

BLOCKCHAIN  
IN PRACTICE



Vol. 02 *The blockchain &*  
sustainable development







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Many associations, non-governmental organisations and businesses have jumped on the blockchain bandwagon in order to secure and support initiatives with a social or environmental purpose. Some of the most advanced projects include microloan and collateral security platforms, digital identity and fund transfer infrastructures, the creation of voluntary carbon credit markets, green bond issuance and trading, certification of origin for electricity produced from renewable energy sources, the notarisation of climate data processing, etc.

Blockchains have already proved to be powerful traceability tools as well as infrastructures that create transparency and build trust during the exchange of high-value information; but they also come across as being unifying platforms able to coordinate complex ensembles of entities all committed to reaching a common goal.

Ultimately, blockchains are merely databases where management and access are distributed in a transparent manner and information is recorded in such a way that it is immutable. But this means that they have the three qualities required for the institutional building of trust that cements relations between operators, donors, shareholders, clients and beneficiaries:



#### ☞ Immutable engagement:

Where blockchains are concerned, “to say is to do” or rather “to record is to do”. By default, blockchains are designed so that the information recorded is definitive and unerasable. The same goes for any commitments made. If they are recorded in a blockchain to be executed at some point in the future, there is no easy way back; and if one must go back, it will be in a fully transparent manner by recording a reverse transaction, for instance.



#### ☞ Transparent reporting:

Initiatives with a social or environmental purpose are all the more dependent on reporting as reports are to a large extent what ties an operator to its financial sponsor. The data processing transparency offered by the blockchain is a feature that facilitates and reinforces the reporting efforts made by the organisations concerned.



#### ☞ Transparent management:

Blockchains are a simple and accessible solution that makes database administration a transparent and auditable process when it comes to transferring funds, managing digital identities and resources to be distributed, issuing guarantee of origin certificates, etc. This is a theoretical prerequisite that is generally difficult to implement.

The ecosystems involved in social or environmental impact initiatives are complex and diverse, which makes the blockchain particularly useful as it is able to create a neutral and secure space that is conducive to engagement. social ou environnemental rend la blockchain particulièrement utile, à travers sa capacité à créer un espace neutre et sécurisé qui favorise ainsi l'engagement.

## Blockchain and social issues

Most social purpose projects are currently geared towards financing businesses or individuals that do not have easy access to the traditional financial system on account of unfavourable macroeconomic or geopolitical circumstances.

It is currently estimated that a total of 4.4 billion US dollars in loans have been granted for decentralised project finance via the blockchain, and the value of outstanding loans is estimated at 557 million US dollars<sup>(1)</sup>. A geographic breakdown shows that such financing clearly leans towards emerging countries, which account for over 90% of the decentralised loans granted to finance ongoing projects. This is largely because of lower bank-account penetration and prominent informal economies in the least economically developed parts of the world.

As a result, decentralised lending infrastructures are all the more relevant. Blockchains are central to such infrastructures and add a level of transparency and security to payment flows that would otherwise be difficult to achieve. The World Bank says that approximately 1.7 billion people currently have no access to basic banking services<sup>(2)</sup>.

We can also see humanitarian aid projects being developed in areas with distressed communities, with one example being the Building Blocks project run by the United Nations World Food Programme. The programme uses the blockchain as an integrated digital identity infrastructure, providing refugee populations with access to food, education and healthcare.

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# 4,4

billion US dollars in loans granted to fund social projects via the blockchain.

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# 557

million US dollars in loans aimed at financing social projects via the blockchain currently in progress.

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# 90%

of decentralised loans geared towards funding social projects concern emerging countries.

(1) At 18/10/2023, source: rwa.xyz. Here we only take into consideration loans granted for operational projects operating real assets. Loans granted for purely financial purposes, for instance to create a leverage effect on financial trading, are not included in this statistic.

(2) Source: The Global Findex Database 2021: Financial Inclusion, Digital Payments, and Resilience in the Age of COVID-19.

# CASE STUDY

## BUILDING BLOCKS – DIGITAL IDENTITY AND FUND TRANSFERS

United Nations World Food Programme (WFP)



### PROBLEM

Refugee populations and communities in disaster areas often have no identity documents and therefore no access to most essential services. Certain populations may be stateless or at risk if they reveal their identity, so they are not in a position to keep any proof of origin on them. From an operational perspective, this is an even more complex problem as it can in some cases concern hundreds of thousands of people in distress simultaneously<sup>(3)</sup>.

**+4M**

people supported every month<sup>(5)</sup>

**325M\$**

in assistance provided<sup>(5)</sup>

**529M**

in cash-based transfers processed<sup>(5)</sup>

**2,4M\$**

saved in bank fees<sup>(5)</sup>

### SOLUTION

A consortium blockchain was set up to be managed jointly by the WFP's various partners. It is used as a digital identity ledger and resource coordination and allocation platform, in accordance with the rights of refugees stipulated in the 1951 Geneva Convention<sup>(4)</sup>.

It coordinates the transfer of funds from partner organisations, reducing the costs of such transactions and also making them more secure. Where necessary, the blockchain is able to conceal the identity of the beneficiaries of any transactions recorded and can therefore protect individuals while also tallying the resources to be distributed in an automatic and secure manner.

### OUTCOMES

Building Blocks was tested on around a hundred people in Pakistan back in 2017. The project now boasts a million beneficiaries in Bangladesh and Jordan, where the equivalent of 325 million US dollars have been transferred via the blockchain.

The UN initiative reckons that approximately 2.4 million US dollars in bank transfer fees have been saved thanks to the implementation of Building Blocks. The project was also rolled out in Lebanon following the Beirut port explosion in August 2020 and helped to coordinate 56 million US dollars' worth of humanitarian aid. Building Blocks has also been extended to Ukraine and played a key role in coordinating the transfer of 337 million US dollars from 18 different humanitarian organisations to 3 million people. The programme estimates that an additional 185,000 people have received emergency aid thanks to this solution<sup>(5)</sup>.

As a secure ledger, it avoids double counting without the need to set up a central accounting body for verification purposes.

These advantages make the blockchain particularly useful in circumstances where resources are scarce and it is of crucial importance to allocate them properly.

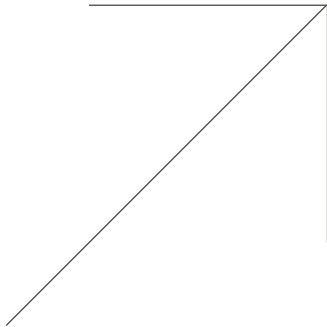
Moreover, this infrastructure is managed jointly by various different organisations and offers them a neutral and transparent space, for instance to transfer funds without the ledger being at the risk of corruptibility.

(3) Source: UNHCR, the United Nations Refugee Agency, consulted on 19/10/2023.

(4) Source: UNHCR, the United Nations Refugee Agency, Convention and Protocol Relating to the Status of Refugees, consulted on 19/10/2023.

(5) World Food Programme, November 2023.

## Large-scale savings thanks to the blockchain



On the strength of the experience acquired and results achieved with Building Blocks, the United Nations (UN) has since developed several other humanitarian projects based on the blockchain:



UN Women joined **Building Blocks** and set up a pilot scheme to transfer cash to female refugees in Jordan. The initiative was then extended to Kenya.

The WFP has also developed **Blocks for Transport**, which seeks to facilitate resource shipping documentation throughout the supply chain.



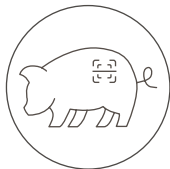
The **United Nations Development Programme** (UNDP) has developed various pilot schemes:

- ✎ Crowdfunding
- ✎ Food traceability in Ecuador, with an integrated payment system to foster reinvestment in means of production and boost sales growth
- ✎ Food monitoring in Serbia



The **United Nations Food and Agriculture Organisation** (FAO) has set up a traceability system for pig farmers in Papua New Guinea.

The **United Nations International Computing Centre** and Joint Staff Pension Fund have created a digital identity card or digital “certificate of entitlement” for United Nations retirees – talks are underway to extend it to all United Nations staff.



**UN-Habitat** and the **Office of Information and Communications Technology** have set up a system for monitoring ownership of land plots in Afghanistan.

The **United Nations International Children’s Emergency Fund** (UNICEF) has launched Digicus, a prototype used to digitise the agreements it reaches with its partners in Kazakhstan (governments, NGOs, universities) via smart contracts.

The United Nations is also carrying out studies on intellectual property and innovation management in the civil aviation industry(6).

(6) Source: United Nations, Joint Inspection Unit report “Blockchain applications in the United Nations system: towards a state of readiness”, July 2020, consulted on 19/10/2023.

## Blockchain for Good

Since 2018, this association has sought to build bridges between the blockchain ecosystem and those involved in sustainable development through three means of action:

- collecting data about impact projects built on blockchains,
- mapping and analysing these projects by field of activity,
- sharing, exchanging and debating.

## Smart contracts

Computer programmes used to automatically execute conditional clauses in a transparent manner.

## Project Genesis 2.0

A project set up to explore the use of blockchain, smart contracts and other related technologies with the aim of demonstrating the technical feasibility of tracking, delivering and transferring digitised carbon forwards.

## Blockchain and environmental issues

Environmental purpose projects have emerged too and are on the increase. Such projects use low-carbon blockchain solutions and make little – or even no – use of high-performance computing, which means they consume electricity more sparingly.

One of the most advanced environmental projects is **Base Carbon**, a company listed in Canada. It uses the blockchain to create digital carbon credit certificates and secure dematerialised trading in such certificates. Base Carbon has so far issued over 1 million Verified Carbon Units (or VCUs) for a carbon emissions reduction project in Vietnam, for which it has partnered up with **Citigroup**<sup>(7)</sup>. In China, **JD Logistics** (a subsidiary of e-commerce giant **JD.com**) is exploring the blockchain with a view to offering its clients carbon footprint calculation services throughout the supply chains it serves.

The **Energy Web** consortium founded in 2017 by some ten energy firms helps other industry players to improve the traceability of the energy they produce, generate and store. The initiative started off with **Shell, Tokyo Electric, Sempra, Equinor, Centrica, Stedin, TWL, Singapore Power, Elia Group and Engie**, but is now made up of 62 members. Alongside its traceability solutions, Energy Web has also developed other solutions enabling over-the-counter energy trading, digital identity security and personal data protection, as well as the application of standards governing the renewable nature of the energy used by blockchains to operate<sup>(8)</sup>.

There are plenty of other examples in the environmental arena. The **Blockchain for Good** association maintains an online directory of blockchain projects in this field and has so far registered 1,298 projects, including 302 in the environmental and climate fields<sup>(9)</sup>. The **Bank for International Settlements** has also disclosed a selection of environmental projects that make use of the blockchain. This selection was drawn up as part of Project Genesis 2.0 carried out with the Hong Kong Monetary Authority and looking into the benefits of smart contracts for enabling and securing carbon credit markets<sup>(10)</sup>.

Blockchains are also being used in sustainable finance. One example is the sovereign green bond issued by the Hong Kong government (HKSAR) via the blockchain in February 2023. The Hong Kong bond was issued for a notional amount of 800 million Hong Kong dollars, in collaboration with **Goldman Sachs, Crédit Agricole CIB, HSBC and Fidelity**<sup>(11)</sup>.

(7) Source: Base Carbon, November 2023.

(8) Energy Web, consulted on 19/10/2023.

(9) Blockchain for Good, consulted on 19/10/2023.

(10) Bank for International Settlements, Project Genesis 2.0, Smart Contract-based Carbon Credits attached to Green Bonds, October 2022.

(11) Source: Hong Kong Monetary Authority, November 2023.



The **Bank for International Settlements** (BIS), a coordinating body for central banks worldwide, encourages the use of blockchain and smart contracts. The BIS believes they are useful in securing and enabling the development of “green” financial instruments and thus upholding the climate targets set out in the Paris Agreement<sup>(12)</sup>.

In addition, the **OMFIF**<sup>(13)</sup> reckons that it makes particularly good sense to use the blockchain for issuing such instruments because of the need to standardise and secure high-quality data. Combining blockchain with the use of smart sensors has proven to be an effective and rather low-energy solution for securing the links that exist between underlying assets and the financial instruments through which they are financed<sup>(14)</sup>.

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## DEBUNKING A COMMON MISCONCEPTION...

**T**he very vast majority of blockchain transactions now operate through the least energy-intensive blockchain networks. Only two of the top ten blockchains make use of high-performance computing<sup>i</sup>. They account for fewer than 1.5% of the total number of transactions processed<sup>ii</sup>. Many of the innovations to have emerged in the past fifteen years have made blockchains more operationally efficient and significantly reduced their carbon footprint:

**01.** Blockchains no longer have to make systematic use of high-performance computing to maintain their integrity. The University of Cambridge<sup>(15)</sup> reckons that the second-biggest blockchain, **Ethereum**, has thus been able to slash its electricity consumption by 99.99%.

**02.** New, lighter layers of computing infrastructure created alongside the original blockchains now allow for more sparing use of electricity while increasing their processing capacity<sup>iii</sup>.

**03.** Bloomberg Intelligence<sup>iv</sup> believes that renewable energy now accounts for the lion's share of the energy used to handle the most electricity-intensive transaction security operations<sup>(16)</sup>.



**halfin**  
@halfin

Thinking about how to reduce CO2 emissions from a widespread Bitcoin implementation

9:14 PM - Jan 27, 2009

Back in 2009, just after the very first blockchain was launched, one of its most important contributors, cryptographer Hal Finney, was already talking about paying particularly close attention to reducing Bitcoin's carbon emissions and expected a collective effort to be made to reduce its environmental impact.

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(12) Source: Bank for International Settlements, Project Genesis 2.0, Smart Contract-based Carbon Credits attached to Green Bonds, October 2022.

(13) Official Monetary and Financial Institutions Forum

(14) Source: [https://www.omfif.org/focm\\_ch5\\_green-bond-market/](https://www.omfif.org/focm_ch5_green-bond-market/), consulted on 18/10/2023.

(15) Source: “New tool estimates environmental impact of blockchain networks” by Alexander Neumueller, Climate Aspects, Cambridge Digital Assets Programme, April 2023.

(16) Source: “Bitcoin electricity consumption: an improved assessment”, by Alexander Neumueller, Research Lead – Climate Aspects, Cambridge Digital Assets Programme, Cambridge Centre for Alternative Finance, August 2023.

# CASE STUDY

## The European Commission's European Blockchain Sandbox

Four of the 20 projects selected by the European Commission include a social or environmental component<sup>(17)</sup>:

- Tokenisation of real-world assets in the renewable energies industry by 2Tokens, ABNAmro, Assetblocks and Rabobank
- Notarisation of climate data processing by the Commissariat à l'Énergie Atomique (CEA, France's Alternative Energies and Atomic Energy Commission)
- Digital Product Passports to promote the circular economy by Twin
- A dashboard of ESG key performance indicators by Traent



### FOCUS 01

#### – TOKENISATION OF REAL-WORLD ASSETS IN THE RENEWABLE ENERGIES INDUSTRY

##### PROBLEM

There is still not much transparency surrounding the link between assets and liabilities when it comes to renewable energy projects. This is particularly true when non-financial data need to be tracked.

##### SOLUTION

The blockchain is used to tokenise real-world assets (through the structuring of asset-backed securities) and to hold, transfer and automate transactions in securities for shares purchased in renewable energy assets. NFTs are used to represent underlying assets and stablecoins<sup>(18)</sup> are used for dividend payments and settlement-delivery, in accordance with MiFID II.

##### OUTCOMES

The blockchain makes it possible to reconcile the assets and liabilities of financial securities automatically and almost in real time; to execute automated operations conditioned by a certain number of variables, such as asset performance; and to make reporting more transparent while simplifying the settlement-delivery process.

### FOCUS 02

#### – NOTARISATION OF CLIMATE DATA PROCESSING

##### PROBLEM

CO<sub>2</sub> concentration data are spread out, as are the laboratories that process them. A shared database that is reliable, transparent and immutable is needed to produce temporal series of CO<sub>2</sub> concentrations that can be exploited to build statistics.

##### SOLUTION

Blockchain is used to notarise the processes used by various different laboratories to treat CO<sub>2</sub> concentration data collected from sensors deployed in urban areas.

##### OUTCOMES

The blockchain is able to record the processes applied by each laboratory to treat CO<sub>2</sub> concentration data and thus make them transparent, immutable and auditable by third parties. Each party can therefore audit and reproduce the processes for treating raw data applied by other members within the ecosystem.

# Interview with...



**Yacine Ait Kaci**  
Founder of the ELYX Foundation  
(under the aegis of the Bullukian  
Foundation)



**Romain Bonjean**  
Manager Emerging Tech PwC  
and coalition project leader

Joint interview with Yacine Ait Kaci and Romain Bonjean.

**What do the blockchain, Sustainable Development Goals, PwC and ELYX (the United Nations digital ambassador) all have in common?**

Romain Bonjean: A firm conviction! That we are entering an era in which new technologies also have a key role to play in achieving the Sustainable Development Goals. We, together with the ELYX Foundation, firmly believe that the blockchain can help resolve some of the issues that the world is going to face in the future. We are seeing more and more projects involved in efforts to pursue one or more of the UN's Sustainable Development Goals (SDGs). In their 2022 report, our peers from the Blockchain for Good and Positive Blockchain associations counted more than 1,200 blockchain projects with a strong "sustainability" focus.

Yacine Ait Kaci: Alongside PwC, we therefore drew up a list of 10 firm convictions to demonstrate through concrete action that these emerging technologies (including the blockchain) can help speed up the transformations needed to achieve the SDGs. The aim is to give a wide spectrum of stakeholders (corporates, start-ups, NGOs, institutions) an opportunity to adopt one or more of these convictions on which basis to set up projects and create tangible uses as a means of proving what we intuitively believe to be true.

**Which are the finest blockchain "for good" initiatives you are aware of?**

YK: One example is an initiative we support that consists of artistic experiences in three stages. The first is the physical installation stage calling on the public to enter a space, after which an immersive digital layer adds an educational dimension in the form of a game or discovery; at the end of the experience, participants are invited

## What do the SDGs refer to?

The Sustainable Development Goals (SDG) refer to 17 objectives established by the United Nations to be achieved by 2030. They offer solutions in response to the global issues facing humanity, such as poverty, inequality, the climate, the environment, prosperity, peace and justice. It is crucial to meet each and every one of these goals as they are all interconnected.

## Web3

Web3 or Web 3.0 relies on the use of decentralised platforms based on blockchain technology, thanks to which ownership of data reverts to the users of these data.

to make a concrete contribution through the blockchain. One of these experiences is geared towards mangrove regeneration. Mangroves account for 75% of tropical coastline and two-thirds of them are endangered, and yet they serve as carbon sinks and sources of biodiversity. In this experience, the public is invited to enter an artistic installation of a mangrove created from paper and light, and then to don a VR (virtual reality) headset and perform various actions needed to support its regeneration. The public therefore witnesses the effects of these actions on plant and animal life first-hand as it is transported forward in time by way of an immersive narrative. The public then dives back into the installation for the third and final stage of the experience: a call to make a concrete contribution. Technology developed by a start-up firm, carbonable.io, enables the public to purchase a carbon credit-backed token that can help regenerate a given mangrove. The public can choose the amount invested in this token, ranging from a few euros or cryptocurrencies to several hundreds of thousands, and it can be traded throughout the project's lifetime.

RB: Another example is the action being taken by Consent-Chain. This start-up is a member of a coalition that has developed a blockchain solution used to obtain and optimise the traceability of the informed consent given by each patient enrolled in a clinical trial, in an environment that is transparent, secure and compliant with GDPR standards (General Data Protection Regulation).

Besides the action being taken by this particular coalition, there are many other start-ups tackling these topics head-on. Take Crusoe Energy, for example, a start-up that captures wasted methane streams to power Bitcoin mining centres, or UNICEF, which is developing a DAO<sup>(19)</sup> to fairly (re)distribute power for a globally distributed digital public good.

On a different note, we firmly believe that it is as important as ever to raise awareness about these new technologies in order to debunk certain misconceptions and biases that have become popular belief. This is why we at PwC continue to submit concrete proposals to ensure that France remains a pioneer in Web3-related topics, such as when we drafted a lifecycle analysis of the Tezos protocol and its environmental impact, and again when we and the Institut Montaigne co-wrote a report listing the benefits that ought to be exploited along with 8 recommendations to help us become more competitive in this type of digital infrastructure. We are also closely involved in various World Economic Forum (WEF) working groups, sharing the progress we have made on Tech for Good topics and placing them on the world's economic agenda.



### What advice would you give people who would like to take more of an interest in this topic and perhaps even get involved?

RB: Begin by being inquisitive and learning about it! There are more and more articles and solutions to be found at the crossroads between blockchain and sustainability. People should not think twice about contacting start-up founders and experts and meeting up with them to chat about the topic over a coffee.

They could then get involved in those networks that are trying to shake things up... our coalition is one good example, but there are many other clusters (such as Blockchain for Good) that would be delighted to enjoy the support of talented and motivated citizens.

They should remember that engagement is a versatile notion that can be adapted to each individual's obligations and aspirations. Engagement can involve interacting directly with the technologies by testing protocols and getting involved in developing them, or supporting impact projects whether directly or through edge effects (by purchasing tokens, either directly via start-up cap tables or by becoming investors, etc.)... All options are on the table in an ecosystem that is fundamentally based on community and collaboration.

YK: I can recommend the work of Blockchain for Good, which takes 12 themes and uses them to identify ways in which the blockchain can be used to achieve the SDGs. These 12 themes cover agriculture, education, energy, healthcare, the arts and finance.

- END -

Completed writing on 10th November 2023

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- I. Here we take as a proxy the market capitalisations of blockchain networks ranked by size. This top 10 accounts for 85% of total market capitalisation. Within this top 10, the two blockchain protocols that make use of the type of high-performance computing required for 'transaction block validation' and 'ledger securitisation' operations are the Bitcoin and Dogecoin networks. The other protocols use 'proof-of-stake' mechanisms that do not resort to such computing but instead an economic type of mechanism whereby funds are sequestered in exchange for the payment of a reward.
- II. Data at 17/10/2023. 'Vote transactions' made through the Solana network have been excluded in order to represent the network's discretionary transactions as accurately as possible. If we were to include 'vote transactions', the base would be much larger and transactions handled through networks making use of high-performance computing would account for fewer than 0.1% of all transactions made through the ten biggest blockchains.
- III. These are referred to as layer-2 infrastructures as they are level-2 layers added to basic (layer-1) infrastructures. This is the case of networks such as Lightning Network, Arbitrum, Optimism and Base, for example. These layer-2s are used to execute a very large number of transactions per second. They consume very little energy and cost very little. The main blockchains, layer 1s, can also serve as custodians, generally able to handle fewer transactions at a higher cost but also in a more secure manner. Combining these two layers of infrastructure creates a solution that optimises security, efficiency, low economic cost and low energy consumption. Like these layer-2s, blockchain infrastructures referred to as 'sidechains' have proved particularly efficient in terms of energy consumption and economic cost. They have their own organisational security mechanisms and operate alongside the main blockchains, hence their name. This is the case of networks like Polygon, for instance, a sidechain widely used by firms such as Mastercard, Starbucks, Mercedes, Saint Laurent and Paris Saint-Germain.
- IV. Various technical developments have emerged in this arena, in some cases going beyond the use of "conventional" green energies like hydropower, solar power and wind power. Examples include natural gas flaring and methane production from cattle, although these remain on a marginal scale for the time being. Transaction validation firm, Marathon, announced on 2nd November 2023 that it is launching a 280kW methane flaring project in the state of Utah. The capture of waste methane emitted by landfills therefore offers the firm a dual opportunity to produce sustainable energy while also helping to reduce greenhouse gas emissions.

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Published by Rothschild & Co Asset Management, a portfolio management company with capital of €1,818,181.89, 29, avenue de Messine - 75008 Paris. AMF approval no. GP 17000014, RCS Paris 824 540 173.

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