

Blockchain and the Climate Adaptation Imperative: Developing Effective Solutions to Bridge the Adaptation Gap



International Association for
Trusted Blockchain Applications

March 2022



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* This document was conceptualised by the Resilience and Adaptation Sub-Group under the Climate Action Working Group. A subsequent restructuring of the working groups has led to the Climate Action Working Group merging with the former Social Impact Working Group to form the Social Impact and Sustainability Working Group.



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Abstract

With a growing set of climate change-induced impacts affecting human and environmental systems, adaptation to these changes is increasingly needed. However, society in general is mostly unaware of the required actions beyond mitigation. Stakeholders lack a ‘toolkit’ that provides resources on analytical, financial and operational technologies, particularly related to adaptation. This is particularly true for blockchain technology, despite its potential to offer groundbreaking solutions for the climatically vulnerable.

The International Association of Trusted Blockchain Applications (INATBA) urges the blockchain community to actively collaborate with governments, communities and climate-vulnerable businesses to identify and develop a favourable environment for the development of blockchain applications that support better climate adaptation planning, investment and implementation. The industry needs a concerted, multi-stakeholder programme that promotes mutual awareness raising, engagement and standards-setting to marshal blockchain technology for climate adaptation.



1. Blockchain for Sustainability: Climate Adaptation is the Missing Element

Market analysts have highlighted the growth opportunities in climate adaptation technology, including an assessment that the global market in resilience and adaptation is already valued at \$3 billion with the ‘technology potential’ in the market estimated to grow by 14 % per year through 2024, bolstered by ‘high’ R&D and innovation potential and ‘very high’ IT application potential.¹

Blockchain applications have been widely used to enable secure, immutable and accessible processes related to data, analytics, and value conveyance within the sustainability sector. A large number of these applications specifically address the climate emergency.

However, and while there is considerable growth in IT applications for climate adaptation, in areas like big data, IoT, and data platform developments, the blockchain community has, likely unintentionally, ignored climate adaptation. Adaptation, or the process of adjustment to actual or expected climate change and its effects, has very few developed blockchain applications. Potential solutions would tackle the myriad of analytical, data transfer, finance and assurance aspects that limit adaptation action.

The authors of this report are INATBA members who believe the time is past due for a conscious mobilisation of blockchain to meet the adaptation challenge. We suggest that reasons for this inattention to climate adaptation are varied but may fundamentally come down to a lack of awareness and connections between the adaptation and blockchain communities. Linking the two communities, as we explore in this report, can be effectively achieved through a variety of initiatives involving government, business and third sector actors to take deliberate steps to encourage engagement and collaborative pilots.

While the blockchain community is relatively silent on climate adaptation, the world is awakening to the issue. Last year, for example, the World Economic Forum (WEF)² listed extreme weather as the most pressing global threat. All of the top five threats on WEF’s list are related to the climate emergency. Effects of climate change include severe and extreme weather events (heat, floods, drought, storms), destabilising ice sheets resulting in rising sea levels, loss of biodiversity, collapsing ecosystems and food systems, mass migration changes and spread of vector-borne diseases. Damage estimates under pessimistic but plausible (no further decarbonisation) climate scenarios include a quadrupling of the frequency of significant (>15 %) global grain yield failures by 2050³, up to one billion climate

¹ Climate Change Business Review (2021). *Technology Potential in the Climate Change Industry*, Volume XIV, NO. 7-8-9.

² Granados Franco, Emilio. “What Are the Biggest Risks to Business? New Data Shows Climate Concerns Are Rising.” *World Economic Forum*, 8 Oct. 2020, <https://www.weforum.org/agenda/2020/10/global-risks-interactive-map-shows-climate-issues-rising/>.

³ McKinsey Global Institute. “Climate Risk and Response: Physical Hazards and Socioeconomic Impacts.” *McKinsey Sustainability*, Jan. 2020, p. 74. <https://www.mckinsey.com/-/media/mckinsey/business%20functions/sustainability/our%20insights/climate%20risk%20and%20response%20physical%20hazards%20and%20socioeconomic%20impacts/mgi-climate-risk-and-response-full-report-vf.pdf>.



refugees by 2050⁴, loss of capital stock to flooding increasing from today's \$35 billion to \$140 billion by 2050⁵ and an average lost GDP productivity owing to heat could be between \$4 and \$6 trillion in 2050, approximately double the loss today⁶. The WEF notes that for both North America and Europe, 'failure of climate change adaptation' is a top ten environmental risk to doing business.

While not a panacea, adaptation can prevent much of this forecasted damage. The Global Adaptation Committee estimates that a \$1.8 trillion investment in climate adaptation, including projects like flood defences, climate adapted agriculture, etc., by 2030 would yield \$7.1 trillion in benefits⁷. Despite the importance placed on adaptation by the international community, there is a clear gap between the policies and investment required and the resources currently allocated.

Calls for action on adaptation are growing. In 2015, the Paris Agreement broke ground in this area by introducing a 'Global Goal on Adaptation' that established that international finance for climate action should focus equally on mitigation (reducing emissions) and adaptation. Further extreme climate-related catastrophes over the past few years have resulted in more collective alarm. While finance and action on adaptation remain well below what is needed, discussions on adaptation are increasing, including heads of state attending events like the Climate Adaptation Summit⁸ in early 2021, the increasing prominence of adaptation at the latest Conference of Parties (COP26) event in Glasgow, Scotland during November 2021 and growing attention to physical climate risk in financial disclosures⁹.

In spite of the considerable and growing calls for enhanced action on climate adaptation by the policy and business communities, the blockchain development community has not yet comprehensively taken up the adaptation challenge. There are a variety of exciting blockchain applications to address climate mitigation and emission reduction, key aspects of the climate challenge. This is not the case for adaptation. An internet search using the terms 'blockchain,' 'adaptation' and 'applications' yields a variety of public reports that reference potential applicability of blockchain, but with a few notable exceptions, specific, commercial applications that address climate adaptation are missing.

There are a number of reasons for this 'application gap'. The 'toolkit' for adaptation, especially the data, the statistical metrics and approaches needed to understand and incentivise adaptation benefits, is not fit for purpose. This largely correlates with a corresponding 'adaptation gap.' A series of reports addressing this gap over recent years have taken stock of the disparity between adaptation needs, including investments, policies and plans to reduce the risk of vulnerable communities, and adaptation action. The latest *Adaptation Gap Report* notes that adaptation 'is now widely embedded in policy and planning across the world,

⁴ International Organization for Migration. *IOM Outlook on Migration, Environment and Climate Change*. 2014, https://publications.iom.int/system/files/pdf/mecc_outlook.pdf.

⁵ Ibid, p. 94.

⁶ Ibid, p. 98.

⁷ Global Commission on Adaptation. "Adapt Now: a Global Call for Leadership on Climate Resilience." *Global Center on Adaptation*, 13 Sept. 2019, <https://gca.org/reports/adapt-now-a-global-call-for-leadership-on-climate-resilience/>.

⁸ *Climate Adaptation Summit 2021*, <https://www.cas2021.com/about-cas2021>.

⁹ "Task Force on Climate-Related Financial Disclosures." *TCFD*, <https://www.fsb-tcfd.org/>.



but levels of engagement and the quality of instruments are vastly different from country to country¹⁰.

There are a number of studies¹¹ that have highlighted how blockchain and allied technologies, such as remote sensing, machine learning and big data analytics, can be transformative tools in bridging this gap, which will be explored later in the report. The blockchain community is largely flying blind, with insufficient clarity regarding the problem, solution, resources and need for digital solutions to enable the technical, operational, business, policy and broader societal challenges of adaptation.

Part of the challenge may lie in the fact that climate adaptation is needed in almost every system and sector on earth, from agriculture, to coastal areas, energy systems, transport and biodiversity protection. No one approach, or simple 'doing of adaptation', is generally applicable – adaptation needs to include physical measures such as flood defences and socio-economic and institutional measures like raising awareness of climate risks and laws and incentives to support adaptation.

¹⁰ United Nations Environment Programme. "Adaptation Gap Report 2020." *UN Environment Programme*, 14 Jan. 2021, <https://www.unep.org/resources/adaptation-gap-report-2020>.

¹¹ See for instance, Van Wassenaeer, L., van Hilten, M., van Ingen, E., van Asseldonk, M., 2021. *Applying blockchain for climate action in agriculture: state of play and outlook*. Rome/Wageningen, FAO and WUR. <http://www.fao.org/documents/card/en/c/cb3495en>.

2. The Added Value of Blockchain for Adaptation

Numerous blockchain applications have been developed for different challenges that are in close proximity to adaptation. When an application encourages sustainable forestry through secure, trustworthy and immutable data and value transfer across a wood product supply chain, it might not directly consider how climate change impacts the growth and future of a forest. By considering the climate risks and how they may accelerate over time, for example related to wildfires, the application could become adaptation-centred by integrating these insights along with adaptations that might protect forests.

When considering blockchain for climate adaptation measures, we need to ensure that the technology brings additional value. Blockchain can help with lack of trust across the whole value chain, improving traceability, transparency, information integration and consensus, with new value creation, revenue streams and improved distribution channels. These channels provide fairness and efficiency, removing technological and operational barriers and deploying nature-based solutions.

Blockchain can act as a tool to provide adaptation funders with assurances that the project they are funding adaptation activity that is well maintained and understands and addresses climate change. For instance, are the flood defences being maintained and adjusted to meet future climate changes? Blockchain technology can also provide the benefit of knowing the origin of data, which brings increased reliability, especially in peer-to-peer networks for transparent data exchange, data analysis and information. At the same time, blockchain technology can help eliminate manual reconciliations, reducing waste in process. Smart contracts may facilitate transparent and standardised transactions, self-executing tasks or terms, thus improving operational efficiency. Blockchain can also enable more efficient monitoring and accreditation processes.

Some specific applications include:

The Well Adapted Coffee Supply (WACS)

WACS, is Adaptation Ledger's¹² front-end application that may be linked to more generic supply chain applications to provide a more complete understanding of how coffee producers are undertaking scientifically validated measures to reduce their vulnerability to the climate crisis. WACS is primarily a tool for integrating data inputs from remote sensors and other sources (digital and non-digital) that creates a more transparent and immutable record of the VRCs¹³ that farm plots generate via adaptation efforts.

¹² "Core Enterprise." *Adaptation Ledger*, <https://www.adaptationledger.com/core-enterprises>.

¹³ Variable Rate Control.



SCALE Project (Scaling up Climate Ambition on Land Use and Agriculture through NDCs¹⁴ and NPAs¹⁵)

This joint project by the United Nations Development Programme, Food and Agriculture Organization of the UN and International Climate Initiative¹⁶ is piloting a blockchain technology project for the digitisation of the value chain for agriculture and food systems and for tracking sustainability. The project focuses on designing key data elements that represent climate-resilient practices and it aims to help policy makers, food producers and audit agencies stimulate the uptake of climate-resilient practices registered in blockchain.¹⁷

Sustainable Cashmere Production

This project, piloted under the United Nations Development Programme, is tracking cashmere sourced from small-scale nomadic herders using sustainable practices to a processing factory in the capital and finally to end consumers willing to pay premium prices for sustainable production.¹⁸ The project helps uplift the poor and marginalised, it aids in fighting corruption, insures animal welfare and guarantees ethical sourcing.¹⁹

Sustainable Mining (Dig_it)

Like many other businesses, the mining industry needs to go greener, and in particular needs to prove this ambition to the public. The Dig_it project by IOTA develops and integrates Oracles with centralised industrial IoT platforms used in the mining industry and allows to securely export trusted data across stakeholders, including the public. Having access to trusted and real-time machine data, as well as environmental data, allows for a timely planning as well as reaction and risk mitigation, in turn increasing the mining sector efficiency and safety. Shared data will allow the public to monitor the decisions taken by the Dig_it system. With such information, a climate adaptation strategy can be developed in response to expected and measured value of CO2 production, water consumption and waste production in mining sites and their impact on populated areas and their inhabitants.²⁰ Also considering the fact that mines are susceptible to flooding stresses, the importance of trusted and real-time data provided by DLTs as this promotes the understanding of the environmental impact of the mines and adapt measures to prevent flooding.

Paperless Trade (TLIP)

The Trade and Logistics Information Pipeline utilises the IOTA Tangle, a novel distributed ledger technology to develop and pilot an authenticated and

¹⁴ Nationally determined contributions.

¹⁵ National Adaptation Plans.

¹⁶ "More than Just Cryptocurrencies - Using Blockchain for Climate Action in Agriculture." *UNDP Climate Change Adaptation*, <https://www.adaptation-undp.org/using-blockchain-for-climate-action-in-agriculture>.

¹⁷ Ibid.

¹⁸ Huang, Roger. "UN Pilot In Mongolia Uses Blockchain To Help Farmers Deliver Sustainable Cashmere." *Forbes*, 28 Dec. 2019, <https://www.forbes.com/sites/rogerhuang/2019/12/28/un-pilot-in-mongolia-uses-blockchain-to-help-farmers-deliver-sustainable-cashmere/?sh=230f156c17d9>.

¹⁹ Akmeemana, Chami. "Making A Difference To The Mongolian Cashmere Value Chain." *Convergence.tech*, <https://blog.convergence.tech/mongolia>.

²⁰ *Dig_IT*. <http://digit-h2020.eu/>.



verifiable paperless trade solution. The platform enables multiple stakeholders within a trade lane to conduct paperless transactions, whilst including the benefits of blockchain technology, authenticated sources and immutable, verifiable documents. DLTs like IOTA can promote climate adaptation within the supply chain sector. By providing immutable records, DLTs promote the traceability of supply chains. Transactions that are stored can't be changed illegally which fosters trust in the data and among participants. The origin of materials like wood and even unsave products can be tracked. This transparency and trust within supply chains eases the way of adaptation. The importance of trusted supply chains that DLTs can provide can be particularly of high importance for agricultural supply chains, as trusted and up to date information about weather and climate conditions for example allow better adaptation to the effects of climate change.

Many of the above applications are supporting climate adaptation, but they do not all consider climate adaptation in their design and potential. In other words, some might not integrate a full-throttled adaptation planning perspective, that takes on board capacities for understanding the future climate, its impact on the vulnerable business, system or facility, and the adaptations that may address all of these.

Knowing that there are significant challenges to blockchain adoption and deployment, it is imperative that there is a regulatory space that enables pilot use cases as well as regulatory sandboxes which would test possible blockchain solutions with their full potential (regulatory and legal barriers can sometimes lead to the implementation of a 'soft' use case which fails to represent the full potential for innovation possible from the technical/commercial point of view).



3. Defining the Barriers

Barriers to blockchain adoption²¹ are particularly apparent in the case of climate change and adaptation applications. In general, climate adaptation efforts attract a fraction of the investment²² poured into mitigation projects. This so-called 'mitigation bias' carries on into the blockchain space, magnifying fundamental barriers to designing, developing and implementing blockchain solutions for climate change adaptation.

As discussed earlier, the broad nature of adaptation and the lack of a natural focus on any one industry could be a reason for the slow uptake. In addition, the relatively recent focus on climate impact and adaptation means that adaptation is a good 20 years behind in public, governmental and business awareness compared to climate mitigation. Adaptation has only been a significant focus of public finance, at least in terms of planning and investment, for the past decade. The field is still less known than mitigation, meaning the financial opportunities for blockchain developers have been less apparent.

Some specific barriers include a lack of:

- *Appropriate adaptation metrics and standards.* The absence of suitable adaptation metrics can be explained by the limited availability of relevant underpinning data, data analysis and information, a lack of common definitions and standards for metrics which hinder effective comparisons, and conceptual and practical difficulties in developing composite, aggregable metrics that can support cross-sectoral, national, or global overviews. Competing objectives and definitions of adaptation also create tension. Metrics often need to serve different stakeholder needs and decision-making objectives. Clarity in defining standard metrics and objectives is central to overcoming these issues.
- *Awareness of adaptation in the blockchain developer community.* This presents a chicken-egg problem resulting in few pilot projects, lessons learned and practices in the adaptation space to inspire more action. There is therefore a corresponding lack of examples to share with adaptation practitioners that limits demand.
- *Incentivising policies focused on blockchain's particular advantages.* As climate impacts and needed adaptation cover the breadth of sectors in industry and society, the corresponding policies to incentivise blockchain-enabled adaptation need to be sensitive to the wide variety of environments under which adaptation needs to take place, from the individual and household to corporate and government adaptations. Each of these requires a clearer understanding of the appropriate incentives and policies that can overcome informational and practice barriers to uptake.

²¹ Meijer, Carlo R.W. De. "Remaining Challenges of Blockchain Adoption and Possible Solutions." *Finextra*, 29 Feb. 2020, <https://www.finextra.com/blogposting/18496/remaining-challenges-of-blockchain-adoption-and-possible-solutions>.

²² Worley, William. "'Huge Gaps' in Financing for Climate Adaptation, UN Report Warns." *Devex*, 15 Jan. 2021, <https://www.devex.com/news/huge-gaps-in-financing-for-climate-adaptation-un-report-warns-98918>.



4. Proposals for a Blockchain-Enabled Future of Climate Adaptation

The authors believe that with a coherent and deliberate set of actions, these barriers can be overcome to create a nourishing environment for a future better adapted to climate change with the aid of blockchain applications. Some starting considerations are explored below.

Awareness Raising Within the Blockchain Community

We first need to address the lack of awareness amongst the blockchain community about the urgent need for climate change adaptation applications. Developers and blockchain practitioners are natural problem solvers and innovators; but they cannot be expected to develop a solution for a problem of which they are not aware.

First, there needs to be a concerted effort to educate and engage actors in the blockchain ecosystem about the pain points, gaps and opportunities in climate change adaptation solutions. This will enable them to conceptualise the appropriate use cases and blockchain-enabled approaches. Groups such as INATBA should play a leading role in organising such educational efforts.

Second, there needs to be a mechanism for those working on blockchain solutions for adaptation to come together and learn from each other. This could take the form of an interactive platform, a partnership network or even some kind of online database. It is important that developers can crowd-source knowledge, lessons learned and other resources to design and deliver progressively better solutions.

Convening Stakeholders

Building on the ideas raising awareness and developing education, it is important for all stakeholders in the adaptation space to convene and co-create shared goals and targets. This will break down the current silos between policy, academia and technological innovation spheres.

Policymakers, academic institutions, private sector actors, investment community (in particular as they look at the 'Environmental, Social, Governance' aspect), community leaders, NGOs and the blockchain community must work together to design and implement policies and initiatives that incentivise adaptation projects. This sort of collaboration should be happening at the local, regional, national and international levels, as adaptation needs will differ from community to community.

Developing Metrics and Standards

In order for the blockchain community to develop effective, value-adding adaptation solutions, it will need new or further developed data, metrics and standards to help steer adaptation actions and data analytical conveyance through blockchain applications. These metrics need to be useful for both the blockchain developer and the adaptation practitioner. Groups working to



promote trusted blockchain applications, like INATBA, can work with groups that are working to identify and further develop statistical metrics and consensus on what metrics to apply for different contexts, such as the International Platform on Adaptation Metrics (IPAM)²³.

²³ IPAM International Platform on Adaptation Metrics, <https://www.adaptationmetrics.org/>.



5. A Future Agenda for Blockchain and Adaptation

The next steps in launching a blockchain ecosystem for climate adaptation is to convene stakeholders in raising awareness and engagement to further identify adaptation and blockchain intersections. A starting point is simply encouraging an understanding of climate adaptation as a distinct, and equally important imperative as reducing greenhouse gas emissions. The more stakeholders understand the need for adaptation and the challenges in its application, the greater the potential for blockchain applications to address these challenges. The INATBA Social Impact and Sustainability Working Group is planning on convening its members, representatives of policymakers in the digital and climate adaptation areas, and adaptation practitioners and experts to start the dialogue. We hope you join us.



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