Authentics:

A Social Impact Token Economy

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Abstract

In 2016, the UN released its most ambitious agenda to date for ending poverty and creating a sustainable, equitable world. The Sustainable Development Goals (SDGs) have opened a \$12-trillion-dollar market opportunity for companies that can offer innovative and sustainable business models in support of the global humanitarian agenda.1 However, lack of security, automation, and performance data in infrastructure projects hinder non-governmental organizations (NGOs) from successfully allocating foreign aid investment dollars to recipient Small and Medium Enterprises (SMEs). The result is billions of dollars of uncommitted foreign aid.2 The international community has therefore called for technical leadership from the private sector to bridge this investment gap.3

Authentics is a blockchain platform that ties loans to securitized assets via patented, encrypted IoT technology, then automates payments through a Token Economy. The result is an automated, data-driven lending system that benefits both NGOs and SMEs. The Authentics Token Economy closes the global investment gap by allowing for faster, fairer, and more direct lending, while empowering SMEs with voting rights and equity earlier in the loan lifecycle.

¹ http://report.businesscommission.org/report

https://players.brightcove.net/791607097001/default_default_index.html?videoId=6021063408001

https://unstats.un.org/sdgs/report/2018/overview/

The Authentics Token Economy democratizes foreign lending in support of the UN's mission to eradicate extreme poverty through greater accessibility to financial services, value chains and open markets. It has a wide variety of applications across infrastructure projects, both foreign and domestic. The underlying hardware, patented by Authentics' parent company, Vitro Technology, has a proven track record of adding security, transparency, and agility in foreign aid projects, and is the first ECC embedded IoT technology of its kind.⁴

1. Introduction

Foreign Aid commitments reach into the hundreds of billions of dollars every year, but the majority of these dollars remain unallocated. In 2018 the UN Task Force on Digital Financing put out a call for fintech innovations to fill a \$2.5T investment gap to achieve the SDGs by 2030. In the same year, Asian Development Bank (ADB) committed to invest \$31.6 billion to loans and grants for business opportunities, but as of the beginning of 2019 barely \$2 billion of this was contracted.⁵ The present challenge in building a more equitable world is not one of funding, but of execution.

A major contributor to this investment gap is lack of secure, automated, and transparent technical solutions for NGOs like ADB and the World Bank to operate their investment projects. Investments today are manual, complex, and prone to error. To remedy this, foreign consultants with little connection to the local area are brought in to manage the projects, leading to unclear mandates, lack of operational strategy, removal of agency from the aid recipient, and embroilment in local politics.⁶ Overhead and complexity increase lending risk, which leads to consolidation. As of 2018, the average loan value had risen to over \$250 million.⁷ The result is high-risk loans that are expensive for NGOs and inaccessible to SMEs.

⁴ https://vitro.io

5

https://players.brightcove.net/791607097001/default_default/index.html?videoId=6021063408001

https://www.nytimes.com/2018/06/26/world/africa/mckinsey-south-africa-eskom.html

https://ppi.worldbank.org/content/dam/PPI/documents/H12018 PPI Report.pdf

Authentics solves the key challenges in foreign lending through security, automation, and data. By bringing IoT and blockchain into the lending space, NGOs are able to secure and automate their lending process, allowing for lower-cost, lower-risk loans, which in turn make loans more fair and more accessible.

The solution begins with Vitro Technology's patented hardware: the crypto secure gateway, Vitro Crystal®. Vitro Crystal leverages ECC cryptography implemented by microchip-in-hardware to offer secure just-in-time-registration and verified Root of Trust via Digicert, for a wide variety of IoT applications.

When the Crystal is installed into equipment, such as a water pump or a solar panel, it collects, encrypts, packetizes, and sends operating data to the cloud. Additionally, it will generate an ERC721 token containing smart contracts with the full scope of loan data. Schedule, payments, and all other administrative details of the loan will be automatically surfaced and updated via a secure transfer from the Crystal to the cloud.

Secure, automated data allows NGO administrators to monitor the project with confidence, pivot when necessary, and discuss the project with the recipient SME from a place of shared understanding. This automation allows for significantly reduced costs and manpower for the NGO, reducing the average loan size and increasing the number of loans by orders of magnitude. Flexibility closes the foreign aid investment gap.

Once the investment project is underway, loan payments between NGO and SME are done via AUTX tokens. The creation of a Token Economy to support the loan has several advantages: (1) it levels the playing field for use of various fiat currencies inside the system, (2) it secures every payment inside the lending system, (3) it facilitates a platform for Authentics to inject and manage a fair DAO system, which bestows voting rights and equity to the SME as the loan is repaid. This DAO framework, which will be explained in more detail later in this paper, is the cornerstone of Authentics' philosophy of putting power into the hands of SMEs and facilitating a constructive exit for the lending NGO.

This paper will describe the Vitro Solution and the Authentics Token Economy in detail, from technology to investment. The opportunity is material from a technical, economic, investment, and philanthropic standpoint. Our team believes it is possible to realize

the UN's global agenda, and the time is now. Blockchain and IoT technology have provided the necessary ingredients to optimize and automate foreign aid in a way never before possible.

2. The Vitro IoT Solution

In 2015, Vitro Technology set out to solve two main challenges plaguing foreign lending and infrastructure projects: (1) capturing authenticated data from equipment installations and (2) utilizing this data to authorize service agreement payments on a recurring basis.

IoT addresses the first challenge. IoT is a multi-disciplinary pursuit involving hardware, security, software, communications, hosting, and device management. Finding no viable alternative, Vitro developed an open-source Edge-to-Cloud platform, including hardware that directly incorporates Elyptic-Curve Cryptography key generation (ECC) and communications based on OpenSSL with a Root of Trust specifically designed for IoT. The result is a secure path for the transfer of data from sensors to cloud IoT that takes advantage of the latest innovations in lowered costs and low-bandwidth communications. Finally, Vitro incorporated an innovation that hashes data at the Edge, building data into blocks that include Proof of Origin: a trustless, non-consensus-based algorithm leveraging secure hardware ECC crypto at the Edge. The result is a hardware platform that has qualified for Amazon's AWS highest security rating (HSI^[1]) and DigiCert PKI^[2] best-practices.

The second challenge of recurring payments brings blockchain directly into the scope of the solution. As much as IoT brings value, it also brings a high burden of transaction verification and processing. Each IoT site incurs recurring monthly processes that carry costs ranging from hosting to connectivity to billing. The clerical burden of these micro-transactions has prevented widespread adoption of IoT despite its obvious benefits. Blockchain technology incorporates smart-contract execution of automated recurring service payments. With Vitro, these payments are based on authenticated operating data that verify what services were delivered and should be paid, while Vitro blockchain preserves an immutable record suitable for audit and financial controls.

The third piece is the allowance for additional service agreements with this new freedom and verification of data. This is where the Authentics Token Economy allows for scalability of this relationship through automation, which will be discussed later in this paper.

2.1. Vitro's Proof of Efficacy

Vitro's revolutionary platform allows customers to control and monitor remote sensors and equipment (e.g., water wells, meters, solar panels, electronic billboards) with authenticated operating data and automated transaction processing.

Vitro has successfully executed projects financed from the World Bank, Asian Development Bank, USAID, and other governmental and non-governmental organizations. Vitro's technologies have been functioning on the global market for two years, delivering advanced insight and solving problems with IoT device connections in various vertical markets. Installations range from the U.S. to Pakistan, from China to Poland.

The security and authentication of data offered by Vitro products injects trust into the lending space, which allows for all kinds of freedoms not possible under the old structure. For one, it disintermediates loans by allowing for the direct connection between NGO and SME, removing the need for administrators and consultants. Second, verified data allows for transparency, better decision-making and therefore a higher success rate of the project's intentions, as demonstrated in the Vitro WSSM Civic Water Case Study⁸.

2.1. Future of IoT

Since 2008, the number of connected IoT devices has surpassed the human population. Civic energy and water infrastructure alone have connected millions of devices within the IoT network worldwide. The global market for IoT in utility applications alone will reach \$59.9 billion by 2022, from \$21.4 billion in 2017 at a compound annual growth rate (CAGR) of 22.9% from 2017 to 2022.9

IoT is largely targeted to the utilities and services we

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https://www.prnewswire.com/news-releases/the-global-market-for-the-internet-of-things-iot-in-energy-and-utility-applications-should-reach-599-billion-by-2022-from-214-billion-in-2017-at-a-compound-annual-growth-rate-cagrof-229-from-2017-to-2022-300548384.html

rely on daily. However, most IoT solutions suffer from serious, known security vulnerabilities that have generated widespread and damaging breaches. Breaches have led to a loss of control over remote assets, falsified operating datasets and weaponized network attacks on equipment owned by other entities. The demand for IoT is well documented and encompasses vast total addressable markets across numerous vertical industries. However, the critical missing component is a platform that can deliver secure, authenticated datasets from remote IoT equipment. For this reason, Vitro is uniquely positioned to be the catalyst in a paradigm shift that will span industries and countries across the world.

Vitro's IoT innovations are the foundation of the Authentics Token Economy.

3. The Authentics Token Economy

Authentics leverages the Vitro innovation of authenticated data and offers a decentralized blockchain Token Economy, with progressive lending practices built directly in. The result is a fully-secure, fully-automated lending system that mobilizes and democratizes the foreign lending landscape, making lending easier, fairer, and more effective.

3.1. Components

Authentics is built upon the following components:

AUTX. An ERC20 utility cryptocurrency token that transits fiat currency to cryptocurrency, and cryptocurrency to ERC721 loans.

Vitro Token. An ERC721 token is a loan tied to a smart contract.

Distributed Asset Ownership (DAO). Authentics projects are managed cooperatively by the local SMEs and the investing NGO. Equity, ownership, and voting rights are transferred to the SME in proportion as the loan is paid off. This is in direct contrast to the typical model, in which ownership is only transferred upon the loan's full payment. This concept underpins Authentics' commitment to empowering SMEs in the local community.

Voting rights (Karma and Dharma) are distributed to investors and transferred to local participants as the loans for Vitro authenticated equipment are repaid. This guarantees a flexible and equitable management

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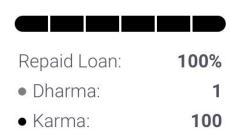
of projects, building equity for local participants as the project matures.

In practice this will allow for changes in the project operating parameters, contract performance monitoring improvements, adjustments of the tariffs and fees, new business offerings and investment decisions to be transparently proposed and voted by participants. Additionally, adhoc contract management like imposing and lifting penalties for non-performance or non-payment are possible to decide in a fair and empowering manner.

Supporting Vitro Hardware The integration of Vitro hardware with blockchain allows easy, fast and robust payment methods originating on mobile phones or biometrics. Using a digital currency allows us to automatically distribute revenue to the asset owners and operators.

Repaid Loan: 0%
• Dharma: 101
• Karma: 0





3.2. Participants

Authentics loans take place via the Authentics Token Economy. The participants in that economy are as follows: **NGOs.** NGOs such as the World Bank and the Asian Development Bank are targeted as the main global participants. NGOs and other impact investors are enabled by Authentics to lend in local service projects.

SMEs. Small-to-medium enterprises receive loans from participating NGOs.

Customers. Customers of the SME pay via mobile device in fiat currency.

Local governments. Local governments maintain one voting right in each project.

Service providers. Original Equipment Manufacturers (OEMs) and other goods and service providers sell initial loan equipment.

Of these participants, the SMEs are the center of the Authentics Economy as the performer of the main function in Authentics: developing local economies toward a more sustainable and egalitarian world.

3.3. Authentics in Action

The following is an example of the Authentics Token Economy in action. It is meant for illustration only:

A leading NGO approves a loan to a water purification business in Dar es Salaam, Tanzania, with the goal of improving health, access to basic necessities for the local population, and the local economy. The loan amount is \$100,000 and intended for equipment purchase, installment and some basic marketing.

Vitro floats sufficient AUTX aimed at the total loan value to local service providers at a fixed price. The number of tokens dispersed is based on a frozen value. For example, if originated AUTX is trading for \$.10, then 1m AUTX tokens will be dispersed.

The NGO purchases AUTX and loan equipment from the service providers via fiat. After the successful exchange of tokens for fiat, the equipment is installed with Vitro hardware and operationalized in Dar es Salaam. The NGO purchases their Vitro loan (ERC-721). This Vitro token creates a layer of smart contracts containing all relevant loan information, such as payment amount, schedule, expected data return on water distribution and the appropriate

number of dharma (voting rights) points. At this time, all dharma points belong to the lending institution, the NGO.

The AUTX coins are recharged into Vitro's treasury. The effect on the token supply is neutral, appreciating the net asset value.

At this time the project site is ready to operate. From this point on, all transactions will be filtered through AUTX and the exchange. This includes repayment of the loan and monthly service fees.

The SME takes operational control of her enterprise. Her direct sales are done in the local currency, Tanzanian Shilling, over mobile devices. When customers purchase purified water, they scan a QR code with their phone to transfer fiat from their mobile wallet to the local operation. The goods are set at a fixed price and not reflective of the volatility that may occur within AUTX.

As the SME makes sales, her mobile wallet gets stuffed. She will store this money in fiat until a loan installment is due. When it is time for a payment, fiat is transferred via the Authentics app to the participants: The NGO, The SME, the local government, etc. The purchase of coins via the exchange and transfer to preferred fiat is done automatically, executed via the smart contracts and based on authenticated operating data.

Upon the first month's payment, The SME receives one point of Karma, which is converted from the NGO's Dharma points. Each month she pays her installment, this process continues, converting one point of NGO Dharma into one point of SME Karma. In the DAO system, Dharma and Karma equal equity and voting rights. Once the SME has paid back 51% of her loan, she now has majority rights to manage the business as she sees fit.

Unlike traditional loans today, which require the loan to be paid in full before this type of ownership is transferred, the Authentics DAO system puts power into the SME's hands sooner, while facilitating the smooth transition of the NGO out of the region, so it can continue its work in new areas.



3.4. Adoption

Although the Authentics Token Economy solves key barriers for effective foreign lending, we nevertheless understand that change can be a barrier itself. Therefore, we have been intentional about building in key interaction points that will incentivize adoption of the Authentics Token Economy. They are described below:

Removing the middleman. Today NGO loans typically require the involvement of a third-party consultant to install and deliver the loan project. The Authentics Token Economy allows SMEs and NGOs to work together directly via secure, authenticated, and accessible data.

Mobile payments in local currency. While the NGO and SME will be responsible for lending and paying in AUTX, the end customer will pay via local currency, facilitating ease of adoption.

Agility. Once projects get started, unexpected problems often crop up. The visibility allowed in the Authentics system will give insights to both NGOs and SMEs about the health of the project. Operating data allows for the agility necessary to right the project and keep the SME's new business healthy and on track, decreasing defaults and late payments.

Increased ownership transfer. The DAO system built directly into the Authentics Token Economy is a win for SMEs wanting to build a business and improve their standard of living. Working with Authentics ensures a fair loan, a better chance of success, and puts the ownership of their business in their hands.

Automation creates accessibility. The automatic creation of loan data tied directly to equipment allows for the execution of smaller loans. This gives NGOs the power to spin up more aid projects where and how they see fit, and to take on projects that in the past would have been too small to justify. This closes the foreign aid investment gap and delivers aid directly to the people that need it most.

4. Market Opportunity



As stated above, the investment gap to realize the SDGs is \$2.5T. NGOs have the funding to realize their

missions, but the complexity of foreign aid projects is a hurdle to the allocation of these funds. It is Authentics' intention to pull that investment money into the Authentics Token Economy. As NGOs adopt the Authentics solution, the dollars currently frozen will become liquid in AUTX.

4.1 Token Investors

Authentics will mint a first offering of one billion tokens \$.01 each. As Authentics makes its offering to NGOs, we expect adoption to be slow at first. However, given the size of the market, even capturing fractions of a percent will result in huge capital injections into the Authentics Token Economy.

To take an earlier example, ADB has \$30 billion dollars they have yet to invest. If they pass even 0.5% of these investment dollars in Authentics, the result is an influx of \$150,000,000 into the Authentics Token Economy. This is an opportunity from only one NGO. There are 10 million NGOs in the world.¹⁰

Given the vast size of the market, supply and demand will be in flux. Huge injections of capital are expected as NGOs purchase tokens in order to fund their projects, with smaller periods of selling tokens as the projects become operational. Our mission is to create a sustainable ecosystem with a foundation for steadfast growth. For this reason, we insulate capital purchases from AUTX currency exposure by creating block trades. This is a private trade executed off the exchange, with a fixed price.

For early investors, Authentics will manage its supply through splits over new mints of tokens, ensuring the best return for early adopters. Authentics will, of course, introduce incremental issuances of tokens over time for sanity.

Token supply and circulation can reach into the hundreds of billions of dollars as NGOs are able to have more flexibility in their lending process, and adopt AUTX as a secure, measurable, and easy way to utilize the funding that is in their mandate to spend.

4.2 Projections

Authentics will focus its customer acquisition efforts on NGOs that have used Vitro products in the past and government agencies with modernization and

http://nonprofitaction.org/2015/09/facts-and-stats-about-ngos-worldwide/

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security mandates in the public goods and services space.

To solidify the value proposition, the Authentics team will assemble a demand pipeline of SMEs in targeted geographical areas with an interest in NGO lending. Additionally, Authentics will ensure it is part of the global conversation through paper submissions, article and case study publications, and public speaking events, which are already in progress. The expectation is that AUTX value will remain stable for the first 6 months after the platform creation, as initial investor buying begins.

Given the size of NGO lending, the first customer is expected to create high returns for early investors. Capturing the funding of one major NGO could result in growth of 30x. If there are more participants of this size, the growth could look more like 1000x in 24 to 48 months.

The known challenge will be time to first customer, and the development and administrative effort to get the first project started. Upfront funding, therefore, is incredibly important.

4.3 Authentics Use Cases

Vitro products have already garnered interest or are being actively utilized in the following verticals:

Water
Solar
LED
Electricity
Broadband/Online ad sales

These are only a few of the potential project types that can utilize Vitro hardware and the Authentics Token Economy.

4.4 Alignment with Sustainable Development Goals

The SDGs are ambitious, interconnected goals designed to build an equitable world. The Authentics team shares this vision. The Authentics Token Economy contributes to the SDG vision along the following themes:

 Eradicate extreme poverty by ensuring the vulnerable have equal rights to economic resources, including ownership and control

- over basic human necessities, new technology, and financial services.
- 2. Create decent work and economic growth by supporting job creation, entrepreneurship and access to financial services, particularly for micro-, small- and medium-sized businesses, through technological innovation.
- Grow industry, innovation, and infrastructure by supporting widespread access to affordable credit, value chains and markets.

While participation in the Authentics Token Economy makes financial, operational and missionary sense for NGOs, the Token Economy is designed to ultimately benefit the loan recipient. We believe this is the true intention of NGO lending and ultimately of all SDG projects. Authentics benefits recipients of aid in the following ways:

Democratizing the financial lending system. The average NGO loan is over \$250 million. Loans of this size tend to exclude the SME sector altogether. Further, they tend to favor governments, which often have agendas not altogether in line with the local population's priorities. With Authentics, foreign aid becomes accessible to an entirely new segment of people.

Instilling trust in the lending process. Transparent operational data and a fair cost structure reduces graft and the acceptance of graft, while giving common talking points to the NGO and SME around the general health and direction of the project.

Proof-of-Origin data from the operating equipment incorporates the inputs such as rents or electricity that are paid by the operator and outputs such as clean water that are paid by customers. Each participant has visibility into the operations and value flows.

Operating and payments data is auditable and transparent. Equipment purchase, installation, provisioning are all done in the open. This satisfies the reporting requirements of project loans without depending on local lenders or guarantors.

Fair loans and equity. Authentics provides the tools for small and medium enterprises to attract global financing and satisfy their reporting requirements. Automated repayments based on revenue and a distributed governance layer give equity to local

participants as the loans from global investors are repaid.

Authentics promotes the injection of foreign aid without the conditions imposed by foreign operating control of the capital goods. This capital base will allow the underserved SME to build collateral that can be used to finance future expansions with local banking. The SME also builds expertise in the operation of the equipment, giving them the opportunity to advise other SMEs on building similar models in other regions or countries.

5. Technical Design

5.1 Supporting Vitro Technology

Open Source. Vitro is one of the only IoT platforms based on open source, delivering transparency and auditability for software while incorporating the latest updates from the Linux community, NIST, and other open-source participants.

ECC Cryptography. The Vitro Crystal Gateway features hardware-based, ultra-secure key storage to ensure that the firmware it runs, the accessories it supports, and the networks with which it connects are not cloned, counterfeited, or tampered with. Vitro security is based on Elliptic Curve Cryptography (ECC), and employs keys generated by each Vitro Crystal remotely in secure, hardware-based key storage. Our IoT platform incorporates hardware-based certificate storage and automated Root of Trust (RoT) provisioning via Digicert.

ECC Authentication. Authenticated datasets are the crucial payload of IoT. Vitro Proof-of-Origin involves authenticating local datasets via local ECC hashes and signatures. Leveraging ECC keys across the multiple applications of Root-of-Trust and Proof-of-Origin is a patent-pending process. This approach ensures trust in data transit and data authentication while being perfectly suited to remote IoT devices.

Blockchain is a data structure for computer software that through cryptography and decentralization enables the storage of data that remains immutable in a non cooperative environment in the absence of any leader.

The first popular implementation of a blockchain data structure created a non-governmental currency

which could maintain global balances for individuals without a centralized authority.

Since then blockchain design patterns have been produced to implement advanced value flows, digital representation of physical assets and trustless decentralized governance systems among others.

Smart Contracts. A smart contract is a set of codes running on blockchain that controls transactions between parties and ensures that all contract conditions governing transactions are met. Smart contracts leverage Etherium logic and span projects from public Etherium on-chain executions to private Hyperledger applications.

5.2 Blockchain Architecture

Authentics runs in a public blockchain.

Motivation:

Performance - Public blockchains force developers to produce high quality code as their contributions will be public and have very visible outcomes.

Cost - Developing for a public blockchain allows to use widely-used standards and ignore infrastructure implementation costs.

Time - Open source code is widely available to drastically reduce the time required for implementation.

Community - Support from open source developers is readily available.

Operations:

Authentics runs via Ethereum, the most widely-used, open source cryptocurrency platform in existence. This provides stability, community, and reliability to the Authentics Token Economy.

To learn more about Vitro Technology, read the Vitro Yellow Paper¹¹.

6. The Authentics Team

David Goodman brings his unique insight for both hardware and SaaS platforms to Vitro Technology. Previously, David developed hardware-SaaS companies which were successfully sold to leaders in their

8

¹¹ www.authentics.com

respective fields. Key Ingredient, founded in 2005, developed a recipe-sharing social media platform that grew into the largest recipe database outside of Japan.

Neysa King earned a Master's degree in Global History, studying human rights, genocide, and state-sponsored violence, before moving into technical product and business development. She has founded several companies and has managed and grown SaaS and hardware products for both startups and large enterprises. Her approach to business development is user-focused and data-driven.

Piotr Król has extensive embedded systems training and previously worked at Intel in Poland, developing BIOS for various processors. Vitro Technology hardware was developed under Piotr's direction, and operates on a custom Linux kernel that is very close to mainline distribution. The SaaS is based on AWS IoT for device connectivity; and AWS and Odoo for CMS and CRM. Piotr leads of team of 8 engineers based in Gdańsk. The engineering team includes embedded Linux/Qt, AWS, and DevOps.

Creighton Beery is the Director of Business Development for Vitro. As a development leader, Creighton works with clients to help them use IoT and blockchain technology in order to meet business objectives and explore cutting edge use cases. He has been entrenched in the block chain space since 2012 and is passionate about optimizing foreign lending. Creighton has worked with dozens of clients to help them understand, evaluate, design, deploy, operate and scale IoT and blockchain networks. He holds a bachelor's degree in Management and Finance from Texas State University and currently lives in Austin, Texas.

Wendy Wong has extensive experience in engineering, manufacturing, and sourcing. Wendy worked for 5 years with Delta Power, one of the largest power supply manufacturers in China targeting industrial and commercial customers. She later worked for 7 years at SMT, a large PCBA contract manufacturer, and collaborated with David as the product manager in the successful launch of the Key Ingredient Recipe Reader. Recently, Wendy worked with CSOT, based in Wuhan, one of the largest LCD manufacturers in China. While at CSOT, Wendy was responsible for both open-cell and OEM LCD sourcing, quality, and manufacture.

7. Acknowledgments and Resources

The Authentics team would like to thank Alberto Cuesta Cañada for his expertise in token economics and Martha Fierro for design and branding.

To learn more about Authentics, download additional material, and follow our progress, visit www.authentics.com.