



WHITEPAPER

The Missing Link: How A Distributed Ledger System Can Support Global Climate Action

A Collaboration for Sustainable Land Use, from Climate Advisers, Lestari Capital and Lykke Corp

Written by:

Lynn Connolly, Lykke Corporation

Erika Drazen, Climate Advisers

Gabriel Eickhoff, Lestari Capital

Peter Graham, Climate Advisers

Gabriel Thoumi, CFA, FRM, Climate Advisers

Devan Wardwell, Lestari Capital

INTRODUCTION

Integrating environmental factors into a business strategy is not only a broad and deep process, but it will also involve big jumps and innovation.

Johan Schot, “The challenge of going green” Harvard Business Review.¹

The objective of this whitepaper is to support climate action by promoting the development of tracking and traceability mechanisms that are built on new technology with inherent, web-based transparency systems. Distributed Ledger Technology (DLT) is an easily deployable technology that can play a critical underlying role in meeting the objectives of the Paris Agreement, which requires an immediate and dramatic shift of our global economic systems. DLT has the potential to demonstrate how Non-State Actors and private sector companies in particular perform against their stated climate objectives, by making new data publicly available, that is directly incorporated into a wide range of financial transactions.

The world’s natural resources, including geology, forests, soils, air, water and living organisms, are finite and precious, and yet until recently, the private sector operated without accounting for the true value of this natural capital. The push towards greater valuation of natural capital, including internal carbon pricing and recognition of various environmental impacts, is a trend only begun by the corporate sector at scale within the last 5 years.

A landmark report by UNEP in 2013 estimated that major global industries accumulated more than \$7.3 trillion worth of “externalities” or unaccounted liability costs related to the effects of their operations. This sum is based on a financial valuation of effects on third parties and the environment, including greenhouse gas (GHG) emissions and negative impacts on forests, watersheds and ecosystems. The report ultimately concluded that if these natural capital assets did have an economic value and the costs of environmental damage were accounted for, then the profits of sectors like oil, gas, agriculture, forestry, cement and steel “would be wiped out”.²

The emergence of quantitative financial research along with growing recognition of the necessity for climate action has resulted in a shifting private sector in 2017. The rise in corporate commitments in support of Paris targets is encouraging. According to the United Nations Framework Convention on Climate Change (UNFCCC), more than 2,200 companies have made new commitments supporting various components of the Paris Agreement since its inception, backed by investors representing over \$17 trillion in market capitalization.³

The departure from a top-down, “one size fits all” approach to international environmental policy is widely considered one of the greatest achievements of the Paris Agreement. By eschewing a centralized approach for more diversified and inclusive policy-making, the rate of voluntary commitments from the private sector

¹ <https://hbr.org/1994/07/the-challenge-of-going-green>

² TEEB (2013), The Economics of Ecosystems and Biodiversity: Mainstreaming the Economics of Nature: A Synthesis of the Approach, Conclusions and Recommendations of TEEB. <http://www.teebweb.org/our-publications/teeb-study-reports/synthesis-report/>

³ <https://www.nrdc.org/experts/companies-did-or-did-not-defend-paris-agreement>

has accelerated. Business leaders have begun to recognize the advantages of pre-empting a stratified regulatory environment and are responding to increasing pressure from consumers and partners that demand action and accountability. Awareness of climate-related business risks is also growing, particularly for industries that rely on natural capital. To meet emissions reductions commitments, policy makers, regulators and industry sustainability bodies are also creating more demanding restrictions for the commodities, transportation and energy sectors, along with other large drivers of GHG emissions.

Collective action of this nature is both unprecedented, and fundamentally necessary to restructure the systems where companies collide with our environment. Encouragingly, conservationists, policy makers and private sector companies are coming together, often for the first time, to mobilize around the common '2-degree Celsius goal'. Yet with this unprecedented action also comes an unprecedented capacity and monitoring headache. The inclusive nature of the Paris Agreement and the resulting surge in commitments, particularly from the private sector, has created a wide range of actors that now fall under emerging national and jurisdictional GHG accounting systems.

Under the UNFCCC, countries must provide national inventory reports on GHG emissions and removals and Biennial (Update) reports on policies and measures that support long-term targets.⁴ These emerging reporting systems face both a domestic challenge of engaging a range of actors, along with a global one, where their GHG inventory and accounting data must also mesh within an international framework for reporting on, and eventual accountability for, results. The most critical inhibitor to success in these relationships is transparency and traceability of verifiable data, a necessary precursor to accountability. Only with greater visibility can progress be tracked and parties held accountable for climate and sustainability mandates, including sustainable supply chains, zero-deforestation goals and corporate emissions caps.

Greater accountability in our market systems requires a valuation of natural capital assets, in a way that equitably reflects the true value of these precious resources. While emissions trading or compensation strategies have detractors, these programs work within a market context, helping shift the forces that drive emissions, deforestation and environmental degradation. By framing the dynamic in a language of financial deterrents and incentives, markets can easily understand and react, but only if there is accurate and complete data to inspire action and increase pressure.

How can a change in our accounting practices be revolutionary? DLT has the potential to create consensus, based on data, between entities that may not necessarily trust each other. DLT can be integrated into market systems, offering greater transparency in transactions that currently lack visibility, and which are a source of continual tension between environmental campaigners and Fortune 500 companies. Quantitative, real-time, validated sustainability information, made available to anyone with an internet connection, has the power to ultimately drive a series of cascading actions throughout global supply chains.

The tools necessary to establish consensus on the accuracy of data are the foundation for DLT systems, which are built to require transparent and immutable information that can be made readily accessible

⁴ The required contents and level of details of national reports and/or the timetable for their submission are different for developed and developing country Parties. This is in accordance with the principle of "common but differentiated responsibilities" enshrined in the Convention. <http://unfccc.int/focus/mitigation/items/7173.php>

through an android or iOS app. Such data could enable climate advocates, governments, consumer goods manufacturers and the financial sector to analyze and assess how a wide range of private sector companies and other non-state actors are performing against their stated conservation, environmental impact and emissions reductions commitments.

WHAT IS DISTRIBUTED LEDGER TECHNOLOGY?

Distributed Ledger Technology (DLT), provides a highly trusted solution for maintaining the integrity of transactions between counterparties. DLT systems enable the processing of transactions such that the transaction data is immutable, transparent and remains secure over a decentralized network. Compared to centralized, legacy accounting systems, with little to no verification independence; DLT is relatively inexpensive and flexible, and provides independent verification of transaction parameters. A verification system that relies on an independent group of validators provides a high degree of

DLT: We are using the acronym DLT to refer to blockchain based distributed ledger systems and the wider family of potentially emerging and related technologies. Currently, blockchain is the most recognizable and widely used form of DLT systems.

integrity and trust throughout the entire transaction process, and has the capacity to track each link in a global supply chain to final settlement. DLT provides an immutable and trusted audit trail of the transactions, providing any interested stakeholder with the same information, data, and transparency on the lifecycle of the transaction. With DLT, this data can also be accessed through a smart device with an Internet connection offering features that were unavailable or cumbersome with older legacy technologies. A wide-ranging group of actors are researching how to leverage this technology, from supply chain giants like Walmart and Amazon to the Government of Sweden, which is developing a land registry powered by DLT.

The fundamental principles by which all DLT systems operate can offer insight into the potential for this new technology as to serve as a foundation for tracking and traceability mechanisms that support climate action, including:

- **Distributed:** DLT is completely distributed, meaning it can be accessed by any user with a smart device and does not rely on a centralized entity like a bank or registry. Several computers keep redundant copies of the data to be agreed upon which eliminates the requirement for a single entity to maintain the 'canonical' record of data, which in turn leads to a highly resilient and fault-tolerant system. In addition, decentralized data reduces costs and ensures records are still retained if one point in the chain were to fail.
- **Traceable:** DLT provides users with readily accessible data on relevant information for any product, starting from the origination point to the final transaction. In the palm oil industry, this could mean the ingredient in a final retail product can be traced back through the entirety of the supply chain to the plantation where it was harvested. This would enable large commodities buyers to make more informed purchasing decisions and better-respond to consumers demanding greater sustainability.
- **Community-Verified:** The transaction verification process for DLT is crowdsourced to transaction validators around the world.
 - A minimum of two unrelated validators are required to verify and confirm each element of data in each transaction.

- Consensus is determined through a matching process, as the data is entered by each a party to the transaction. This is checked by a 3rd-party validator.
 - Importantly, validators cannot determine if the original data entered the DLT system was correct, but they can quickly determine if the transaction parameters between the counterparties do not match up to each other, whereby the transaction is not verified.
 - Transactions may also enter the DLT system in an encrypted state, enabling the validators to determine that actual transaction parameters match the information entered by each counterparty, thus they do not need to see “inside the envelope”.
 - Validators are independent to the transaction, and therefore this verification process results in an immutable, highly trusted transaction. Once verified, information is “cryptographically hashed” in the system, meaning it is permanently recorded in the DLT system with a timestamp and can be accessible to everyone on the DLT network. This approach enables both trust in the data and amongst participants in the system.
- **Immutable:** DLT’s verification system, based on consensus protocols, ensures transactions are tracked in a way that cannot be modified. This adds elements of trust that were previously only offered by a single point of data entry on a legacy system. Redundant controls are built into the technology to secure information, ensuring that in the highly unlikely chance data were altered, any modification would be obvious and traceable.
 - **Transparent:** DLT transactions and data are transparent and visible to any user in the system.
 - **Accountable:** DLT data can be displayed through an app that provides details on each transaction. This data is highly reliable across various accounting and measurement systems, even if they are not developed in tandem. This could mean that when buying an airline ticket, a consumer could have easy access to data on how that company intends to offset the carbon emissions from that customer’s particular flight.
 - **Easily Deployable and Adaptable:** DLT data is accessed through an app residing on any smart device. It provides flexibility and adaptability as information can be deployed in any form, to any user. In addition, users can reference delineated data and perform their own measurement calculations.
 - **Low Cost:** DLT streamlines the transaction process, which eliminates the need for intermediaries, and cost efficiencies are achieved at every point in the development and transaction process.

In a climate context, DLT has long-term potential to serve as a foundation for a new climate economy, supporting the global reorientation of markets, both by making them more efficient and by providing transparency that can lead to greater accountability. This bottom-up transparency tool can be the basis for recording any type of transaction, meaning DLT can shed light on how companies value natural capital and ultimately compensate for their impacts.

In the near term, there are immediate applications for DLT that can help advance pressures applied to private sector actors with a range of climate and sustainability commitments. However, while DLT can enable validity of the transaction, the underlying data also requires validation at the entry point or origin of the data. Therefore, a verification process on the data for “entry” to the DLT system also needs to occur.

DLT systems can also create value for an entirely new asset class based on natural capital. This is already happening in the renewable energy sector, where DLT systems are being used to build smarter power grids and

enable peer-to-peer energy sharing. The same model can be applied to ecosystem conservation and restoration initiatives, effectively establishing a market value to conserve endangered landscapes.

In summary, the social scalability of a DLT system has the long-term potential serve as a backbone for emerging environmental accountability systems, with native, fundamental properties of decentralization, trust-minimization and transparency built into the system. The frameworks now being developed for DLT systems can effectively meet the operational requirements for both traceable supply chains and the tracking of environmental finance from their origin specific to climate mitigation and adaptation activities on the ground. DLT systems also have the potential to enable a new class of transparent and fungible assets that are sourced from for our world's natural capital, which can create market value for natural assets in order to protect them. With the right support and directed effort, a DLT system could serve as the foundation for a new global reorientation towards a more environmentally accountable economy.

CORPORATE CLIMATE COMMITMENTS: THE NEED FOR VERIFICATION AND TRANSPARENCY IN CORPORATE OFFSETTING

The Paris Agreement is built on a “trust but verify” system, signed by national governments who are accountable to each other. Private sector companies, financial institutions, Non-State Actors and sub-national authorities are recognized as critical actors in the implementation of the Agreement but are not directly accountable. This leaves governments with the challenge of developing and enforcing legislation and policy necessary to achieve their promised targets, or Nationally Determined Contributions. Among the tools available, policy makers are evaluating opportunities for alignment with forward-thinking business leaders and industry sustainability bodies in the adoption of market-based mechanisms. While corporate emissions trading and other environmental compensation strategies have detractors, they remain one of the primary tools available to push market systems towards an accountable, sustainable and low carbon economy.

Consider the aviation industry. If international aviation were its own country, it would be one of the top ten highest emitters of carbon dioxide emissions in the world — and because this pollution is emitted at high altitudes, scientific research suggests it may exert an even more powerful warming effect. As the world's population and economies continue to grow, demand for international air travel is also rising, which will result in an estimated 56,000 new commercial passenger aircraft in the next 25 years. As a consequence, carbon emissions from aviation are forecast to rapidly increase in the next 25 years, possibly tripling or quadrupling by 2040.

The International Civil Aviation Organization (ICAO) and its 191 member states agreed in 2016 to implement a global market-based program to reduce emissions in the form of the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA), which will limit future increases in greenhouse gas emissions from international civil aviation to 2020 levels. ICAO's commitment also includes parameters for the world's first carbon dioxide efficiency standard for aircraft. Although the industry has already begun to implement more efficient operations, the vast majority of emissions reductions will be realized through the use of new fuel-efficient aircraft. Upgrading the world's fleet will take many years, and even after initial improvements in operational and technological efficiency, projections show an “emissions gap” of 7.8 billion tonnes of carbon dioxide over the period of 2020 to 2040. This combination of a hard cap, efficiency standards and a global market-based scheme is a pragmatic, short-term solution for mitigating emissions, in conjunction with long-term-emissions reductions strategies. The resulting economic incentive is expected to accelerate

efficiency gains, overcoming the business-as-usual inertia that exacerbates climate-related risk.

The emergence of ICAO's CORSIA and other global or international market-based incentives for emissions reductions creates opportunities to significantly scale up economic demand for forest conservation and restoration programs. At the same time, donors, investors and international and local conservation communities are seeking better transparency and traceability tools to ensure the deployment of any large-scale funding is efficient, effective, legitimate and complies with established social and environmental safeguards.

For a national government following the rules and guidance of the UNFCCC and its Paris Agreement, a transaction system with built-in transparency and traceability is needed to facilitate the use of domestic and international emissions trading systems. For those countries intending to access international market-based incentives for reducing emissions from deforestation and forest degradation and forest restoration (REDD+), there is a key operational requirement to register and track verified emissions reductions along with supporting data. A strong accounting solution to track the financial flows can reduce the risks from the perspective of a corporate buyer and provide this information for consumers. Where a national government permits the transfer of emissions reductions associated with project-level REDD+ activities, to an international airline, for example, a smart accounting system is also needed to facilitate the effective and verifiable integration of REDD+ activities into jurisdictional and national-level monitoring and reporting systems. While demand for GHG offsets is expected to increase these issues must be addressed through a solution that provides greater transparency and increases certainty of the validity of emissions reductions. Without a strong solution, the emerging environmental services sector risks a limit or delay private sector capital commitments which may ultimately limit the effectiveness of this effort to shift sectors and economies onto a sustainable, low emissions pathway.

HOW DLT CAN IMPROVE RESULTS-BASED PAYMENT SYSTEMS

A DLT system has the potential to serve as an efficient solution for those responsible for developing and implementing climate change strategies to meet jurisdictional or national targets. Once verified GHG emissions and reductions data (including the activity, location, time period, verifier and other relevant information) is entered into a DLT system, transactions associated with that data, including corporate offsetting or other sources of financial compensation for results, become fully transparent digital assets that can be reliably tracked from the first contractual arrangement at origin to final retirement.

In 2017, the growth in sustainability commitments, including sustainable supply chains, is even more relevant, given the heightened importance and increased rate of commitments from non-state and sub-national actors. With such a diverse group, the importance of encouraging and supporting these commitments often outweighs the onerous tasks of monitoring and verifying them long into the future. A neutral, democratized system such as DLT can help ensure greater consensus on records and support accountability efforts based on verified data. With traceable, immutable data that is publicly available, transparency data can then be tied to traditional market systems, creating a readily accessible pool of information for civil society watchdogs and policy makers alike.

At the grassroots level, more advocacy groups are paying greater attention to corporate sustainability efforts, as the levels of funding for initiatives such as climate and sustainability scorecards increase. A DLT

system can improve these reporting initiatives, by providing information previously only self-reported by corporations. A transaction system for tracking climate-linked corporate finance would, for example, enable stakeholders to track which airline companies are purchasing emissions units, what has been achieved with those investments and if they are meeting their stated goals. With new and more reliable data, watchdog organizations can more closely monitor these companies for possible greenwashing behavior, and consumers can make more informed decisions.

Similarly, in the commodities sector, sustainability certification bodies such as the Roundtable on Sustainable Palm Oil (RSPO) now require members to compensate for past clearance of High Conservation Value (HCV) land. In 2017, a group of more than 60 companies have declared outstanding deforestation liabilities, which must be redressed through forest restoration and conservation payments. Palm oil grower companies must meet these compensation requirements to maintain their membership in the RSPO, a certification that is becoming increasingly strategic as markets and consumers demand more sustainable commodities. For example, Felda Global Ventures' potential payment is estimated at \$5.2 million. These sizeable potential investments require an efficient, transparent, traceable and public system that as of yet does not exist. This system will need to track and monitor whether these companies are meeting their commitments equitably or have found a way to sidestep their responsibilities.

DLT systems have already been proposed as an effective tool among key proponents of the Paris Agreement, most recently at the 2016 UNFCCC conference in Marrakech (COP 22), to address the risk of double counting of emissions reductions within market-based frameworks. As awareness of the potential of DLT grows, it is being considered more widely as a solution to ensure the integrity of transactions and to track the flow of finance for results-based payment systems.

Examples of how a DLT system can benefit climate mandate tracking and traceability include:

- **Systems Integration:** DLT helps project-level initiatives successfully integrate into multiple, disparate systems increasing the potential and ease of adapting systems to meet new demands and/or opportunities to link with other systems. For instance, linkage to systems such as jurisdictional systems (including GHG emissions trading registries) would mitigate the issue of double counting, resulting in more reliable and accurate data.
- **Verification Via Transparency:** For climate mitigation and tracking, transaction parameters can also include information regarding the source of origin for the credit and/or product. This source of origin could also have a unique code similar to a serial number and can remain a part of all subsequent transactions throughout the supply chain as a data/parameter element. Therefore, where the transaction audit trail is stored on the DLT system by verifiers, it will also include any climate mandate parameters that were initially recorded. This audit trail can be accessed and be transparent to any user.
- **Climate Mitigation Tracking:** Information collected through a DLT based tracking system could be imported to an information dashboard to track how offsetting programs translate to real-world impacts, including for forests, peatlands biodiversity and emissions reductions. Financial transactions associated with activities to conserve forests and protect carbon sinks can be linked to achievement that support the UN Sustainable Development Goals.
- **Immediate and Long-Term Solution:** A well-formed, standardized natural asset on a DLT system would meet an immediate need to support greater adoption of REDD+ efforts, while also laying a strong

foundation to easily integrate such systems into disparate national and jurisdictional frameworks.

- **Empowering Stakeholders with Reliable Transparent Information:** Data resident on DLT systems can be used to arm consumers, policy makers, industry groups and other stakeholders with verifiable information that can be used to hold companies accountable.
- **Integrating Transparency Data Directly into Payment for Performance and Market Systems:** The traceability and transparency of data resident on DLT systems can also create stratification within capital markets, creating more value for high-performers and imposing sanctions on those who fail to back up their commitments with real action.

SOLARCOIN: A NEW SUSTAINABILITY CURRENCY

“What if there were not just an Internet of Information, but an Internet of Value? Some kind of global, vast distributed ledger that runs on millions of computers all around the world and that would enable anything of value to be stored and transacted in a secure way?”

-Don Tapscott, - Berkman Klein Center for Internet and Society at Harvard University⁵

Examples of how DLT is changing the sustainability space are already emerging. For example, SolarCoin is a new digital currency that can be generated by households and companies that produce solar energy. Using a system similar to airline miles, SolarCoin creates incentives to generate and sell fungible units accumulated from voluntary action to green economic growth from solar electricity.

SolarCoin’s system for recording and verification is built on DLT. This system makes it easy to trace, track, trade and exchange SolarCoins for other every day currencies, or even to buy products directly. A verified generator of solar energy can claim SolarCoins at no cost. Each circulating SolarCoin represents 1 MWh (megawatt hour) of solar electricity generated. Each 1 MWh of renewable electricity displaces more than 1,500 pounds of carbon dioxide that would have been released by burning fossil fuels like natural gas and coal.



From: <https://consumervaluecreation.com/2017/0>

By working closely with the solar industry, the SolarCoin Foundation facilitates the sustainability circle, promoting uptake for grassroots solar systems, creating jobs in the Renewable Energy sector, and supporting growing demand for renewable energy from consumers. In summary, SolarCoin can be a potential model for other natural asset classes built on results-based payments models, while potentially creating options for these natural assets to be offered directly to consumers.

⁵ <https://www.altoros.com/blog/the-internet-of-value-8-top-sectors-being-transformed-by-DLT/>

SUSTAINABLE SUPPLY CHAIN TRANSFORMATION: TRANSPARENCY AS A CATALYST

“It’s not surprising that people don’t know where things come from. That’s not the point of a commodity. You just buy it. But now we’re asking the commodity markets to change and start to care about where things come from, and it’s changing how companies do business.”

-Marco Albani, Director, Tropical Forest Alliance 2020

Forests are an integral part of the world’s climate efforts, and yet they are disappearing at an alarming rate. More than 46,000 square miles of forest are lost each year, the equivalent to 48 football fields every minute, and slightly smaller than the country of Costa Rica. The commodities industry alone (Soy, Pulp/Paper, Beef and Palm Oil) currently drives more than 75% of global deforestation, which translates to roughly 15% of global GHG emissions.⁶

Momentum to curb this impact is building, as more actors become focused on a forest protection agenda. Working groups like the Tropical Forest Alliance have brought together over 400 actors from business, government and civil society to remove deforestation from global supply chains by 2020. Since its inception in 2014, more than 190 governments, companies, indigenous peoples and civil society organizations have endorsed the landmark New York Declaration on Forests and its ambitious goal to protect forests and end natural forest loss by 2030.

Reduced costs and improvements in technology are making tools like satellite imagery, drones, and other data gathering systems more accessible than ever before, as these services develop new algorithms to track deforestation with unprecedented precision. In 2017, the World Resources Institute launched a global platform with Cargill and IOI Corporation that uses satellite monitoring to track and manage forest-related sustainability performance, allowing banks and other financial institutions to evaluate deforestation risk in their commodity investments. Other leading NGOs, including WWF, ZSL and Forest Trends are breaking new ground through in-depth research on the level and nature of corporate commitments. A recent example of the impact of this type of information was demonstrated by Chain Reaction Research, where drone video footage showing recent deforestation in Indonesia contributed to a large multinational company facing a \$5 million RSPO restoration and compensation liability.

These developments represent important progress, but still only one half of the equation, as they are not linked to the market systems that are driving deforestation and emissions. Demand is already rising for more traceable supply chains and sustainable product sourcing. Greater pressure, from consumers and policy makers can be applied if the information gathered by watchdogs can be coupled with supply-chain traceability, enabling a snapshot during each transaction that reflects the operations and environmental impact of an entire global supply chain.

DLT: TRANSPARENCY AND TRACEABILITY FOR SUPPLY CHAIN TRANSFORMATION

DLT technology can be useful to a wide range of supply chain actors and sustainability advocates. Actors responsible for determining if and how a company could implement a commitment to deforestation-free supply chains can find benefit in an easily-deployable technology that meets rising demand for traceability

⁶ <http://www.forestbonds.net/sites/default/files/userfiles/1file/6316-drivers-deforestation-report.pdf>

supply chains and offers an equitable smallholder solution. NGO watchdogs, sustainability coalitions and government policy makers that wish to address the drivers of deforestation at the supply chain, jurisdictional and national levels can also promote uptake within the corporate sector by supporting the implementation of DLT technology through advocacy campaigns and policy research.

Amid a trend of rising corporate commitments – up 200% from 2016 depending on some measures – and consumer awareness, deforestation is still happening. This is not for lack of effort, but lack of knowledge and traceability infrastructure, as an industry giant like Unilever simply cannot track its entire supply chain. More pressure can be applied by integrating sustainability scores directly into market transactions, which is one of the best tools to establish better visibility for how companies are tracking against their commitments. The transparency afforded by an open DLT system can incorporate market information into frameworks for transparency and thus can catalyze more informed action.

The key to achieving a shift towards more sustainable supply chains is to ensure the proper financial deterrents are in place to motivate companies to follow their commitments. Once deterrent mechanisms are put into action, it is equally important that companies compensate equitably, through redress mechanisms that seek to match the value of the natural capital that was destroyed through concession conversion or production. The process to catalyze this change across entire sectors is not an easy or rapid task, but technologies like DLT, that securely record and publicly disclose supply chain transactions can enable better verification of sustainability claims. Such a system assigns liability in every step of the process, providing that data is recorded by the parties involved.

The recordings of these transactions can also contain maps and carbon stock information and the exact location of the sourcing of the product. This will directly support climate mandates and other sustainability development goals. The secure recording of these transactions provides for verification of sustainability claims and helps assign liability in every step of the process, providing data is recorded by users. DLT can address the key drivers of deforestation in global supply chains in a number of unique ways, including:

- **Supports Financial Deterrent Mechanisms:** Various compensation programs, required by sustainability bodies like the RSPO and FSC, can benefit from the public disclosure and immutable transactions inherent in a DLT system.
- **Rapidly Deployable Traceability Solution:** Utilizing a DLT system as a backbone for a standardized supply chain system could significantly reduce the inputs required from involved parties, making implementation and maintenance more efficient. In addition, the DLT system can also be leveraged to track chain of custody procedures at each interaction or transaction in a commodity supply chain.
- **An Equitable Smallholder Solution:** A DLT system facilitates communication through data amongst all participants, ensuring data and transactions by various companies can all be integrated, thereby supporting more equitable purchase relationships even if smallholders do not have the latest technology.
- **Furtheres the Objectives of Watchdogs:** A DLT system would provide NGOs, civil society organizations, and other stakeholders, access to verified transaction information enabling them to hold giants like Unilever more accountable to their commitments to deforestation-free supply chains.

- **Supports National Climate and Forest Management Goals:** Integrating a DLT system into a National Forest Monitoring System (NFMS) and/or measurement, reporting and verification system for LULUCF could increase the scope of information collected and improve the quality of reporting and verification processes.
- **New Data for Scoring and Rating Systems:** A DLT system provides an entirely new ecosystem of market-linked data that can be used by governments, NGOs and consumers to assess companies' and governments' performance with respect to deforestation and other environmental commitments.
- **Promotes Trust Amongst Diverse Actors:** The data on a DLT system is immutable, highly transparent and decentralized.
- **Provides an Easily Adoptable Market Standard:** Downstream commodities buyers and consumer goods manufacturers can require their trading counterparts to use a DLT system, without requiring that they use a standard with a pre-defined set of criteria or one tied to a company/working group.

RECOMMENDATIONS FOR POLICY MAKERS: SUPPORTING TECHNOLOGY UPTAKE AND DIFFUSION

The Paris agreement's key to success depends on hammering out the details to build a robust transparency mechanism." – The Yale Center for Environment Law and Policy ⁷

The most important action for climate advocates and policy makers is continued support for more refined systems and processes to track how Non-State Actors are performing against national and international climate policy, with a focus on transparency and tracking of individual climate commitments. A DLT-based solution can be a foundation for advancing this priority, providing a new window into how the billions of transactions within our global economy interact with the environment. Policy makers can support the diffusion of this new technology through both the public and private sectors by promoting understanding of the concept and encouraging private companies to leverage this technology to make sustainability-related transaction data widely available to observers. Better information supports greater accountability, and enables climate-related commitments at scale, in support of relevant national and global climate efforts.

DLT has potential to level the playing field for developing countries and transitional economies by counteracting the impact of the 'trust' deficit, from an investor perspective, by facilitating high standards of verification. United Nations agencies can also be a strong vehicle for institutional diffusion, particularly through the UNFCCC, UNDP, FAO, UNEP, the Green Climate Fund, the Global Environment Facility and the national agencies responsible for international development assistance. Most, if not all, of these entities have committed to supporting implementation of the Paris Agreement, especially in supporting developing countries and transitional economies in the development and implementation of low emissions development plans that will meet or exceed Nationally Determined Contributions. Therefore, international institutions can play an important role in financing the research, and development and testing of DLT systems to accelerate diffusion.

The adoption of DLT technology has already begun today, but diffusion is still in its infancy, and has yet to reach fully commercialized level. Without additional support of public policy or international institutions, the private sector will continue to drive the diffusion of DLT at pace, which may not include the climate-related

⁷ <http://envirocenter.yale.edu/transparency-the-backbone-of-the-Paris-Agreement>

data elements that have the potential to offer better accountability. As new applications are tested and institutions and individuals become more comfortable with distributed ledger tools, the body of software engineers with distributed ledger fluency will increase, the cost to design applications will decrease and the rate of adoption will accelerate. Governments, national and international institutions, and other stakeholders can speed up diffusion of DLT by individually and collectively supporting applications of DLT systems that enhance various aspects of transparency and sustainability, particularly for the uses outlined in this paper. Further research into policy and operational applications is also needed to help speed up diffusion and raise awareness of the myriad benefits of this technology.

Below are sector-specific recommendations for policy makers, advisors and interested parties in how the benefits of DLT outlined in this paper can be realized in each unique context.

Suggested Next Steps for Jurisdictional and National Actors
Apply DLT systems to meet requirements of the Paris Agreement’s transparency framework
Integrate DLT into National GHG Registries, with application extended to tracking domestic emissions reduction policies, programmes and projects, including emissions trading / offset transactions
Explore integration of DLT into National Forest Monitoring Systems, with applications to support tracking REDD+ activities and non-carbon values, and which can link with land-use planning systems
Support research on DLT application in climate policy contexts, including carbon pricing, emissions trading, climate change impacts and adaptation

Suggested Next Steps for Private Sector Actors
Fund internal research and development on how DLT could improve transaction efficiency and associated cost-savings and contribute to sustainability and risk reduction
Pilot DLT applications in transaction systems involving commodities with potentially high GHG footprints, including those linked to deforestation
Offset project or programme developers use DLT to record and track transactions of verified emissions reductions
Support research on DLT application in climate-related policy contexts, including carbon pricing, emissions trading, climate change impacts and adaptation
Research cost-basis and test applications of DLT within supply chains, including links to local, smallholder suppliers

Suggested Next Steps for NGOs

Research application of DLT systems to improve transparency in implementation and financing of climate-related policies and measures, and to support application of social and environmental safeguards

Test application of DLT systems in payment-for-ecosystem service and other nature-based benefit sharing models, including improved access to information and benefits by local communities and indigenous peoples.

Explore the potential for DLT to help inform and target campaigns for greater supply chain and emissions trading transparency

Partner with public and private sector actors in piloting DLT-based transparency systems.