure their impact and track progress against global goals.

Agreement on common standards – still work to be done

The financial industry needs common standards and to agree on which indicators we use to measure, assess and drive financial decisions that help to allocate the right capital, invest in the right things, steer portfolios (balancing upside, downside and impact), and develop targeted products and services. Given their global relevance, an insurance-driven initiative³ has chosen the SDGs. To measure insurance impact, the UN indicators needed to be translated from country level to sector-specific, to effectively measure sector-specific contributions and enable companies to steer efforts accordingly. All industrial activity will have an impact, often contributing and harming simultaneously. For instance, for SDG 7 (Affordable and Clean Energy), insuring fossil energy capacity will enhance access to energy (and thereby affordability, as well as enhance energy security) but simultaneously generate carbon and pollution. By setting financial metrics side-by-side with risk and impact metrics, financial institutions can assess trade-offs, simulate scenarios, and best design products, steer portfolios, and transition strategies.

Concerns about trust and control persist

While a growing array of companies do collect granular data, they understandably want to control usage and access to it by third parties. Data about production, suppliers, emissions is of strategic and operational value. Providing it to platforms and reporting bodies can undermine companies' ability to compete or to reap benefits from data within their networks. Sharing data requires that operating companies have not only legal protections in place but ultimately trust the service providers and platforms to which they provide access. Emerging rules on

³ [ICMIF launches world's first Insurance SDG Benchmark measuring the impact of insurance on the UN Sustainable Development Goals - International Cooperative and Mutual Insurance Federation](#)



data protection, privacy and rights create additional risks and complications for companies. The legal handling of data, industry practices, and mechanisms for analysis and storage are not yet adequate to digitally manage the varied and nuanced roles and rights stakeholders have to access or use data.

A participant also noted the extent to which data is siloed:

“Data sharing is not something that is encouraged; cost and culture are big hindrances, even where there is good optimisation use cases which make sense in the West, they do not make sense there because of the cost of labor. We have another problem in developed countries. Internally, in the factory, there is an IT team and OT who do not talk to each other; they have different people, different sets of protocols, so making these units talk, coordinate, and connect is already a real challenge to get the uptake benefit of connectivity.”

Institutional gaps undermine tracking provenance and integrity across networks

Connecting data across markets, companies and through various transformation processes is very complex. The underlying operations and causes of emissions are varied; the technical capacity and methods to source data are heterogeneous. There are concerns whether adequate integrity and accuracy of data can be assured while also tracing its provenance across different actors and processes, combining if from across different networks, countries and companies. Even if technically and organisationally feasible, the costs of collecting and confirming data are on the rise.

Different approaches are emerging, but common foundations are lacking

There is dynamic yet still evolving ecosystem of centralised platforms, blockchain networks, data collection coalitions and networks as well as a growing array of analytical tools and specialists. A wide array of service providers plays important roles in assisting companies in their efforts to first navigate the complexity of reporting obligations, including their regional and sector-specific nuances, and compliance with current and emerging standards. But these efforts may not by themselves be able to solve for gaps in inter-operability and trust while still addressing all the capacity gaps of smaller firms and in emerging markets. There are many overlapping ecosystems across which data cannot easily be exchanged without breaking the chain of data identity, provenance and trust. There are platforms that while technically scalable, cannot by themselves sustainably reach all the actors needed to fulfil the coverage required for full scope 3 and related reporting.

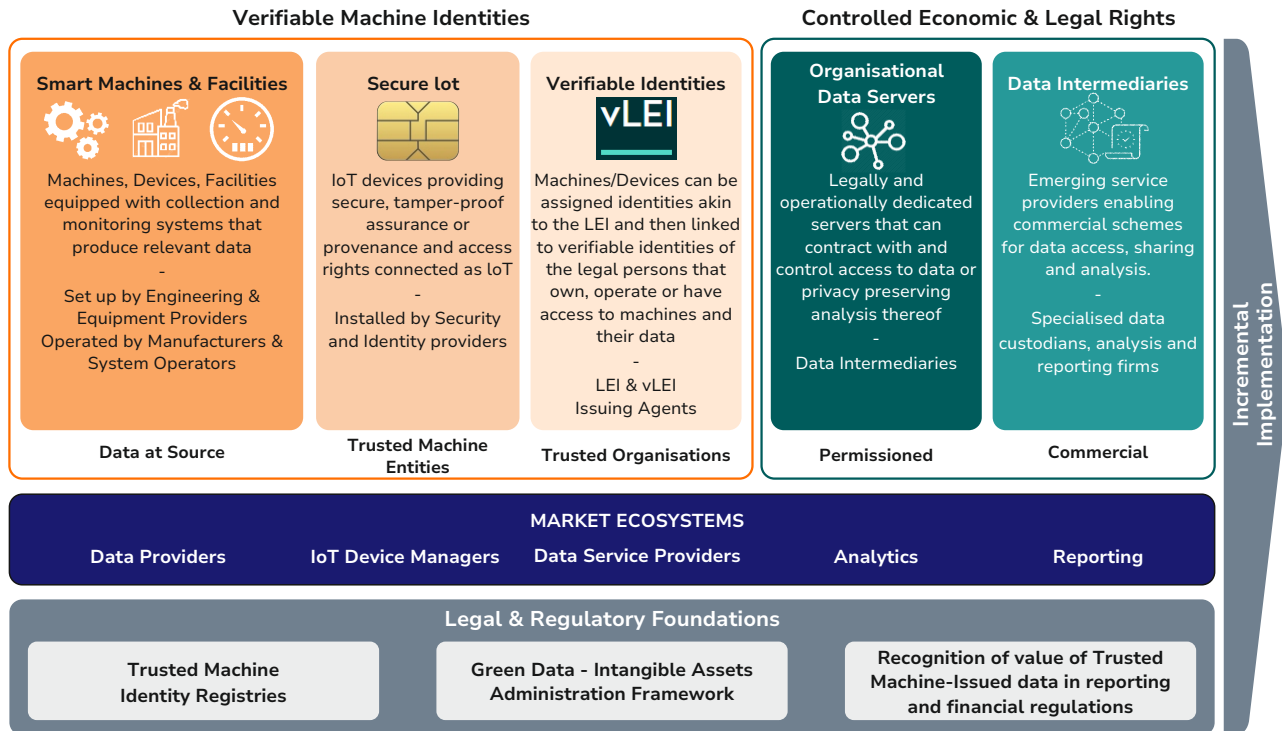
A practical framework

Practical and incremental steps can be taken to source and share granular traceable data. Stakeholders considered that there are some pragmatic steps that can foster interoperability and trust through a framework for machine identity, linking it back to the identity of data issuers, setting out appropriate rights to control access and share data and enabling companies further up the chain to trust its provenance and authenticity. These need to be grounded in an understanding of the interests and role of existing stakeholders within the market ecosystem and grounded in discrete links to and foundations in national and private law, working with governments that advocate for open and multilateral markets.



This section outlines key concepts and considerations stakeholders debated in the roundtable.

Figure 3: Framework overview



From private devices to verifiable machine identities

Like solutions for trusted identities of companies and people, machines and devices now need a non-state and interoperable identity framework to reliably record and originate granular data. The international community can build on precedents from high security industries such as medical devices and the aircraft industry as well as automobiles, where devices already have unique IDs and controls to track data or changes. Some work has already been started by the ISO TR307 on digital identifiers. Similarly, an inherently international approach building on existing infrastructures can leverage the learnings in governance and institutional design from GLEIF and the stakeholders in its Regulatory Oversight Committee. Step by step, existing identities, assurance companies and security application services providers see the opportunity to assign machines and sets of devices with identities to which granular data can be tagged as it moves between and across organisations.

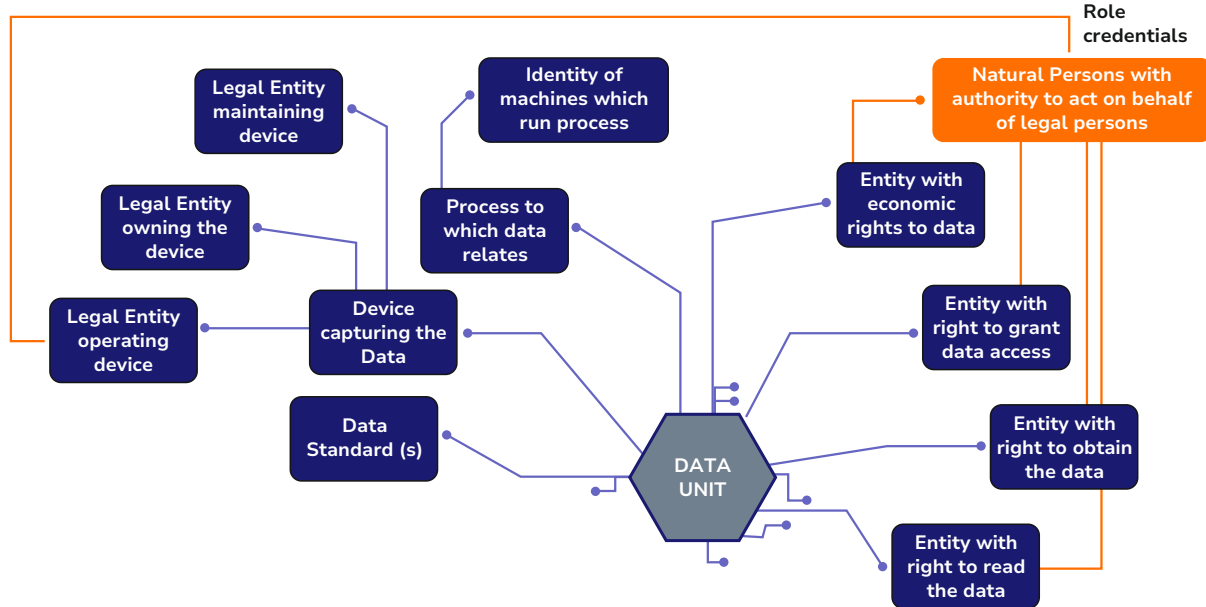
Exercising nuanced legal and economic data rights and controls

Stakeholders emphasised the varied array of rights, forms of access and usage and latent risks to parties of sharing not just underlying but also meta data related to their environmental footprint. Advances in technical and legal approaches to data sharing ecosystems can enable us to set real-world data rights, relations and permissions at a very granular level while according both legal and operational rights to data to appropriate actors in the ecosystem.



Figure 4: illustrative array of relationships between stakeholders, machines and green data

Data Consent Relationships



Permission-based data management and consent

A consent framework needs to enable participants to trust arrangements used to manage access to or sharing of data. Multiple parties have, in practice, different rights to data in different forms; sometime to obtain the actual data, but more often or more simply to read it or obtain information about it, or derived from analysis of it. By designing and linking organisational roles and data rights and relationships of legal entities to machine entities, machine-issued or product data can be controlled in more nuanced ways. Originators of data – or those controlling machines – need to be assured that data is not being shared in ways that undermine their own commercial or strategic interests or may eventually exercise market power over them. Organisational servers and data intermediaries need to be under the control of the publishers of the data to assign privacy, sharing and monetisation policies on their data, thus encouraging wider sharing of the data and development of new business models. Having more granular data about direct or indirect carbon emissions from different production steps and processes along supply chains could also help inform policy makers as they seek to prioritise interventions that can have the most impact on reducing overall emissions.

Commercial data access and exchange, driven by intermediaries

A trust framework for decentralised data verification, event management and data exchange enables the data to be shared while verifying provenance, integrity and the rights and roles of legally recognised entities to the underlying data. This would consist workflow processes for independent verification and management of access to data while preserving data sovereignty, confidentiality and ownership. Initiatives like PACT and NZDPU already provide the framework and data schema shared among various industry players. In comparison to a reporting framework, it is not meant to describe how things should be done but rather to facilitate the technical data exchange between entities in the value chain, responding to the Scope 3 measurement challenge. When devices capture data, legal entities prepare this data, and industry initiatives describe the structure of that data, the interpretation, and the calculation methods, PACT can then enable the digital exchange of that data so that value chain actors from the top to the bottom are enabled to integrate carbon performance into their decision-making.



Harnessing capabilities and ambitions of ecosystem stakeholders

There is already a sophisticated ecosystem of specialist firms that collect and tag data, and help their clients manage and analyse it for reporting purposes. These firms and collaborative initiatives are still needed to set up the identifiers and taxonomies for data collection and management. An effective framework will provide these actors with incentives for the deployment and verification of machine identities and the means for data interoperability to be extended beyond their own ecosystems. Specialists will be essential in applying their deep sector and product knowledge to schemas for bundling devices and machines at the right level to put the data tagged to them into meaningful and practical units.

Business models to support the transformation of data suppliers

Tracked data and access controls can enable new models to fund the costs and skills needed to deploy devices and adopt more data-driven operational practices. Reliable and granular data should attract a premium, either through lower risks or lower costs, as well as capacity to optimise business operations. An efficient market-oriented framework will enable intermediaries and supply chain anchors to reallocate some of these gains to provide fund technology deployments. Venture capital firms active in new IoT recognise that there are new deployment business models including through data collection as a service that can be better supported if granular data access controls are available to enable volume-driven pay-by-use monetisation.

Setting public-private legal and regulatory foundations

Scalable data ecosystems need to be able to operate across jurisdictional boundaries, yet still enable actors to comply with and have the security of recourse to national legal systems. A framework for trusted machine-issued data can rely substantially on private law and networks. But ultimate liability and appeals will depend on their treatment under national and international law.

Machine identities can benefit from **registers anchored in national legal systems**, recognised by one or more national governments. This can form the basis for integration into private law agreements as well as international accords. An assurance framework should draw on national standards and institutions for setting minimum requirements and arrangements for verification and issuance of unique identity numbers. Registers could potentially be internationalised through treaties comparable to the Cape Town Agreement for aircraft parts; but more practically, they could start from a small group of like-minded countries and the replication of indirect issuance and verification services such as those operating under the Global Legal Entity Identifier System or through independent assurance bodies⁴.

Economic rights and revenues derived from sharing data should be recognised as distinct albeit **intangible assets, with their own administrative and fiscal arrangements** akin to the status of copyrights, patents or other immaterial assets. A regime should be set up for handling the administration of and fiscal revenues from machine-issued data, regardless of the jurisdiction in which a machine is physically located, monitored or used. Some jurisdictions enable such intangible assets (e.g. film, music or book rights, patents) and revenues derived from them to be registered and managed in one jurisdiction despite their usage covering many other countries around the world. This will be essential to unlock market forces to motivate the transformation, by enabling data access to be treated in a more nuanced way, without getting tied up in debates about data ownership⁵.

⁴ See for instance members of the IIOA: <https://iioa.global>

⁵ The notion that of data ownership can be treated by the law in ways akin to physical objects has largely been unproductive. Data is an obtuse concept; its value is not in 'possessing' it but being able to access, enhance and use "it". Access to and usage of data has a value that is evident from the rise of many digital platforms but the approach to enabling its monetisation by producers of it requires a flow rather than a stock-based approach to its economics. Further insights into the legal issues and debate can be found in [Calzolari, Giacomo and Cheysson, Anatole and Rovatti, Riccardo, Machine Data: Market and Analytics \(January 23, 2023\)](#).



Reporting requirements and regulations, particularly in financial markets, should explicitly **recognise the superior value of verified machine-issued data** over unverified data. With mounting pressure on companies to apply with a myriad array of reporting requirements, liability and the repercussions of gaps or inaccuracies in data are yet to be tested. But authorities should have a vested interest in creating favourable conditions for trusted data sources and could directly or indirectly induce financial markets to recognise higher quality data through lower costs of finance or premiums.

Components of incremental implementation

A practical framework for trusted, granular and inclusive data markets for green reporting can be built upon emerging digital public infrastructure. A well-designed governance mechanism in digital public infrastructure creates incentives that satisfy the self-interest of all stakeholders to drive the adoption and funding of these new market structures. The role of digitalisation in driving the green transition is understood by public agencies supporting it through regulations and funding schemes.

Incremental enhancement of product or machine level data

Stakeholders can start with products and machine identities that are already well defined. It is important to have operational products, machine or groups of machines that can be uniquely identified as meaningful “objects” to which carbon emission data packages can be attributed. While value chains and production process are heterogeneous and often complex, at many points of production and logistics, objects are already securely defined and tracked, assigned with proprietary identities. A starting point is to build around well-defined objects and processes for which we already have identities and data. Provenance and granularity of data corresponding to inputs can be isolated and classed by their level of assurance or and integrity. The methods for improving each data component can be worked on in sequence without undermining the clarity of the remaining inputs. This would need to be aligned with and build upon a register of applicable carbon accounting measurement and accounting standards that can be reliably deployed to standardised product or machine units and could draw on work within PACT on developing harmonised product-level accounting standards

Tap market-based incentives for companies to make it inclusive

A market-based incentive structure is required to unlock the potential of data sharing. After taking stock of existing practices and rules pertaining to the establishment of data provenance and interoperability, and considering the assurances and capabilities, a suitable incentive scheme is required. This will remove business challenges such as resource allocation to green reporting by incentivising the entities reporting their data and addressing their concerns regarding data sharing. This empowers and supports SMEs to collect data and deploy data capture and measurement tools, while equipping firms with the capability to control access to that data. An ecosystem that attains granularity in data collection and drastically reduces the cost of assuring integrity, increases information usability for strategic decision-making, financial products, and reporting.

A prototype register and regulatory framework

Digital Identities and credential systems enable linking objects and persons (in their roles as officers) to the legal entity accountable for that object/person. With robust governance based on both public and private governance committees, GLEIF offers a backbone for the issuance of trusted digital identities for legal entities. GLEIF is also supporting the development and deployment of “role credential” (such as for the Chief Executive or Financial



Officer of a company) that enable to verify who has signed data or declarations on behalf of a legal entity and whether they are authorised to do so. A similar approach could be developed to apply to machines and IoT devices, or monitoring devices connected to machines and objects – enabling the verification of identity and credentials issued by that identity to serve the needs of ESG reporting, data collection, authenticity, and traceability of data. GLEIF's Regulatory Oversight Committee (ROC) provides an example of how governments can provide a robust link to national law and regulation without recourse to complex multilateral treaties or non-scalable equivalence.

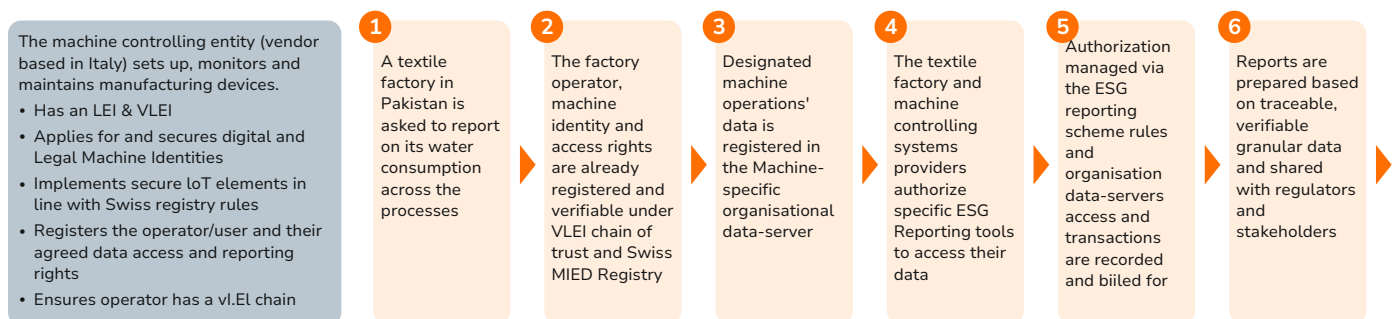
Piloting trusted machine-issued green data reporting standards

Authorities responsible for green reporting should play a pivotal role in piloting machine-issued data standards. Multi-party innovation programmes should integrate a prototype arrangement into operational tests modelled on innovation hub programs. This can create practical opportunities for different stakeholders across government agencies and the private sector to work through design and governance issues while trying to promote more scalable and robust ways to not only comply with reporting obligations but contribute to the overarching goals of transforming the economy to address climate and environmental challenges.

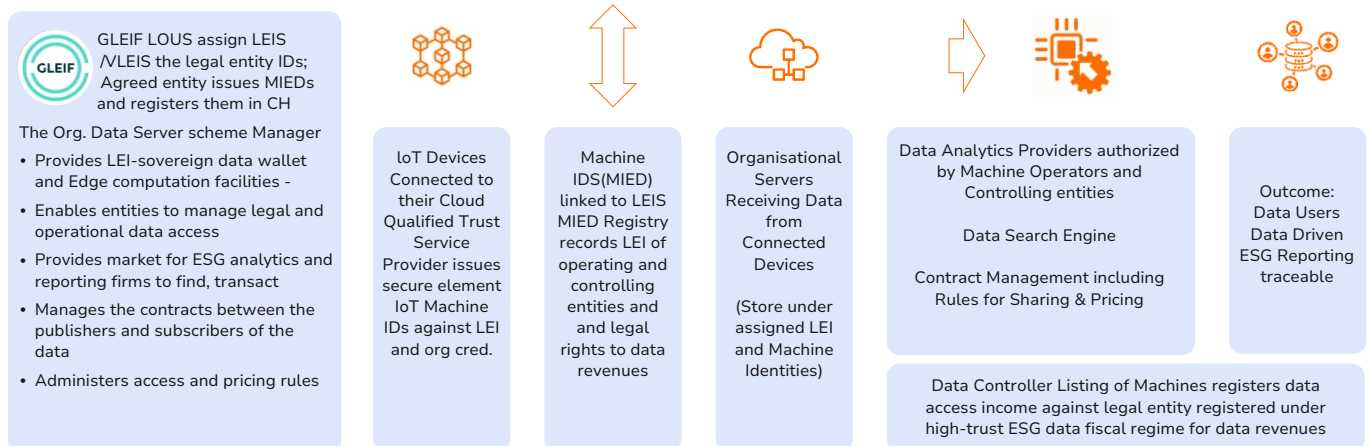
Figure 5: Implementation example

Implementation example: Textile industry incorporating incentives for data reporting & monetization

End User Functions



Supporting Institutions & Infrastructure





Potential pilot workstreams

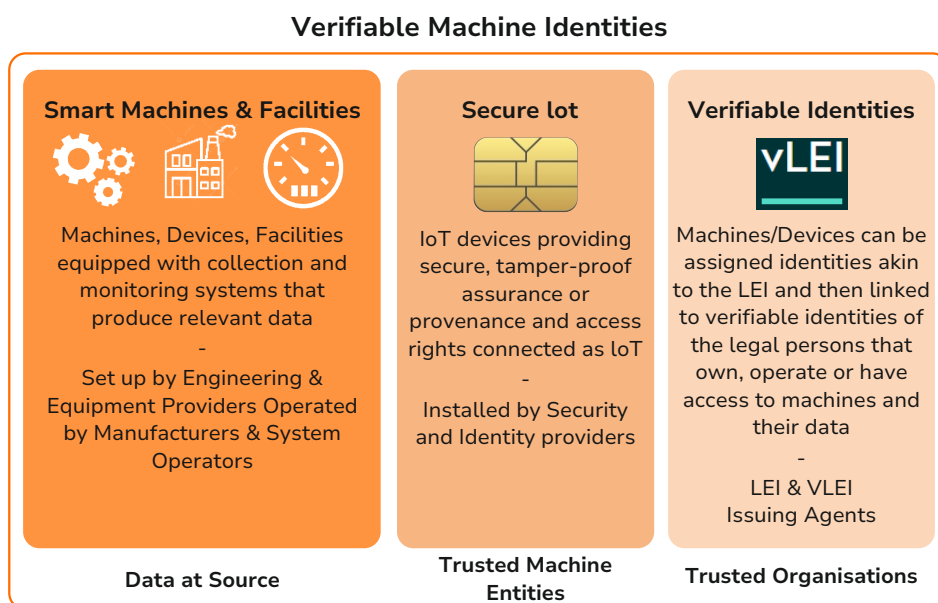
Trusted machine IDs are essential for trusting machine-issued data. For machine IDs to be reliable themselves and globally accepted, mechanisms are required to issue and verify the identity of such machines, their integrity and the rights of entities controlling or using them. These could be limited to proprietary or national networks. Incentives mechanisms are needed promote the adoption of machine IDs.

What do we need?

A framework for trusted machines and verifiable data will require some core elements to be designed in collaboration with relevant stakeholders and embedded in legal frameworks that allow for operations across jurisdictions. Significant progress can be made by building on existing international and industry initiatives and architectures, including those provided by GLEIF, the WC3, ISO working groups and the decentralised identity foundation.

There is an opportunity for forward-thinking jurisdictions to support the development of the legal and regulatory foundations needed for harmonised legally acceptable machine IDs and ID management systems.

Figure 6: Machine ID components - illustrative



Core components needed to design trusted machine-issued data include:

1. Machine or object Identity standards

Machines, devices and objects will need unique identifiers following standards compatible with and building upon existing frameworks such as the ISO standards for legal entities, GS1 product codes, BICs for containers and industry specific arrangements such as for medical devices or aircraft parts. Work by the ISO TR307 technical working group on identifiers of objects and machines can also be built upon in developing appropriate standards. Expertise will be required for setting out principles for linking objects, devices and machines that together constitute real world units of production that can be practically used as a basis for data collection and tracking.



2. Trusted machine standards and assurance network

Requirements for trusted machine status will be required to ensure that machines issuing data are secure, access is appropriately controlled and that technical and operational quality standards are in place to protect against tampering and fraud. A network of assurance agents could be mobilised to help issue verifiable machine identity and register and update status of qualified devices.

3. Online registry

An open and secure registry of machines, their status, their controllers and other pertinent information must be maintained and open for appropriate access to verify identities of machines and the veracity of data credentials issued from them. Machine controllers and qualified issuers must be required to update data on the registry in accordance with scheme rules to be defined.

4. A conceptual framework for dealing with data of mixed assurance levels

Not all data can be machine-issued or traced through all the steps of production and transformation that aggregate emissions and impact. There must be a practical modular approach to reporting that acknowledges that data tagged to an object at a given stage of its production may have different levels of accuracy, sourcing and assurance. An incremental approach to introducing trusted machine-issued data is required. Initial pilots may need to be designed around specific sectors, production chains and process levels, with constructive input from advanced industry stakeholders.

5. Recognition within financial and scope 3 reporting regulations of the value of trusted machine-issued data

Regulators in charge of setting and enforcing disclosure standards for scope 3 reporting should design ways to differentiate between self-declared and verified machine-issued data. There needs to be mechanisms for superior data quality to be reflected in commercial incentives, such as lower costs of finance, audit or administrative procedures.

6. Integration with consent-based data sharing networks

Consent-based and market-driven data sharing will require the different roles and rights of legal entities to machines and data to be clearly defined and embedded in the consent-based architecture and cryptographic services used to verify data authenticity and provenance. The registry and legal framework can build upon the foundations provided by GLEIF and related initiatives for inter-connecting ledgers⁶.

These elements of the framework for machine-issued data could be developed via an operational, iterative pilot project anchored with one or more set of industry stakeholders and jurisdictions. Governments with interest in promoting green finance and data services innovations could be called upon to support the feasibility study and help to integrate it within legal and administrative frameworks to clearly identify the different legal and economic rights to data produced and managed by machines⁷. The pilot would also build upon operational data sharing consent frameworks and initiatives responding to the broader need for digital public infrastructures.

⁶ This could include collaboration with the initiative to support unified ledgers, as outlined in the recent BIS publication on the "Finternet" (see <https://www.bis.org/publ/work1178.htm>).

⁷ This could draw on administrative regimes for other immaterial assets such as copyrights, patents and music rights, that may be registered in one country but be used and generate income from use in third countries. This could help unlock economic incentives for data issuers or machine controllers.



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