

# Impact Tokens

A blockchain-based solution for impact investing





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### **Impact Tokens: A blockchain-based solution for impact investing**

April 2019

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# Abbreviations

<b>AI</b>	artificial intelligence
<b>CSR</b>	corporate social responsibility
<b>ESG</b>	environmental, social and governance
<b>FAO</b>	Food and Agriculture Organization of the United Nations
<b>GHG</b>	greenhouse gas
<b>GIIN</b>	Global Impact Investing Network
<b>ICO</b>	Initial Coin Offerings
<b>IoT</b>	Internet of Things
<b>MRV</b>	monitoring, reporting and verification
<b>NGO</b>	non-governmental organizations
<b>SDG</b>	Sustainable Development Goal
<b>UN</b>	United Nations
<b>UNCTAD</b>	United Nations Conference on Trade and Development



# Executive Summary

The United Nations Sustainable Development Goals (SDGs) invite a range of public and private sector actors to support its agenda of ending poverty, protecting the planet and ensuring that all people enjoy peace and prosperity by 2030. They offer a solid framework for investors and corporations to follow and align their activities and investments accordingly. This has spurred a growth in impact investing, which is an investment approach seeking to generate positive, measurable social and environmental impact alongside a financial return. However, according to a 2018 survey done by the Global Impact Investing Network (GIIN), the following barriers are still preventing impact investing from scaling up to better address the financing needs of the SDGs:

- Appropriate capital across the risk/return spectrum
- Common understanding of definition and segmentation of impact investing market
- Suitable exit options
- Sophistication of impact measurement practice
- High-quality investment opportunities.

Blockchain technology offers new investment and economic opportunities by enabling the transfer of value in a frictionless manner, by providing trust as an immutable ledger and by converting assets into digital tokens that can be programmed through smart contracts. Blockchain offers solutions that are particularly promising to address the underlying challenges of the impact investing industry. “Impact tokens” describe a group of tokens with the specific goal of unlocking investments for projects with positive social and environmental impacts. Four key benefits of impact tokens were extracted from a review of over 200 projects that are either active or in development. Impact tokens can:

- Increase trust between parties
- Promote financial and social inclusion
- Improve data collection and accelerate monitoring, reporting and verification processes
- Incentivize behaviours that promote sustainability.

Most of the reviewed cases focus on digitizing existing marketplaces, reducing transaction costs, and creating new platforms for exchanging non-financial value such as impact, natural capital and data. This paper looks at some of the key characteristics of these tokens; how they can be applied in sectors such as agriculture, fisheries, education or energy; how they can provide verified proof of impact for investors; and ultimately how they can address each of the five barriers to upscaling impact investing.

Impact tokens, and blockchain in general, offer solutions to mobilizing investments toward the SDGs. For that to happen, though, innovation must continue and needs to be supported by public and private sector actors, non-governmental organizations and international organizations. All will have an important role to play in speeding up the development and adoption of this technology.



## Selected Case Studies

- 1) **Fishcoin** incentivizes data capture and sharing at all stages of the seafood supply chain.
- 2) **Veridium** transforms industry standard carbon offsets into digital tokens.
- 3) **Plastic Bank** is a plastic offset program that rewards people with tokens or fiat currency for collecting plastic.
- 4) **Moeda** is a social investment platform that connects investors directly with entrepreneurs.
- 5) **Hara** incentivizes the collection and verification of data and connects farmers with each other.
- 6) **Redd-Chain** tokenizes land-use assets and incentivizes the engagement of local community actors.
- 7) **ixo Foundation** records children's school attendance on the Ethereum blockchain and issues tokens as proof of impact.
- 8) **Energi Mine** promotes energy-saving behaviours.
- 9) **BYD** is a carbon banking solution that rewards individual users of electric vehicles with carbon credits.
- 10) **SolarCoin** incentivizes solar energy production.



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# 1

## Introduction

In 2015, the United Nations (UN) adopted the Sustainable Development Goals (SDGs), providing guidance on how to reach them by defining the intended impacts for each one of the 17 global goals. The SDGs, which are a global blueprint to end poverty, protect the planet and ensure that all people enjoy peace and prosperity by 2030, present high-level targets to aim for as a society and invite a range of actors to support this agenda. In that regard, they offer a solid framework for investors and corporations to follow and inform their activities and investments. This has spurred a growth in impact investing, which is an investment approach seeking both financial returns and positive social and environmental impacts. However, many challenges still prevent impact investing from being implemented on a larger scale.

Blockchain technology, which has generated a wave of attention because of cryptocurrencies, enables new opportunities through the tokenization of impacts. While various organizations have started experimenting and looking at blockchain as an instrument to advance the SDGs, research on the different ways digital tokens can be applied toward the SDGs is still scarce. **Impact tokens**, the focus of this research, is a term that describes a group of tokens using blockchain technology that represent positive social and environmental impacts of specific activities. Their key benefits address some of the challenges of impact investing, thus contributing to reducing the SDGs' financing gap.

The 10 case studies highlighted in this paper were selected from a review of over 200 projects either active or in development. The reviewed tokens highlight two dimensions of impact tokens: (i) single focus versus multi-issue focus and (ii) marketplace applications. Some of the reviewed tokens specifically focus on one particular SDG, while others have created entire ecosystems with a wide variety of players and interactions that simultaneously contribute to many SDGs. Many were designed to digitize and improve current marketplaces through new financial models that offer real



peer-to-peer trading, while others attempt to create new marketplaces around unrealized non-financial values such as natural capital and data. The reviewed tokens are spread across the following themes:

### **ENVIRONMENTAL**

- Agriculture
- Fisheries
- Forestry
- Water
- Conservation
- Carbon markets
- Renewable energy
- Energy efficiency
- Circular economy
- Supply chains
- Transport

### **SOCIAL**

- Education
- Healthcare
- Governance

### **FINANCIAL**

- Impact investing
- Insurance
- Crowdfunding
- Philanthropy



# 2

## Financing the UN SDGs

The UN estimates that the total investment needs of reaching the UN SDGs are between USD 5 trillion and 7 trillion per year.

The UN estimates that the total investment needs of reaching the UN SDGs are between USD 5 trillion and 7 trillion per year. Developing countries alone require USD 3.9 trillion in investment annually (International Monetary Fund, 2018) and are estimated to have an investment gap of about USD 2.5 trillion (United Nations Conference on Trade and Development [UNCTAD], 2014). Considering that public sources are currently responsible for 64 per cent of investments, filling the SDG investment deficit in developing countries would require the public sector to increase spending by an astonishing USD 1.6 trillion every year (UNCTAD, 2014).

Given this scale of additional investment needed, it is clear that private sources of capital must play a significant role in financing the SDGs. To mobilize investments of this size, the participation of a wide range of asset owners is necessary: namely the major institutional players, such as sovereign wealth funds, pension funds, insurance companies and development finance institutions, as well as smaller investors like endowments, foundations, high-net-worth individuals and family

offices. Governments and other public sector organizations play an essential role in enabling financial flows into SDG-related projects. Besides creating an accommodating regulatory, political and legal environment for investments, governments should leverage their limited public resources by de-risking projects. This is an essential component of creating robust and bankable project pipelines.

Fortunately, sustainable investing has gained considerable traction in the financial industry during the last decade. Many of the large asset managers are in the process of, or are already, integrating



### RISK CAPITAL

Risk capital refers to funds allocated to high-risk and high-return investment vehicles. It includes investments in subordinated and unsecured debt, seed capital and other venture-type investments in early-stage companies.

### CONCESSIONAL FINANCING

Concessional financing refers to any type of financing whose terms are more generous than what would be available on capital markets. For example, for loans, concessionality can be achieved through lower interest rates, longer grace periods or maturities.

environmental, social and governance (ESG) considerations when making investment decisions. Sustainable investing is estimated to comprise over USD 20 trillion in assets under management, which accounts for nearly 25 per cent of all managed assets around the world (Kell, 2018). Fund managers acknowledge that emphasizing their ESG credentials can lead to an increase in their assets under management. The popularity of sustainable investing is further reinforced by the increasing empirical evidence on the financial outperformance of these assets.

A common misconception of a trade-off between financial performance and ESG impact has been proven wrong by the aggregated evidence from over 2,000 empirical studies: 90 per cent of them confirming that high ESG assets either outperform or perform on par with traditional assets (Friede, Busch, & Bassen, 2015).

This sustainable investing trend in the financial industry can certainly benefit the financing of SDGs, especially as the impacts of sustainable investments are often measured based on their contribution to the SDGs.

As a type of sustainable investing, impact investing can be a catalyst for financing the SDGs by providing valuable risk capital on concessional terms. While it has been growing rapidly in recent years—with the industry estimated to be worth USD 502 billion in 2018 (Global Impact Investing Network [GIIN], 2019b), a sharp increase from USD 228.1 billion the previous year (GIIN, 2018)—industry participants point out that challenges remain for impact investing to reach scale.

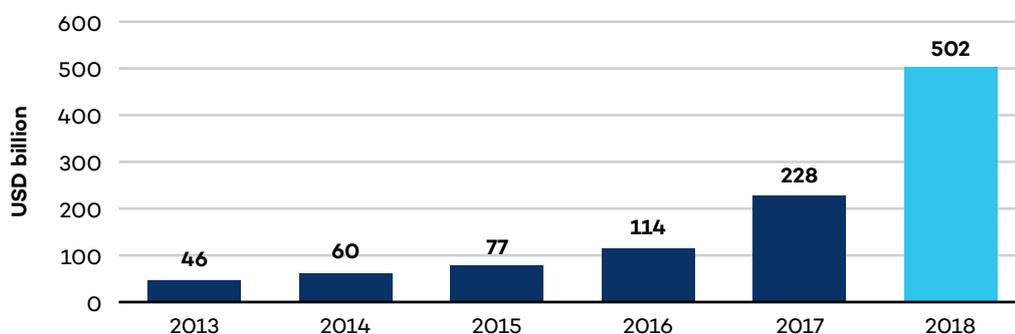


Figure 1. Impact investing for assets under management

Source: GIIN, 2017a, 2018, 2019b.



## BLOCKCHAIN

Blockchain is a decentralized ledger technology, meaning that the ledger is stored in multiple copies on many computers within a decentralized network so that a single person or organization does not own and control the ledger. Anyone connected to the Internet (and granted access in the case of private blockchains) can use it. The ledger is governed by a consensus protocol, which is an algorithm requiring a majority of the computers on the network to agree with any changes made to it. Once a consensus has been reached, all the computers on the network update their copies of the ledger simultaneously. Transactions are usually bundled together into blocks that are cryptographically and chronologically chained together, producing an immutable, shared record of the “truth” that cannot be tampered with (Casey & Vigna, 2018). The verification of each block of transactions is incentivized through a competition in which “miners” solve complex mathematical problems in exchange for a payout.

Technology will play an important role in helping impact investing reach scale. With rapid developments in the areas of artificial intelligence (AI), robotics, machine learning, the Internet of Things (IoT), autonomous vehicles and blockchain, some of the fundamental challenges of projects linked to the SDGs can now be overcome in a cost-efficient manner. Among technological innovations, blockchain may have received the most attention, with proponents comparing its significance to that of the Internet.

Indeed, blockchain, which is often called a “machine of trust,” can deliver solutions across industries, from logistics to financial services. Blockchain-based technologies are particularly well placed to improve the flow of capital by decreasing transaction costs and mitigating key investment risks, including counterparty and liquidity risks. This results in a lower cost of capital and better access to investment opportunities for a broader range of capital providers than what is possible with the current financial infrastructure. Indeed, solutions that address the fundamental inefficiencies of the system in place are the most effective in mobilizing the magnitude of financing needed to achieve the UN SDGs by 2030.



# 3

## Impact Investing

The GIIN defines impact investments as “investments made with the intention to generate positive, measurable social and environmental impact alongside a financial return.”

Within sustainable investing, impact investing is particularly relevant for raising financing for the SDGs. The GIIN defines impact investments as “investments made with the intention to generate positive, measurable social and environmental impact alongside a financial return” (GIIN, 2019a). Indeed, the intentionality of achieving impact is arguably the most important characteristic that distinguishes impact investing from more traditional investment mandates. As Renat Heuberger, CEO of South Pole, has pointed out, “Most organizations can look at their portfolio and find areas that are creating social impact; without the distinction of ‘intention’, the discussion becomes watered down and nothing new” (World Economic Forum, 2013, p. 7).

While traditionally impact investing has focused on providing financing to projects in developing countries, the latest data suggest that this is changing significantly, with 44 per cent going to developed countries (GIIN, 2018). Impact investing is particularly relevant for SDGs, as, depending on the specific mandate of the

investor, it can be a source of invaluable concessional financing. In addition, 42 per cent of impact investors are using the SDGs as a tool or indicator for measuring their impact (GIIN, 2017b).

Impact investors can be categorized based on their return expectations: impact-first or finance-first. Impact-first investors are satisfied with a risk-adjusted return, which is below the market rate. In some cases, they just expect to recuperate their initial capital as long as the investment generates outstanding ESG returns. Projects that are essential for the SDGs often lack the stable revenue



42 per cent of impact investors are using the SDGs as a tool or indicator for measuring their impact.

streams needed to produce sufficient return for traditional investors. In those cases, impact capital could be a cheap source of financing, especially alongside some form of public support.

However, not every impact investor is satisfied with below-market rates of return. Finance-first impact investors require an attractive risk-adjusted financial return alongside a measurable ESG return. It is important to emphasize that impact investing is an investment approach and not an asset class. It can be made across various asset classes, including money market instruments, fixed income, venture capital and private equity.

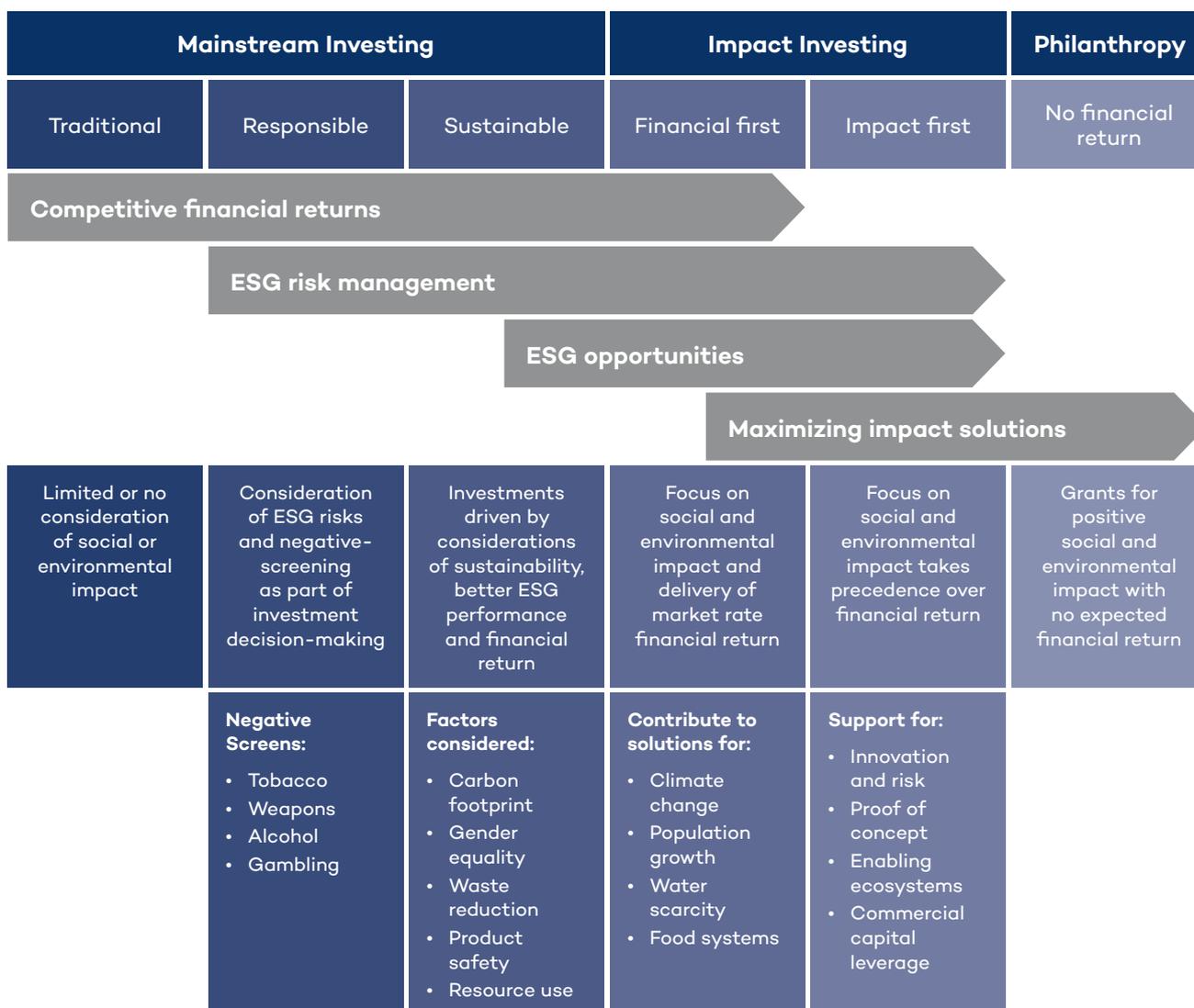
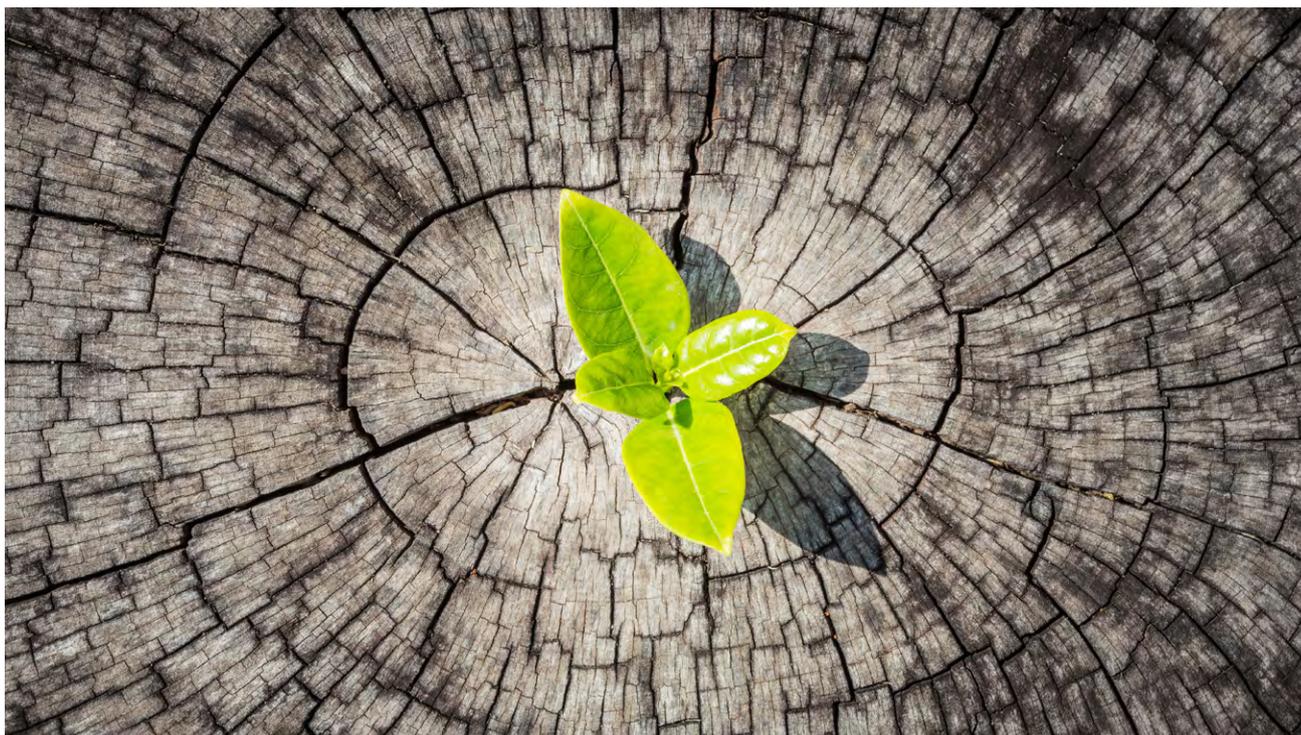


Figure 2. Impact Investment Spectrum

Source: Impact Investing Spectrum by Sonen Capital



The challenges of impact investing vary depending on the geographical location of the investment and the type of investor in question. However, GIIN's *Annual Impact Investor Survey 2018* (GIIN, 2018) of more than 200 respondents identified the following general challenges, in order of importance, that are the most pressing for the growth of the impact investing industry. The top five challenges are as follows:

1. Appropriate capital across the risk/return spectrum
2. Common understanding of definition and segmentation of the impact investing market
3. Suitable exit options
4. Sophistication of impact measurement practice
5. High-quality investment opportunities.

### **CHALLENGE 1.**

*“Appropriate capital across the risk/return spectrum”* refers to the need for blended finance solutions. Different sources of capital have different return expectations, risk appetite and investment horizons. In order to have investable project pipelines, the participation of the different types of capital is needed. That includes risk capital, patient capital and concessional capital providers, among others.

### **CHALLENGE 2.**

*“Common understanding of definition”* refers to the limited understanding among investors of what impact investments are about and how to integrate them into existing portfolio mandates. *“Segmentation of the impact investing market”* highlights the challenge of a diverse industry with different financial return mandates, motivations for engaging in the sector, impact themes, geographies and asset classes.



## PATIENT CAPITAL

Investors providing patient capital do not expect to generate a profit in the short term but instead have a long-term investment horizon. In sustainable investing, patient capital can also be characterized by higher risk tolerance and willingness to cap financial returns if justified by the impact generated.

### CHALLENGE 3.

The lack of “*suitable exit options*” refers to the liquidity risk of impact investments and the difficulty in getting fair valuations when investors want to exit their positions. As most impact investments comprise private securities, such as private debt and private equity, they have long holding periods and no secondary market. Exits need to be planned years in advance and may be further delayed by prevailing market conditions.

### CHALLENGE 4.

Concerns around the “*sophistication of impact measurement practice*” highlight the industry’s needs for more robust, reliable and standardized ways to measure non-financial returns. The quality of impact-related data is a crucial component of this. This is especially a concern for investments in emerging and developing countries.

### CHALLENGE 5.

The limited number of “*high-quality investment opportunities*” has challenged the industry since the beginning. It refers to the lack of robust, bankable project pipelines and to the lack of investment opportunities at the scale that large institutional investors would require. Respondents of the GIIN (2018) *Annual Impact Investor Survey 2018* highlighted the difficulty of establishing a track record, especially as most industry participants are relatively new in the space. Furthermore, they have also pointed out that good investment opportunities exist, but in markets characterized by high risk.



# 4

## Impact Tokens

**Tokens are digital representations of an asset or utility that are typically built on top of existing blockchains.**

Money as a medium of exchange, store of value and unit of account has evolved over its thousands of years of existence, undergoing many technological changes: from bartering, to commodity money (seeds and livestock), to precious metals (copper, silver and gold) and paper money, to fiat currencies, checks and credit cards, to modern digital banking. Each time a money system was no longer seen as practical, it was replaced by a technologically superior one, making money more transportable, as well as easier and faster to exchange over increasing geographical distances. Each step has also introduced new, trusted centralized third parties needed to verify and authorize the transactions.

Today, many people believe that money should move just as easily as emails, meaning that it should be connected to the Internet, unconstrained by geography or institutions, and that transactions should be simple, autonomous, instantaneous and free. Recent developments in cryptography and blockchain technology have

enabled yet another way of transacting that can also significantly change the role and influence of intermediaries. Digital tokens can move society toward more decentralized economies due to their many technological benefits and potential at distributing value in ways that are fairer and more secure through direct peer-to-peer transactions.

Tokens are digital representations of an asset or utility that are typically built on top of existing blockchains. They are at the centre of many innovations developed with blockchain technology, as



## Programmable money allows us to reimagine and redefine the rules used by two entities for transactions.

they offer ways to make current systems more efficient and to create entirely new ones through the reduction of intermediaries, which results in drastic decreases in bureaucracy, fees and transaction costs. But this barely scratches the surface of what tokens can do.

Since tokens are software-based digital assets that allow us to represent any form of value as an entry on a blockchain, by digitizing it, we can also integrate smart contracts. These contracts are self-executing, programmable computer codes that define the rules between two or more transacting parties and, as such, can be used to manage the economy operating around tokens. Smart contracts are built with specific “if X, then Y” properties, meaning that they automatically execute once certain conditions are met without the need for a third party. This all creates a powerful new concept: money is programmable.

In its most basic form, money is a shared set of rules for exchanging value. Trust in these rules is critical for any monetary system to be well functioning. Programmable money allows us to reimagine and redefine the rules used by two entities for transactions. The rules are like terms and conditions, authorizing when and how the value is exchanged. As long as the entities transacting within a system agree to the same rules, the tokens used for the transactions can take on complex behaviours. The transacting parties can trust each other, knowing that the rules are enforced by smart contracts and monitored by a decentralized blockchain network. This certainty makes it possible to build all sorts of programs that go beyond merely sending and receiving money.

Tokens can represent other exchangeable valuables such as time, ownership, contracts, certificates, expertise, commodities, goods, services, vouchers, loyalty points, memberships, financial instruments, governmental bonds or even energy produced. They can also be assigned all sorts of creative

conditions, features or restrictions. For example, one could program the money to be automatically released over time as a way to control budget and expenses, but it can also be used to develop flexible pricing mechanisms, to process microtransactions for pay-by-the-minute services by fragmenting the tokens into smaller bits, to develop performance-based payments, to automate crowdfunding, to create incentives rewards programs and to restrict token use to specific items like food. These are just some examples; the potential applications that can be developed using programmable money are essentially limitless.

The emergence of the token economy offers new possibilities for creating systems that are decentralized and secure, which can give communities new tools of governance, such as the development of incentive mechanisms around common objectives. Tokens can also completely reinvent business models, create new economies and change society's view on earning income by converting non-financial values such as passive work and natural capital into something that can be monetized and traded across a blockchain. Personal data, which is already used and sold without consent in many cases, could generate financial rewards for individuals, and large assets, such as property, could be parcelled into tokens as smaller shares of the entire asset.

### IMPACT TOKENS

Impact tokens contribute to the UN SDGs and often represent a specific impact in the form of a measurement metric such as number of vaccinations, tonnes of carbon dioxide or number of children attending school. These tokens are registered on a blockchain and can be tracked along a supply chain. They offer proof that a positive impact has been delivered, which can then be attributed to a particular activity or investment.



Cryptoeconomics and tokens are still at an early stage of development. Exploration of the different types of tokens and their attributes is currently being done through trial and error, and innovations around how to use them are expected to continue for years to come. Tokens already offer practical solutions at a small scale, but they can fundamentally disrupt and alter the way the world transacts.

The function and purpose of a token can vary widely. Today, it is generally agreed that there are three main classes of tokens:

1. Cryptocurrencies (like Bitcoin)
2. Utility tokens, which give access to a good/service offered by the issuer of the tokens (like Fishcoin and Solarcoin) and are meant to be primarily used within a blockchain-based ecosystem that they are connected to
3. Security tokens, which represent tradable financial assets (like real estate, artwork, company equity) that meet the strict regulations specific to the country they are issued in.

Within these three main categories of tokens, many sub-types have started to emerge according to their specific functions and purposes. One of them, impact tokens, are centred on the capacity to deliver measurable and verifiable impacts, from which better-informed decisions can be made regarding investments and the allocation of resources. Most of the impact tokens created so far are utility tokens, and they have started appearing in a variety of sectors and industries. As such, they can further be categorized under the different areas where they are having an impact, such as education, health, energy or agriculture.

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## By providing digital proof that impact investments deliver specific desired outcomes, impact tokens can become valuable assets.

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This can lead to the development of new financing models based on verified outputs, and to an increase in the overall amounts invested in the impact economy from the public and private sectors.

Impact tokens are particularly well placed to address the critical challenges of impact investing. After a review of over 200 cases on how tokens can be used for impact, some at the concept stage, some already in activity, four significant benefits and features of impact tokens seem to emerge. Impact tokens can:

- Increase trust between parties
- Promote financial and social inclusion
- Improve data collection and accelerate monitoring, reporting and verification (MRV) processes
- Incentivize positive behaviours for sustainability.



# 5

## Ten Case Studies Demonstrating the Benefits of Impact Tokens

Blockchain allows people who do not know another or do not trust one another to safely and securely transact valuables between them.

### 5.1 Increasing Trust Between Parties

Building and managing trust between parties transacting with each other is an essential service that benefits society and that has allowed many intermediaries to become indispensable and very profitable. However, some have gone beyond their role of intermediaries to become gatekeepers with a tremendous amount of control over customers and society at large. The 2007 financial crisis was a powerful reminder of the high price of trust when it is placed in large centralized entities. Similarly, in the tech industry, certain companies have become enormous centralized ledger keepers, building huge records of personal digital data transactions, which recent hacks and data scandals have shown present some serious negative implications for people's privacy.

Because impact tokens are built upon blockchain technology, they also bring along its main value: decentralized trust. Blockchain allows people who do not know another or do not trust one another to safely and securely transact valuables between them. It is a digital ledger on which everything of value can be recorded. Instead of fallible humans or institutions acting as record keepers, validating the transactions and guaranteeing the integrity of the ledger, a blockchain uses advanced cryptography to securely link all the records together in a decentralized public ledger that no single person or organization controls. Hence it lessens the need for powerful central authorities, and instead hands control back to individual users. This decentralization feature can also make systems more secure since there is no single point of failure, making it extremely difficult to hack as opposed to a centralized database.



By registering each transaction on a public ledger that anyone can access, public blockchains can also bring a higher degree of transparency to supply chain management. This means that any government or company interested in improving its integrity can use the technology to develop a decentralized, transparent and immutable historical record of all transactions and ownership. This could bring new levels of transparency and accountability in many industries that have been struggling with fraud scandals, production issues, human rights abuses and counterfeiting, which have led to a reduction in public trust. *Fishcoin*, for example, seeks to improve the sustainability of seafood supply chains by incentivizing data capture and sharing on a blockchain at every step.

## Case Study 1: Fishcoin

**Theme:** Supply chain

**Sub-themes:** Fishing

**SDGs:**



**What is it about:** Fishcoin is a decentralized ecosystem that incentivizes data capture and sharing at all stages of the seafood supply chain to improve the livelihoods of fishers while making the industry work more sustainably to better protect biodiversity and reduce food waste (Fishcoin, 2018). Supported by the UN World Food Program, Fishcoin addresses the fragmentation of most seafood supply chains by using blockchain technology and through the design of a peer-to-peer network that allows buyers, governments and consumers to follow each step of a fish's journey, right back to its origin.

**Context:** The 2016 Food and Agriculture Organization of the United Nations (FAO) report on aquaculture and fisheries highlighted many problems in the industry. Close to 90 per cent of the world's marine fish stocks are overfished or fully exploited, and up to 35 per cent of fish are discarded or wasted within supply chains. In addition, illegal, unreported and unregulated fishing results in the theft of tonnes of seafood every day. With over 85 per cent of the world's seafood being harvested in developing nations by small-scale seafood producers, these problems are exacerbated by a highly fragmented seafood industry that lacks transparency and has unscalable gatekeepers and extreme information asymmetries. The collection of accurate data, particularly from fishers at the start of the supply chain, has been challenging to implement in a cost-efficient manner.

**How it works:** Fishers can record catch data on their phones using an application called mFish. That data is then presented to the next person in the supply chain who can add to it. The key data elements, such as name, location, fish type and weight, are uploaded on the blockchain along with the identities of the parties (to prevent fraud and bogus data). Smart contracts programmed into the blockchain platform generate the Fishcoin tokens as rewards for the data providers in exchange for their data inputs. Fishcoins can then be stored or converted into mobile phone airtime top-ups, with other exchange options possible in the future.

Fishers in many developing nations often do not have bank accounts, IDs or ways to use the currency in the first place, rendering payments by bank transfers effectively useless. However, most do have mobile phones. Data plans, which are pre-paid and time-based for different hours of the day, have become a universal commodity. Eachmile, in collaboration with the Global System for Mobile Communications (GSMA), which represents over 750 mobile phone operators worldwide, provides data plan top-ups to the fishers in exchange for collecting data and uploading it on the blockchain.



Fishcoin tokens are paid for by the downstream actors in the supply chain, such as wholesalers and importers of seafood, who need the data to ensure the quality of the products, improve their operations and reduce waste. By creating an incentive to participate in the program and sharing catch data, FishCoin can lead to an overall more sustainable and responsible supply chain.

#### Main points:

- Fishers can earn additional benefits.
- Governments can use the data collected to better regulate the industry.
- Consumers have more information about the food they buy and can make better-informed decisions.
- Overfishing and waste are reduced.
- Investments in sustainable seafood supply chains increase.

This can also shift power dynamics and change relationships between individuals and institutions in both the public and private sectors.

Blockchain has the potential to reshape systems into ones where trust between parties, which is the fundamental point upon which we decide to transact with someone, is not required anymore. In a globalized economy where people can transact over the Internet with anyone and anywhere, this is particularly critical. Societies can be drastically simplified, and this can also shift power dynamics and change relationships between individuals and institutions in both the public and private sectors.

Collaborative projects can flourish with higher levels of transparency and decentralized consensus-making processes, while also rewarding their contributors. It is unsurprising that many of the observed impact token projects tend to focus on markets where there is a need to build trust and to develop a consensus around accounting processes and procedures. *Veridium*, for example, partnered with IBM to bring more confidence and transparency to voluntary carbon markets using digital tokens as a representation of a carbon offset that can be freely traded on a decentralized marketplace.

## DIFFERENT BLOCKCHAINS

An important distinction to make and to keep in mind when discussing the various projects using blockchain technology is that blockchains differ depending on their levels of decentralization, transparency and access, which can sometimes result in misleading or misunderstood claims.

Public permissionless blockchains like Bitcoin and Ethereum are as decentralized as possible and all transactions are transparent to the public. Anyone can access them and not one single entity has control over the network.

Private blockchains, on the other hand, are controlled by an entity (or group of entities) and require permission to have access to them. They are only as decentralized and transparent as what is authorized and therefore are not completely trustless.

Each has its pros and cons and serves different purposes, particularly in these early stages of the technology's development. Some projects use a combination of these or even a hybrid approach referred to as public permissioned blockchains. A useful analogy is that a private blockchain is like an intranet, while a public blockchain is like the Internet.



## Case Study 2: Veridium

**Theme:** Carbon market

**Sub-Themes:** Natural capital, CSR

**SDGs:**



**What is it about:** Environmental tech start-up Veridium (n.d.) partnered with IBM to transform industry standard carbon offsets into digital tokens that can be freely traded on a decentralized marketplace that automates the accounting and offsetting processes across global supply chains. The purpose is to make it easier and cheaper for companies and individuals to account for their footprint and neutralize the impact they have on the environment.

**Context:** The idea of carbon credits is that market forces can push down the total amount of pollution companies produce. The credits, which any entity can purchase, function as tradeable permits, each worth one tonne of carbon. Carbon credits are already being traded, but the current market structures create too much friction. They are illiquid, difficult to track, hard to calculate and not standardized.

REDD+ projects focus on reducing carbon emissions caused by deforestation and forest degradation all around the world. However, the process of measuring carbon emissions is resource intensive, and there is a lack of transparency in the market. Also, given the remoteness of REDD+ sites, it can be difficult to know for sure the authenticity of a project.

**How it works:** The Veridium marketplace uses the VERDE tokens as its base currency. The tokens are issued and managed on the Stellar blockchain network, and they are backed by carbon credits issued for the conservation of the Rimba Raya Biodiversity Reserve, a 64,000-hectare-large area in Borneo that is home to several endangered species and that serves as the “natural capital” for the carbon credits.

Veridium builds trust between buyers and sellers of carbon credits through transparent accounting and offsetting processes that are verified and executed through a smart contract with a set of open standards that automatically integrates carbon credits into corporate transactions and supply chain management.

**Main points:**

- Accounting of carbon market is transparent.
- It can increase investments in CSR.
- Carbon emissions are reduced.

## 5.2 Promoting Financial and Social Inclusion

Financial inclusion addresses inequalities, increases investment opportunities, encourages collaborations between businesses and individuals, levels the playing field for investors and entrepreneurs, and can give people economic security. An estimated 1.7 billion adults globally, or about 30 per cent of the total population, currently do not have a bank account, excluding them from essential financial services they need for everyday life and to invest in their futures (World Bank,



By setting up these wallets, many unbanked and underbanked populations get instant access to financial tools and services for the first time, allowing them to participate in the global economy.

2018). The main reasons for not having a bank account are limited geographical access to banks, insufficient funds, a lack of identification to open an account, and credit histories. Recent progress was made with the development of new financial services accessible via mobile phones and with the increase in microfinance institutions, but challenges remain around identification, technology infrastructure and operating costs.

Impact tokens promote financial inclusion by being at the centre of blockchain-based

ecosystems that allow peer-to-peer transactions to take place between all actors within it. Many of the reviewed cases require participants to set up a digital wallet, which is a software program that interacts with various blockchains to enable users to receive, store and exchange tokens with anyone in the world. By setting up these wallets, many unbanked and underbanked populations get instant access to financial tools and services for the first time, allowing them to participate in the global economy. This has great potential to democratize access to finance and investments by connecting the wallets to a growing number of blockchain-based services. For example, *Plastic Bank* takes advantage of tokens and digital wallets to promote financial inclusion while contributing to the circular economy.

## Case Study 3: Plastic Bank

**Theme:** Circular economy

**Sub-Themes:** Waste recycling, CSR, financial inclusion

**SDGs:**



**What is it about:** Plastic Bank (n.d.) is a plastic offset program that rewards people with tokens or fiat for collecting plastic waste and taking it to recycling centres. This program is currently running in Haiti, the Philippines, Brazil and South Africa.

**Context:** Recycling plastic programs already exist in developing countries, but with a few problems. Crude oil prices and the market value of plastic can fluctuate a lot. This reduces incentives by creating uncertainty about the amount of financial rewards for people participating in these programs. The rewards are usually in the form of cash, which also puts the individuals at risk of robbery; many women and children participating in these programs fear getting mugged.

**How it works:** The Plastic Bank program is modelled after carbon offsets. To incentivize the collection of plastic, the program provides an above-market rate for plastic waste. Anyone can participate and earn tokens in exchange for bringing the plastic waste to the recycling centre. Transactions are tracked and managed transparently on a blockchain-based application and participants receive and store their tokens on pre-installed digital wallets. These tokens exist in two forms: one tied to the U.S. dollar that can be exchanged for fiat and one that can be exchanged for goods and services such as food, water and tuition.



Once the plastic has been recycled, Plastic Bank sells it back to corporate clients, who pay a premium over the commodity price, which funds the creation of tokens awarded to the participants.

**Who benefits:** Corporations can use similar programs as part of their CSR strategy and reduce their environmental impact, earning good public relations in the process. The data serves as proof of impact for the corporations, which can make verified claims backed by numbers that they have helped reduce plastic waste. The ultimate goal for this kind of program is to incentivize a circular economy where corporations participating in the program reuse the plastic that they produce and prevent it from entering the ocean.

Plastic Bank can use the information to improve the program further as it learns more about the needs of the participants and the market for plastic waste.

Finally, participants can safely earn and spend tokens, especially women and children.

**Main points:**

- Reduction of plastic waste
- Financial inclusion for participants
- Incentivizes investment in a circular economy
- Encourages performance-based CSR

On top of digital wallets, many of the cases reviewed promote the setup of a digital ID on a mobile phone as a critical link to facilitate the transfer of assets and to increase a program's integrity. According to the World Bank, over one billion people worldwide currently do not have ownership over their identity (Desai, Diofasi, & Lu, 2018); meanwhile, the number of people accessing the Internet through their mobile phones is increasing rapidly (Granrynd, 2018). Blockchain offers the ability to store sensitive personal data securely. This can significantly boost government, financial and insurance service delivery.

The use of tokens can considerably cut transaction costs and make it easier, faster and cheaper to transfer money between individuals. Without a central authority, the fees generally collected by intermediaries are much less of a factor. This is particularly beneficial to individuals in developing countries relying on high fee remittances for significant portions of their income. Investors and funders also stand to gain from a reduction of operating costs and faster transactions, which can accelerate the monetization of impacts and investments toward them. *Moeda* is a cooperative investment platform connecting underbanked community-owned enterprises with impact investors from around the world who can directly invest with the flexibility of digital tokens and track their impacts.



## Case Study 4: Moeda

**Theme:** Impact investments

**Sub-Themes:** Financial inclusion

**SDGs:**



**What is it about:** Moeda is a cooperative investment platform that connects impact investors directly with small businesses that promote the SDGs. Blockchain technology guarantees the transparency of the projects for investors from around the world who can directly invest with the flexibility of digital tokens and track their impacts. The hope is that this raises more capital for community-owned enterprises that face challenges finding funding through the traditional banking system and eliminates gender bias against women-led projects (Reis et al., 2017).

**How it works:** The Moeda platform has two portals: one for investors that lists all the seed projects that they can directly fund and one for entrepreneurs who seek funding. The projects listed all directly contribute to the SDGs.

Before being listed, all initiatives must undergo a screening and risk-assessment process. Furthermore, to inform future investors, Moeda also developed an Impact Formula that measures the financial returns of the listed projects. The main performance indicators of the formula are wisdom, cooperation, trust and environment.

The fiat-pegged Moeda tokens (MDA), built on top of the Ethereum blockchain, serve as currency on the platform, allowing for direct peer-to-peer payments. This removed the hurdles tied to fiat currency transfers, making the transactions faster and cheaper.

Moeda charges 3–5 per cent fees on each transaction to support the company and improve the services offered.

**Main points:**

- It is a community-focused lending system.
- It offers real-time transparency of impact investments.
- Small underbanked businesses can raise more capital.

Tokens can also advance financial inclusion through Initial Coin Offerings (ICOs), which is a crowd-fundraising event when a token is created and offered to purchase for the first time. ICOs lower the barrier of entry to become an investor or an entrepreneur. Many small investors can join the financing of projects all around the world that was previously reserved only for big financial institutions, while small projects can find the funding needed through small individual sources.

### 5.3 Improving Data Collection and Accelerating MRV Processes

People are less inclined to invest and donate where there is a lack of transparency or understanding of how their money is being spent. Is it going straight into the pockets of intermediaries or is it having a direct, targeted impact? Impact tokens can greatly enhance trust through improved data collection by accelerating MRV processes in a transparent manner.



Impact tokens can increase the amount of quality data collected by incentivizing actors along a supply chain (e.g., farmers and fishers) to capture, provide and verify the data on the blockchain in exchange for tokens. The ledger then becomes a growing transparent database of impact data that anyone can access. This has the potential to democratize access to the information and to create a more inclusive and participative ecosystem where the data and the tokens are freely exchanged between the various actors through peer-to-peer transactions. *Hara* has created a decentralized and transparent data exchange for the agriculture sector, providing farmers and all other agricultural players access to near-real-time valuable information to improve economic decisions.

## Case Study 5: HARA

**Theme:** Impact data

**Sub-themes:** Agriculture, supply chain, insurance, financial inclusion

**SDGs:**



**What is it about:** HARA (2018) is a decentralized and transparent data exchange built on top of the Ethereum blockchain to democratize and improve data-driven decisions for the world's most socially impactful sectors, starting with agriculture in Indonesia. Farmers and all other agricultural players get access to valuable near-real-time data to improve economic decisions. As part of the ecosystem, HARA tokens were created to incentivize the collection and verification of the data, and to build connections between farmers, markets, governments, financial institutions, non-governmental organizations (NGOs) and consumers.

**Context:** Over 30 per cent of global food produced is either lost or wasted, costing USD 990 billion each year (FAO, 2019). In developing countries, a third of the loss occurs during the production phase, mainly because of managerial and technical limitations during the storage, transportation, processing, packaging and marketing stages of food production. Poor land-use practices and a very fragmented supply chain also contribute to the problem.

The agriculture sector also has a problem with data, which tends to be centralized and expensive to acquire. Farmers do not have the right incentives to participate in providing data, the quality and verification of the existing data can be questionable, and it is often locked in data silos, all of which lead to asymmetrical access to the information.

**How it works:** HARA was developed by big Indonesian data analytics company Dattabot. It provides a decentralized data exchange that connects data providers and buyers with a tokenized market-driven revenue distribution model. The exchange, powered by blockchain technology, is traceable, transparent and secure, and integrates smart contracts that automate transactions and validate ownership rights.

The Hara ecosystem is populated with four main stakeholder groups:

- 1) Data providers (farmers, data companies, NGOs, IoT devices, satellites)
- 2) Data qualifiers that verify the data
- 3) Data buyers (banks, insurance companies, retailers, NGOs, governments)
- 4) Value-added services that process and enrich the data produced (academic institutions, credit bureaus, analytics companies).



Using a mobile application, data providers submit critical information like farmer identification data (ID, land ownership, location), cultivation data (commodity, date, selling price, diseases, pests), ecological data (weather, temperature, soil quality), market information and transactional data. Once the data has been submitted to the HARA exchange, it is verified by data qualifiers who act as a crowd-sourced indicator of data quality. Finally, the data can then be bought, consumed through a web portal and further processed.

To make it all work, the HARA tokens were created as part of an incentive mechanism that has been endorsed by the local government. Data buyers contribute to the creation of the tokens, which serve as a reward to the data providers, verifiers and enrichers for their work and inputs. Before joining the program, participants set up digital wallets where they will receive and store the tokens, which can later be spent or exchanged for various products and services such as discounts on agricultural supplies, educational supplies and phone credits.

Hara plans to expand to other developing countries with high levels of Internet users and mobile penetration rates such as Bangladesh, Vietnam, Thailand, Kenya, Uganda, Mexico and Peru.

**Who benefits:** Farmers gain access to real-time information about prices, sales and best practices that can be used to identify market opportunities, improve inventory management, boost productivity, reduce weather- and climate-related risks, and overall improve their livelihoods. Furthermore, financial inclusion is promoted through the use of digital wallets and tokens, giving the unbanked population (close to 50 per cent of adults in Indonesia are still unbanked [World Bank, 2017]) access to financial services for the first time.

Financial institutions (banks, insurers) can use the information to better formulate credit scoring and calculate insurance premiums. Administrative and legal issues related to the absence of land certificates and tax registration numbers, for example, are eliminated. This also helps with the risk assessment of loans and speeds up disbursements to farmers, as money and time are saved in the process of verifying the data, given that banks can now have direct access to the information on the blockchain instead of having to first go through the government.

Governments can see in real time what is happening in the industry and use the information to formulate better data-driven policies that improve their ability to anticipate problems, control inflation, speed up land certification processes and enhance food security threatened by climate change.

Finally, consumers know more about the origins of their food.

#### Main points:

- It promotes the financial inclusion of farmers.
- It improves the effectiveness of financing instruments for agriculture.
- Agricultural resources can be used more efficiently and avoid waste.
- It democratizes quality data and creates data symmetry for all players.
- It incentivizes sustainable supply chains by including local actors.

Some of the reviewed cases take it a step further by combining blockchain technology with satellite data, IoT devices, biometrics and AI to automate certain data collection and analysis processes for even more instant, independent and accurate information. This can provide an even deeper insight into the investments made and drive smarter decisions to optimize sustainable development. *REDD-Chain*, for example, creates a forest finance ecosystem that combines these different technologies to offer more sustainable monitoring and management of forests.



## Case Study 6: REDD-Chain

**Theme:** Deforestation

**Sub-Themes:** Sustainable farming, climate change mitigation, financial inclusion

**SDGs:**



**What is it about:** REDD-Chain (2018) is a forest finance ecosystem that combines blockchain technology with IoT and AI analysis to offer a more sustainable monitoring and management tool for forests. It tokenizes land-use assets in REDD+ projects and rewards investors and local community actors promoting the conservation of the forest.

**Context:** REDD+ is a climate mitigation measure aimed at reducing emissions from deforestation and forest degradation in developing countries. The idea is that, by giving forests a financial value through the issuance of carbon credits, this will provide an incentive for locals to keep the forests intact (rather than cutting them down to raise cattle) and lead to improved forest management overall. It has been estimated that between 12 and 29 per cent of global GHG emissions come from land-use change (van der Werf et al., 2009).

Many challenges slow down the implementation of REDD+ projects and programs. The monitoring and verification of GHG emissions related to deforestation, along with the processes of certifying projects (to confirm that forests were under threat and the project succeeded in better managing forests) and paying for carbon credits, are resource-intensive in terms of time, money, technology and human labour. In addition, these systems are complicated to coordinate and require participant trust due to a lack of transparency. These factors result in implementation delays and inefficiencies while creating risks for potential investors, hindering the program's potential to reduce deforestation and protect biodiversity.

**How it works:** The REDD-Chain Project is embracing new technologies (blockchain, IoT and AI) that specifically address many of the challenges that REDD+ projects face.

Blockchain technology brings transparency of accounting to the program, which reduces the possible misallocation of funds and fraud while it enables the traceability of impacts for donors and recipients and encourages the increase of results-based payments with smart contracts to automate many of the resource-intensive processes tied to administration and MRV. Observation on the conservation of forests is done primarily using high-resolution satellite images, providing confirmation that the conditions of the smart contracts in place have been fulfilled. Additionally, new remote sensing technologies monitor tree counting, species detection, canopy growth, soil moisture, humidity and wind speeds to provide better management tools. Finally, AI enhances data verification and quality while generating new knowledge and predictive analysis such as deforestation patterns.

The engagement of local actors, who are rewarded with tokens for submitting information on forest conservation via mobile apps, promotes better project implementation through sustainable onsite reporting. The token system also serves as proof of impact for outside investors.

**Who benefits:** Local farmers can improve their land management and monetize forest conservation on REDD-Chain. Furthermore, by setting up digital wallets, many farmers gain access to financial services and have a way to store and exchange currencies.



The financial sector can get more involved, and a wider pool of investors can join in the efforts. Small individual investors can become token holders (shareholders) and participate in the conservation program, which was primarily reserved for large investors due to the previous costs of engagement and coordination efforts. They can also have verifiable proof that their investments are having an impact.

#### Main points:

- It provides better management of forests through more accurate and transparent data, faster and cheaper MRV, and improved engagement of local stakeholders.
- It increases investments in conservation of forests from large and small investors (crowdfunding).
- It reduces carbon dioxide emissions from deforestation.
- It offers financial inclusion of local actors.

## Impact tokens offer the possibility of measuring impacts and trace back which investment and which donor can claim the attribution.

Impact tokens offer the possibility of measuring impacts and trace back which investment and which donor can claim the attribution. This has been an ongoing problem in impact evaluation, as it can be challenging, if not impossible in some cases, to isolate, measure and estimate accurately just how much of an impact a particular intervention or investment has had. With tokens, one can identify the direct causality between one contribution and the total impact by separating it from other external factors that have influence. Measuring the results of an investment provides insight into the efficiency and effectiveness of the funding, which can raise incentives for more impact investments.

Verified proof of impacts can also promote results-based funding approaches, under which payments are contingent on achieving independently verifiable pre-defined results. Results-based

funding can incentivize and improve policy implementation effectiveness, increase accountability and reduce risks for funders and investors. However, for this approach to work, objectives need be specific and measurable, recipients of the funding must trust that the payment will be delivered according to what was previously agreed to, and the measurement and verification of the results need to be done accurately by a trusted authority. Impact tokens offer real added value on all of these challenges by not only accelerating the collection and verification of the impacts but also by using smart contracts as guarantees for the payments. *AmPLY* by the ixo Foundation is an excellent example of this.

## Case Study 7: AmPLY

**Theme:** Impact investing

**Sub-themes:** Education

**SDGs:**



**What is it about:** AmPLY, from the ixo Foundation (2017), is digitizing the management of South Africa's early education program by recording children's school attendance on the Ethereum blockchain and issuing tokens as proof of impact in exchange for governmental subsidies.



**Context:** The South African government has a per-child-per-day subsidy program of over USD 200 million, which supports over 800,000 children qualifying as low-income across thousands of registered preschools around the country. For teachers to access these subsidies, they currently must track daily attendance through an unverifiable paper-based system and have lengthy quarterly reports reviewed by administrators at the Department of Social Development before any payments can be sent out to the centres' bank accounts. It is a time-consuming and costly process that can also be prone to errors and fraud.

**How it works:** The ixo Foundation created a "proof of impact" protocol, which allows the collection and verification of data about sustainable development projects to be recorded on a distributed ledger that uses a mix of public, public-permissioned and private blockchains to maximize the benefits of the technology while also ensuring data privacy. Amply is an initiative developed through grants from the UNICEF Innovation Fund and Innovation Edge, a local investment fund.

In this project, children in South Africa are given self-sovereign digital identities (all personally identifiable information is encrypted within an individual's personal data store that only they and their parents have control over) on a ledger that records their educational history and allows them to receive the benefits they are entitled to. When a child arrives at school, a teacher uses a mobile application to log attendance in a verifiable standardized claim format, making the data interoperable across platforms. This claim, along with its associated tamper-proof metadata (location, date, time of collection) and the child's digital ID can then be verified by an external authority. Finally, a smart contract generates an impact token that the school can then redeem for subsidies from the government.

Applications like Amply can reduce fraud and costs associated with these programs while also giving service providers and funders valuable insight and proof that their money is well spent. The data is accessible on the blockchain by anyone, and it enables governments, researchers, donors and NGOs to make more informed decisions about their work to optimize impact.

Any organization can build applications via the ixo Protocol to create an SDG impact claim about the work they have achieved and generate impact tokens, which can then become a new asset class that could set the basis for a more organized and regulated form of investing. The hope is that delivering proof of impact showing that the money has been well spent increases impact investments and access to government subsidies and social impact bonds. ixo plans to expand the Amply project across the country and to develop similar concepts for other impact projects, such as a reforestation program in Madagascar and a clean water project in South Africa.

**Who benefits:** Students and teachers can have access to the benefits they are entitled to without fail and much quicker, which incentivizes the reporting and overall well functioning of the programs.

Governments can use the information received to understand better where and how the services are delivered and improve program resources planning and allocation.

Investors have proof that their money is being used for what they intend it for.

**Main points:**

- It decentralizes and democratizes the funding and delivery of impacts.
- Impacts become a new digital asset.
- Reducing the cost and time of evaluation leads to results-based payments.
- It increases funding for activities that contribute to the SDGs.



## 5.4 Incentivizing Behaviours That Promote Sustainability

By generating greater confidence among the public, consumers, investors and shareholders, impact tokens can also increase investment flows and enable more effective distribution of resources. Governments and companies can use impact tokens to improve their programs and empower citizens and customers by rewarding positive behaviours that promote sustainable development. *Energi Mine* uses tokens to incentivize energy-saving behaviours at home and in the workplace.

### Case Study 8: Energi Mine

**Theme:** Energy conservation

**Sub-Themes:** Sustainability, CSR

**SDGs:**



**What is it about:** Energi Mine is a decentralized market for energy that uses advanced technologies such as AI and blockchain to sustainably manage energy and incentivize energy-saving behaviours (switching to low-carbon transportation, purchasing energy-efficient appliances and promoting energy conservation in the workplace) through the EnergiToken (ETK) (2018).

**Context:** Energy-efficiency programs in the United States have not achieved significant scale or realized dramatic reductions in total GHG emissions. Existing smart meters inform people by quantifying their energy use in real time, making energy consumption more visible to consumers and encouraging them to be more energy efficient. However, smart meters alone have not changed energy consumption behaviour. Reducing energy consumption can be further incentivized with reward systems.

**How it works:** Energi Mine uses blockchain technology and AI models to manage energy consumption, make energy procurement smarter, improve efficiency and cost-effectiveness and, ultimately, mitigate the effects of climate change. It procures energy and assesses market data to identify the optimum time to buy or sell energy. It also manages individual data and processes consumption data with algorithms that advise when and how to use energy in a smarter way.

Consumers can earn ETK tokens as part of the program by exhibiting energy-saving behaviour such as commuting via public transportation, buying an electric vehicle or consuming less energy at home or in the workplace. These tokens are created by global partners, which come in four different categories: low-carbon transportation (electric vehicle dealerships or rentals, bike-sharing schemes, public transport authorities), employee rewards (employers can sign up and reward their employees with ETK when they exhibit energy-saving behaviour; the employer reaps the benefits of saving energy costs), energy-efficient appliances (sellers of washing machines) and solar panel vendors.

ETK tokens can be sold and ultimately exchanged in fiat currencies, saved to pay for future energy bills/electric vehicle charging/public transport, or traded on a peer-to-peer exchange where customers can buy and sell energy.



**Who benefits:** Large institutions can purchase large quantities of ETK to run their own incentive schemes in line with their CSR strategies of improving energy efficiency, reducing energy use, and limiting their GHG emissions and overall environmental impact.

Individuals can reduce their energy bills and their environmental impact as well.

**Main points:**

- It increases investments in CSR.
- It promotes low-carbon businesses.
- It encourages energy-saving behaviour.

Impact tokens can create entire investment ecosystems where everyone with the same shared goal is a participant and an investor. Governments and companies can engage on a personal level with citizens and consumers who care about impacts by rewarding them if they contribute to a government's sustainability program or a company's overall CSR strategy. Since transactions on the blockchain can be verified instantaneously, and the rewards can be received and used immediately, the incentives and thus the potential to influence behaviours are much stronger. Chinese electric car company *BYD* is attempting to reward the use of its electric vehicles with individual carbon credits.

## Case Study 9: BYD

**Theme:** Carbon market

**Sub-Themes:** Electric vehicles, CSR

**SDGs:**



**What is it about:** Chinese company *BYD*, the world's largest manufacturer of electric vehicles and power storage batteries, is integrating blockchain technology in its product line to offer a carbon banking solution that instantly rewards individual users of electric cars with carbon credits.

**Context:** China, the largest emitter of carbon dioxide emissions in the world, will soon become the largest carbon market in the world. The Chinese National Carbon Trading Scheme, created and implemented by the Chinese government, is designed to build strong economic incentives for the country to transition to a sustainable energy future, making those who continue to emit GHG pay by using carbon credits, while those who use clean and renewable energy sources will be able to earn those credits.

One of the big issues with carbon markets is the lengthy certification process, which can take months if not years, therefore delaying and reducing the intended incentives.

**How it works:** Seeing this Carbon Trading Scheme as a new opportunity, *BYD* co-developed a carbon banking solution with *DNV GL*, a global risk management company that certifies the process design and checkpoints, and *VeChain*, a blockchain platform that offers automobile life-cycle management, among other things, on which the application runs. This public blockchain-based ecosystem will collect the data through the application, calculate the emission reductions and then, almost instantly, through a smart contract, reward users with carbon credit tokens for using a clean form of transportation and taking steps to reduce carbon emissions.



The application collects data from drivers and their cars, including power and fuel consumption, as well as carbon footprint. This is done through a smart contract that uses an emissions reduction formula to award carbon credit tokens almost instantly, following vehicle usage. Those tokens can later be exchanged or used to buy other products.

**Who benefits:** Citizens are encouraged to use clean energy vehicles through a rewards program. They also receive access to their vehicle and driving behaviour data (mileage, damage, maintenance and repairs), which can be used during vehicle repairs and insurance claims.

Governments get access to faster and more accurate data on the mobility of participating citizens to track the use of electric vehicles and monitor the exchange of carbon credits in the transportation sector. This can encourage the use of subsidies to speed up the transition to clean energy transportation, and it provides valuable information on how similar programs could be replicated in other sectors and industries.

Companies like BYD can use the aggregated data to improve their products and to make the business case for increased investment in CSR strategies that include participatory customer engagement.

**Main points:**

- It promotes carbon emission reductions.
- It increases private sector investment in CSR and carbon neutrality.
- MRV is streamlined, and the data can be analyzed to improve urban mobility.

As part of a growing impact economy, many individuals care more and more about the impacts of the products they purchase. They crave authenticity and want to associate themselves with brands and services that share their values, and that can prove their sustainability claims. Many companies have caught on to that and have started rewarding their customers for contributing to their impact mission. Renewable energy companies have started using this method to encourage the development of installations by turning consumers into “prosumers,” meaning they can earn extra income for generating clean energy. *SolarCoin* is the world’s largest community-based solar electricity reward program.

## Case Study 10: SolarCoin

**Theme:** Renewables

**Sub-Themes:** Solar energy, crowdfunding

**SDGs:**



**What is it about:** SolarCoin (n.d.) is a digital asset to incentivize solar energy production and accelerate the global energy transition by increasing returns on investment and decreasing payback time. It is the most significant community-based solar electricity reward program in the world. In collaboration with Lumo, a French crowdfunding platform for renewable energy projects, anyone can become an investor in solar energy projects anywhere in the world.

**Context:** Solar energy is the largest and most democratic renewable energy source, as even small groups or individuals can use solar panels for energy production. With subsidies for solar



power being reduced or eliminated in many countries, SolarCoin represents a new and needed alternative to incentivize and fund solar installations.

**How it works:** SolarCoin is a reward, like Air Miles, for solar electricity generation. Solar energy producers are rewarded with digital tokens at the rate of one SolarCoin per one megawatt-hour of verifiable solar energy produced, which can help offset the cost of electricity, enabling solar installations to be paid off more quickly.

To earn tokens, installation owners must register their installation with the SolarCoin Foundation, which then issues SolarCoins on a semi-annual basis directly to the owner's digital wallet address, where they can be stored, used for payments with a growing number of businesses, traded for goods and services, or exchanged for other cryptocurrencies on global exchanges. The use of this currency incentivizes the production of solar energy.

Furthermore, by partnering with the crowdfunding platform Lumo, retail investors and small investors can fund solar energy installations anywhere in the world. Lumo users receive an additional impact investing return, on top of their usual return on investment, in the form of SolarCoins.

SolarCoins is powered by ElectricChain, which is a blockchain that uses a proof of stake algorithm allowing it to use less than 0.001 per cent of the energy of Bitcoin. It is also in full regulatory and legal compliance wherever it operates (63 countries). It gathers non-confidential data related to solar owners and builds a network of installations.

**Main points:**

- It accelerates individual and small investments for renewables.
- Solar installations can be crowdfunded.
- It encourages the decentralization of energy production.



# 6

## How Impact Tokens Address the Challenges of Impact Investing

### ADDRESSING CHALLENGE 1: APPROPRIATE CAPITAL ACROSS THE RISK/RETURN SPECTRUM

Tokenization refers to the digitalization of the equity and debt financing used in the project. Through the tokenization of impact investment funds and projects, a much broader spectrum of investors can have access to these investments. Tokenization will lower the barriers of entry for retail and other small-scale investors by decreasing the minimum investment sizes required, making transactions more cost-efficient, offering a convenient distribution channel and enabling the creation of a liquid secondary market. Through better diversification of capital, high-impact projects will have access to investors across the risk/return spectrum.

The role of impact tokens in addressing this challenge:

- **Increasing trust between parties:** By increasing the transparency of the projects involved, for both operational and impact performance, a larger variety of investors will engage in the sector. This can be particularly important for projects in emerging and developing countries, where an increased level of trust can increase capital flows materially.
- **Promoting financial and social inclusion:** Impact tokens can contribute to the democratization of finance. A large part of society does not have access to the historically high-performing asset classes, such as private equity and venture capital, that comprise most impact investments. Through impact tokens, almost anybody can invest in these asset classes without having to worry about minimum sizes, liquidity or transaction costs. Tokenization enables fractional ownership and can automate many aspects of the client on-boarding process. This decreases transaction costs and makes smaller investment sizes possible.



## ADDRESSING CHALLENGE 2: COMMON UNDERSTANDING OF DEFINITION AND THE SEGMENTATION OF THE IMPACT INVESTING MARKET

Although the definition of impact investing still needs to be standardized across the industry, tokenization can address the issue of market segmentation. The challenge with a heavily segmented market is that both projects and available capital might be scarce for certain parts of the market, which can affect valuations accordingly. Impact investing is a particularly diverse industry with different financial return mandates, motivations for engaging in the sector, impact themes, geographies and asset classes. Blockchain, through tokenization, can increase transaction volumes across the market by engaging alternative sources of capital and enabling a liquid secondary market.

The role of impact tokens in addressing this challenge:

- **Promoting financial and social inclusion:** By extending the investor base for impact investments, impact tokens can improve the distribution of capital across the different segments of the market.
- **Improving data collection and accelerating MRV processes:** One major challenge of impact measurement is how to attribute positive outcomes to the project in question. This can lead to skepticism or even a lack of trust in the environmental and social performance of impact investments. Uncertainties around the impact generated will make investors hesitate to commit capital to these projects. Impact tokens are well placed to address this attribution problem by improving trust in the data and offering ways to track impact performance during the life of the project. In other words, impact tokens can link money to impact.

## ADDRESSING CHALLENGE 3: SUITABLE EXIT OPTIONS

Exiting investments in illiquid, unlisted financial instruments can take a considerable amount of resources. In other words, when investors decide to sell their investments it is difficult to find buyers at reasonable valuations. This liquidity risk needs to be priced in by investors, resulting in a higher cost of financing for impact investments. On the other hand, if the project is tokenized, investors will be able to trade these impact tokens similarly to traditional listed equities without the additional costs and administrative burden of being listed on conventional stock exchanges. This will allow better price discovery and create liquidity for these otherwise illiquid securities.

The role of impact tokens in addressing this challenge:

- **Increasing trust between parties:** As blockchain represents a system in which trust is inherent; impact tokens can be traded peer-to-peer right after issuance, making secondary market transactions easy and frictionless. In addition, digital token exchanges can create liquidity and mitigate the exit-related risks of tokenized projects.
- **Promoting financial and social inclusion:** By extending the investor base for impact investments, impact tokens can also improve liquidity when investors are exploring opportunities to sell their portfolio of projects. Crowdfunding has proved to be a successful way to fund projects, as the retail investor-driven ICO craze of 2017 and 2018 demonstrated (Floyd, 2018). Similarly, if retail and other small-scale investors can participate in impact investment opportunities, they can provide liquidity and drive valuations at the time of exit as well.

## ADDRESSING CHALLENGE 4: SOPHISTICATION OF IMPACT MEASUREMENT PRACTICE

Any impact measurement tool or methodology is only as useful as the data going into it. Quality impact data is often hard to source, especially in emerging and developing countries. When investment decisions are based on the environmental and social footprint of projects, accurate and reliable data is fundamental for the growth of the industry. Data provided by trusted hardware and



other IoT devices can be stored on the blockchain in an immutable manner. This will provide more transparency and trust in the environmental and social performance of projects.

The role of impact tokens in addressing this challenge:

- **Improving data collection and accelerating MRV processes:** Impact tokens can represent quantified units of an impact that can be traded and potentially used as offsets or as a contribution to companies' CSR initiatives. A key component of impact tokenization is the reliable measurement of impact. This is an area where blockchain can significantly improve transparency and reliability in a cost-efficient manner.
- **Incentivizing behaviours promoting sustainability:** Impact tokens can also be used as incentives for stakeholders to provide or validate data before it is uploaded to the blockchain. Validators earn impact tokens that can either be sold or used as perks for services related to the underlying project. Many blockchain applications have faced the challenge of devising reliable methods to upload accurate information to the blockchain. In other words, finding ways to link the on-chain and off-chain worlds in a trusted manner. Relying on the community for validation can solve this so called "oracle problem."

## ADDRESSING CHALLENGE 5: HIGH-QUALITY INVESTMENT OPPORTUNITIES

Blockchain-based solutions can improve the financial viability of impact investments in multiple ways. First, they can eliminate or mitigate significant project-related risks, which would otherwise need to be priced in by investors. These risks include counterparty risk, data risk, liquidity risk and some forms of political risk. The mitigation of these risks will result in a lower cost of financing, improving the overall bankability of projects. Second, blockchain-based solutions can decrease transaction-related costs significantly. This is particularly a problem in the case of projects based in emerging or developing countries. For example, the high cost of cross-border payments through the traditional financial system could have a material impact on the financial viability of projects in these countries. Due to the fixed transaction costs involved, microtransactions would not even be possible using the current solutions. Blockchain enables the frictionless transfer of value, eliminating most, and in some cases all, of the intermediaries needed to facilitate transactions.

The role of impact tokens in addressing this challenge:

- **Increasing trust between parties:** Impact tokens offer a transparent and secure way to raise financing for high-impact projects. They are well placed to overcome many of the transactional challenges faced by projects in developing countries when relying on international sources of financing. In the traditional financial system, counterparties need to trust large financial intermediaries to facilitate the transactions. This intermediation has a cost, which can be significant when developing countries are involved. In the case of token-based financing, these costs do not apply.
- **Promoting financial and social inclusion:** A larger pool of capital-seeking impact investment opportunities can improve the cost of capital for projects across the entire risk/return spectrum.
- **Improving data collection and accelerating MRV processes:** Projects feeding operational data to the blockchain will have better valuations than the ones relying on conventional technologies for collecting and storing data. Potential buyers need to spend significantly fewer resources when conducting due diligence for blockchain-based projects due to the large amount of reliable data that is readily available.
- **Incentivizing behaviours promoting sustainability:** Impact tokens can stimulate the consumption of sustainable goods and services by providing financial incentives to users and customers. This can support the profitability of related high-impact businesses.



**Table 1. Summary of how impact tokens address the challenges of impact investing**

<b>Benefits of Impact Tokens</b>	<b>Challenge 1: Access to Capital</b>	<b>Challenge 2: Common Understanding and Market Segmentation</b>	<b>Challenge 3: Suitable Exit Options</b>	<b>Challenge 4: Impact Measurement</b>	<b>Challenge 5: High-Quality Investment Opportunities</b>
<b>Increase trust between parties</b>	X		X		X
<b>Financial and social inclusion</b>	X	X	X		X
<b>Improve data collection and accelerate MRV processes</b>		X		X	X
<b>Incentivize positive behaviours</b>				X	X



# 7

## Conclusion

**Impact tokens have the potential to unlock the investment needed to achieve the SDGs by providing trust, transparency, low transaction costs, and measured and verified impact data.**

Impact tokens have the potential to unlock the investment needed to achieve the SDGs by providing trust, transparency, low transaction costs, and measured and verified impact data. Projects using them are rapidly multiplying in every sector of the economy, and while most are still at the early stages of development, many are moving beyond pilot tests with the backing of large institutional players willing to take risks to be among the first to successfully implement these innovative ideas. Impact tokens offer solutions to many of the challenges of impact investing, and while their benefits should continue to be tested and further developed by entrepreneurs, everyone has a role to play in their evolution.

The UN or other international organizations could facilitate their development and adoption by creating a set of guidelines around impact tokens, to define their key characteristics and how they can contribute to the SDGs. Also, the creation of an open-source database of all the active or in-development projects would be useful to monitor and evaluate the progress made, as well as to identify new ideas and trends taking place.

Governments have a significant role to play in the regulation of the blockchain industry, but they also stand to benefit directly from it. They can use impact tokens to better plan and allocate resources to social programs by understanding better where and how the services are delivered. Having much



quicker and accurate information can allow them to formulate better policies (for example subsidies to speed up the global energy transition) and anticipate problems.

Private companies can start incorporating these new tools as part of their CSR strategies to improve supply chain efficiency and environmental footprint. Impact tokens can provide the proof needed to make the business case for CSR, attract investments and boost the circular economy. Their use can further engage consumers around shared values and make the processes more participative by improving linkages between all actors across the board while also promoting financial and social inclusion in many parts of the world.

Impact tokens and other blockchain-based technologies are well placed to address the challenges of the impact investing industry. As the case studies further demonstrate, there is no shortage of good, innovative ideas in the space. It remains to be seen which ideas can get implemented and gain adoption among industry participants in the coming years. Some of the solutions, such as the tokenization of impact, would require some level of standardization to gain more traction. There would also be a need for dedicated venture funding to support start-ups active in the space. This is especially important since the ICO funding model has raised regulatory concerns. Indeed, there is much work to be done before we see the benefits of blockchain materialize, but once the necessary platforms and infrastructure are built, the upscaling of the impact investment industry will have fewer obstacles to overcome.



## References

- Casey, M.J., & Vigna, P. (2018, April 9). In blockchain we trust. Retrieved from <https://www.technologyreview.com/s/610781/in-blockchain-we-trust/>
- Desai, V. T., Diofasi, A., & Lu, J. (2018, April 25). The global identification challenge: Who are the 1 billion people without proof of identity? World Bank. Retrieved from <https://blogs.worldbank.org/voices/global-identification-challenge-who-are-1-billion-people-without-proof-identity>
- EnergiToken. (2018, March 8). *Decentralizing global energy markets by regarding energy efficient behaviour: Power to the people*. (White Paper version 5.0). Retrieved from [https://energitoken.com/whitepapers/whitepaper\\_en.pdf](https://energitoken.com/whitepapers/whitepaper_en.pdf)
- Fishcoin. (2018, February). *Fishcoin: A blockchain based data ecosystem for the global seafood industry*. Retrieved from <https://fishcoin.co/files/fishcoin.pdf>
- Floyd, D. (2018, April 19). \$6.3 billion: 2018 ICO funding has passed 2017's total. *Coindesk*. Retrieved from <https://www.coindesk.com/6-3-billion-2018-ico-funding-already-outpaced-2017>
- Food and Agriculture Organization of the United Nations. (2016). *The state of the world fisheries and aquaculture: Contributing to food security and nutrition for all*. Retrieved from <http://www.fao.org/3/a-i5555e.pdf>
- Food and Agriculture Organization of the United Nations. (2019). SAVE FOOD: Global initiative in food loss and waste reduction. Retrieved from <http://www.fao.org/save-food/resources/keyfindings/en/>
- Friede, G., Busch, T., & Bassen, A. (2015, December). ESG and financial performance: Aggregated evidence from more than 2000 empirical studies. *Journal of Sustainable Finance & Investment*, 5(4), 210–233.
- Global Impact Investing Network. (2017a). *Annual impact investor survey 2017* (7th ed.). Retrieved from [https://thegiin.org/assets/GIIN\\_AnnualImpactInvestorSurvey\\_2017\\_Web\\_Final.pdf](https://thegiin.org/assets/GIIN_AnnualImpactInvestorSurvey_2017_Web_Final.pdf)
- Global Impact Investing Network. (2017b). *The state of impact measurement and management practice* (1st ed.). Retrieved from [https://thegiin.org/assets/2017\\_GIIN\\_IMM%20Survey\\_Web\\_Final.pdf](https://thegiin.org/assets/2017_GIIN_IMM%20Survey_Web_Final.pdf)
- Global Impact Investing Network. (2018). *Annual impact investor survey 2018* (8th ed.). Retrieved from [https://thegiin.org/assets/2018\\_GIIN\\_Annual\\_Impact\\_Investor\\_Survey\\_webfile.pdf](https://thegiin.org/assets/2018_GIIN_Annual_Impact_Investor_Survey_webfile.pdf)
- Global Impact Investing Network. (2019a). What is impact investing? Retrieved from <https://thegiin.org/impact-investing/need-to-know/#what-is-impact-investing>
- Global Impact Investing Network. (2019b). *Sizing the impact investing market*. Retrieved from [https://thegiin.org/assets/Sizing%20the%20Impact%20Investing%20Market\\_webfile.pdf](https://thegiin.org/assets/Sizing%20the%20Impact%20Investing%20Market_webfile.pdf)
- Granryd, M. (2018, September 20). More than just a phone: Mobile's impact on sustainable development. World Economic Forum. Retrieved from <https://www.weforum.org/agenda/2018/09/more-than-just-a-phone-mobile-s-impact-on-sustainable-development/>
- Hara. (2018). *Blockchain for better decisions: A global & transparent blockchain-based data exchange* (Whitepaper v. 1.03). Retrieved from [https://haratoken.io/doc/HARA\\_Token\\_White\\_Paper\\_v20181206.pdf](https://haratoken.io/doc/HARA_Token_White_Paper_v20181206.pdf)
- International Monetary Fund. (2018). World Economic Outlook: Database – WEO groups and Aggregates information. Retrieved from <https://www.imf.org/external/pubs/ft/weo/2018/02/weodata/groups.htm>



- ixo Foundation. (2017, December 8). *The ixo Protocol White Paper (Draft 3.0 for Technical Review)*. Retrieved from [https://ixo.foundation/wp-content/uploads/2017/12/The-ixo-Protocol-Draft-White-Paper-3.0-for-technical-review-12\\_8\\_2017.pdf](https://ixo.foundation/wp-content/uploads/2017/12/The-ixo-Protocol-Draft-White-Paper-3.0-for-technical-review-12_8_2017.pdf)
- Kell, G. (2018, July 11). The remarkable rise of ESG. *Forbes*. Retrieved from <https://www.forbes.com/sites/georgkell/2018/07/11/the-remarkable-rise-of-esg/#6751b02f1695>
- Plastic Bank. (n.d.). Join the movement. Retrieved from <https://www.plasticbank.com/>
- REDD-Chain. (2018). *Project summary*. Retrieved from [http://cleantech21.org/fileadmin/content/NBE/C21\\_H4C\\_REDD-Chain\\_Sum082018\\_v04.pdf](http://cleantech21.org/fileadmin/content/NBE/C21_H4C_REDD-Chain_Sum082018_v04.pdf)
- Reis, T., Chun, B., Diaconis, A., Yu, I., & Todaro, A. (2017, July). *Moeda White Paper*. Retrieved from <https://www.bitcv.com/storage/pdf/whitePaper/ilxSe2hENaHHaZhVTNBFfe2X3aQ3RsLer5gXzwI9A.pdf>
- SolarCoin. (n.d.). *SolarCoin: A blockchain-based solar energy incentive*. Retrieved from [https://solarcoin.org/wp-content/uploads/SolarCoin\\_Policy\\_Paper\\_EN-1.pdf](https://solarcoin.org/wp-content/uploads/SolarCoin_Policy_Paper_EN-1.pdf)
- United Nations Conference on Trade and Development. (2014). *World investment report 2014: Investing in the SDGs: An action plan*. Retrieved from [https://unctad.org/en/PublicationsLibrary/wir2014\\_en.pdf](https://unctad.org/en/PublicationsLibrary/wir2014_en.pdf)
- Van der Werf, G. R., Morton, D. C., DeFries, R. S., Olivier, J. G. J. Kasibhatia, P. S., Jackson, R. B., Collatz, G. J. & Randerson, J. T. (2009). CO<sub>2</sub> emissions from forest loss. *Nature Geoscience*, 2, 737–738. Retrieved from <https://www.nature.com/articles/ngeo671>
- Veridium. (n.d.). *Unlocking the world's environmental asset markets: White Paper (WP192301)*. Retrieved from <https://www.veridium.io/static/whitepaper.pdf>
- World Bank. (2017). The Global Findex Database 2017: About. Retrieved from <https://globalfindex.worldbank.org/>
- World Bank. (2018, April 19). Financial inclusion on the rise, but gaps remain, Global Findex Database shows (Press release). Retrieved from <https://www.worldbank.org/en/news/press-release/2018/04/19/financial-inclusion-on-the-rise-but-gaps-remain-global-findex-database-shows>
- World Economic Forum. (2013, September). *From the margins to the mainstream: Assessment of the impact investor sector and opportunities to engage mainstream investors*. Retrieved from [http://www3.weforum.org/docs/WEF\\_II\\_FromMarginsMainstream\\_Report\\_2013.pdf](http://www3.weforum.org/docs/WEF_II_FromMarginsMainstream_Report_2013.pdf)



# Glossary

## BLOCKCHAIN

Blockchain is a decentralized ledger technology. This means that the ledger is stored in multiple copies on many computers within a decentralized network so that no single person or organization owns or controls the ledger. Anyone connected to the Internet (and granted access in the case of private blockchains) can use it. The ledger is governed by a consensus protocol, which is an algorithm requiring a majority of the computers on the network to agree with any changes made to it. Once a consensus has been reached, all the computers on the network update their copies of the ledger simultaneously. Transactions are usually bundled together into blocks that are cryptographically and chronologically chained together, producing an immutable, shared record of the “truth” that cannot be tampered with. The verification of each block of transactions is incentivized through a competition in which “miners” solve complex mathematical problems in exchange for a payout.

## CRYPTOCURRENCIES

Cryptocurrencies are tokens in the form of digital currencies that use a combination of cryptography and blockchain technology to secure and record transactions on a public or private ledger. Unlike traditional currencies issued by national governments, cryptocurrencies are decentralized, meaning that they are not regulated by any central entity, and they allow for direct peer-to-peer transactions between parties.

## OPEN SOURCE

Most blockchain projects and many tokens use an open-source code that anyone can examine to make sure it is not doing anything they do not want it to do. Open-source projects promote collaboration, sharing and innovation because they permit other people to make modifications to source code and incorporate those changes into their own projects. They are also arguably more reliable, secure and stable since they typically involve many independent programmers testing the software and fixing bugs. Much of the Internet itself was built on open-source technologies.

## DIGITAL IDs

Blockchain offers the technology to guarantee trust and security in digital identity systems, a tamper-proof mechanism on a smartphone to store sensitive personal data creating digital identities for citizens who lack formal identification documentation and provide vital links to facilitate the transfer of assets. Digital IDs guarantee that only you and you alone are in control of your identity. It can be updated at any time, and you can grant access to it or to only certain parts of it. Technology firms and governments are exploring options such as using biometrics to create such a digital identity and developing standards for interoperability so that they can be used anywhere at any time. This can significantly boost government, financial and insurance service delivery.

## INTERNET OF THINGS (IOT)

IoT refers to the expanding network of physical objects connected to the Internet and communicating with the external environment and between each other. They allow task automation, can be remotely monitored and controlled, and provide all sorts of data analytics. IoT devices go beyond conventional devices like computers and smartphones to now include cars, security systems, electronic appliances, lights and thermostats.



## **PUBLIC, PUBLIC-PERMISSIONED, PRIVATE BLOCKCHAINS**

On a permissionless blockchain, anybody can become a node (i.e., a network validator), create a wallet on the blockchain and send transactions. There is no centralized entity operating the network or having the power to change the underlying protocol or shut down the system. All transactions processed by the network are visible to the public. Most cryptocurrencies, like bitcoin, operate on a permissionless public blockchain.

For a public-permissioned blockchain, there is a centralized entity or selected entities that have the power to grant permissions to perform specific functions on the blockchain, such as validating transactions. As it is a public blockchain, transactions are transparent and can be seen through the relevant blockchain explorer. For example, Ripple's XRP, a cryptocurrency, is operating on a public-permissioned blockchain.

Private blockchains are usually set up for a specific purpose and are controlled by a single entity. They are often used by companies that want to take advantage of the blockchain technology to streamline their internal processes.

## **SMART CONTRACTS**

Smart contracts are computer programs intended to verify or implement a contract. They execute a pre-defined set of terms automatically in a trackable and irreversible manner without the need for a third party. The idea was initially described by Nick Szabo, a cryptographer, using a vending machine as an example: a specific set of input generates a predefined output. While it is possible to have basic smart contracts on the Bitcoin blockchain, they only gained real traction with the emergence of Ethereum. This blockchain platform enabled the creation and implementation of complex smart contracts and contributed significantly to the popularity of smart-contract-based decentralized applications (dApps).

## **TOKENS**

Tokens are a digital representation of an asset or a utility that is usually built on top of existing blockchains. Today, most of the created tokens are built on top of the Ethereum platform, which has a native coin ETH, as well as various Ethereum-based tokens (collectively called ERC-20 tokens), although more recently many large projects have started developing their own blockchain networks.

## **SECURITY TOKENS**

Security tokens are digital tradable financial assets that meet the strict regulations specific to the country they are issued in. They are used as a currency but also represent ownership in an underlying asset. Like traditional stocks or bonds, they are regulated and can be exchanged and traded, but unlike regular securities, which are tracked on paper or in a centralized database, they are recorded on a decentralized blockchain that tracks who owns which assets, making it much easier to transact with them.

## **UTILITY TOKENS**

Utility tokens, or application tokens, are cryptocurrencies that give access to a good or a service offered by the issuer of the tokens. They are meant to be primarily used within a blockchain-based ecosystem that they are connected to and can serve as rewards for participants of the platform. They are not investments but can be traded on exchanges for other cryptocurrencies or fiat money.

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Published by the International Institute for Sustainable Development.

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