HOW BLOCKCHAIN CAN HELP YOUR BUSINESS BUILD A MORE TRANSPARENT, CLEAN, SUSTAINABLE WORLD

Co-authored by Amazon Web Services (AWS)

Enterprise Blockchain for a Sustainable Future

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THE TIME FOR ACTION IS NOW

While blockchain technology is most often associated with the financial sector, use cases for blockchain in the realm of social and environmental sustainability have revealed the technology's potential to revolutionize this space.

Blockchain technology's ability to track, trace, store, and securely share the data that underpins the implementation and success of sustainability projects, programs, and policies means this emerging technology is uniquely positioned to transform the way we address looming global challenges like safe food distribution, equitable access to energy, and the overconsumption of resources across industries.

Major initiatives such as the 196-country Paris Agreement - given extra clout following the United States' decision to rejoin in January - and the European Green Deal were signed to reduce the effects of global warming, while countries across the world have committed to reducing their carbon emissions to varying extents. The United Kingdom has pledged to reduce its emissions 68 percent by 2030, while India is

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pushing to ensure 40 percent of its power comes from renewable sources by 2030.

These state-level agreements are creating a trickle-down effect that obligates private enterprises and organizations to take action and this will grow from a trickle to a torrent. New regulations and the need to remain compliant have pushed corporations into action, and as investors take a closer look at sustainability metrics as an indicator of a company's ability to remain competitive, entire industries are beginning to shift to more sustainable models.

While there are currently a number of sustainability frameworks in play across industries, one of the most widely referenced is the Environmental, Social, and Corporate Governance (ESG) framework. The ESG framework addresses how an organization serves all its stakeholders, from employees, to communities, consumers, and the planet itself.

The ESG framework is related to the Sustainable Development Goals (SDGs) set by the UN in 2016. Most SDGs are designed to create a positive impact in the areas of environment, social, and governance.

Though these three pillars of sustainability are addressed separately for the purposes of providing a clear framework, they are in no way siloed causes. Environmental, social, and governance topics within the framework of sustainability inform each other, and are inherently interconnected.

As consumer behavior continues to shift, and global awareness of the need for far-reaching sustainability initiatives increases, enterprises are more often being held responsible for their impact on the world, both in terms of their environmental effects and their influence in shaping social norms. According to a recent report by KPMG, 71 percent of CEOs feel it is their personal responsibility to ensure that their organization's ESG policies reflect the values of their customers and by extension, societal norms.

By acting on this responsibility, organizations and enterprises that adopt sustainability goals based on the ESG framework may see a positive impact on their bottom lines as well. The ESG standing of companies is beginning to play a significant role in attracting retail investors, as highly rated companies are increasingly correlated with long-term value.

On the other side of the income statement, over the next 7-10 years, we will see financial fines increasingly levied against companies for non-compliance and those that have not taken adequate measures or are not able to prove and communicate their efforts towards compliance will be punished in the stock markets. Even before non-compliance fines are handed out, investors will price in the risk of these fines for companies in their investment strategies.

Decades of campaigning has moved not only governments, but also the world's biggest enterprises to be proactive in their sustainability efforts beyond reducing carbon emissions, analyzing processes and reevaluating the balance of short-term profit versus long-term, sustainable growth. To meet their ambitious goals, organizations are increasingly turning to emerging technologies that support transparency, security, sustainability and importantly independent verification of the sustainability claims they make to provide irrefutable proof of goal attainment.

Still, there can be significant obstacles on the road to identifying solutions to sustainability challenges and to freeing up the budgets required to put these solutions in place. While technological advances may be crucial to meeting sustainability goals, deploying, managing, and maintaining new technologies can be time consuming and costly.

Cost per conversion
673.27

Quality
9.38
-0.1%

THE ENVIRONMENTAL, SOCIAL, AND GOVERNANCE FRAMEWORK FOR SUSTAINABILITY

While the term sustainability is most often associated with environmental causes, the term doesn't just refer to a balanced approach to resource consumption, but also encompasses the need for measured economic growth and governance as well as social development. Most importantly, these goals need to be achieved at a level that can be maintained by future generations.

Environmental, social, and governance criteria are recognized as the key areas for sustainability success, and can be broadly summarized as cutting carbon emissions (and other harmful byproducts of production) and efficiently consuming resources (and eliminating waste), ensuring the fair treatment of employees and stakeholders, and delivering ethical corporate processes and systems that support sustainable long-term growth.

The ESG framework provides for three primal sustainability themes, and breaks those themes down into more granular benchmarks for assessment. This holistic view of sustainability enables organizations to target and analyse processes, policies, and systems across the business environment to inform sustainable decision-making processes.

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Environmental	Social	Corporate Goverance
Climate change strategy	Equal opportunities	Business ethics
Biodiversity	Freedom of association	Compliance
Water efficiency	Health and safety	Board independence
Carbon intensity	Human rights	Executive compensation
Environmental management systems	Customer products and responsibility	Shareholder democracy

As an enterprise's ESG rating begins to carry greater weight as investment and credit decision taking models, tools and frameworks are launched to rate and track an organization's commitment to sustainability through time.

At the WEF 2020 Annual Meeting in Davos[1], some of the world's largest companies expressed their support for the development of standardized metrics and disclosures that may allow companies to align reporting to ESG indicators and allow for more transparency in the tracking of sustainability initiatives.

As investors begin to take a greater interest in a company's ESG rating, a variety of tools such as reporting APIs provide the ability to monitor corporate ESG metrics, providing a degree of insight into an organization's ability to adhere to its ESG commitments through auditable, verifiable data.

The ESG Enterprise API[2] is a prime example of how APIs are allowing for greater transparency into an organization's ESG initiatives. This API allows potential investors to search for ESG risk ratings with a database that maintains over 40,000 ratings worldwide.

Bloomberg's Environmental and Social Scores[3] are also designed to provide insights into corporate environmental and social initiatives. ES Scores from Bloomberg allow investors to evaluate and compare organizations based on key performance indicators including climate change and health and safety and cover more than 10,000 companies globally.

Finally, Refinitiv[4], an American-British global provider of financial market data and infrastructure, provides a database of ESG scores that assess a company's ESG performance while accounting for industry and company size biases. Refinitiv scores are calculated based on 450 ESG measures and weighted depending on the industry and size for more accurate comparison between organizations.

The information provided by these reporting tools offer tangible insight that can be transferred into decision making tools such as bank credit risk models, which in themselves give a strong incentive for corporates and the banks that finance them to stick to their ESG promises.

However, these tools have their limitations, and in most cases only track the ESG performance of larger organisations, providing little or no insight into their wider network of suppliers that make up their supply chain. This leaves a serious reporting gap whereby we have insight into what happens within the company from an ESG perspective but little to no insight into what happens before parts enter the production facility or after manufactured goods leave the facility.

Another challenge to ESG reporting is that not all manufacturers have the same strategy for production. Some are vertically integrated and are therefore able to provide reporting very deep into their supply and distribution channels, while others are not vertically integrated so are able to report only on the assembly stage in the supply chain and not upstream from this point nor downstream in the distribution chain of their product.

Comparing the ESG scores of these two companies with different supply and distribution channel strategies for investments or credit decisions is thus akin to comparing apples and scuba diving equipment and establishing meaningful benchmarks for their industry based on some aggregation of their ESG scores is nigh impossible.
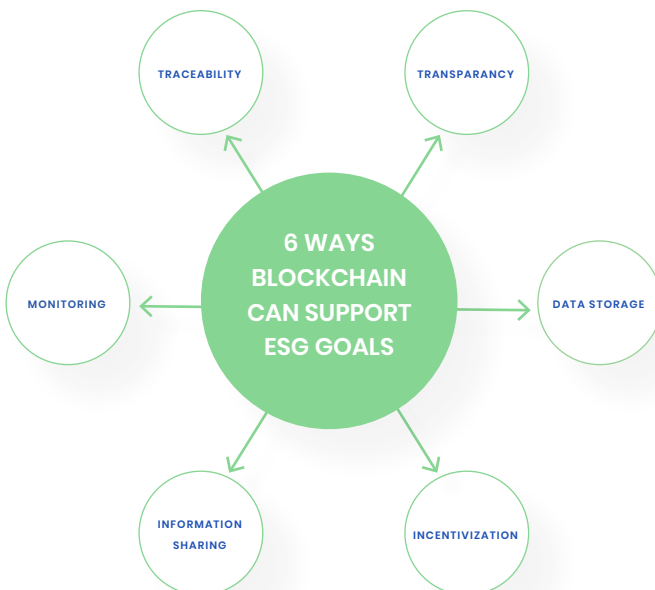
This gap in reporting and the challenges for meaningful comparisons may be addressable with the use of decentralised ledger technology that, when combined with other 4IR technologies, can be used to:

- collect data from the very edges and the various touch points in the supply and distribution chains

- store this data immutably to ensure data integrity

- link this data to unique serialised units of production output

- share best sustainable practices between suppliers

- incentivize suppliers and distributors to adopt sustainable practices

- make this aggregated data independently verifiable for consumers, investors, financiers, insurers and regulators

BLOCKCHAIN AS A
SUSTAINABILITY ENABLER

Blockchain's potential for disruption is clear. The decentralized ledger technology business value-add will exceed USD$176 billion by 2025 and USD$3.1 trillion by 2030[5], according to Gartner. Blockchain has already made significant waves in the financial sector, and although use cases for the technology's ability to support sustainability goals may still be in their nascent stages, organizations that have leveraged blockchain in their sustainability efforts have seen notable early success.

TRACEABILITY

TRANSPARANCY

MONITORING

6 WAYS BLOCKCHAIN CAN SUPPORT ESG GOALS

DATA STORAGE

INFORMATION SHARING

INCENTIVIZATION

Blockchain's ability to decentralize, store, and trace irrevocable transactions will create unforeseen value across almost every industry, but issues around sustainability arguably offer blockchain adopters their most profound opportunity to impact both society and the planet for the greater good.

Whether in tracing and streamlining the food supply chain, reducing energy consumption, or solidifying trust and transparency through smart contracts, blockchain is set to play a significant role in the ways that humanity tackles some of its most urgent sustainability challenges.

This report will explore the ways that blockchain can drive sustainability across environmental, social, and corporate governance issues through its inherent trust and transparency, its ability to create new opportunities for value creation, and next-level traceability. It will shed light on the ways that simple, 'low-code' blockchain solutions will be the future of this space, empowering businesses and ecosystems to take control of the benefits that decentralised ledger technologies offer them in fulfilling their ESG ambitions and obligations.

UNDERSTANDING TODAY'S SUSTAINABILITY CHALLENGES

While the implementation of sustainability projects, policies, and programs is critical in securing a more equitable, cleaner future, launching, monitoring, and managing these efforts has proven to be a challenge. We, as a global population, continue to create more and more data and it becomes increasingly difficult to track, trace, and act on that data in ways that may inform our quality of life in the future. To see true success, leaders and citizens alike will need transparent, traceable data and transactions that they can trust and verify.

Blockchain's energy consumption

Although blockchain is able to enhance sustainability efforts, it has recently garnered a reputation as a resource intensive technology itself. However, the environmental impact of blockchain technology must be distinguished from the environmental impact of certain processes that are run on blockchain.

Kranzberg's (1986)[6] first law of technology states that "Technology is neither good nor bad; nor is it neutral." While blockchain technology's reputation as a resource hungry technology may implicate it as a strain on the environment, it is important to keep in mind that Bitcoin mining is only a small part of the potential for technology and blockchain more broadly is an enabler of, rather than a deterrent to, achieving Sustainable Development Goals.

Bitcoin mining, as well as the process needed to confirm Bitcoin transactions is run on a blockchain and is the technology's most infamous use case. Bitcoin mining uses an energy consuming consensus mechanism – proof of work – to reach consensus in the network about the state of the network while other blockchains operate using consensus algorithms which are not any more energy consuming than any other software that we use every day.

While keeping an immutable history of Bitcoin transactions may be one of the most publicized use cases for blockchain technology, it certainly isn't the technology's only application and its overall impact on the environment is yet to be fully understood. In fact, many academics argue that the energy consumed by Bitcoin is unlikely to become a major threat to the climate in the future[7], at least not any more of a threat than streaming video services. Bitcoin miners themselves are also taking sustainability concerns into account as they continue to shift to renewable energy sources,

Further iterations of blockchain technologies with alternative consensus mechanisms such as proof of stake have already made the transition to a far less energy consuming solution to

network consensus and stand to render the controversy moot as their energy consumption is several orders of magnitude[8] lower than proof of work.

In the discussion of blockchain technology's ability to support sustainability efforts, a distinction must also be drawn between 'environmental' initiatives and 'sustainability' initiatives. Environmental initiatives revolve around reducing pollution and harm to the environment, while sustainability initiatives are more all-encompassing, referring to those that cover the spectrum of environmental, social, and governance.

More people, more data, more challenges

Our planet is currently home to 7.5 billion people and according to United Nations predictions, that number could reach 9.7 billion by 2050, and surpass 11 billion by 2100. As the population increases, the demand for resources and the urgent need to distribute those resources in a sustainable way grow in tandem.

Traditional models of tracking, sharing, and securing data have left significant gaps in our ability to monitor sustainability efforts, hold governments and organizations accountable, and plan for a more equitable, sustainable future. As we continue to create waves of new data, this challenge is only becoming more complex.

Reports by the Food and Agriculture Organization of the United Nations indicate that approximately one-third of the world's food is being wasted, equivalent to about 1.3 billion tons annually[9], while

690 million people go to bed hungry each night. With sprawling global supply chains, fraudulent and counterfeit products enter supply chains with relative ease, and it is difficult to identify those responsible and it is difficult to therefore take actions against them. While these statistics should raise concerns, encouraging examples are emerging. Although the world faces serious problems, recent technological developments designed to monitor consumption and provide deep insights into sustainability efforts have made a significant positive impact within a number of sustainability projects and programs.

1.3 billion tons of food wasted annually

Blockchain's role in achieving sustainability goals

Blockchain in particular has allowed the tracking, tracing, and sharing of data crucial to achieving global sustainability goals. The World Economic Forum[10] has highlighted the potential for the technology to build resilient and transparent supply chains, to create stronger and more accountable public institutions and to spur responsible sourcing and sustainable consumption of goods and services.

> *"There are 3 areas where blockchain could be an SDG game changer: building resilient and transparent supply chains; creating stronger and more accountable public institutions; spurring responsible sourcing and consumption."*
>
> *– WeForum*

From food supply chain monitoring, to energy consumption data, to smart agricultural contracts, blockchain is quickly becoming a key tool in the global fight against excess consumption, corruption, and inequality.

The world is waking up to the need to tackle humanity's biggest challenges, and the first steps involve creating greater transparency, accountability, accessibility to information and independent verification possibilities which in turn will inform sustainability policies and practices across industries.

While there is certainly no silver bullet for the challenges we face, there are technologies which are already at our disposal that will act as enablers to drive widespread improvement in sustainability initiatives, both tangible and intangible.

Blockchain is one such technology. As consumers demand greater visibility of the provenance of the products they consume, and businesses become increasingly accountable regarding the ways they manage the use of natural resources, distributed ledgers that provide immutable records offer a new paradigm for accountability.

The expression 'out of sight, out of mind' certainly applies to many of the world's issues around sustainability. A 2017 BCI Supply Chain Resilience Report[11] claims that 69 percent of companies fail to have complete visibility over their supply chains. This lack of visibility remains an inherent cause of mismanagement, corruption and waste across the world.

While financiers have begun to consider a corporation's impact on the planet and society in their credit pricing models, more can be done to actively push corporate borrowers to invest in sustainable projects. According to a recent report by the Bank for International Settlements (BIS), banks lack a holistic approach that takes into account an organization's overall carbon footprint (including indirect emissions from suppliers and manufacturers along the supply chain).

For example, while a major automobile manufacturer may be granted a loan based on their reported carbon footprint, that credit pricing does not take into account the carbon emissions created by third party suppliers and other participants along the supply chain.

In the short term, steps can be taken to make the resource extraction, production processes and supply chain logistics more efficient, to ensure the safety of both consumers and employees, and to hold businesses accountable for their consumption.   However, first we must gain access to information that was previously inaccessible. From that information we gain insight, and that insight must be translated into more informed and conscientious action. Blockchain technology is a fundamental building block in that transformation.
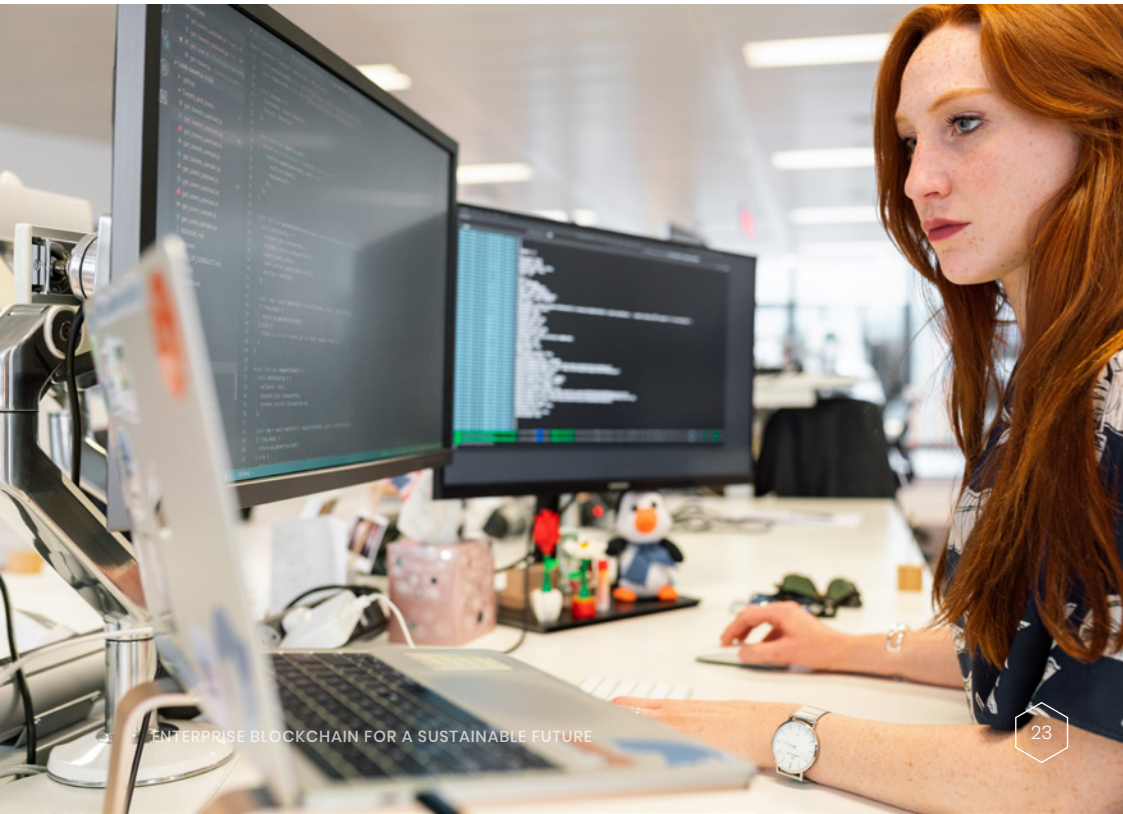
Consumer demands and changing regulations are driving change

The ever-growing list of sustainability challenges faced by enterprises and governments today can seem overwhelming. However, it is vital that these challenges are addressed proactively, not only for the future of our planet and society, but also for business continuity.

As customers increasingly shift to more ethical and conscientious behaviours, businesses that fail to follow the shift and reform traditional practices to be more environmentally and socially conscious will likely face a significant disadvantage losing ground to competitors whose products, services and brand image are more closely aligned with conscientious consumer expectations. In fact, according to retail measurement service Nielsen, 73 percent[12] of global consumers say they would "definitely or probably change their consumption habits to reduce their impact on the environment."

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73 percent of global consumers say they would "definitely or probably change their consumption habits to reduce their impact on the environment."

– Retail measurement service, Nielsen

Regulatory authorities are increasingly holding businesses accountable for their impact on society and the environment, and organizations will need to provide clear, accurate, and transparent reporting to remain compliant. Against this evolving regulatory backdrop, organizations would do well to establish clear sustainability actions and metrics so that they will be able to prove compliance. But this alone will not be enough. Organizations will also need to put in place solutions to store these metrics in a way that supports independent audit and irrefutable verification of the metrics. There are a number of technologies required to achieve this, blockchain being one.

BLOCKCHAIN FOR
ENVIRONMENTAL
SUSTAINABILITY

There's no doubt that sustainability projects have increased in gravitas in recent years, with the widespread realization that failure to take proactive steps with environmental, societal and governance issues could have damaging long-term consequences.

But how can we ensure that sustainability initiatives have their desired effect? Managing environmental sustainability issues requires input from a variety of stakeholders across a value chain, and as goods change hands, it can be difficult to maintain an accurate picture of the end-to-end journey and costly to reconcile data collected from all stakeholders in the value chain. As a technology, Blockchain is uniquely equipped to bolster sustainability initiatives through increased accountability, transparency and trust providing a foundational solution to the complex and costly data collection and reconciliation challenges.

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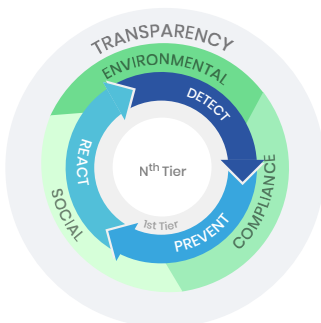
RESPONSIBLE MATERIAL PROCUREMENT

As consumers begin to demand more ethically sourced products, the expectation will be that those sourcing the products are able to verify their provenance. Until the relatively recent advent of Blockchain, consumers had been forced to rely on information provided by distributors, and take suppliers at their word.

An inspection into the meat supply chain in Belgium in 2018 focused on the largest processor of meat products in the country found that 133 of 200 (66.5%) cuts of meat inspected did not conform to food safety standards[13], despite claims by the company that they were in full compliance with the standards. This led to the two largest retailers in the country pulling products from the processor from the shelf as public outcry mounted. In response, both retailers launched blockchain based supply chain applications to reinforce public trust in the products on the shelf[14]. The cost of removal of the products from the shelf is far greater than the cost of implementing a solution that provides verifiable evidence of food safety to consumers.

Research from Accenture shows that 60 percent of consumers have made more environmentally friendly, sustainable, or ethical purchases[15] since the start of the pandemic and that nine out of 10 of those conscientious consumers are likely to continue their ethically-driven purchase habits in the future.

Blockchain-powered companies like Everledger[16] have created tools to increase consumer and enterprise insight into the provenance of a given object. By combining blockchain, AI, and IoT, Everledger digitally streamlines compliance processes and allows companies to demonstrate the true origin of their products.

Without the transparency and tracing afforded by blockchain technology, consumers are obliged to trust retailers and are generally left without the ability to verify the source of their purchased product. Blockchain can track products from their points of origin all the way to the shelf, in the process preventing waste, reducing inefficiency and ensuring product authenticity and legitimacy.

As supply chain transparency becomes increasingly important for ensuring the quality and security of raw ingredients and the efficient use of natural resources, international beverage supplier AB InBev partnered with SettleMint and Fujitsu to deploy a Blockchain platform that could give full transparency and traceability in its supply chain of barley, from the consumer back to the farm.

The pilot, which went into production in January 2021, linked barley farmers in the North East of France with one malthouse in Antwerp, Belgium and the Stella Artois brewery in Leuven, Belgium. Through this platform, AB InBev will begin to aggregate and benchmark data to help indirect farmers improve their yields and decrease the environmental footprint of their supply chain.

At scale, the data collected will not only provide a fully end-to-end view of the supply chain to consumers, but can help to advance agricultural development: improving growers' yields and water and energy efficiency, as well as soil health.

The fishing industry has long been wrought with illegal activity and fraudulent labeling. A new initiative from the World Wildlife Fund[17] leverages blockchain technology to track fish from "bait to plate." This project aims to cut down on "Illegal, Unreported and Unregulated" (IUU) fishing and protects both marine biodiversity and consumers.

EFFICIENT, DECENTRALIZED ENERGY

Currently, legacy data management infrastructures employed by major energy providers result in electricity being used at suboptimal levels and with unnecessarily high costs.

In many regions, the issue is not only one of overconsumption and waste, but also of societal inequality and potential for corruption. Oftentimes, electricity providers act as intermediaries between power companies and end-users by providing billing and metering usage services. End-users in certain markets are known to pay premiums as high as 40 percent[18] for this service.

Person-to-Person (P2P) energy grids are a Blockchain-powered energy distribution model that have the potential to revolutionize the way electricity is distributed and consumed. These energy sharing schemes provide electricity suppliers and consumers with the opportunity to trade energy without the need for existing third party intermediaries.

CURRENT LEGACY ENERGY SUPPLY
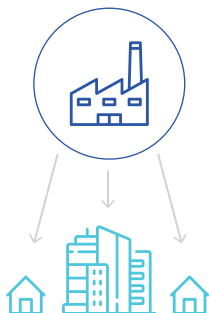
P2P ENERGY DISTRIBUTION
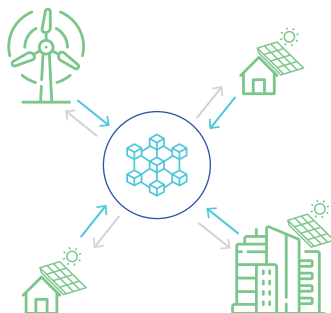
P2P energy grids enable consumers to make granular decisions about when to draw from the grid and when to contribute to it based on fluctuating supply and demand and prevalent per kilowatt rates in real time. With a decentralized ledger that tracks energy transactions, P2P energy grid users have seen unprecedented flexibility in the way electricity is supplied.

The P2P model envisages smart meters that are connected to a decentralized network that allows consumers to buy energy directly from the grid, rather than going through intermediaries, delivering the transparency, immutability and automation lacking from the traditional energy distribution model. When these smart meters are connected with smart devices and appliances in the home, the two will be able to work together to optimise energy consumption in the home and make choices about the sources of energy that are aligned with the sustainable behavioural shifts of consumers.

Along with traditional consumer demand for electricity - whether in homes or businesses - P2P energy models have a number of other transformative use cases, including electric vehicle charging and local energy storage banks. With electric vehicles expected to comprise 57 percent of global passenger car sales by 2040[19], the potential for P2P energy grids is immense. In short, P2P grids represent a serious threat to the existing model of energy distribution.

Companies such as Peaq[20] are partnering with automotive manufacturers to install the required hardware and software in-vehicle that will empower society to benefit from the decentralised energy grids and other potential use cases where a unique identity of a vehicle combined with financial or non-financial transactions are needed in the not too distant future.

Electron[21] is another such industry disrupting energy model that leverages blockchain to enable new energy markets to be created. This model addresses the challenges of a decentralizing grid and aims to provide a global market infrastructure that is not yet available in traditional, semi-analogue energy models.

INCENTIVIZING SUSTAINABLE PRACTICES AND SUPPORTING THE CIRCULAR ECONOMY

Despite the insistence of governments that they will support efforts to tackle climate change, the historical reality for many organizations around the world is that it is simply not in their primary interests to change the way they consume energy. If balance sheets remain healthy, there is no serious incentive for the way they consume energy to evolve.

Blockchain has the potential to change that, providing a new incentive for organizations to reduce energy consumption and to participate in waste reduction and recycling programs. Blockchain's ability to track metrics including energy consumption, cost, and waste levels and to tokenize these can give businesses large and small - along with consumers - rewards in the form of tokens when energy consumption behaviours are modified to support attainment of societal goals.

Equally, if participants are able to contribute to a shared energy infrastructure through solar panels or other electricity generating sources via P2P grids, they could earn credits or receive micro-payments for their contribution, with the rate received per kilowatt-hour being determined in real time by supply and demand. Later, when participants draw energy from the grid, they then make micropayments at prices that are also determined by supply and demand at the time of payment offsetting those they earned by contributing energy to the grid earlier. This "netting" of contributions

to and withdrawals from the grid could be settled according to a predetermined cadence avoiding the need for fiat flows in and out thereby reducing bank transaction fees and settlement times.

The greater transparency and ability to transact securely afforded by Blockchain is powering a much-needed transformation in traditional energy distribution models. The application of Blockchain projects like P2P energy grids and tokenized consumer rewards in this space democratized energy consumption, addressing over-consumption and societal inequalities simultaneously.

The concept of circular economies is also changing the ways in which we produce and consume goods. Circular economies attempt to address consumption at the point of creation, keeping products and materials within a closed loop and replacing materials as they are used for production.

Closed-loop recycling systems, a prime example of the circular economy, will play a key role in the sustainable consumption of resources. This new way of reducing and reusing involves recycling materials for use in similar types of products, focusing on bringing materials back into the same company or industry. This, in turn, minimizes waste in the recycling process while reducing pollution and preserving resources, but such a system requires full transparency for the stakeholders involved in order to succeed.

PROVING PROVENANCE WITH GREATER TRANSPARENCY

As consumer attitudes to food consumption and farming practices change, the food industry will face increasing pressure from consumers to prove that products are grown and sourced ethically and responsibly. Manufacturers will have to prove that they produce food in a way that protects the environment, public health, and takes animal welfare into consideration.

Data from the United Nations Food and Agriculture Organization reveals that meat consumption is set to hit its lowest level in nine years, and fell 3 percent from 2019 to 2020[22]. This drop has been attributed to increasing consumer concern about health and food safety as well as the rising awareness of the vulnerabilities and unsustainable nature of the meat supply chain.

Top 5 countries increase/decrease in per capita consumption by different meat types

2029 vs. average 2017-19
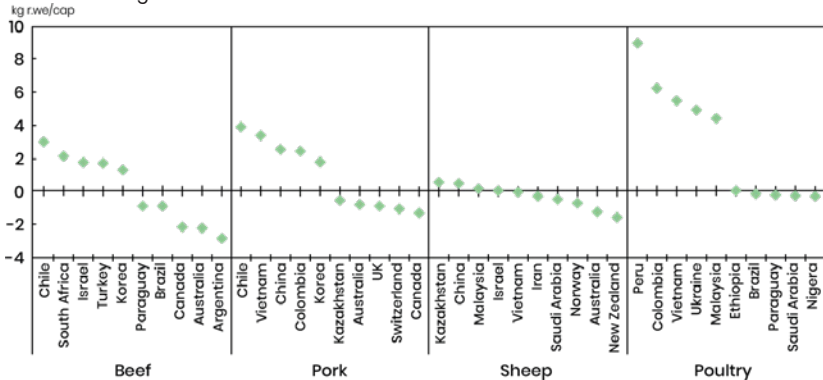
Source: OECD/FAO (2020), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database)

This growing concern among consumers will force the agricultural sector to rethink how they produce and distribute consumable goods. Consumers want to know that their food was grown sustainably, sourced ethically, and transported safely.

Traceability will be crucial to garnering consumer trust in the food supply chain. SettleMint has already partnered with supermarket giant Carrefour and the world's largest brewer AB InBev to deliver a digital traceability solution that utilizes dynamic QR codes attached to a product during the packaging process.

Once scanned, this code gives the consumer the unique opportunity to track the entire life cycle of the product, from farm to shelf. The Carrefour application provides customers with a range of insight including the name and location of the farmer, and even provides details about animal breeding, slaughter and packaging for meat products. The AB InBev application provides a detailed overview of the journey that the barley took from grain to glass including timestamps for all steps in the process of transforming barley into beer and all the logistics steps in between.

Retail chain Carrefour has already taken steps to ensure transparency across its supply chain. Carrefour teamed up with Vinçotte, a Belgian inspection body, and SettleMint to digitize its supply chain using Blockchain. The organizations collaborated to deliver a digital traceability solution that utilizes a dynamic QR code which is attached to a product during the packaging process. Carrefour's supply chain has also benefited, with supply chain issues now easier to track and resolve.

SettleMint & AB InBev's Leffe - track and trace app

SettleMint & Carrefour's - digital traceability solution
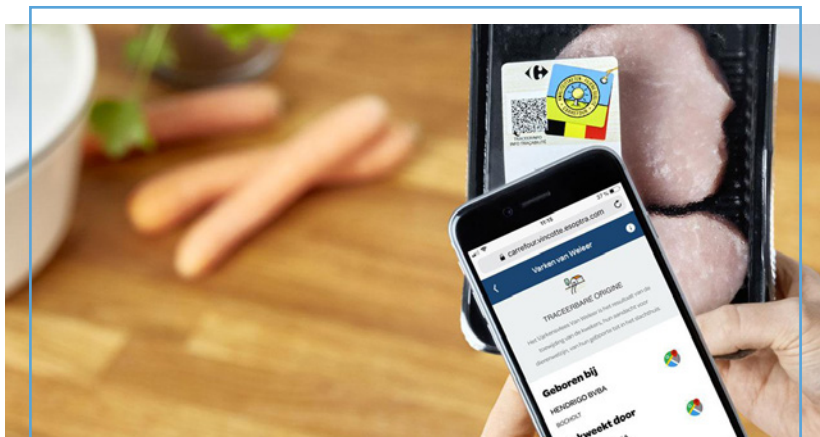
GREEN FINANCING

Green financing is quickly increasing in popularity. In short, green financing is the use of loans - either public, private, or as part of a micro-lending program - to support sustainable companies and fund the projects and investments they make. This form of funding is specifically designed to encourage individuals and businesses to shift to more sustainable business processes. Green financing can come in the form of federal loans to large companies, all the way to a simple rebate on an eco-friendly purchase.

The global green bond market issued a record US$269.5 billion worth of bonds in 2020, an increase from US$266.5 billion in 2019, according to the Climate Bonds Initiative - the UK entity that sets standards for green issuers - and funds for sustainable projects and incentives will continue to grow in the coming years as many financiers look to embed sustainability metrics into their credit decision taking process.

While providing funds and discounts is a laudable approach to incentivizing a more sustainable future, issues arise when attempting to confirm that sustainability metrics are authentic and that funds were, indeed, used to support sustainability.
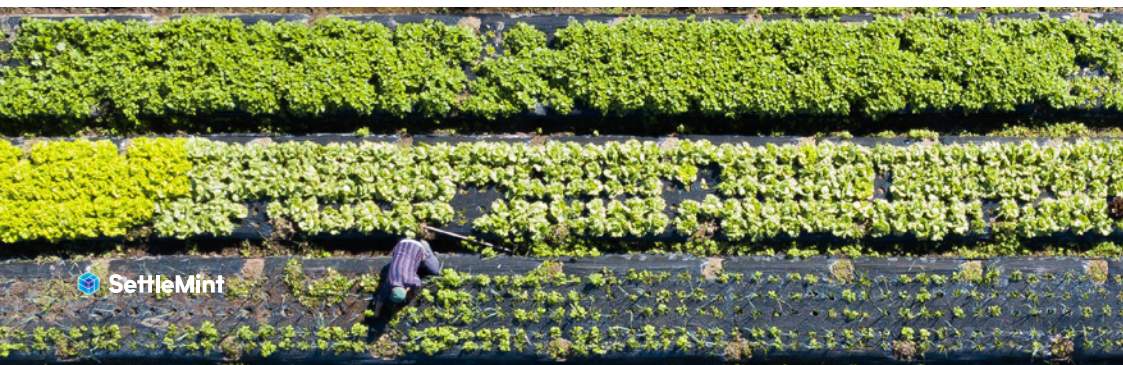
Blockchain technology's ability to immutably store this data and to tokenize assets will support the verification of the existence of funded projects, and verification that the project satisfies sustainability requirements.

As an example of blockchain further democratizing loans and financing, Ripio[23], a blockchain startup in Latin America which originally operated a bitcoin payment platform, has recently expanded its offering to include the Ripio Credit Network (RCN). RCN allows users to create installment loans using Bitcoin.

The aim of RCN is to decentralize the lending process by leveraging a series of smart contracts and the existing Ripio credit application opening up more lending opportunities for individuals who have traditionally been unable to secure loans due to a lack of credit history or ownership of a bank account.

BLOCKCHAIN FOR
SOCIAL GOOD

The term 'social sustainability' may be a new concept to many. Though intrinsically tied to environmental sustainability, social sustainability examines the long- and short-term impacts of initiatives designed to support people and communities. Social sustainability efforts aim to support freedom of association, human rights, equal opportunities, and individual and community health and safety. Diversity, equality, ethical labor practices and more fall under the social sustainability remit, a pillar of the EGSs that focuses on individual well-being.

Within the enterprise sphere, social sustainability projects address employee wellness, community engagement, and socially responsible policy-making. While traditionally, governments and charitable organizations have been the cornerstones of projects that support social sustainability, private businesses are increasingly expected to contribute to the cause both within their own workforce and in the wider community.

Edelman's annual trust report found that 71 percent[24] of respondents believe CEOs need to take the lead on issues like equal pay and discrimination rather than waiting for government regulations to enforce standards for employee well-being.

TRANSPARENT, TRACEABLE HEALTHCARE DATA

The world's attention has been fixed on the healthcare industry since the start of the COVID-19 pandemic in March 2020. This global battle against a virus dominated headlines in 2020, and continues to do so in 2021. Since the onset of the pandemic, day-to-day life has been disrupted for billions of people and the crisis has re-emphasized humanity's dependence on science, technology and innovation.

As the pandemic wore on, the need to share sensitive medical and health information quickly and securely was made apparent. Sharing this information and data on a secure, decentralized ledger could mean the difference between identifying the next global health crisis in time, or risking another wave of infection.
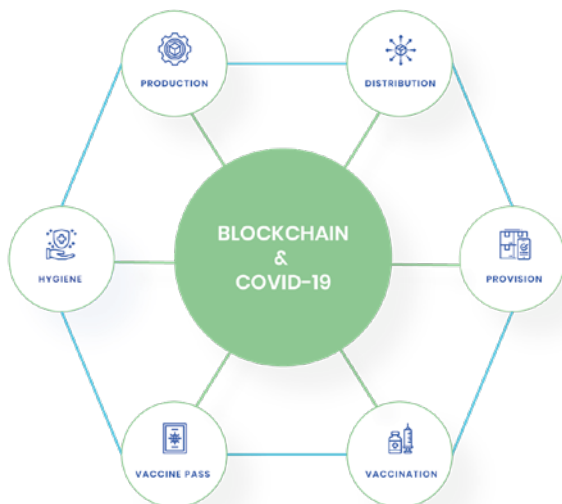
While the end of this global crisis may be on the horizon, the need for transparent, traceable healthcare data that can be shared safely across borders has been made clear. Blockchain technology may be the key to unlocking global healthcare insights that could mitigate worldwide health crises in the future.

Within the healthcare industry, blockchain could support clinical trials by ensuring patient management systems are fair and transparent and ensure the fair and timely distribution of necessary equipment and vaccines by tracing transactions in the supply chain on a distributed ledger that provides all stakeholders the ability to independently verify data stored on chain.

FIGHTING FAKES

Blockchain's ability to track and trace vaccines along the supply chain may increase the accountability of governments to their citizens, and protect consumers from counterfeit doses. According to the Infectious Disease Data Observatory at Oxford University, 10 percent of all medicines on the market today are either substandard or falsified. Research by the World Health Organisation discovered that no less than 30% of medicines sold in the Middle East and Africa region are counterfeit[25].

Blockchain provides the ability to effectively track the movement of vaccines across sites, greatly reducing the potential for medical fraud and waste, issues which could both have deeply damaging consequences if not tackled.

According to the Infectious Disease Data Observatory at Oxford University, 10 percent of all medicines on the market today are either substandard or falsified

StaTwig[26], an India-based organization that was born out of the UNICEF Innovation Fund, is one of many medical companies beginning to use blockchain to ensure the safety and appropriate use of vaccines. Their two products, VaccineLedger and BabyBoo, track and monitor vaccines using blockchain technology from the moment the vaccine is manufactured, to the time it is administered to a child. StaTwig monitors critical vaccine information such as chain of custody, temperature, and storage humidity.

Giving citizens the opportunity to trace the provenance of their vaccine dose is a transformational trust initiative that could reduce the possibility of counterfeit vaccines which have sprung up since mainstream vaccinations became available.

It is hard to underestimate the potential for blockchain in terms of the ways it can be used to track vaccines and other medicine - not just following the effects of COVID-19, but also with future infectious diseases and their cures.

DIGITAL IDENTITY

As more governments consider 'vaccine passports' as a solution, it is apparent that storing vaccination information on a Blockchain would provide greater visibility of information which will in turn increase trust and catalyze economic recovery.

Moreover, documents containing sensitive, identifying information like vaccine passports, driver's licenses, or bank documents currently need independent verification every time they are requested. Mobile "digital identity wallets" have the potential to drastically reduce the paperwork, back-and-forth data transactions, and overall hassle of having to manage the ever-growing pile of identity documents.

Self-sovereign identity solutions put individuals in control as owners of these kinds of identity data. Digital identity wallets like SettleMint's IdentiMint, allow users to store and share information relevant to the specific context for data sharing.

BLOCKCHAIN FOR CORPORATE GOVERNANCE

While there are myriad use cases for blockchain technology to support governmental and non-profit initiatives, the technology's ability to disrupt and manage corporate governance is often overlooked. Corporate governance relates to systems which control and manage company resources and activities. Upholding corporate accountability involves a variety of policies, processes, and people in order to meet the expectations of the company's shareholders and other stakeholders with integrity, responsibility and transparency.

Sustainability in the context of governance and corporate social responsibility encompasses the ability of companies to positively influence ecosystems, society and economic development. A variety of initiatives fall under the umbrella of corporate sustainability, including a company's energy use, waste, pollution, natural resource conservation, and their treatment of animals.

The instances of fraud and misreporting of CSR initiatives have been on the rise in recent years. According to a recent EY Forensic & Integrity Services' report out of India, 75 percent[27] of respondents did not have a governance structure or policy to address ethical lapses or fraud in CSR programs. Blockchain has many diverse use cases for sustainability initiatives in the corporate and governance space, and its transparency has the potential to cut down on fraudulent financial reporting, increase accountability and give sustainability projects the momentum they need to succeed.
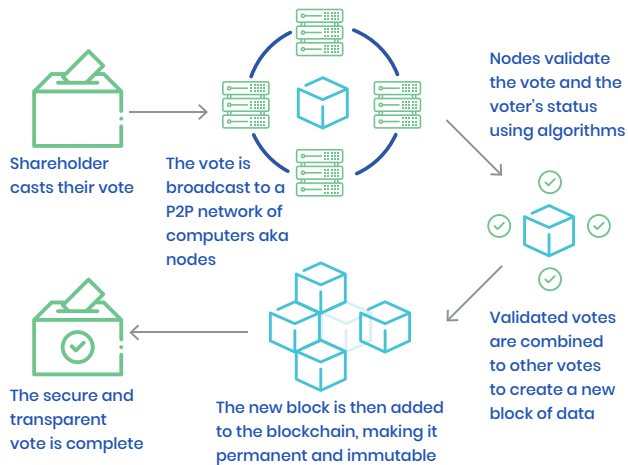
Corporate accountability

Under increasing pressure from governments, employees, and the public at large, businesses across the world have ramped up their sustainability efforts. In fact, 90 percent of the S&P 500 now file sustainability reports, according to the Governance & Accountability Institute[28].

However, this statistic alone should not deceive, and good intentions regarding sustainability do not always translate into hard results. The numbers certainly paint a bleak picture in the success rates of sustainability projects with Bain & Company research estimating that a staggering 96 percent of sustainability projects fail[29].

There are a variety of reasons why this happens, and failure is oftentimes linked to a lack of executive support, a lack of investment or resources, and stagnant behaviors or cultures within an organization. Even when corporate sustainability projects report success, due to a lack of transparency, it can be difficult to determine if the data and outcomes are reported accurately.

Shareholder voting is one such example of a process whose reputation is often defined by its relative lack of transparency. Shareholder voting generally operates in a proxy voting structure in which only a small percentage of shareholders are actually able to execute their governance voting rights. Traditional technology reinforces this status quo, but blockchain technology has the potential to provide greater access to a wider pool of stakeholders through both anonymity and transparency.

Shareholder casts their vote

The vote is broadcast to a P2P network of computers aka nodes

Nodes validate the vote and the voter's status using algorithms

Validated votes are combined to other votes to create a new block of data

The new block is then added to the blockchain, making it permanent and immutable

The secure and transparent vote is complete

While many organizations embark on sustainability projects with good intentions, the reality for many is that when they must allocate an actual budget, executives begin to get nervous about their bottom lines. This is in many ways understandable, and even expected, as sustainability projects almost always need to be linked to some form of long-term value creation, but this nonetheless remains an inhibitor to positive change.

According to Bain & Company estimates, adhering to potential future sustainability regulations could cause a typical consumer products company to lose up to 20 percent to 25 percent of today's margins[30]. However, the report notes that these estimates are often modeled on a " future that looks more or less like today". The reality is that as consumer and regulatory demands continue to shift toward a more sustainable future, research increasingly shows evidence of the link between successful ESG efforts and increased rates of returns, according to the report.

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Enforcing Governance with Smart Contracts

Aside from non-mandated sustainability initiatives, blockchain's transparency also has the potential to ensure organizations are able to meet various compliance regulations. For many, this represents an attractive prospect and clear business case which delivers tangible value at its end, delivering an irrefutable record of a company's ability to achieve regulatory compliance.

The global carbon credit scheme[31] is one major example of an initiative that, if stored on a blockchain, could create an enhanced ecosystem of exchange based on transparency and trust while creating huge benefits for the environment. Carbon credits are an international attempt to mitigate the growth in concentrations of greenhouse gases, and currently comprise a marketplace that guides industrial and commercial processes towards low emissions or less carbon-intensive activities.

The EU Emissions Trading System is the world's first major carbon market and covers around 40 percent of the EU's greenhouse gas emissions. Working within a cap and trade principle, carbon credits can be bought and sold by installations covered by the system.

While carbon credit schemes have had mixed success, they represent a prime example of a system that would be significantly enhanced by Blockchain's unique features. McKinsey estimates that demand for carbon credits could increase by a factor of 15 or more by 2030 and by a factor of up to 100 by 2050. Overall, the market for carbon credits could be worth upward of $50 billion in 2030, according to the company[32].

CARBON MARKET
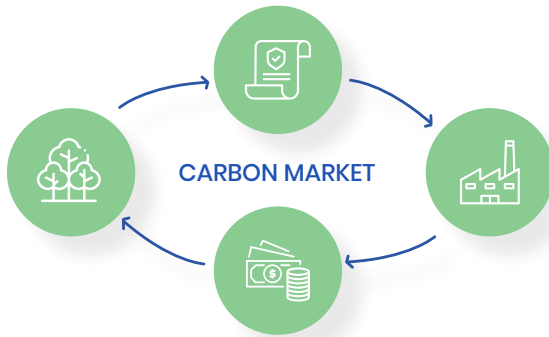
This new form of value represents an opportunity that is ripe for fraudulent activity if not managed appropriately. The potential for carbon credit crime is such that Interpol released a guide to Carbon Trading Crime as early as 2013, specifically outlining the potential for manipulating measurements to fraudulently claim additional carbon credits, as well as the sale of carbon credits that either do not exist or belong to someone else.

Interpol was right to raise a red flag, as a recent report by Compensate, a Finland-based nonprofit offset brokerage, found that of 100 certified offsets investigated, 90 percent[33] either failed to offset as much as they claim or were not permanent. The transparency of blockchain technology can ensure corporations and governments deliver on their environmental promises and do not misreport or manipulate data.

Legal document storage on a decentralized ledger will have a vast impact in cutting down on fraud when tracking environmental agreements, leaving no room for data to be misinterpreted or manipulated. This will provide a whole host of benefits - increased

data integrity, higher levels of automation and an enhanced understanding by non-technologists of what a smart contract represents.

Energy supplier Elia, together with SettleMint and Actility, explored the opportunities offered by blockchain technology to build an energy system that could deliver greater operational flexibility, reliability and scalability. Using the SettleMint platform, Elia built a smart contract solution to automate processes associated with supplier registration, bidding, fulfilment, measurement and verification, as well as delivering financial settlement for tertiary suppliers.

The solution has helped Elia to foster an automated, trust-based ecosystem with its partners, with minimal friction in processes, including automated payment flows and ease of onboarding for new energy resources, as well as secure automated grid balancing. It delivers trustworthy data, enhancing compliance through an immutable record of data.

Challenges in blockchain implementation

While blockchain may be a key enabler of sustainability projects and programs, as with any major strategic business innovation, implementing blockchain has traditionally required technical expertise, precise planning, and ongoing support from those who hold purchasing power.

The very nature of blockchain makes it challenging for organizations to successfully implement. Blockchain protocols use different programming languages, while each protocol needs different tools for the compilation and migration of contract code. Compatibility issues from evolving developer tools are inevitable. This all adds up to an unnecessary, drawn out headache for developers, which only increases the chance of project failure.

Prohibitive factors in blockchain implementation

COMPLEXITY

COST

ACCESSIBILITY

LACK OF EXPERTS

KNOWLEDGE GAP

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The complexity of blockchain implementations increases not only with the number and type of participants, but also with the types of data integrated and the level of automation built in. In terms of participants, options range from a small group of permissioned B2B users on a private chain, to large consortia that also incorporate B2C access. In a nutshell, although Blockchain's end goal is some form of procedural simplicity, getting to that point is invariably defined by complexity.

The lack of available technical skills is arguably the most common hurdle that organizations will face when it comes to effectively implementing Blockchain solutions. As with any emerging technology or trend, third party developers inevitably spring up and promise the world to clients, when in reality they are unable to deliver the promised results.

With the number of global Blockchain developers estimated to be just over 100,000 - a relative lack of certified Blockchain training courses is a factor
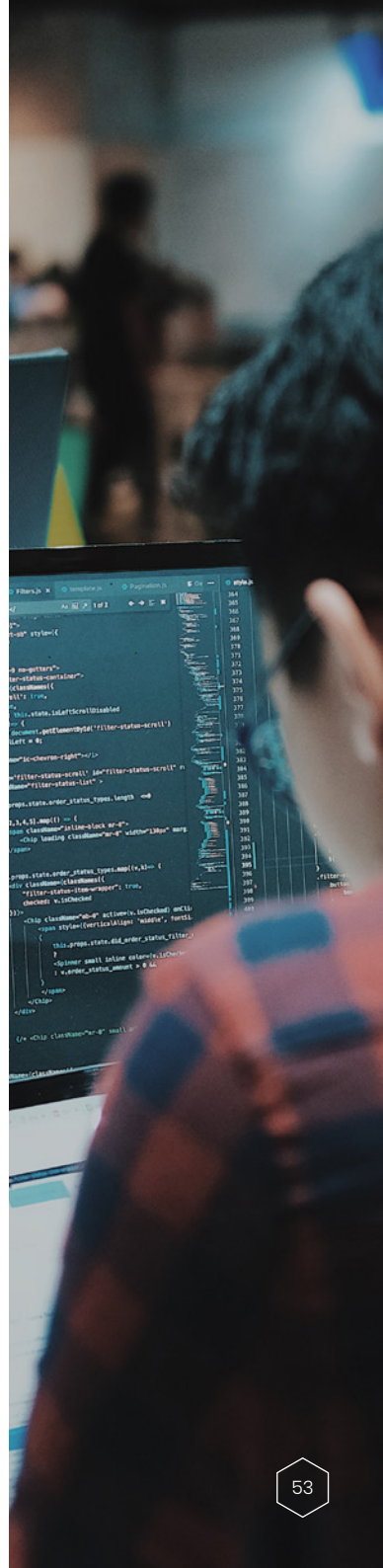
in this – if organizations wish to integrate Blockchain into their processes, they need to know that vendors they choose to partner with are competent and trustworthy.

A scarcity of verified Blockchain experts inevitably causes an unenviable fork in the road for businesses who wish to implement Blockchain solutions. Businesses either take a risk by spending big on a project whose success is far from guaranteed, or cut corners and pay for the services of second-rate Blockchain developers.

Although 55 percent of executives asked by Deloitte identified blockchain as one of their organization's top five strategic priorities, there undoubtedly remains widespread skepticism regarding the return on investment and trustworthiness of the technology. The idea of transparent, immutable records sounds almost utopian to some, but will ring alarm bells with many who control the purse strings. The fact is many won't like the idea of sharing 'immutable' data with other organizations across a ledger.

Convincing non-IT decision makers of the benefits of Blockchain is one thing, but successfully winning their support to see a project through to the end is another.

Cost is frequently seen as a major barrier to blockchain adoption. The fact is that proven, certified blockchain experts come at a price, and between design, development and deployment, costs continue to pile up. Add recurring costs for maintenance, and blockchain projects can quickly go over budget.

With tight budgets and an uncertain economy, major investments into emerging technologies may be a non-starter, even for the businesses who want to contribute to the sustainability of our planet and population.

SettleMint believes that the key to making blockchain work for the masses is minimizing heavy lifting around coding, taking the pressure off the organization, and allowing them to focus on innovation.

```javascript
// Set config
window.config =

// Import bootstrap
require('./bootstrap')

// Set Vue globally
window.Vue = require('vue')

require("./directives");

// Vue store state management
Vue.store = store;

// Localization
Vue.use(vuexI18n.plugin, store, {
  onTranslationNotFound (locale, key) {
    return `Key '${key}' not found for locale
  }
});

// add translations directly to the application
Vue.i18n.add('en', enLangFile);

// set the start locale to use
Vue.i18n.set('en');

// set vue routes
Vue.use(VueRouter);
```

THE FUTURE OF ENTERPRISE BLOCKCHAIN FOR SUSTAINABILITY

It is clear from its varied use cases that blockchain is already playing a significant part in the global fight for a more sustainable future. As blockchain technology continues to advance, new use cases will emerge that create even greater transformational potential leveraging the inherent benefits that blockchain provides such as transparency, independent verification and open access.

The UN's Sustainable Development Goals were designed as a blueprint for a better and more sustainable future. However, with a fast-approaching 2030 deadline, it is imperative that organizations and governments leverage emerging technologies to achieve these goals.

Blockchain technology allows us to envisage a world where data is shared openly and safely, where citizens have autonomy over their data, and fraudsters are caught and held to account before counterfeit products hit the market, or fraudulent financial reporting undermines global sustainability efforts.

As more and more organizations shift their focus to sustainability, and consumers demand greater visibility into the origins of the goods they purchase and the processes used to extract the raw materials they use, it is apparent that this vision of the future is not only possible, it is here.

As we continue to break down barriers to access to emerging technologies like distributed ledger technologies, we can truly begin to innovate, monitor, and iterate upon sustainability initiatives that will secure a future that is clean, transparent, and equitable for generations to come.

ESG APIs are proven to provide clear, auditable data on the performance of some of the world's largest businesses, but gaps remain for their global networks of suppliers. In order to achieve a more complete picture of the ESG performance of organizations throughout the supply chain, this information needs to be accessible and transparent. To properly track all suppliers along the chain, mid-market APIs are necessary to close the gap.

From smart wallets that secure your most valuable assets and data, to protecting the very food we eat, blockchain's inherent traceability, security, and transparency will be crucial as we shape our future.

As regulations on sustainability, corporate accountability, and data security continue to develop, organizations that implement blockchain solutions now will be well equipped to adapt in this new, more conscious economy.

SettleMint

- Dashboard
- Explorer

SMART CONTRACTS
- State Machines
- Miscellaneous

USERS & ROLES
- Users

SETTINGS
- Contracts
- Webhooks
- Look & Feel

DOCUMENTATION
- API docs
- Email support
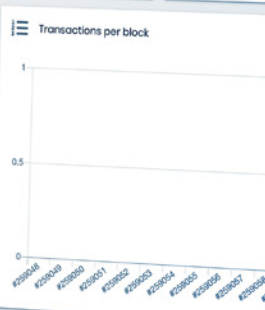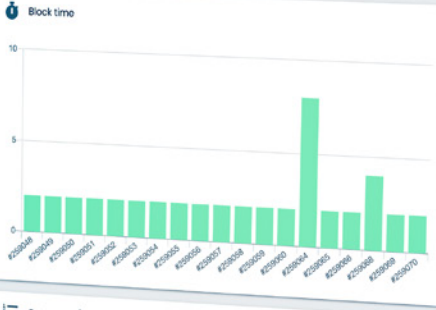
Best block
259,070

Last block
1s ago

Avg time b

Gas limit
9,007,199,254,740,991

Gas price
0 ETH

Avg gas per

Block time

Transactions per block

Gas usage (last 20 transactions)

Gas usage (last 20 blocks)

SETTLEMINT'S
BLOCKCHAIN PLATFORM-AS-A-SERVICE (BPAAS)

SettleMint has developed a platform for enterprise blockchain applications. Using the platform, organisations can speed up the go-to-market of DLT-based capital markets products and infrastructure.

Leverages existing IT skills

Built up in several layers that solve the many technical challenges developers face with blockchain technology, the platform empowers organizations to use their existing IT skills to build and deploy blockchain solutions. Featuring an integrated development environment that contains the base components for blockchain platforms as well easily customizable code libraries, organizations using SettleMint's Platform can go from concept to in-production applications in weeks not months, and at a fraction of the cost of building from scratch.

Easily integrates with legacy infrastructure

Several of the layers that make up SettleMint's BPaaS are specifically designed to simplify the process of integration with legacy systems, something that is particularly relevant in the context of capital markets' applications where lack of common standards and fragmented IT solutions and data architectures prevail. For example, SettleMint provides an infrastructure wrapper that enables developers to deploy secure blockchain infrastructure using containerized workloads in Amazon Web Services, Microsoft Azure and Google Cloud off the shelf. This means organizations can keep their legacy infrastructure such as on-premises servers, but securely plugin to their blockchain implementation. Further, SettleMint's BPaaS comes with a distributed API and connectors, effectively providing a zero configuration API layer that enables seamless integration of the blockchain implementation with legacy systems. Finally, SettleMint's BPaaS includes an intuitive user interface that makes it easy for systems admins and developers to build, deploy, integrate, and operate distributed applications.
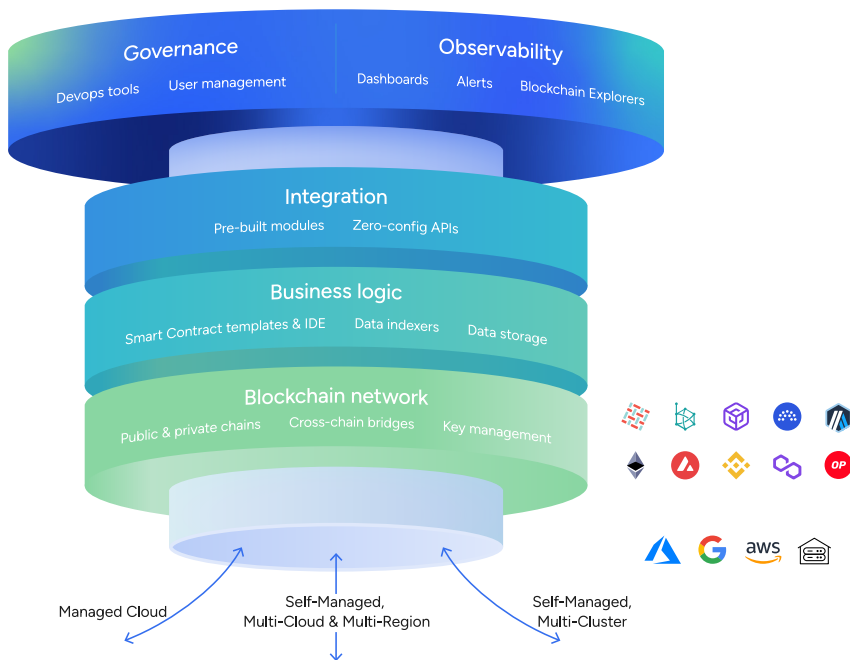
The Ultimate Blockchain Transformation Platform

The technology your IT team needs to easily build and launch production-ready blockchain applications incredibly fast.

- ✅ Compliant ✅ Secure ✅ Reliable
- ✅ Resilient ✅ Scalable
- ✅ Customizable ✅ Interoperable

Governance

Devops tools   User management

Observability

Dashboards   Alerts   Blockchain Explorers

Integration

Pre-built modules   Zero-config APIs

Business logic

Smart Contract templates & IDE   Data indexers   Data storage

Blockchain network

Public & private chains   Cross-chain bridges   Key management

Managed Cloud

Self-Managed, Multi-Cloud & Multi-Region

Self-Managed, Multi-Cluster

SOC 2 COMPLIANT TYPE II

ISO 27001 Certified

Matthew Van Niekerk
Founder & CEO SettleMint
matthew@SettleMint.com

"With Europe taking an extremely proactive approach towards accelerating blockchain adoption, and the in the context of China promoting the technology at the highest levels of power, the coming years are very likely to see rapid innovation and uptake in the sector. Given that most organizations still have limited technical capacity to build and engage with blockchain solutions, however, there's a real danger that many organizations will be left behind. As a technology facilitator for blockchain, our goal at SettleMint is to ensure that all organizations have the opportunity to leverage blockchain technology towards bringing the wide potential benefits it offers."

End Notes

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19. https://about.bnef.com/electric-vehicle-outlook/
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21. https://electron.net/
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23. https://www.ripio.com/ar/
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Recognized by industry leaders