

Ethereum Business Readiness Report 2023

Assessing the potential and capabilities
of public Ethereum and the broader Ethereum
ecosystem for businesses



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Foreword: Think Longer Term

By Paul Brody

As you read through this report, you may at times feel as I did: first encouraged, then discouraged, then encouraged again. Last year, we experienced a deep crypto winter whose effects are still with us.

As long as this remains an immature and high innovation ecosystem, it is likely that we cannot be entirely free of bad actors who take advantage of uncertainty and confusion. Even though, the year has been a good one.

Some of the good news has come from the strong progress of criminal cases against bad actors. This isn't just a moral victory or a message to bad actors, it represents an important and often unappreciated change in the competitive landscape: it's very difficult for ethical companies to compete with unethical firms. Bad actors make promises they have no intention of keeping, which means they always have what seems like a better deal on offer.

Bad actors, a lack of regulatory clarity, and a weak market have all slowed down enterprise adoption, but they have not stopped it. And, though overall blockchain adoption in the enterprise may have slowed, the share taken by Ethereum has gained significantly. Ethereum, and when I say Ethereum, I mean the public network and its various Layer 2 partners, has become the global de-facto standard for real blockchain innovation.

This by itself is a huge milestone because it starts to reduce the complexity firms experience when they enter the blockchain space. More and more, the default choice tends towards Ethereum, which means that more effort is spent on the business application and the value proposition than trying to choose the "perfect" network. Like most computing platforms, Ethereum isn't the best out there, it's just the most widely used.

Despite risk and uncertainty, some of the world's top companies have increased their commitment to Ethereum, including Franklin Templeton, Fidelity, and Blackrock. My own firm, EY, has been steadfast in our support and focus on Ethereum for 8 years now. Sadly, I can't announce additional commitment because I'm already 100% in.

Many use cases, such as tracking inventory, carbon emissions, product provenance, or procurement automation aren't related to financial markets. However, one thing we have learned in past years is that sentiment for (or against) blockchain solutions and fear or interest

seem to be highly correlated with the performance of the finance space.

On that front, progress has been good but uneven. Regulators in Europe and Asia are making consistent and steady progress toward operating models that support asset-backed tokens and crypto-assets. Once those are in place, we can hope to see regulatory frameworks or DeFi and other advanced services follow. The US is following more slowly.

Finally, we are making progress in industrial applications as well. Crucially, privacy technology continues to mature and enterprises are getting more comfortable with the idea of using tokens on public networks and being able to protect their sensitive data. That comfort has translated into a trickle of progress. One day, it will be a flood.

The most consistent thing missing from every analysis is a reasonable sense of timeline. The blockchain industry is far too big to go back to the days of 100-200% annual growth. In the first five years of EY's blockchain business, we grew more than 100% every single year. That's not sustainable.

We are now heading towards large-scale adoption, but we need to take our cues from other industries. It took about 40 years for much of the US railroad infrastructure to be built. Cloud adoption growth has been going strong (more than 20% a year) for over 15 years now. It took nearly 20 years for most of the SWIFT network to be built-out and another 20 for it to become the payments behemoth it is today.

While we can hope things will go a bit faster with blockchain, we are certainly not going to solve each and every problem in blockchain in a year or two. This is a multi-decade project, and if we want to sustain our enthusiasm and our energy to complete this transformational and valuable task, we need to calibrate our expectations accordingly. Seen from that angle, 2023 has been a year of excellent progress. ■



Paul Brody

Principal & Global Blockchain Leader, Ernst & Young
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Executive Summary

In June of 2022, we published our inaugural Ethereum Business Readiness Report. The goal of that report was to explore the adoption of Ethereum and the Ethereum ecosystem as a business platform, and shed light on its uses outside the familiar realms of cryptocurrencies, consumer DeFi or NFTs. We also proposed a framework by which businesses could assess the business readiness of the ecosystem. The work was based both on quantitative and qualitative criteria, including our proprietary database of business Ethereum projects, interviews and case studies. This 2023 report provides an update of that work. The main points we touch on include:

Section 1: The Year in Business Ethereum

Reviewing the previous year, we find that it **was a year of both challenges and evolution**. On the challenges side, the most significant event was the turbulence brought on by the failure of Terra/Luna, the bankruptcy of FTX, the collapse of cryptocurrency markets, and the subsequent crypto winter. This all **put a damper on business use of the technology** (though not in all cases). The year also saw a large number of sometimes significant hacks and successful scams, underscoring how **serious the security challenge in this space remains**. Finally, the year was defined by **regulatory divergence**. Some jurisdictions, most notably the US, have come down hard on crypto in the wake of all the scandals, creating uncertainty. Others, including Europe, are providing more clarity.

Against this difficult backdrop, **the Ethereum ecosystem as a whole showed remarkable resilience**. DeFi platforms performed relatively well during the market upheavals, providing an excellent example of the power of decentralized business models (as opposed to the centralized models that were at the heart of most of last year's failures). **The Ethereum community also flawlessly managed The Merge**, the largest upgrade to Ethereum since its launch, and one of the most complex. Not only did The Merge **reduce Ethereum's energy footprint by more than 99%**, it was also a testament to the **strong governance and overall robustness of the ecosystem**. Other indicators of this robustness include Ethereum's continued significant lead over other Layer 1 blockchains

in terms of the number of active developers, as well as the continued growth of its Layer 2 ecosystem.

Finally, despite crypto winter, **the year saw strong growth in certain sectors**. Global brands, including the likes of Starbucks, Budweiser, Tiffany & Co, Sotheby's, and Nike, **embraced NFTs**, highlighting the mainstream acceptance and utility of this technology. There was also **a lot of activity in Institutional DeFi**, with major projects by such mainstream organizations as JPMorgan, the Monetary Authority of Singapore, and SWIFT. The year also saw a lot of action in the area of **tokenization of real-world assets (RWAs)**. While cryptocurrencies may have taken a reputational hit during the crypto winter, tokenization seems here to stay.

Section 2: A Snapshot of the Use of Ethereum and EVM in Business Today

In this section, we take a look at the use of Ethereum and EVM-based technologies based on our now extensive, **proprietary data set of business-oriented projects** (so excluding many household names in DeFi and the NFT space, but including Ethereum L2s and EVM-compatible L1s). Our **dataset now includes 260 projects** that meet our criteria, a significant improvement over the 118 we had last year.

When we analyze the data in terms of business projects by industry, we find, like last year, that **infrastructure is still the leader in terms of the number of projects**, followed by capital markets and payments. This underscores the leading role that financial use cases still play in the Ethereum space. That said, we **also find increasing activity in non-financial sectors**, with supply chain and logistics, as well as retail and ecommerce, leading the way.

More broadly, we find a growing ecosystem of projects being built on Ethereum and EVM technology, with both **large corporates and startups alike embracing the technology**. The **majority of applications that have been announced are on public networks**, while high numbers of competing infrastructure companies are **reducing the cost of using the technology**.

Executive Summary *(continued)*

Section 3: Observations and Trends

For our Observations and Trends section we add our qualitative data to the mix, relying on the insights and learnings from our over 20 interviews conducted expressly for this report; the interviews and research for our case studies; as well as extensive desk research.

Among the many highlights, we find that Ethereum is continuing to **establish itself as the preferred settlement and base layer** in the blockchain space. This has been helped by the fact that post-Merge, **it has solved its sustainability issues**. On the other hand, it has **not yet solved its scalability problem on Mainnet**, though advancements in L2s have contributed significantly to increasing speed and reducing costs. This is likely to stay the case for a long time. As we find, as **Layer 2s come of age**, Ethereum is **evolving a “rollup-centric” architecture** with Mainnet as the base layer with a universe of Layer 2s and 3s above it. We also find that **the move to public blockchain continues**, continuing a trend we identified last year.

Unsurprisingly, **privacy remains a priority and a concern**, although it is slowly being solved. **Security also remains a very serious concern**, particularly at the level of Layer 2s and bridges.

We find that tokenization, especially of RWAs, is an increasingly important use case with widespread implications for businesses and that **getting fiat onchain will be an enormous enabler of business applications**, whether through stablecoins, CBDCs, or, increasingly, deposit tokens.

Section 4: Assessing the Business Readiness of the Ethereum Ecosystem

In the final section we return to our data-driven analysis to try and answer the question of whether Ethereum is ready to onboard businesses. First, we **update our Business**

Readiness evaluation from last year, where we judged business readiness based on a number of different metrics. As part of assessing if Ethereum is “business ready,” we also **compare Ethereum to other types of businesses that settle value**, for example, payment networks like Visa and Mastercard. We also explore the **distribution of transaction activity between L2 networks and the Ethereum Mainnet**, especially given the growing importance of L2s in the narrative of Ethereum’s evolution. Based on our data analysis, we conclude that **while Ethereum is progressing as a settlement network, it still has considerable ground to cover** before it can be recognized as the predominant global settlement platform.

Section 5: Conclusion

To conclude, we find that the Ethereum ecosystem as a whole has continued its evolution as a viable decentralized platform for large-scale business use. The **Ethereum Mainnet has become an important settlement layer and the preferred base layer** in the blockchain space, at least for now. Ethereum’s embrace of a “rollup-centric” architecture, with myriad Layer 2s, Layer 3s and other solutions, also means that **businesses can choose from a great many options**. On the other hand, **this also makes the ecosystem more complex**. While adoption has slowed on the back of the scandals of 2022, it has not stopped. Quite the contrary. In many areas **we have begun to see real business value be put on Ethereum**, showing that people are using it to solve real problems.

APPENDICES: CASE STUDIES AND INTERVIEWS

In our appendices, **we print in full 12 of our case studies and seven of our interviews**. As we refer to these cases and interviews throughout the paper, we thought it would be useful to give the reader the full context. We also think these stories and voices provide an excellent “view from the ground” and invite our readers to spend some time with them as a way to round out the picture we have been attempting to paint with this report. ■

Introduction

In the inaugural edition of our Ethereum Business Readiness Report, which appeared in June 2022, we set out to help “the broader business community understand the potential and capabilities of public Ethereum and the Ethereum ecosystem for business use.”

In this second edition, the mission has remained the same. So have the challenges. Like last year, when most of the world thinks of blockchain, they think about cryptocurrencies, consumer DeFi, NFTs and other speculative aspects of our industry.

In the post-FTX, post-crypto-winter world, for the general public, these perceptions are often clouded by perceptions of fraud and scandal. It is regrettable, but understandable, that the general public – including many business decision-makers – still has trouble differentiating between these scandals and the opportunity of what remains a remarkable underlying technology. It is also regrettable. The purpose of this report is to help make that distinction more clear.

As you read this year’s report, we invite you to keep a few key themes in mind.

For one, we have seen a continued maturation of Ethereum as a business platform, something we highlighted last year and that we think has become even clearer this year. Maturation is a slow process, and one that begins with stability. Underneath all the noise of the headlines, we think this report brings out how remarkably stable the Ethereum ecosystem has been. More so than last year, we think it fair to say this year that the core technology is beginning to achieve its promise of being a credibly neutral, trusted, open, global business platform. We believe the information in this report bears that out.

Another key theme is the importance of the interface between the Web3 Ethereum community and the business community. This is the interface that our organization, the

EEA, was formed to support. If we have learned anything in the six years of our existence, it is that widespread adoption of blockchain and Ethereum will in many cases – perhaps even the majority of cases – come through business use.

This may not seem so today, where consumer DeFi and other retail use cases like NFTs continue to have such prominence. But traditional businesses have historically been the interface to consumers for most of the world, and we think ultimately they will be the most important agents of mass adoption. The signs are in this report as well, from the major mainstream financial institutions embracing institutional DeFi to the global brands that have been keeping alive NFT technology and markets.

To succeed, however, the two sides will need to talk to each other more. This can be challenging. The business community is vast and heterogeneous. Unlike many other Layer 1 blockchains, Ethereum is community-driven and heavily committed to decentralization both on a technical and governance level. There is no one voice that speaks for Ethereum (though we have tried to play our part in doing so). This is by design, but it doesn’t make things easier. It is a testimony to our community that it has done so well among businesses despite this fact.

Finally, as we did last year, we would like to leave readers with a few notes on how this report was put together.

A NOTE ON OUR RESEARCH

The information in this report is based on both qualitative and quantitative research. Because our goal is not to produce a scientific paper but to shed light on what is actually happening on the ground in the ecosystem, the emphasis has been on the qualitative – above all, case studies and interviews. That said, this year we are also in a position to rely more heavily on quality quantitative data than we were last year (more below).

Introduction *(continued)*

Case studies

The core of this work remain our case studies. We believe such cases have great value in demonstrating what is really happening and possible as opposed to what could potentially occur. Using the projects in our database as a starting point, we developed a long list of approximately 90 cases that seemed worthy of investigation. We conducted further research, including in many cases interviews, for some 40 cases. Of these, we finalized 12, and we present them in full in the Appendix of this report.

Interviews

We also continue to believe in the value of hearing directly from practitioners and experts, and so we once again focused on long-form interviews. We conducted more than 20 of these expressly for this report, but also relied on other relevant conversations and interviews conducted in the course of other projects and work conducted at the EEA. As with the case studies, we have relied heavily on all these interviews for our analysis. We have also chosen to present seven of our interviews in full in the Appendix.

Data: Active projects in business Ethereum

Like last year, we have focused on quantitative data as well. And here, we are very pleased to have made great

strides. While our initial data set of 118 “business-oriented” Ethereum projects was a good start last year, we didn’t feel it was large enough to provide a definitive picture. This year, we were able to increase that data set to 260 projects. This, we feel, gives a much more comprehensive picture.

Still, gathering data remains challenging. While it is easy to measure what happens on the Ethereum blockchain and so follow the developments of things like cryptocurrencies, consumer DeFi platforms, or NFTs, there is less data available on the use of blockchain for building business solutions, and often much less publicity around them. Once again, we had to dig deeply.

To paint a picture based on our “business” lens, we focused mainly on companies or projects that are active now, have live teams, and are developing solutions that are being used by traditional businesses for solving traditional business problems. This naturally reduces the number of projects, and precluded many of the more well-known purely crypto, consumer DeFi, or NFT-oriented ones.

We also tried to favor projects that are in production, but we included some that are in development, either because they have a good chance of coming to fruition or are significant to us for some other reason. These strict criteria add to the complexity of this work. But they are also what make our data set, at least in our opinion, unique. ■

Section 1

The Year in Business Ethereum

The past year has been a period of significant evolution and challenges for the Ethereum ecosystem. This section looks at the key developments and trends that shaped the Ethereum landscape in the business domain since we published our initial report in June 2022.

YEAR OF CHALLENGES

Cryptocurrency market crash and crypto winter

Though not directly related to the business use of Ethereum as a blockchain platform, the major cryptocurrency market crashes and subsequent “crypto winter” was perhaps the most significant event of the past year.

The trouble began with the failure of the Terra/Luna stablecoin in May, 2022 and hit its nadir with the bankruptcy of FTX, at the time one of the world's largest cryptocurrency exchanges, the subsequent November. There were significant knock-on effects, including the failures of Three Arrows Capital (3AC), Voyager Digital, and Celsius Network.

These and other events sparked a major sell-off, with cryptocurrency prices plummeting. Bitcoin and ether, the two leading cryptocurrencies, saw their prices drop by [over 60%](#) from their all-time highs. The Ethereum market cap dropped from its high of over \$5 billion in November, 2021 to a low of under 1 billion in June, 2022.

This crypto winter has had a detrimental effect on business Ethereum in many ways. It caused serious reputational damage to the whole blockchain industry. This in turn has caused a slowdown in business use of the technology. Projects have been shuttered or put on hold due to uncertainty around the ecosystem or fear of reputational damage (for example, companies not wanting to be associated with “crypto” even if their particular use case has nothing to do with coin speculation).

This was however not universally the case. As we discuss below, for some, by removing hype from the equation, the crypto winter paradoxically provided cover for increased business exploration of Ethereum and blockchain technology.

High-profile security incidents

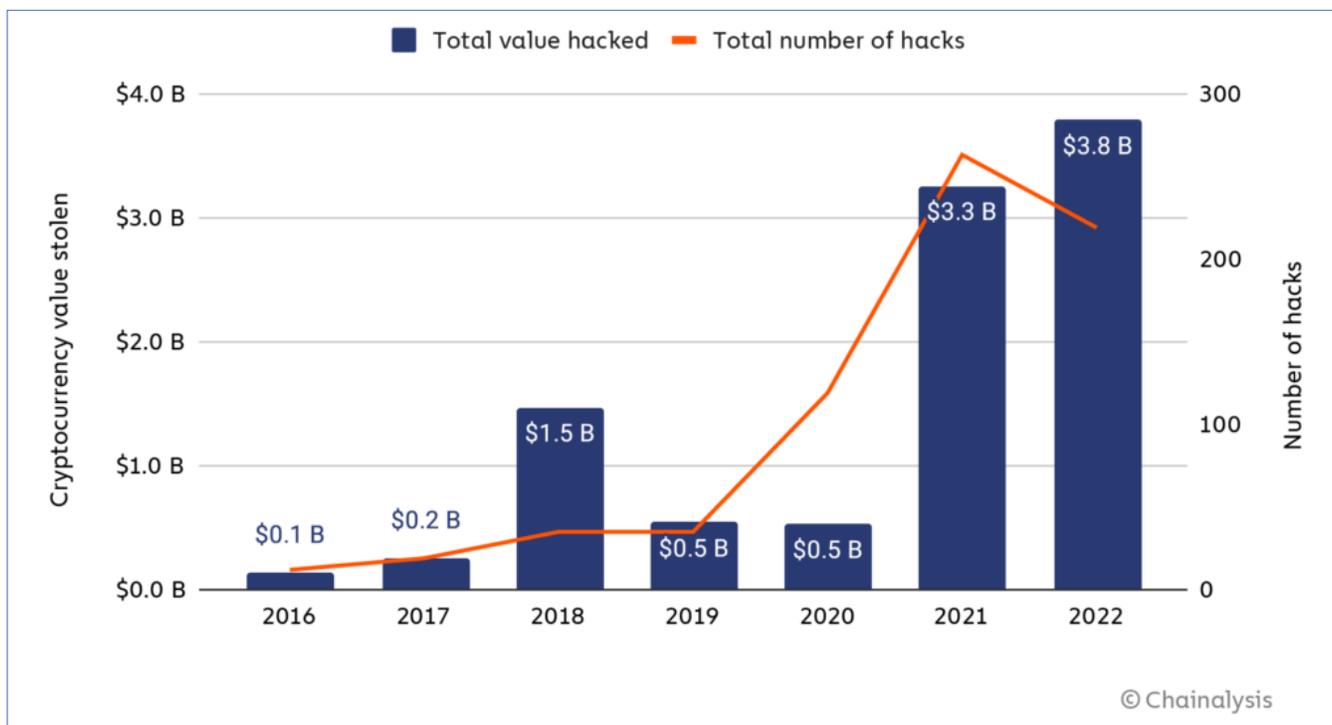
Security is a major concern for all businesses using Ethereum or other blockchain protocols. Unfortunately, we saw a number of significant hacks and other security breaches during the past 18 months.

In November 2023 alone, hackers and rug pullers made off with almost [\\$350 million](#), with USD 100 million in losses occurring on Ethereum thanks to [12 major exploits](#). Overall, hackers and scammers have gotten away with some [\\$1 billion in 2023](#).

While these are staggering numbers, it’s important to note that the Ethereum Mainnet itself has continued to prove resilient. Since its launch in 2015, and despite near-constant attacks, it has never been compromised. All the vulnerabilities in the Ethereum ecosystem are to be found in the layers built above Mainnet, for example, in smart contracts, bridges, or dApps. .

These can be significant. The Axie Infinity blockchain hack, which resulted in a loss of [\\$625 million](#), was due to a sophisticated phishing scheme. Similarly, Wintermute's [\\$160 million](#) hack was linked to a weakness in private keys generated by the Profanity app, and the Nomad bridge lost nearly [\\$200 million](#) due to a smart contract misconfiguration.

Total Value Stolen in Crypto Hacks + Number of Hacks, 2016 - 2022



Source: <https://www.chainalysis.com/blog/2022-biggest-year-ever-for-crypto-hacking/>.

User error is also a problem. Private key compromises accounted for [\\$204 million](#) in losses across 14 incidents in Q3 2023, with notable examples like the Mixin and Multichain incidents leading to [\\$325 million](#) in losses.

Regulatory divergence

Regulation continues to be a major area of interest and concern for business users of Ethereum. This year, the story was one of divergence.

In certain jurisdictions, above all the United States, we have seen an increased regulatory clampdown on the crypto industry primarily catalyzed by the failures and frauds of 2022. The SEC, for example, has been moving hard [to regulate the crypto sector](#) primarily by bringing it under existing securities laws. This has led to widely publicized lawsuits and actions against protocols (like Ripple Labs) and exchanges (Coinbase, Binance, Kraken). The Biden administration has also been vocal about cracking down on “illicit” cryptocurrency use and has been paving the way for a US dollar CBDC (or “digital dollar”), among other

things as a means to obviate the need for [cryptocurrencies and stablecoins](#). Overall, there is a great deal of regulatory uncertainty in the US which some believe is [stifling innovation](#), driving crypto companies out of the country and keeping reputable players (and investors) [on the sidelines](#).

There is more regulatory clarity in other jurisdictions. Probably the most significant event in this regard during the year was the coming into force of the [Markets in Crypto-Assets Regulation](#) (MiCA) in the European Union. MiCA introduces a harmonized regulatory framework for crypto assets and related services. Other regions [like Asia](#) are emerging as places for clearer crypto regulation, making them more attractive to investors and crypto companies. For instance, Hong Kong and Singapore have been proactive in creating an enabling environment for digital asset businesses.

As we pointed out last year, when it comes to regulation, it is important to differentiate between rules aimed at cryptocurrency markets and more general rules around digital assets or the use of blockchain technology. While

The Year in Business Ethereum (continued)

many jurisdictions are concerned about consumer protection and fraud in cryptocurrency markets, they have recognized the benefits of blockchain-based digital assets and decentralized business models. This remains true this year.

A YEAR OF EVOLUTION AND RESILIENCE

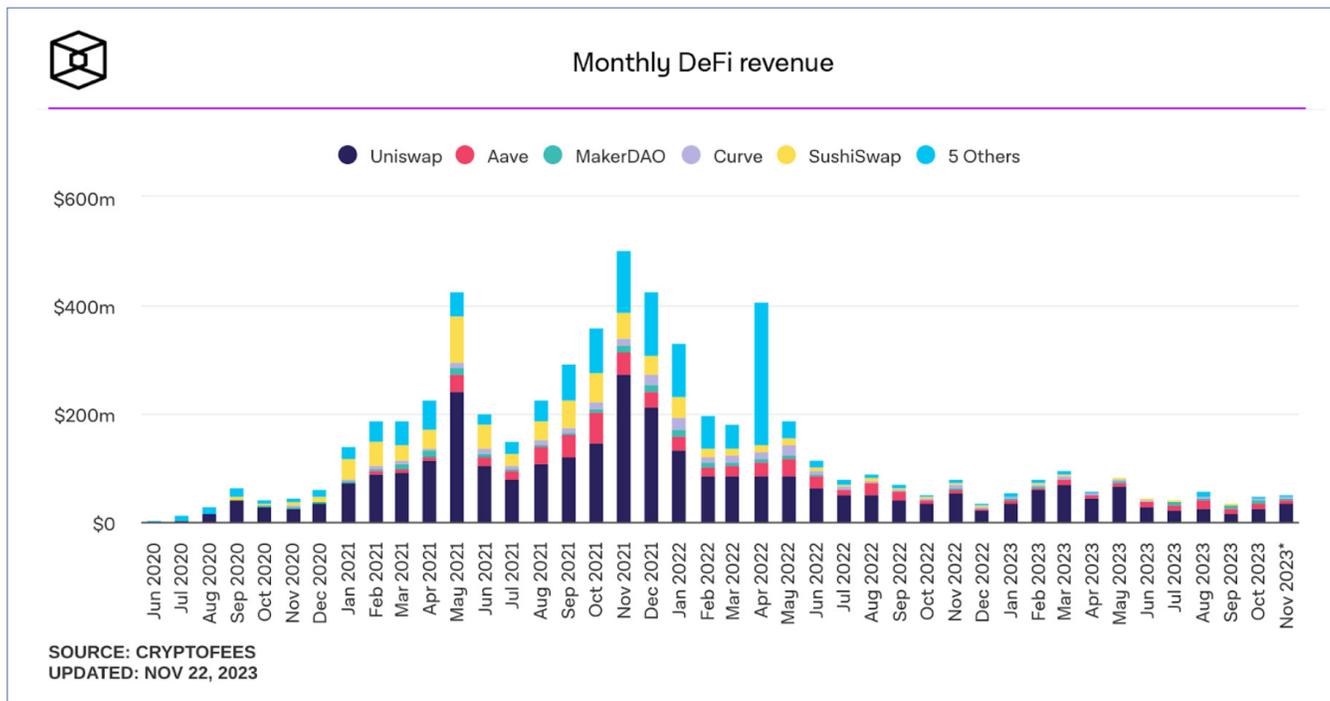
The remarkable resilience of decentralized finance

While the market crashes and subsequent crypto winter hurt the reputation of and dampened activity in the blockchain space, there were some silver linings. Perhaps the most significant of these was the relatively resilient performance of Decentralized Finance (DeFi) protocols on Ethereum and other platforms during the market upheavals. Platforms like Compound, Aave, and Maker, for example, while losing value, held up fairly well even in the most turbulent moments.

This has become an important talking point for the industry, with many (quite rightly) pointing out that all the major failures of 2022 were failures of opaque, centralized organizations like FTX where there was little if any oversight. As they have done throughout history, these

types of conditions provided a fertile breeding ground for human error and fraud. DeFi protocols, which are based on smart contracts that can be examined and are not easily changed, do not generally have these problems and instead offer a high level of transparency and predictability. This doesn't mean that such protocols are not prone to issues of their own (like hacking). But it is fair to say that over the course of the last 18 months, DeFi has provided an excellent example of the power of decentralized business models generally. With this in mind, here are some key metrics as of September 2023 for DeFi generally (not exclusive to Ethereum):

- Over **\$6 trillion** in total stablecoin volume, a testament to the active participation in the stablecoin sector.
- Approximately USD 700 million in revenue generated by DeFi protocols.
- DEX volumes exceeding USD 700 billion, highlighting their rising prominence.
- Aave and Compound reported about \$3 billion in outstanding loans each.



Source: <https://www.theblock.co/data/decentralized-finance/protocol-revenue>.

The Year in Business Ethereum (continued)

- The tokenized gold market reached over [\\$1 billion](#) in value, primarily represented by PAX Gold and Tether Gold, which are both ERC-20 tokens.
- MakerDAO's [integration](#) of HVBank as collateral, achieving over [\\$1 billion](#) in Total Value Locked (TVL).
- MakerDAO's annualized revenue breached a record high of over [\\$200 million](#), driven by an uptick in deposits of real-world assets (RWAs). The shift towards integrating RWAs like US Treasuries indicates DeFi's proactive response to economic challenges, while the increasing complexity of interaction with traditional finance indicates a progressively more robust ecosystem.

DeFi application adoption also paints a vivid picture of the Ethereum ecosystem's industry's growth:

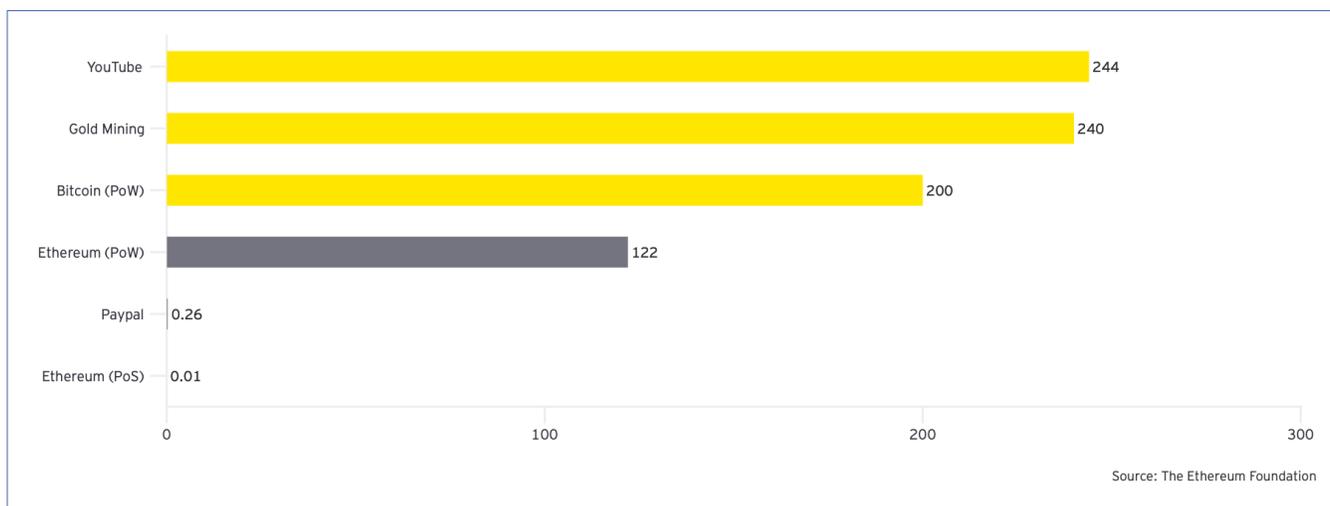
- Over 45 apps with more than \$20 million in TVL.
- Around 27 apps exceeding \$100 million in TVL.
- At least 12 apps reaching over \$1 billion in TVL.¹

The Merge and its implications

Another bright spot for the Ethereum ecosystem was The Merge, which occurred on September 15, 2022. This was one of the most significant upgrades in the history of Ethereum, and among other things, it saw the blockchain move from its original proof-of-work (PoW) consensus mechanism to proof-of-stake (PoS).

The Merge was highly significant for many reasons, both of which we will look at in more detail in Section 3. For one, thanks to The Merge, Ethereum's energy use dropped by [over 99.9%](#). In an instant, the platform went from consuming 122 terawatt hours per year to 0.01, an energy consumption orders of magnitude less than PayPal. For another, The Merge was, by any measure, a significant technical and organizational feat. That it was flawlessly pulled off by a decentralized, open-source community with no hiccups on a platform responsible for hundreds of billions of dollars of value was a testament to the strong governance and robustness of the Ethereum ecosystem.

Activity by Annual Energy Consumption (TWhr per year)



Source: https://www.ey.com/en_ch/technology/how-does-the-ethereum-merge-help-the-real-and-virtual-world-save-energy

¹<https://dappradar.com/rankings/defi/?chains=ethereum%2COptimism%2Cbase%2Carbitrum%2Czksync-era&range=30d>

The Year in Business Ethereum *(continued)*

Post-Merge concerns (centralization and MEV)

While the Merge has been a great success, the move to PoS also raised concerns that became a major topic of conversation in the ecosystem during the year. The chief of these are potential centralization due to staking and Maximal Extractable Value (MEV).

Maximal Extractable Value (MEV) refers to the profit a miner, validator, or bot can make by [including, excluding, or reordering transactions](#) within the blocks they produce. In the context of Ethereum, MEV is often associated with the ability of block producers to extract profits from users through the manipulation of transactions in blocks. This can lead to issues such as front-running, where a miner or validator takes advantage of their position to profit from a transaction before it is executed by others¹. MEV can impact the fairness and decentralization of a blockchain network, as it allows block producers to capture additional value beyond the standard block rewards and transaction fees.

Before The Merge, Ethereum's PoW consensus model was criticized for concentrating power into the hands of a few mining syndicates. The transition to PoS was intended to democratize this process by allowing more people to participate in securing the network through staking. However, there are concerns that staking could increase Ethereum's centralization, as a small number of intermediaries might gain disproportionate control over which blocks are added to the network.

Moreover, the staking process requires a significant amount of ETH (32 ETH to activate your own validator), which could potentially concentrate power in the hands of those who can afford to stake large amounts.

However, it's also possible to stake less than 32 ETH through various methods, such as staking pools or staking on centralized exchanges, which could help mitigate this concern.

In addition, there are concerns about the potential for government influence over the network. For example, over half of the network's activity became subject to new US government sanctions after The Merge, leading to concerns about potential censorship and government control.

Ethereum's robust developer community

As we pointed out last year, Ethereum boasts by far the largest developer community among the major L1 blockchains. That [remains true](#) despite the fact that overall numbers dropped during the course of the year.

As of Oct 1, 2023, the Ethereum open-source community boasted 5,769 monthly active developers (see chart on the following page). This number, however, represents a 22% decrease in developer engagement year-over-year since June 1, 2022. This decline is largely an effect of crypto winter – as economic activity dropped, so too did developer activity.

A closer look at the data also shows that the majority of developers who left the crypto space during this period were newcomers. These individuals, who had worked in crypto for less than 12 months, were responsible for less than 20% of all code commits. In stark contrast to the decrease in newcomer engagement, developers with more than 12 months of experience in the crypto space have continued to build and contribute significantly.

The Ethereum Layer 2 ecosystem continued to grow

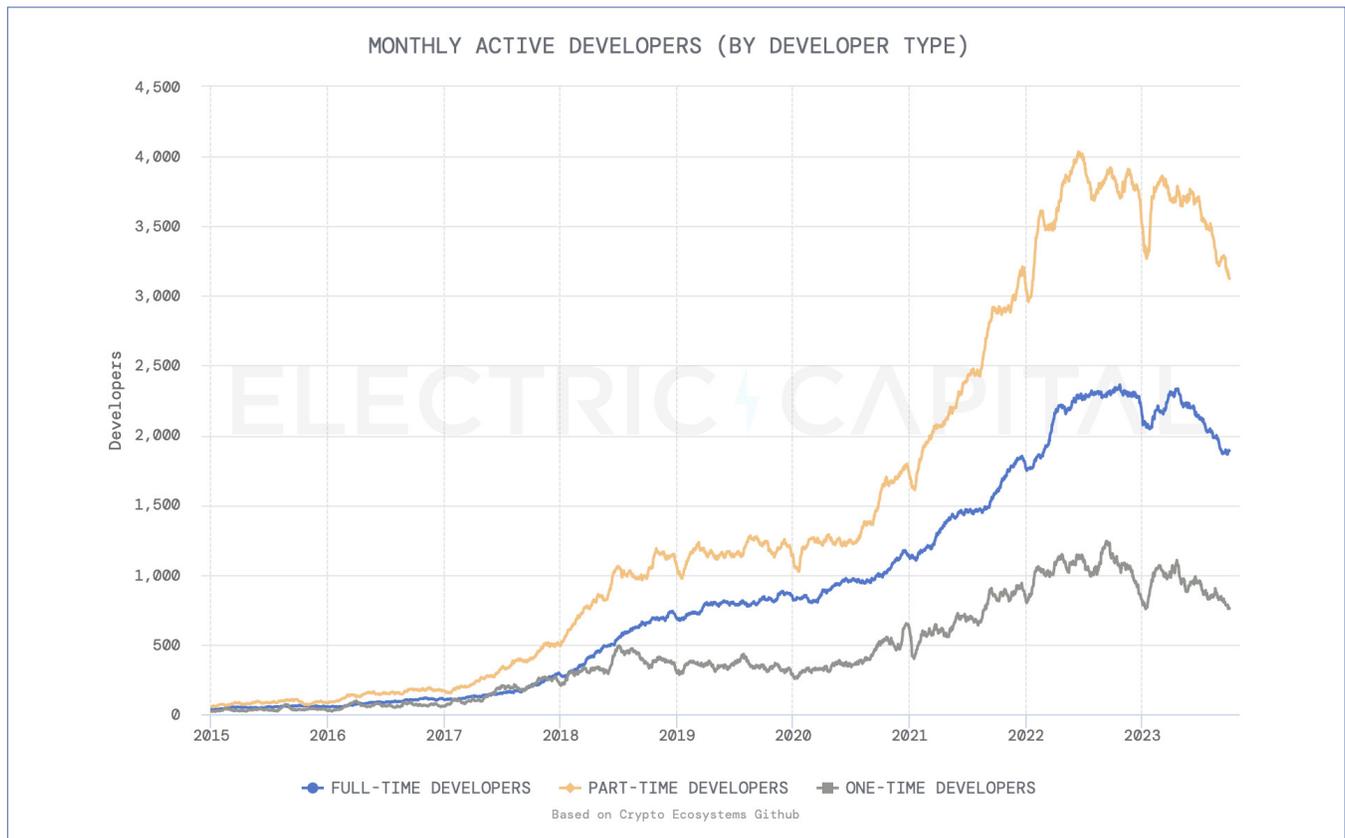
Last year, we wrote that Layer 2 solutions and sidechains are important enhancements to Ethereum and will remain relevant for a long time. This past year has borne this out, as we have seen ongoing growth of Ethereum's L2 ecosystem being built on top of Mainnet.² That can be seen on data platforms such as [L2beat](#).

[Coinbase's Base](#), an Optimistic Rollup L2, is a good example of a powerful new entrant on the scene, demonstrating the economic viability and integration success of L2s in business environments. Coinbase repays a portion of its profits to the [Optimism Collective](#), making it the first profit-sharing deal between a DAO and a publicly traded US company.

Of particular note, as opposed to last year, this year was a movement of Layer 1 (L1) blockchains to become L2s on top of Ethereum. A prime example is Celo (see Interview with Rene Reinsberg in Appendix 2), a PoS blockchain transitioning to an Ethereum L2. Another Example is Coti, which is currently an L1. This December, it announced that in 2024, it will transition to an L2 network focused on privacy and enterprise applications. And shortly before

²Layer 1s (L1s) are foundational blockchains like Bitcoin and Ethereum, handling both transaction execution and data availability, ensuring security but often at the cost of speed and scalability. Layer 2s (L2s) are built atop L1s, focusing on processing transactions off-chain for efficiency, then settling them on the L1 for security. This separation allows L2s to enhance transaction speed and scalability while leveraging the robust security of L1s.

Monthly Active Developers (by developer type)



<https://www.developerreport.com/ecosystems/ethereum> (accessed on 3rd December 2023)

we finalized this report it [was announced](#) that the L1 blockchain Lisk will migrate to L2 via Optimism and Gelato.

A YEAR OF CONTINUED BUSINESS ADOPTION

The Web3 transition: Web2 brands embraced NFTs

The year saw an increased integration of Non-Fungible Tokens (NFTs) by prominent Web2 companies, indicating a growing mainstream acceptance and utility of NFTs in various sectors.

The project that received the most fanfare among people outside the crypto ecosystem is likely [Starbucks Odyssey](#), a membership program that uses NFTs and blockchain

technology. Starbucks Odyssey is an extension of the Starbucks Rewards program, and members can use their existing login credentials to access it. Members earn NFTs for rewards and experiences and can redeem these NFTs for other perks.

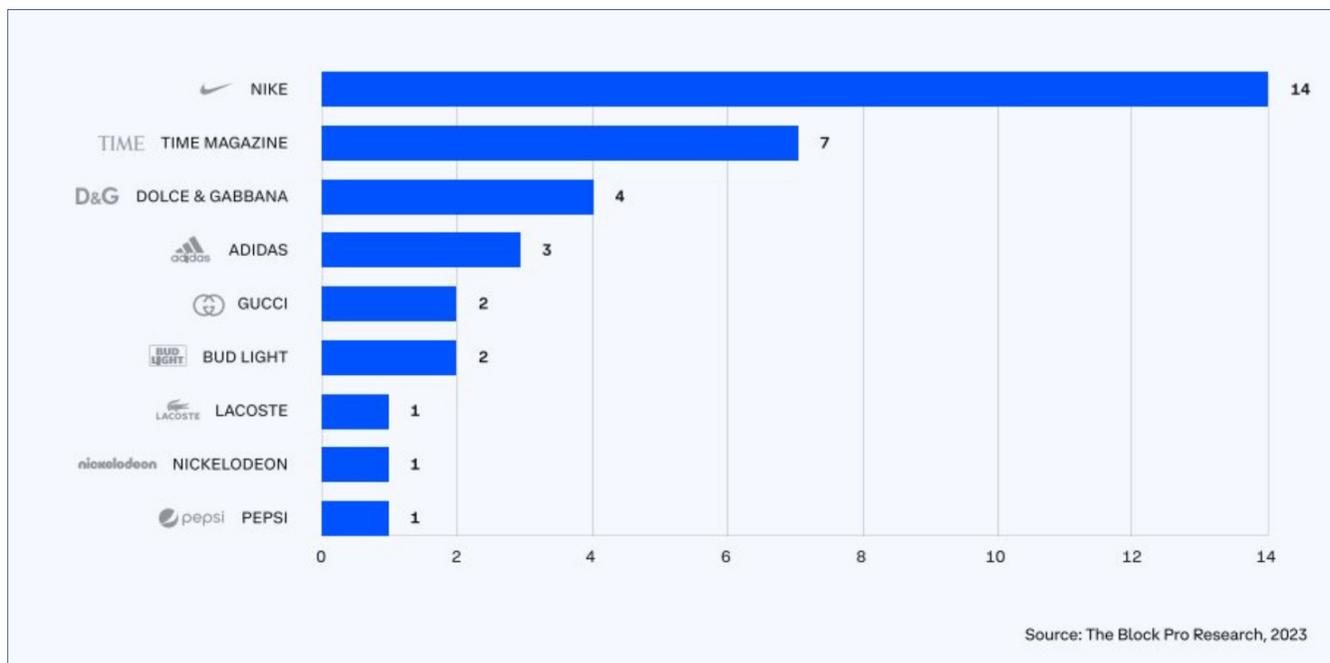
This is one of the most successful Web3 loyalty programs launched by a major international company to date. However, it's important to note that most of these NFTs are not held on any blockchain (according to [TIME Magazine](#)) despite being traded on secondary markets. It's also important to note that Starbucks does not call these NFTs but rather "stamps," which was likely a decision to be more relatable to their wider audience. For now, however, crypto-natives remain the primary fans of this venture.

The Year in Business Ethereum (continued)

Beyond Starbucks, here is a non-exhaustive and diverse list of brand engagements with NFTs over the past 18 months, in no particular order:

- Visa launched the [Visa NFT Creator Program](#), a one-year program that helps digital creators in art, music, fashion, and film. The program aims to help creators accelerate their small businesses by incorporating NFTs into their business models. The program also offers product strategy mentorship.
- [The British Museum](#) partnered with The Sandbox (Ethereum-based virtual world and gaming platform) for NFTs and metaverse interaction.
- [Budweiser](#) launched an exclusive NFT collection for the FIFA World Cup.
- [Tiffany & Co.](#) launched "NFTiff," a limited collection transforming CryptoPunk NFTs into custom-made luxury jewelry, appealing to the affluent CryptoPunk owners.
- [Ticketmaster](#) launched NFT-gated ticket sales with Avenged Sevenfold, allowing NFT owners exclusive access to purchase concert tickets.
- [Spotify](#) is piloting "token-enabled playlists," allowing NFT holders to access curated music.
- [Sotheby's](#) launched the Sotheby's Metaverse, a digital auction platform for art and rare NFTs.
- Of note is also [Nike-RTFKT's NFT](#) universe, which launched in 2021 but whose trading volumes were recently reported to be approaching USD 1.4 billion,

Total NFT Collections Released by Major Company



The Year in Business Ethereum *(continued)*

driven by high demand for limited-edition sneakers linked to NFTs, attracting significant interest from sneakerheads and celebrities like LeBron James.

Broader business activity

While crypto winter slowed business activity, there were some bright spots during the year as well. In particular, we saw significant activity in the area of institutional DeFi, but there were also notable projects in other sectors, as well. (In Section 2, we provide a data-driven overview of activity based on our proprietary business Ethereum dataset.) Highlights that affected the Ethereum ecosystem, in no particular order, include:

- [Stripe](#) introduced a customizable, embeddable fiat-to-crypto onramp, simplifying KYC, payments, and compliance for Web3 developers.
- [ConsenSys](#) collaborated with [PayPal](#) to integrate with MetaMask, enabling seamless Ethereum purchases for US users directly within the app.
- [Visa](#) is exploring payments of Ethereum gas fees with card payments, aiming to simplify crypto transactions by integrating traditional payment methods.
- Gitcoin [partnered with Shell](#) to advance open-source climate solutions, leveraging blockchain for renewable energy and carbon market innovations.
- The European Investment Bank issued a [digital bond](#) on Ethereum.
- [Fidelity](#) began offering crypto trading to retail investors.
- [National Australia Bank](#) (NAB) piloted “the world’s first crossborder stablecoin transaction” on public Ethereum.
- [Google Cloud](#) expanded its data analytics service by adding support for data querying from 11 additional blockchains.
- The Franklin OnChain U.S. Government Money Fund [utilized Polygon](#) for transaction processing and share ownership record-keeping.
- [JP Morgan](#) executed its first [live trade](#) on a public blockchain (as part of Project Guardian, described below).
- Deutsche Bank and SC Ventures completed [stablecoin swaps](#) on the Universal Digital Payments Network.
- [JPMorgan’s ONYX](#) project is now processing up to \$2B a day, initially built upon Quorum, a private fork of Ethereum. That is a significant volume compared to the crypto market.
- [Polygon began a partnership](#) with Tether to support [Lugano’s transformation](#) into a blockchain-powered city. That mirrors [Busan’s](#) \$75 million budget to develop the Korean city’s public blockchain network compatible with several blockchains, including Ethereum.

We find these projects that either were announced or completed over the past 18 months to be of particular note:

Gitcoin partnership with Shell

Gitcoin, a platform that supports open-source software development, has embarked on a year-long collaboration with Shell, a multinational oil and gas conglomerate. This partnership is a significant step towards leveraging blockchain technology to scale the allocation of funding for real-world solutions. Shell’s commitment to this collaboration includes a donation to Gitcoin’s climate solutions rounds for the next four quarters, demonstrating its dedication to contributing towards sustainable development in its business processes.

As Gitcoin’s Head of Impact, Azeem Khan, told us, “this was one of the most important deals in crypto in 2023, to have a Fortune 10 corporation work with an obscure crypto company, with money coming out of research and development, to support the things that we do, but also to showcase how blockchain technology can be used to address large-scale coordination issues, like climate change.”

The partnership also includes Shell’s active contribution to a hackathon slated for Q4 2023, focusing on energy-related issues and utilizing blockchain technology. This collaboration is expected to accelerate the development of open-source climate solutions, with Gitcoin’s Grants Program playing a crucial role. The program has already distributed over \$50 million to early-stage builders working on projects across various sectors, including DeFi, Climate, and Open Source.

The Year in Business Ethereum *(continued)*

Project Guardian: Institutional DeFi on public blockchains

In May 2022, the Monetary Authority of Singapore (MAS) launched Project Guardian, a landmark initiative to explore institutional DeFi on public blockchains. This project attracted major financial players like JP Morgan, DBS Bank, and Marketnode, signifying a robust collaboration between Singapore Exchange (SGX) and Temasek. With Japan's SBI Digital Asset Holdings later joining, Project Guardian represents a significant step towards integrating blockchain into traditional finance. It focuses on developing protocols tailored for the wholesale market, aiming to enhance efficiency and reduce operational costs. A pivotal goal is implementing regulatory frameworks and trust anchors to curb market manipulation and operational risks.

In recent news, UBS Asset Management launched its first [live pilot](#) of a tokenized Variable Capital Company (VCC) fund as part of an expansive VCC project aimed at bringing more real-world assets (RWAs) onchain via Project Guardian.

Project Mariana: CBDC trials and cross-border Transactions

Project Mariana, a collaborative effort involving Banque de France, Swiss National Bank, and the Monetary Authority of Singapore, explored the use of wholesale CBDCs for foreign exchange transactions. This trial employed Ethereum's infrastructure (public Ethereum Sepolia testnet), underscoring the blockchain's versatility and potential in international finance. [Key findings](#) were that central banks can implement governance at the application level without controlling the public blockchain, Ethereum's ERC-20 token standard can facilitate the interoperability of different wholesale CBDCs, and there is clear potential for combining public and permissioned blockchains with DeFi automated market makers (AMMs) for cross-border payments.

CBDCs are a major developing narrative in general. [Brazil's pilot CBDC](#), slated to use Hyperledger Besu, is yet another example of Ethereum infrastructure being used at the institutional level.

SWIFT trialed blockchain interoperability to streamline tokenized asset settlement

SWIFT [successfully tested](#) methods for transferring tokenized assets between multiple blockchains, both public

and private, highlighting potential efficiencies in asset management and interoperability in the financial sector. The [initial scenario](#) tested the movement of tokenized assets between two wallets within the same public blockchain network (specifically, the Ethereum Sepolia testnet). A second scenario examined the transfer of tokenized assets from a public blockchain (Ethereum) to a permissioned blockchain. A third scenario evaluated the transfer of tokenized assets from Ethereum to a different public blockchain. In these experiments, Chainlink served as an enterprise-level abstraction layer, facilitating a secure connection of the SWIFT network to the Ethereum Sepolia network. Moreover, Chainlink's Cross-Chain Interoperability Protocol (CCIP) was employed to ensure full interoperability between the originating and receiving blockchains.

The experiments were conducted with the participation of over a dozen prominent financial institutions and market infrastructures, such as BNP Paribas, BNY Mellon, The Depository Trust & Clearing Corporation, Lloyds Banking Group, among others.

INSTITUTIONAL-LEVEL TOKENIZATION ON ETHEREUM

Finally, one trend that got a lot of ink during the year and is worth mentioning in our context was the [tokenization of Real-World Assets](#) (RWA). This refers to the use of blockchain-based tokens to represent ownership or control of off-chain assets, such as tangible assets like real estate or intangible financial assets like stocks and bonds. While this has always been possible, there was a notable uptick during 2023. To take one example, the market for tokenized US treasuries [grew by 600% during the year](#), to almost USD 700 million. [Euroclear also announced a RWA tokenization service](#). A number of RWA platforms, like Maple Finance or Centrifuge, saw significant growth, pointing to burgeoning (if still relatively small-scale) decentralized debt markets based on off-chain assets.

The RWA trend is important for businesses as a sign that, while there may still be a great deal of uncertainty around cryptocurrencies, tokenization seems here to stay. This means that blockchain generally and – we believe – the Ethereum ecosystem will likely to become increasingly important payment and transaction rails for the off-chain world. ■

Section 2

A Snapshot of the Use of Ethereum and EVM in Business Today

In this section, we break down data collected from 2022 - 2023 on various projects focused on serving businesses or other blockchain companies.

It is essential to note that most household names in the data, DeFi, and NFT spaces have been intentionally omitted, as it does not count as a business use case for the purposes of our report. Examples of these include Uniswap, Aave, and Crypto Kitties.

However, we include L2s and alternative EVM compatible L1s, as these solve two critical bottlenecks for large-scale adoption: fees and transactions per second (TPS). We also include some versions of "permissioned" DeFi protocols focusing on institutional adoption.

To be included, a project must meet at least one of the following criteria:

- The project helps people who are building businesses around the EVM ecosystem
- The project is targeting/onboarding traditional players/assets
- The project involves a traditional business that is now deploying blockchain solutions based on EVM

Our strict criteria and emphasis on business rather than consumer-oriented projects makes data collection challenging. That said, we have more than doubled our data

set from 118 projects in our initial report to 260. We believe this is the most comprehensive and complete data set on business uses of Ethereum currently available.

It should be noted that this data is based on publicly available information. From our conversations around this report with industry participants it should be stressed that a) this is meant to serve as a snapshot of activity and not a comprehensive overview, and b) there is almost certainly a great deal more innovation happening behind closed doors that we simply cannot capture. In other words, our numbers are almost surely low.

Projects are tagged by one main industry, and many use cases to encapsulate the potential uses of their solution as much as possible.

When looking at this ecosystem, we are confident that even when looking solely through our narrow lens of business use, Ethereum is the largest public blockchain business ecosystem.

We start by showing a market map of the blockchain projects we have put together in our research, broken down by various sectors.

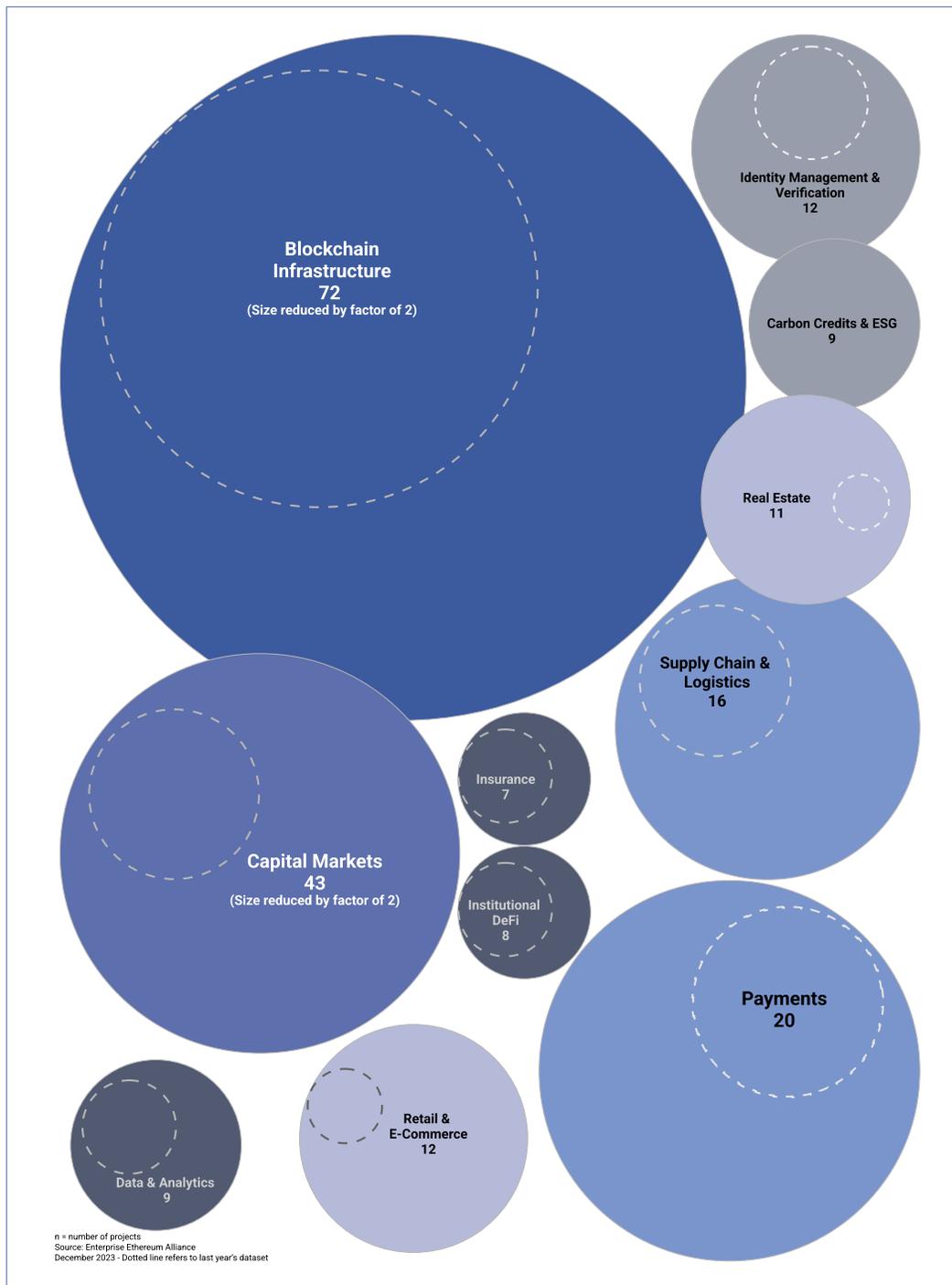
A Snapshot of the Use of Ethereum and EVM in Business Today (continued)

Projects by Industry Using Ethereum / EVM Technology



Source: Enterprise Ethereum Alliance Dataset - Excludes Custody, Media, Security and Trading

Number of Business Projects on Ethereum by Industry (Excludes consumer DeFi and art/collectibles NFTs)



The relative activity by industry in our data sample, measured by number of projects. The lion's share of projects is in blockchain infrastructure or financial services-related industries. Source: Enterprise Ethereum Alliance.

A Snapshot of the Use of Ethereum and EVM in Business Today *(continued)*

When looking at the most active industries, we can still see that many businesses are building infrastructure (BaaS, L2s, EVM-based L1s, node hosting). We see that compared to last year, there are now more projects focused on capital markets that are connected to RWAs which have seen a lot of interest over 2023.

Infrastructure

Infrastructure is still the leader in terms of the amount of projects. This drives innovation and is excellent to see as deploying blockchain solutions is no easy task. In the context of this report, any business adopter of blockchain will tell you they want to avoid reinventing the wheel, so having a competitive market pushes the space forward to ensure blockchains become easier to use. This is also one of the big benefits of the EVM ecosystem as tooling can work across many private and public L2s, giving adopters choices. As an increasing number of L2 solutions are introduced, their integration into the infrastructure represents a significant step forward in realizing the L2 thesis that Ethereum is evolving towards.

Capital markets

Capital markets, including assets like tokenized bonds and RWAs, is the second most active industry from our data. With organizations like ABN AMRO, JPMorgan, UBS, DTCC, and the European Investment Bank all having worked with EVM technology in some way, it is clear there is interest in at least trying out the technology. A clear example is Siemens issuing a 60 million euro (\$64 million) bond on the Polygon blockchain. The tokenized bond was issued under Germany's eWpG legislation for digitally native electronic securities that was passed in mid-2021, which show that regulation is opening the door for more types of experiments and live applications. Some companies are taking it a step further thanks to regulation, such as [Aktionariat](#), which, thanks to Swiss regulations, allows users to tokenize the shares of their companies and put them on the tradeable market.

It should be noted that projects in lending have been moved out into money markets and that real estate is also a separate industry.

Payments

Like last year, we see large entrants beginning to experiment more with the technology. A clear example is

Visa, which experimented with using [Account Abstraction](#) and CBDCs (they also have an extensive [blog post](#) on enterprise blockchain). Paypal still integrates crypto, and it is important to note that Opera (see the case study in the Appendix) has worked to bring crypto payments via Celo (soon to be an L2) to over 200M browsers in Africa, which should open many doors there as a replacement for not only a bank account but also as a way to make payments to businesses.

Supply chain and logistics

The most interesting area for adoption in supply chain is in 'tokenizing' assets and passing them through various parties as a source of truth. Significant players like Shell are now looking to blockchain in part to solve long standing challenges. However there are major roadblocks to using Ethereum Mainnet due to costs and privacy. Hence, the main focus in this area has been on L2s, pinning data to ensure accuracy, or working on other EVM-compatible L1s. This is also why most applications here have happened in either luxury segments or high value B2B transactions such as international trade.

Retail and E-commerce

There are traditional retail brands focused on using NFTs to perform customer engagement type activities or to prove the provenance / authenticity of their premium products. For example, Breitling creates digital certificates for their watches via Arianee or any company doing ticketing via Get protocol.

Currently, as there is a general negative connotation with crypto, businesses may want to stray away from the messaging of using crypto in the backend while others will lean into it. For example Starbucks uses "stamps" on its About page but mentions its NFTs in the FAQ. Over the coming years, we will see the technology abstracted away.

Identity management

RNS.ID has created a Legal Identity for countries, while projects like Citopia from the consortium MOBI are pushing into reality what people in the industry have spoken about for some time, ensuring data portability and decentralized identifiers for IOT use cases. Sometimes, this may only be considered a light application of blockchain, as they simply pin data onchain. However, they do use Ethereum (among others) as the security layer.

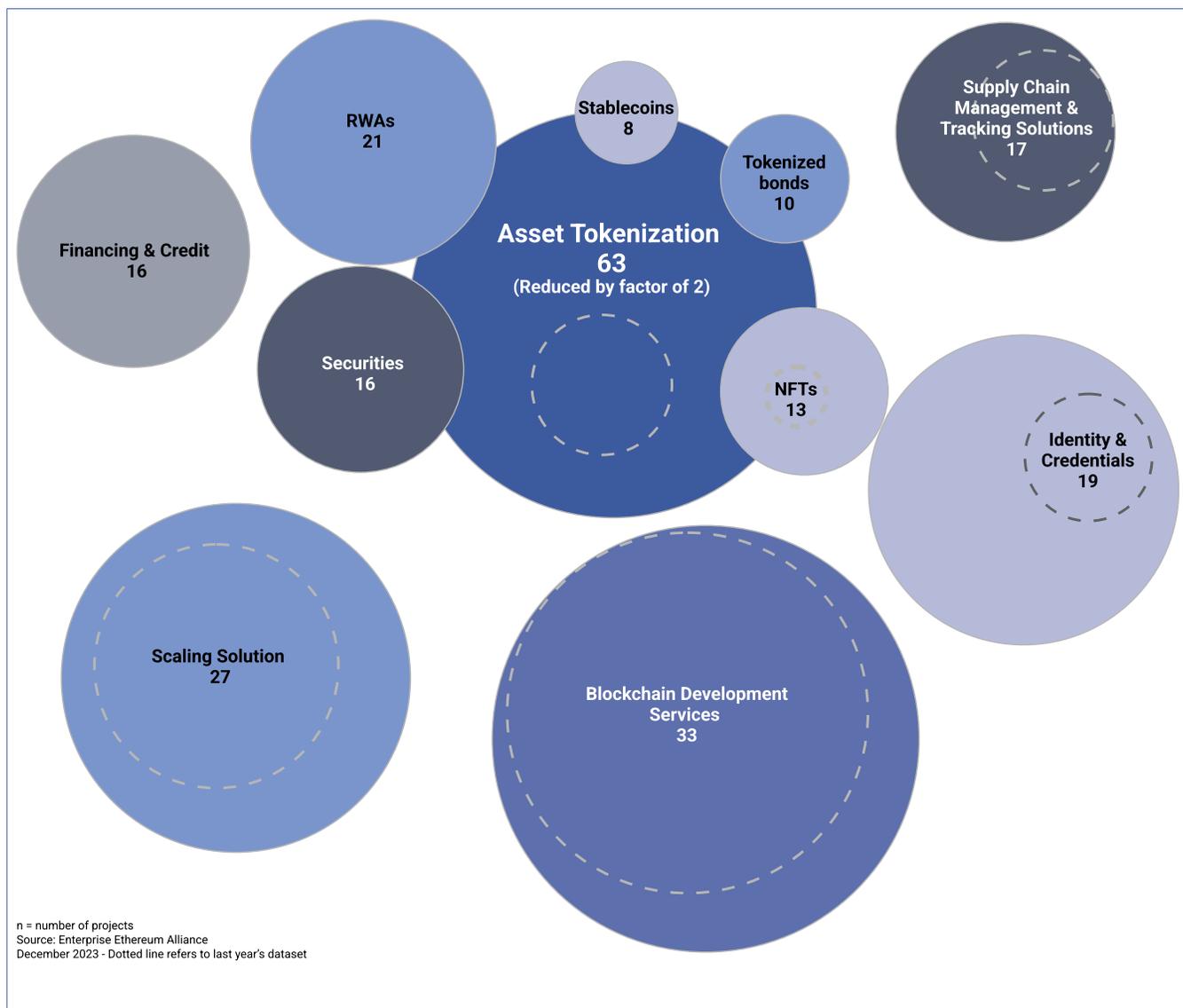
A Snapshot of the Use of Ethereum and EVM in Business Today *(continued)*

Carbon credits and ESG

Since last year as it made sense to bring this into its own industry, many ESG-related solutions have been coming to the market. Traditional carbon credits have

suffered from a lack of accountability and portability, so we are encouraged to see so much activity here. It will be interesting to see how this is integrated into manufacturing processes in other industries over time. With established ones like Nori or new ones like Thallo, purchasing or trading

Number of Business Projects on Ethereum by Most Popular Use Case



The relative activity by industry in our use-case sample, measured by number of projects. The lion's share of projects have to do with Asset Tokenization as well as Blockchain development services. Source: Enterprise Ethereum Alliance.

A Snapshot of the Use of Ethereum and EVM in Business Today *(continued)*

carbon credits to offset emissions is easier than ever. The same goes for applications like Flow Carbon that help finance ESG projects.

BREAKDOWN OF USE CASES

When breaking down our data set by use cases, we can see that asset tokenization is the most popular use case, but this considers both supply chain asset tokenization and ones in capital markets (see the bubble chart on the previous page).

Here, we will break down some of the most popular use cases.

Asset tokenization

This is an important part of bringing real-world assets (both financial elements and actual physical items) on chain, so it is no surprise that across industries this is the biggest application.

Many projects founded in 2021/22 are now coming to market with their solutions. An interesting example is SuperState. The founder, Robert Leshner, was previously co-founder of Compound Labs, which was focused on DeFi. Now he is focused on “modernizing investing through tokenized financial products,” aka bringing off-chain assets onchain. This is a trend seen throughout Capital markets innovation, and a considerable part of that has been the tokenization of US government treasury bonds. Other examples include Ondo and Backed Finance.

Blockchain development services

As with traditional software development, a lot of tooling needs to be developed to speed up the development cycle. Highlights here are players like AWS, Accenture, and EY OpsChain, which all enable businesses to reduce the time it takes to start developing blockchain. Broadcom's acquisition of VMware – a huge under-the-radar blockchain dev provider with a proclaimed “VMware Blockchain for Ethereum,” which, as per their recent [announcement](#) in late

2022, is now in beta – may have exciting developments. Startups like ANKR, Chainstack, Kaleido, Infura, and Alchemy are all advancing their mission of building out tool suites to help both startups and enterprises get off the ground faster with a suite of products.

Scaling solutions

This area has received plenty of attention since the last time we wrote this report, with many advancements and surprises. We explore this in more depth in sections 3 and 4. The most significant note here is Base, an L2 chain based on Optimism, launched by Coinbase. The strategy here cannot be told for sure, but keeping applications, liquidity, and users close to the Coinbase ecosystem is interesting. Linea from Consensys has followed a similar strategy, taking their years of tooling built for the ecosystem to the next level. It is still too early to tell what will happen to all the L2s and scaling solutions as they compete for attention. Seeing how this plays out over the coming years will be interesting.

Financing and credit

Arguably, these solutions have been enabled by many of the DeFi solutions on the market, but the solutions we researched in this use case focus on bringing credit to real-world businesses. Solutions include Bru Finance, a commodity tokenization platform with \$650M in commodities that have been tokenized but, more importantly, a \$150M credit line to farmers/traders/processors of the goods. Another example is Maple, which focuses on providing credit to businesses that need credit lines, allowing investors to capture “off-chain yield,” much like JIA, which focuses on global small businesses. It is not just startups that are doing this. A corporate project from Citi called “Citi Token Services” [claimed](#) they “worked with Maersk and a canal authority to digitize a solution that serves the same purpose as bank guarantees and letters of credit in the trade finance ecosystem,” which is a positive development.

A Snapshot of the Use of Ethereum and EVM in Business Today (continued)

BREAKDOWN OF EVM COMPATIBILITY

This is a new addition compared to last year's report, where we break down the types of EVM compatibility based on all the companies and projects in the dataset. We believe that this is interesting as it adds meaningful context, not so much on what industries and use cases exist but where significant activity is happening.

Public EVM adoption is anything deployed on a public EVM infrastructure. We have broken this down by the main chain it is deployed on. We say "main chain" as it is becoming more and more common that projects are "multi-chain" so in our research, we have focused on tagging them on where they started (and are most active). In most cases, that is the Ethereum Mainnet.

EVM support infrastructure refers to projects that provide infrastructure that hosts or supports businesses with their EVM deployments.

Private EVM adoption is anything that is deployed on private EVM infrastructure.

ETH Mainnet scaling refers to solutions focused on scaling Ethereum Mainnet.

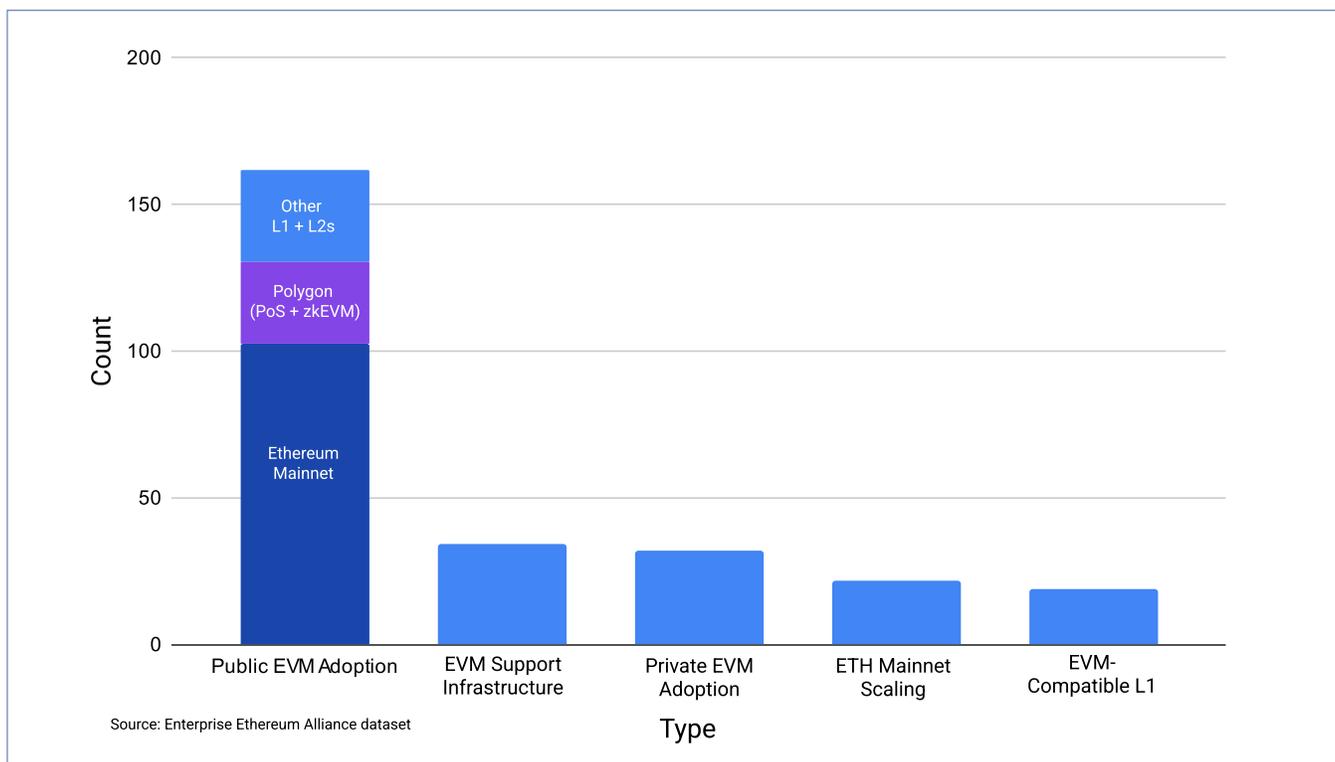
EVM-Compatible L1s are other L1s that are EVM-compatible in some form.

We can see by this that the majority of our data is on public EVM adoption and that this is mostly on Mainnet because most of the business applications are built on top of Ethereum. Second place is Polygon. Other chains we tracked include players like Celo and zkSync.

With ETH Mainnet scaling at 26, we see plenty of projects that are competing to be the "scaling layer to Ethereum," an ongoing trend explored elsewhere in this report.

We make a note of other EVM-compatible L1s at 19, which are either competing chains or private chains that are a copy of Ethereum's code base. We have again excluded players like TRON and BNB chain in this due to the retail focused nature of the chain. ■

Number of Projects per EVM Adoption Type



Section 3

Observations and Trends

In this section we try to highlight the most important observations and trends in business Ethereum today. Insights are derived from a combination of our in-depth interviews with industry experts, our case studies as well as our own research.

ETHEREUM IS CONTINUING TO ESTABLISH ITSELF AS THE PREFERRED SETTLEMENT LAYER

“People on the outside look in and see ... the interest of so many different Layer 1 blockchains in becoming Layer 2 blockchains, in effect asking ‘How do we build on Ethereum?’ ... I think they feel the sense of Ethereum becoming more and more solidified and consolidated as the central hub for doing exciting things.”

– Steven Goldfeder, CEO at Offchain Labs

“Our choice to use Ethereum is driven by the simplicity and transparency of Solidity smart contracts and Ethereum’s wide adoption.”

– Tiffany Brown, CEO of Sage Management

“There is a clear trend when we talk to enterprise customers exploring blockchain solutions: they want to know if it will be compatible with Ethereum or EVM-compatible.”

– John Liu, Head of Product at AWS

Ethereum’s ascent to the preferred settlement or base layer is a trend increasingly acknowledged and leveraged by industry leaders and emerging blockchain projects, something we had hinted at in last year’s report. This recognition stems from its technological advancements, particularly those tailored for business adoption over the past year. Ethereum’s stature is further solidified by the ecosystem’s ability to offer cost efficiency via L2s.¹

While an overly simplified definition, L1s such as Ethereum’s Mainnet are foundational blockchains where transactions are ultimately secured and recorded, while L2s (like Arbitrum and Optimism) are additional layers built on top of L1s to enhance scalability and efficiency. Similarly, a rollup is an L2 scaling solution designed to increase the throughput and efficiency of an L1. The core idea behind rollups is to aggregate or “roll up” multiple transactions into a single transaction, process them off the main chain, and then submit a compressed version of these transactions back to the main chain. This approach significantly reduces the strain on the L1 blockchain, allowing for more transactions per second, reduced gas fees, and improved scalability.²

The efficiency brought by a robust L2 ecosystem makes Ethereum an attractive platform for projects seeking to offload security and consensus responsibilities, thus leveraging its established network for settlement purposes. For instance, several experts we spoke to highlighted the public US company Coinbase launching an L2 using Optimism (which settles transactions on Ethereum Mainnet) as an example of Ethereum’s growing influence as a settlement layer.³

Ethereum’s evolving role as a credible, neutral settlement layer is exemplified by its use in diverse blockchain ecosystems, especially where L1s are launching L2s on Ethereum or migrating entirely to become rollups. Projects like Astar, Canto, and [Eclipse](#) have integrated Ethereum into their operations. Eclipse, for example, combines Ethereum for settlement with Solana’s Virtual Machine for execution,

¹Cost efficiency is a critical factor in bear markets where offsetting token inflation is challenging, which pressures validators who secure the network.

Source: <https://www.bankless.com/the-layer-2-pivot>

²We have observed Ethereum’s shift to a rollup-centric scaling strategy, highlighting the network’s adaptability compared to more rigid, monolithic chains (a blockchain that incorporates all layers within its structure, compared to a modular chain which specializes in a set of functions instead of trying to incorporate all of the layers).

More info: <https://usa.visa.com/solutions/crypto/monolithic-vs-modular-blockchain.html>

³<https://community.optimism.io/docs/protocol/2-rollup-protocol/>

Observations and Trends *(continued)*

showcasing a hybrid approach that leverages different blockchain strengths. [Canto's migration](#) to Ethereum as a Layer 2 ZK rollup, following a similar move by Astar, reflects significant endorsements of Ethereum's capabilities as a settlement layer. Additionally, Celo's announced pivot from L1 to L2, detailed in Appendix 1, further demonstrates Ethereum's flexibility and security.

[Metis' decision](#) to revert to storing transaction data on Ethereum's Mainnet, transforming back to a pure Optimistic Rollup, exemplifies the trust in Ethereum's robustness. This shift acknowledges the challenges of bootstrapping economic security, a feat achieved significantly by Bitcoin and Ethereum. As a result, spinning up an L2 is increasingly seen as a preferable alternative to creating a private L1, offering more controls while still benefiting from Ethereum's L1 strengths.

Beyond industry-specific adoption of Ethereum as a settlement layer, companies outside of the industry, mentioned throughout this report and in the Appendices, are also adopting infrastructure that settles on Ethereum Mainnet. In general, our various discussions with experts leave us with the conclusion that no other ecosystem has as many businesses, from corporates to startups, deploying and ultimately settling on its L1.

ETHEREUM HAS SOLVED ITS SUSTAINABILITY ISSUES

"It's also hard to overstate how important the move to Proof-of-Stake has been. Many large corporations have stringent ESG policies. And these companies have been reluctant to do anything on Ethereum or Bitcoin because of the carbon footprint of Proof-of-Work mining. With Proof-of-Stake, they no longer have this concern."

– Alex Tapscott, Author

"The switch to Proof-of-Stake makes things a lot more viable from a narrative perspective. It kills the argument that blockchains are energy-intensive. That makes it easier for businesses to adopt."

– Vikram Seth, Head of Blockchain and Web3 at Shell

"Ethereum's smooth transition to proof-of-stake consensus, the massive energy savings, and the significant performance improvements enhance Ethereum's business readiness."

– Dr. Weijia Zhang, Chair of the EEA Crosschain Interoperability Working Group and Vice President of Engineering at Wanchain

As discussed in Section 1, the conversation around Ethereum in relation to Environmental, Social, and Governance (ESG) issues has seen a significant evolution, especially in the environmental category. The Merge represented a pivotal moment in Ethereum's history, reducing its carbon footprint by 99.992% and aligning with global ESG standards.⁴

Ethereum has received recognition for that by nearly all of the experts we've interviewed, including third party audits we discovered during our research. For example, Ethereum [earned the top spot](#) in the inaugural institutional-grade crypto ESG ranking by CCData in collaboration with the Crypto Carbon Ratings Institute (CCRI). This ranking assessed the largest digital assets across environmental, social, and governance criteria. Ethereum's leading position, with an AA grade, is attributed to its successful transition to proof-of-stake technology, markedly reducing its energy consumption and environmental footprint.

Ethereum's transition to PoS was timely in terms of the rising importance of ESG and regenerative finance (ReFi) for many businesses. As reported by [ReFi DAO](#), there are approximately 570 projects across 9 different blockchains in this domain, underscoring the growing breadth of blockchain's applications in sustainability. We discuss how Ethereum's improved infrastructure is in line with ESG in our case study with Celo in Appendix 1.

Deutsche Telekom (see interview in Appendix 2) expressed a clear preference for Ethereum due to its alignment with energy sustainability and its ESG goals. This choice reflects a broader industry trend where businesses are increasingly considering the environmental impact of their blockchain platforms. Ethereum's move to a more energy-efficient consensus mechanism resonates with companies looking to balance technological innovation with environmental responsibility.

Shell's Avelia project (case study, Appendix 1) describes using blockchain for mixing carbon-neutral fuels, demonstrating the practical application of Ethereum in achieving sustainability goals. Avelia's project, which involves creating an RWA certificate for carbon-neutral fuels, underscores the blockchain's role in supporting and certifying sustainable practices in various industries.

Some of our interviewees observed that businesses new to blockchain, like those focusing on ESG (and especially carbon credits), stand to benefit significantly from its implementation. There already exist many tokenization projects to that end, but we expect to see more of these

⁴<https://ethereum.org/en/energy-consumption/#proof-of-stake-energy>

Observations and Trends *(continued)*

utilizing public blockchains in the future.⁵ In fact, regulatory frameworks concerning ESG could accelerate the adoption of blockchain where the technology is appropriate.

ETHEREUM HAS NOT YET SOLVED ITS SCALABILITY PROBLEM ON MAINNET

“Public blockchain scaling technologies can drastically lower transaction fees and speed up confirmation times. This was vital for making microtransactions in our invoicing system more viable.”

– Roxpay CEO David Marchand

The scalability and cost-effectiveness of Ethereum infrastructure have become increasingly pivotal in its adoption for business applications. However, the Ethereum ecosystem’s shift towards Layer 2 solutions over private-permissioned consortia arrangements has led to significant strides in transaction speed and cost reduction, making the technology’s operational benefits clearer for businesses.

Advancements in Layer 2 such as rollups and ZK solutions (zkEVM, in particular), have contributed significantly to Ethereum’s ecosystem speed and cost advantages since 2022.⁷ According to several experts we interviewed, these advancements have enabled more efficient auditing processes and the automation of various business activities. Businesses are finding that Ethereum infrastructure can support real-time settlements, marking a departure from the slow, often multi-day settlement periods in their respective industries. But that comes at a cost on Mainnet today, which means L2s have become necessary for businesses looking for low-cost, consistent solutions.

On the finance side, this enhancement ensures immediate liquidity and expedites transaction processing, while in other industries, it is drastically reducing the amount of errors and costs incurred from solving or avoiding said errors. With respect to many other industries, Ethereum’s L2 scalability solutions reduce overhead that results from less automated processes.

For example, Sage’s blockchain implementation on Ethereum (mentioned in Appendix 1) addresses critical challenges in the telecom industry related to costs, scalability, and dispute resolution. They highlight that 70% of wholesale invoices and 20% of orders have errors, leading to expensive and time-consuming disputes, which create financial uncertainties and hinder relationship-building in the telecom industry.

⁵<https://www.ledgerinsights.com/tag/carbon-credits/>

⁶<https://consensys.io/blog/zkevm-enhancing-ethereum-scalability-and-unlocking-new-web3-use-cases>

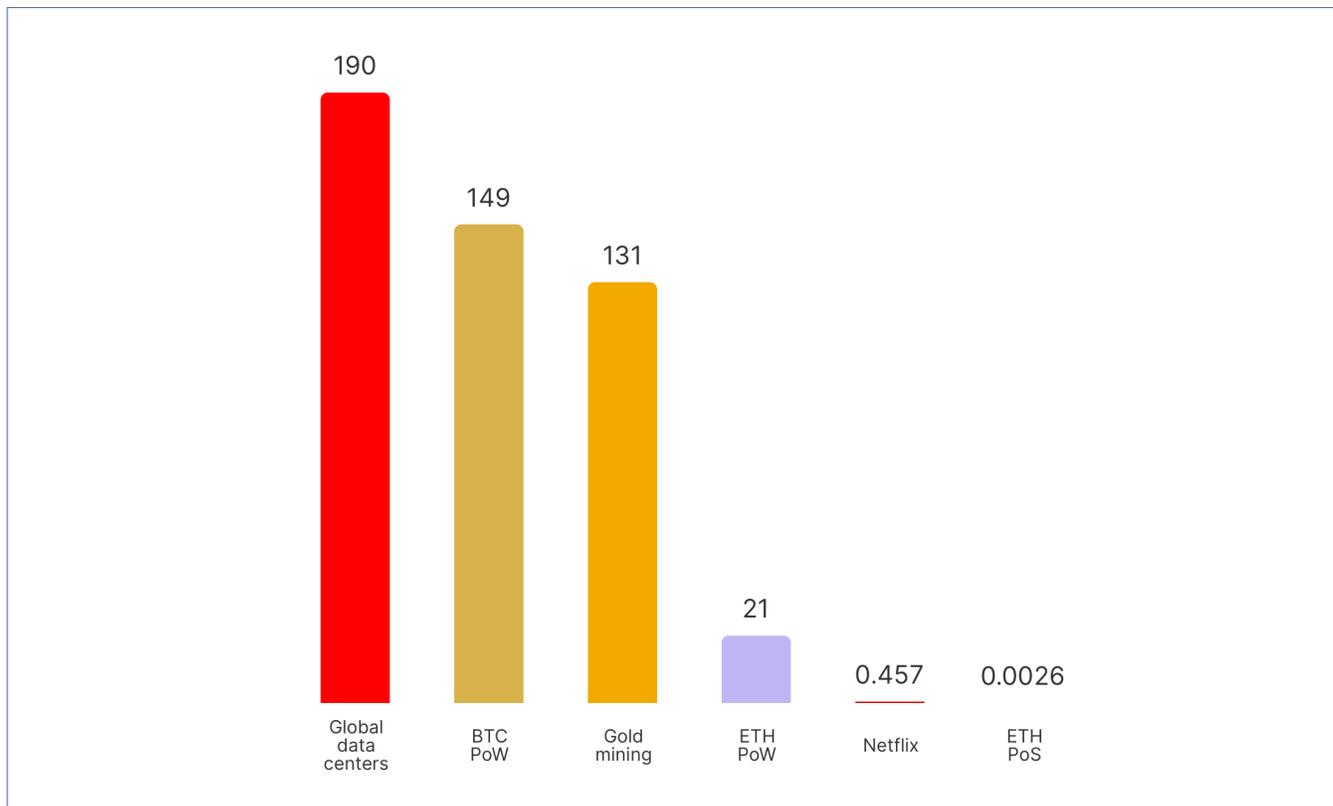
Sage’s solution, utilizing zkEVM technology settling on the Ethereum Mainnet makes real-time mutual endorsement possible, aiming to eliminate the aforementioned disputes and liberate resources. This approach is transformative for the telecom industry, especially for large carriers. A significant aspect of this solution is the privacy control in a public setting, enabled by a Layer 2 solution on public Ethereum, balancing cost-effectiveness, security, and privacy. It is often overlooked that privacy controls already exist at the Layer 2 level, while many projects are utilizing ZKPs for scaling purposes rather than their other purpose of enhancing privacy.

Not all of these scalability solutions are happening on Layer 2, though that is the clear trend. For example, one private-permissioned setting involves Hyperledger Besu and an adapted version of ERC-20, termed ERC-2020. Jake Hartley of Fnality International highlights this case: “We’re melding the institutional quality and safety of central bank money with the capabilities and resilience of distributed ledger technology, particularly Ethereum.” The Fnality Payment System, leveraging this technology, enables real-time wholesale payments by using settlement balances held directly at central banks. Hartley emphasizes the system’s efficiency: “The technology allows for real-time settlement, a significant improvement over the current T+1 or T+2 settlement periods in markets like the US equities market.”

In the context of scalability, specifically for business applications, an interesting development is the [Nightfall protocol](#), primarily developed by Ernst & Young Global Limited (EY). Early models demonstrate that Nightfall can process up to 400 million transactions daily on Polygon and approximately 40 million on the Ethereum Mainnet. While these figures are sufficient for current supply chain applications, EY’s roadmap envisions scaling this capacity to around 4 billion transactions per day at a cost below \$0.01 each. This anticipated increase in transaction volume and reduction in cost are key for accommodating the expected surge in industrial applications. This will be doubly valuable when combined with Nightfall’s privacy-preserving elements.

Further developments at both the Mainnet and Layer 2 level are still to come, which may take Ethereum’s scalability to new heights, further improving security and reducing costs. The most relevant is EIP-4844, or proto-danksharding, a stepping stone toward full danksharding. It’s designed to increase transaction throughput, reduce network

Annual Energy Consumption in TWh/yr



Source: <https://ethereum.org/en/energy-consumption/#proof-of-stake-energy>

congestion and gas fees, and maintain Ethereum's security and decentralization.

ETHEREUM IS EVOLVING A “ROLLUP-CENTRIC” ARCHITECTURE, WITH MAINNET AS THE BASE LAYER, AND A UNIVERSE OF L2S AND L3S ABOVE

“Going forward You’ll have a small number of Layer 1 protocols ... There’ll be lots of Layer 2s and there’ll be a giant number of Layer 3s and Layer 4s, etc.”

– Joseph Lubin, CEO & Founder of Consensys

“Ethereum can serve as a data availability layer while off-chain databases optimize for execution. The use of Zero-Knowledge Proofs ensures that off-chain data is verified, providing data integrity without relying on third-party validation, unlike Optimistic Rollups.”

– Declan Fox, Product Lead at Linea

“The rich array of development tools and widespread community support has sped up our development cycle by 30%.”

– Denis Petrovcic, Co-Founder of Blocksquare

As was discussed at the start of Section 3, Ethereum is increasingly seen as an ideal settlement layer, most notably due to the ecosystem’s Layer 2 and rollup-centric developments of late. Celo’s announced transition from a Layer 1 blockchain to an Ethereum Layer 2 solution exemplifies this shift. Celo leverages Ethereum’s security while maintaining its unique technical advantages and serving its user base, particularly in the Global South.

Rollups have become the most popular form of L2 on Ethereum, and these come in several different flavors. Optimistic rollups, like Arbitrum and Optimism (used by Coinbase’s Base), use a dispute period for transaction verification, while ZK rollups employ complex cryptographic proofs (zk-SNARKs) for instant verification.

Observations and Trends *(continued)*

EVM-compatible zero-knowledge rollups (zkEVMs) have also gained significant attention. These developments indicate a major leap in Ethereum's journey to address its limitations in transaction speed and cost, while also opening the door to more advanced privacy controls. Projects like [Polygon](#), Linea, zkSync by [Matter Labs](#), [Aztec](#), and [Scroll](#) are among several projects working on these features.

Rollups can also potentially be utilized at the consortia level. Declan Fox, Product Lead at Linea, explained that private consortia blockchains require bootstrapping a validator set, whereas, with rollups, the operator outsources that security to Ethereum (see Appendix 2) – It's not necessary to create specific incentives to keep the network running.

One layer above, we find what is often referred to as Layer 3, or the "application layer," where we find applications built on top of L2s and designed to address the diverse needs of various applications, offering enhanced flexibility and customization. For example, Steven Goldfeder of Offchain Labs discussed Arbitrum Orbit, which enables businesses to launch their own chains on Ethereum tailored to their specific needs (see Appendix 2). Orbit allows the creation of either exclusive application chains or open, permissionless systems. The program's ability to establish KYC chains secured by Ethereum combines robust security with customizable access control, making it attractive to businesses seeking both data confidentiality and security.

Orbit may be especially interesting for enterprises that wish to operate consortium chains that maintain data privacy, mirroring the confidentiality found in traditional bank or industry consortia, while still being secured by Ethereum. This is particularly appealing for businesses that prioritize data confidentiality.

Enterprise consortia have faced significant challenges in the past several years in onboarding and retaining stakeholders on private chains due to the limited interoperability and other trade-offs of isolated systems. The trend is toward public blockchains, which, despite compliance challenges, are proving more resilient. Solutions like Arbitrum Orbit may spark interesting developments in that regard.

Arbitrum Stylus, still in the testnet phase, breaks new ground by allowing smart contracts to be written in

languages other than Solidity, beginning with Rust, C, and C++, enabling seamless interaction with Solidity contracts and accommodating businesses' existing technical infrastructure. Developments such as these aim to transcend certain limitations of the EVM, and could lead to interoperability with traditional systems and Ethereum, which was never before possible.

There are plenty of examples where Ethereum's composability with traditional finance is beginning to show its utility. Companies like Paxos and Circle are enhancing efficiency by integrating blockchain solutions with existing centralized companies, rather than replacing them. This approach exemplifies a pragmatic application of blockchain technology in enhancing existing systems.

LAYER 2S ARE COMING OF AGE

"L2 solutions tap into Ethereum's security, giving businesses a solid base to work from. Take Coinbase rolling out its Optimistic Rollup, for example. That was a big deal in the business world. It showed a clear move towards L2s instead of making new Layer 1 chains. L2s offer more flexibility and still get all the security perks from Ethereum's Mainnet."

– Tim Beiko

"Businesses are starting to see the value of using rollups anchored to Ethereum. They're looking for scalability, privacy, and cost savings, and rollups offer all of that. Being connected to Ethereum means these rollups can tap into its huge user and developer community, as well as its liquidity. This is a big change from the old days of enterprise blockchains that were more like isolated islands. Plus, the option to run private, permissioned operations using things like zero-knowledge proofs is a big draw for a lot of companies. There's a lot of room for new ideas and growth in this area."

– Declan Fox, Product Lead at Linea

The growth of Layer 2 transactions compared to transactions that occur directly on Ethereum Mainnet is displayed in the chart on the next page. It can be observed that L2 transactions surpassed Mainnet transactions as early as January 2023. Take note that 100% of these transactions ultimately settle on Ethereum Mainnet. However, as we explore in section 4, this does not mean they are settling more \$ value.

Observations and Trends (continued)

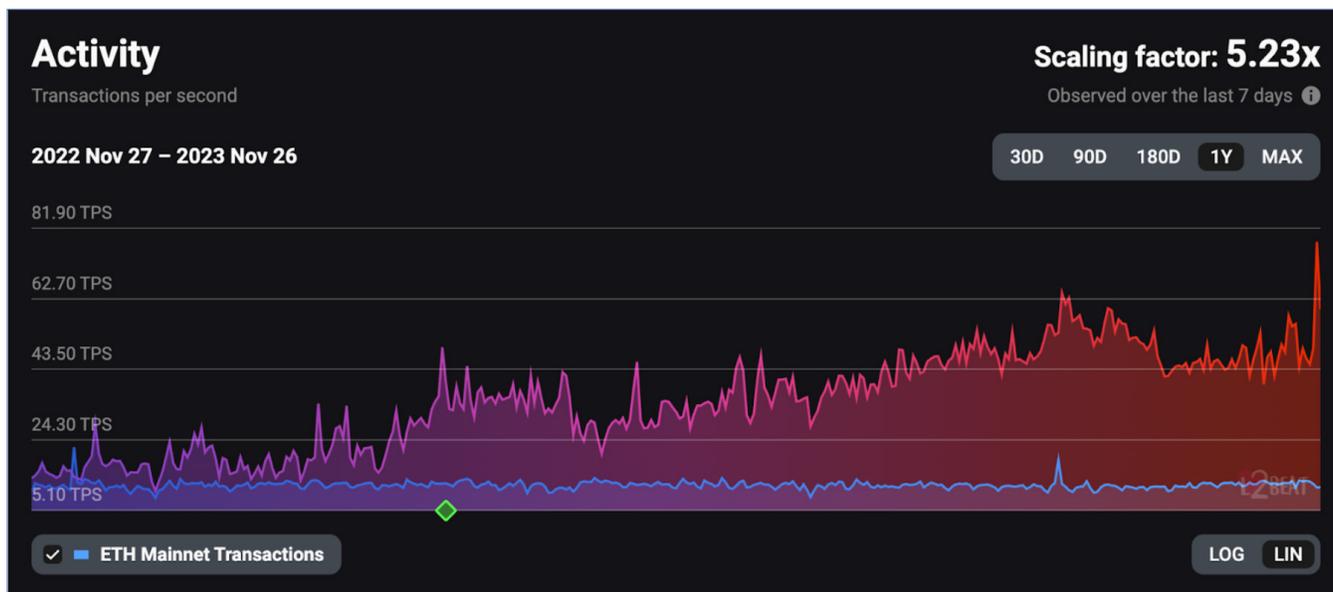
The growing popularity of L2s is in part because building an L2 enables projects to leverage the established credibility and security of Ethereum, making them less reliant on their validators and offering a more efficient route to achieving technical and social credibility. This factor contributes to the trend of existing L1s transitioning to L2s and translates to the potential benefits of operating an L2 over a private consortia chain, particularly when you consider advancements like Arbitrum Orbit (see the interview with Steven Goldfeder in Appendix 2).

L2 solutions on Ethereum also operate with a different financial model than an L1. Their costs to Ethereum occur only during onchain transactions, as they need to settle these transactions on the Ethereum Mainnet later. This model significantly reduces operational costs, allowing L2 solutions to operate more affordably.

There are direct business opportunities for certain companies to operate a rollup. Key winners in the rollup space include [Base](#), which earns \$50k/day in sequencer fees, which signifies the rollup model's profitability. Other companies have taken notes and are interested in spinning up rollups of their own. To meet that demand, the rise of [Rollups-as-a-Service](#) (RaaS) is becoming a significant trend in scaling services, utilizing rollups to bundle transactions, tackling scalability, and driving revenue.

RaaS companies provide rollup technology, freeing developers from certain software and hosting complexities, and this is an important trend within the industry that will ultimately benefit enterprises looking to build in the ecosystem. The evolving RaaS landscape is poised to significantly boost dApp scalability and usability, paving the way for broader Ethereum Mainnet adoption.

Ethereum Mainnet Transactions



Source: <https://l2beat.com/scaling/activity>

Observations and Trends *(continued)*

Perhaps for most businesses not already embedded as vendors within the ecosystem but rather adopters of Ethereum infrastructure, the benefits of L2s are largely related to cost and time savings, and reduction of errors.

In slight contrast, Denis Petrovic, Co-Founder of Blocksquare, highlights the decision to use Ethereum Mainnet for real estate asset tokenization, prioritizing its security and decentralization. He notes, “We chose Ethereum Mainnet for its security and decentralization, as we see higher risks when considering real estate assets to be placed on Layer 2 solutions at this time.” This choice underscores that not all businesses find Layer 2 solutions optimal for interacting with Ethereum Mainnet, with some finding less need for such solutions.

Further, not all projects are migrating to Ethereum to join the rollup bandwagon. Decentralized crypto derivatives exchange [DyDx is transitioning to Cosmos](#). However, crypto exchange [OKX recently launched its zkEVM Layer 2 network powered by Polygon](#). This is only to say that the incentives for migrating to Ethereum may be different for one project than another, and it may not be a one-size-fits-all solution.

However, that does not take away from our observation that, while there’s still progress to be made, the strides in the L2 space mark a substantial step forward in addressing Ethereum’s scalability concerns.

With the future implementation of EIP-4844 (proto-danksharding), which is set to go into effect in 2024, the network will enjoy a significant reduction in transaction fees and improved scalability for L2s. There are those who believe that liquidity fragmentation will ultimately lead to an ecosystem consolidation toward a few major L2s (which has already occurred in decentralized exchanges or DEXes, where Uniswap, Pancake Swap, and Curve represent 78% of DEX volumes in 2023).⁷

However, the majority of experts we have spoken to, such as Joseph Lubin, believe there will at least initially be an increase in the number of L2s and a drastic expansion of applications (e.g., L3s) built on top of them.

THE MOVE TO PUBLIC BLOCKCHAIN CONTINUES

“Companies want to tap into the security and decentralization of Ethereum in a way that’s financially sensible for their product and beneficial for their customers. This is a positive initial step; they acknowledge the merits of Ethereum, with its security and decentralization, as well as the value of its community, even beyond DeFi and NFTs. There’s recognition of a vibrant community and cultural aspect, which even enterprises want to associate and align themselves with to harness that enthusiasm and energy.”

– Steven Goldfeder, Offchain Labs

“Initially, we did a lot of work with private chains. Naturally, we are focused on data security and privacy, and therefore, initial efforts consisted of de-risking the technology and proving compliance. But our key pillars are traceability, trust, and transparency. And it’s very clear that that can only be delivered at scale by public blockchains. With solutions such as zero-knowledge proofs, we can see a greater ability to use public blockchains while maintaining the security and privacy of data where needed.”

– Vikram Seth, Shell

“A lot of people in the Global South and in non-Western countries are already comfortable with [Web3]. And part of it is generational: younger people tend to be more comfortable. These are two big tailwinds.”

– Alex Tapscott, Business Author

Zooming out for a moment, public blockchains, particularly Ethereum, are gaining increasing attention and acceptance in the business sphere.

Initially, businesses exhibited mixed comfort levels with public blockchains, primarily due to privacy and regulatory concerns. However, a growing comfort is now evident, driven by innovations in scalability and rapidly developing privacy solutions. Service providers are responding to this shift, pivoting to meet the rising demand for public blockchain services despite facing resource and talent

⁷<https://www.vaneck.com/us/en/blogs/digital-assets/matthew-sigel-vanecks-15-crypto-predictions-for-2024/#dominance-of-eth-layer-2s-post-eip-4844>

Observations and Trends *(continued)*

acquisition challenges. This trend is [corroborated](#) by an International Security Services Association survey, which shows a notable increase in Distributed Ledger Technology (DLT) projects deployed and in production, rising from 32% last year to 39% this year.

The increased focus on public blockchains, particularly Ethereum Mainnet, reflects a significant shift in the business world. Companies now gravitate towards Ethereum due to its strong ecosystem, security, and decentralization.

Infrastructure funding by companies like VanEck, which has committed to [donating 10% of profits](#) from its Ether ETF to Ethereum core developers, is also significant. This support indicates a strong belief from traditional companies and institutions in the ecosystem's future and the necessity of maintaining robust blockchain infrastructure. This gesture by VanEck can also be considered an endorsement of public goods funding in the ecosystem.⁸

Perhaps one of the most enterprise-level events of the year that directly affects public goods funding in Ethereum is [Shell's partnership with Gitcoin](#) in funding open-source climate solutions. In this partnership, Shell provided 500,000 dollars of no-strings-attached grant funding to Gitcoin, and projects can opt-in for bonus funding from Shell. Importantly, neither Shell nor Gitcoin is picking any of those projects; the community decides which projects to fund. This initiative demonstrates the power of community-driven funding, where users have a say in the projects they believe in.

Celo's efforts highlight Ethereum's usefulness for advancing financial inclusivity, particularly in the Global South. On-and-off-ramps in these regions are crucial for blockchain adoption, providing access to Ethereum-based applications and services.

Brazil, Argentina, and Mexico are highlighted in [Chainalysis reports](#) for their high crypto adoption rates. The growing dominance of stablecoins in remittances, particularly in Mexico, and their use as a hedge against economic instability in hyperinflation-affected countries like Argentina and Venezuela, reflect a shift in economic strategies and the adoption of blockchain as a financial tool in these regions.

In LATAM, the market has distinct needs, particularly in addressing telecom billing events and service level agreements (SLAs). Sage Management's upcoming enterprise-grade blockchain solution, a DApp on Ethereum Mainnet, is set to launch in 2024, aiming to level the playing field in this sector.

Tiffany Brown, CEO of Sage Management, noted, "Blockchain solutions like these are democratizing market and technological access for carriers of all sizes. Before, you had to be a big player or be stuck in outdated legacy processes and systems. This new approach not only lowers the cost barrier but also protects your sensitive data. It's a level playing field now."

Opera discussed its impact in Africa, where the lightweight mobile browser-based Opera Mini is prevalent (see Appendix 2). The project aims to integrate meaningful solutions for the region, separate from the speculative aspect of crypto, and provide access to stablecoins.

The African market presents unique opportunities for blockchain in fostering financial inclusion. The use of cryptocurrency as a financial lifeline is gaining momentum, with stablecoins playing a crucial role by offering convenient access to the US dollar, bypassing local market challenges. However, creating a liquid market for stablecoin swaps into local currencies remains a challenge, given the diversity of currencies across the continent. Successes in countries like Kenya and Nigeria showcase the potential for blockchain to revolutionize financial systems in Africa. Back to the enterprise level, XEROF's model showcases the practical application of Ethereum in frontier markets (see Appendix 1). It enables the swift conversion of significant volumes of fiat currencies into stablecoins, facilitating faster payments on the Ethereum blockchain. This efficiency boosts liquidity access and reduces payment costs, outperforming traditional finance structures.

While there have been notable investments that deliver immediate value for companies – exemplified in the various case studies in this report – securing stakeholder buy-in and the nascent stage of blockchain solutions continue to pose challenges.

Beyond privacy and regulatory concerns, there remains the difficulty of explaining the merits and nuances of blockchain for business use cases in a way that separates

⁸Source of the definition of "public goods" in the context of Ethereum:
<https://www.coindesk.com/consensus-magazine/2023/02/23/ethereums-regens-tend-to-ethereums-public-goods/>

Observations and Trends (continued)

the infrastructure from cryptocurrencies, in particular, without condemning tokenization or the underlying consensus mechanisms in the process. The trade-offs of various blockchain networks and security measures for all of the Layer 2s, smart contracts, and bridges are overwhelming even to a crypto-native.

Steven Clarke-Martin from C10N Labs explains part of the psychological shift that must be achieved for business decision-makers to understand the merits of these novel technologies: “People in business of a certain age recall intranets. Before the internet, there were all sorts of proprietary protocols. When you consider blockchain a network that can process information, the model becomes much easier to understand. People equate blockchain with crypto-assets and prices, but blockchain is just a network with an economic model to maintain itself. Without an economic model – back in the day of old telecom, people had to dig holes, put things in place, pay for equipment,

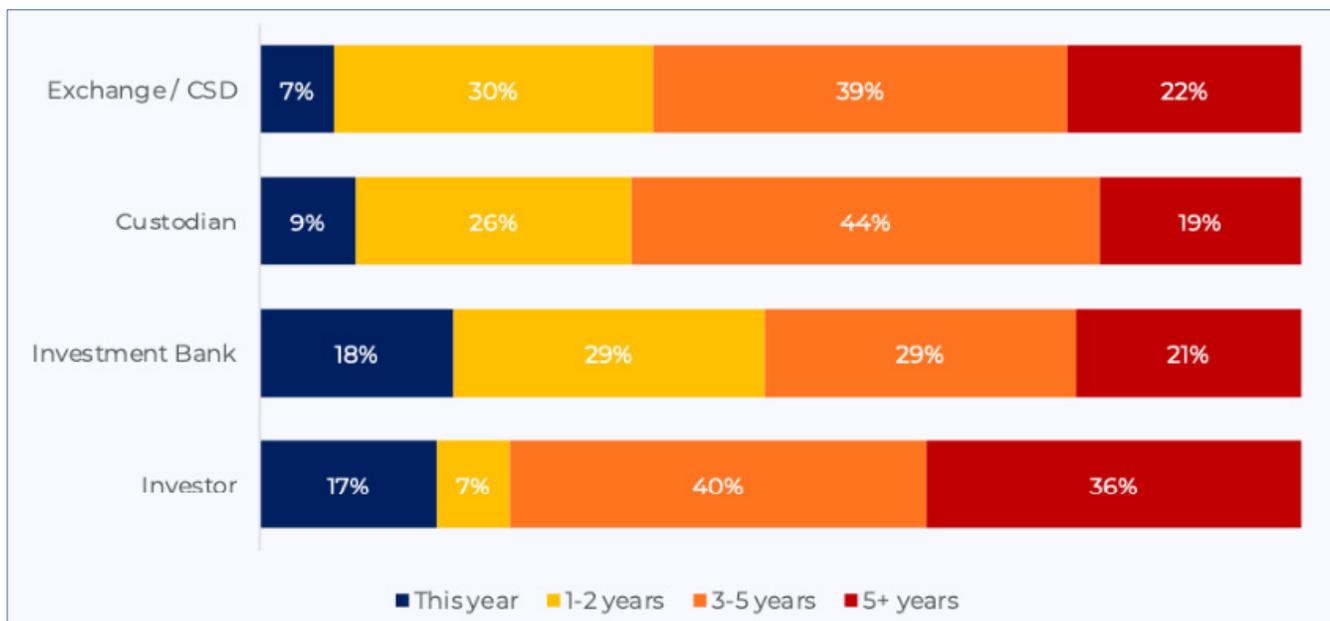
and the internet wasn’t free to operate. Hence, Google and advertising companies created robust businesses to pay for all that infrastructure. We need a new economic model for a decentralized world to pay for this computing. That’s where blockchain networks like Ethereum come in. What is novel about Ethereum is that it is a computation resource globally available to everyone, with a built-in economic system to maintain it.”

TOKENIZATION, ESPECIALLY OF RWA, IS AN IMPORTANT USE CASE WITH WIDESPREAD IMPLICATIONS FOR BUSINESSES

“What used to take weeks of procedures, paperwork, and coordination can now be achieved in mere hours or even seconds.”

– Luc Falempin, Founder of Tokeny

The Majority of Every Segment Now Expect DLT’s Role to Materialise Over More Than Three Years



Source: <https://www.ledgerinsights.com/issa-dlt-survey-capital-markets/>

Observations and Trends *(continued)*

“We chose Ethereum because it allows us to create smart contracts that automate a majority of compliance requirements, significantly reducing administrative workload.”

– Denis Petrovic, Co-Founder of Blocksquare

Ethereum Mainnet currently accounts for over 77% of all tokenized assets according to 21 shares via [this dashboard](#). Though other chains are beginning to eat into Ethereum’s market share, especially since the start of 2023. However, note that many of the chains in this context are also Layer 2s or sidechains of Ethereum.

Tokenization is also persistently becoming more complex, particularly with the trend of Real World Assets (RWAs) gaining momentum among institutional players.

RWAs are assets that have value outside of the blockchain that are tokenized onchain, where they are then considered tokenized representations of “real-world” assets like stocks, real estate, and art. Tokenized RWAs can represent physical or digital assets and can be fungible or non-fungible tokens. This process endows assets with a digital twin of their physical asset’s deed or certificate of ownership.⁹

Importantly, fiat-collateralized stablecoins (tokenized cash and Treasuries) make up approximately 98% of these tokenized assets on Ethereum. This mirrors ratios on other chains, but Polygon stands out as having a much more diverse range of tokenized assets. When viewed through this lens, the RWA trend seems like a drop in the bucket.

We illustrated this trend with a few examples in Section 1. However, as this section has made clear, Ethereum, along with other EVM chains, currently dominates the tokenization sphere. And this does not including tokenized assets on private-permissioned Ethereum instances.

Traditional financial institutions are capitalizing on the benefits of tokenized RWAs, such as instant settlement and 24/7 trading. As mentioned in Section 1, Franklin

Templeton’s tokenization of over \$300 million of its U.S. Government Money Fund on Stellar and Polygon exemplifies this trend.

Down to the company-specific level, BRØK in Norway uses Ethereum Layer 2 Arbitrum for transparent cap table management, focusing on tokenizing share receipts for unlisted companies. This system, enhanced with smart contracts for compliance and government oversight, streamlines administrative tasks and increases transparency in stock transactions. BRØK’s approach illustrates the potential of public blockchain solutions in enhancing corporate transparency and efficiency.

Multiple companies offer tokenization services, typically with the angle of RWA tokenization. Tokeny, for example, approaches tokenization with regulatory compliance as a top concern, using EVM-compatible solutions and a compliance-focused ERC-3643 token standard to enable privacy controls and permissions on public blockchains.

Several of Tokeny’s clients are utilizing private-permissioned tokenized securities to enable access to international markets, streamline onboarding, and promote greater accessibility due to lower price points within a regulated framework. See Rubey and Tokenchampions in Appendix 1.

MakerDAO stands as a leading example in the DeFi sector for adopting RWAs. In 2022, the value of RWAs in MakerDAO’s portfolio climbed from \$17 million to \$640 million. The protocol’s total deposits now include over \$3 billion in RWAs, accounting for 42.7% of its total deposits. In the past year, RWAs have been a significant revenue generator for MakerDAO, contributing to [nearly 80%](#) of its fee income.

It should be noted, however, that the classification of RWAs is still nascent. “Asset tokenization” would perhaps be more fitting than “real-world assets” so as not to confuse onchain assets with off-chain assets. For example, onchain versus

⁹Source: <https://www.rwaworld.fi/>

Tokenization Market Cap by Blockchain

Proposal	Asset Coverage	Features
ERC-20	Broad	Most popular standard in tokenizing assets. Wide DeFi support. Lacks legal specificity.
ERC-721	Broad	Commonly used to represent unique goods ex. Art. Some adoption in DeFi.
ERC-3643	Securities	Specific to assets that are deemed as securities. Has encoded compliance.
ERC-2222	Dividend-Bearing	Standard for assets that are claims on future cash flows. No legal compliance.
ERC-4626	Yield-Bearing	Standard for assets that use DeFi's yield bearing vaults. No legal compliance.

Source: Unreal RWA Primer, Binance Research

off-chain yield is important to distinguish when considering how much of MakerDAO's yield derives from Treasury assets. These assets are not intrinsically onchain and are classified as RWAs – they are not necessarily “tokenized” RWAs until they are brought onchain.

Maker is [exploring the inclusion](#) of tokenized T-bills, while their current investment of T-bills is via offchain, centralized entities.

For some additional perspective on RWAs, the tokenized US Treasury market stands at over \$777M, growing [nearly 700%](#) in 2023. Tokenized T-bills were among the first RWA sectors to take off since the launch of Franklin Templeton's [OnChain U.S. Government Money Fund](#) in 2021. While the most dominant form of tokenized RWAs at this time, it is only one of many RWA categories coming onchain. A number of protocols are [working with RWAs](#) as of 2023, such as Ondo Finance, Backed, Maple Finance, Centrifuge, and Goldfinch. In addition, Ethereum and Polygon take up more than half of the total market cap of those tokenized Treasuries. Polygon has captured the interest of several large businesses, such as Siemens, which has issued its first digital bond on Polygon in a bid to reduce paperwork.

As mentioned at the top of this section, RWAs are an intrinsic part of the tokenization narrative in 2023, particularly when considering institutional-level activity.

Blocksquare (see Appendix 1), leveraging Ethereum Mainnet, exemplifies the innovative use of tokenization in real estate investment. As of 2023, Blocksquare has tokenized over 80 properties as ERC-20s and facilitated transactions worth over \$75M, demonstrating Ethereum's efficacy in real estate tokenization and asset management.

Slightly outside the realm of finance, we can look to the case study of Rubey, which utilizes Tokeny's services to enhance the liquidity of traditionally illiquid assets, and reveals potential in the domain of high-value art and cultural heritage tokenization.

FIAT ONCHAIN (E.G., STABLECOINS, DEPOSIT TOKENS, AND, TO A LESSER EXTENT, CBDCS) WILL ENABLE BUSINESS APPLICATIONS

“There has been enormous growth lately in stablecoins that are backed by US dollars or US treasuries, which some people are calling cryptodollars. That niche has pretty significant product market fit. I think it's around a 130 billion dollar market cap. These volumes are similar to eurodollars a few decades ago when there was a need for different countries to hold dollars.”

– Joseph Lubin, CEO & Founder of Consensys

Observations and Trends (continued)

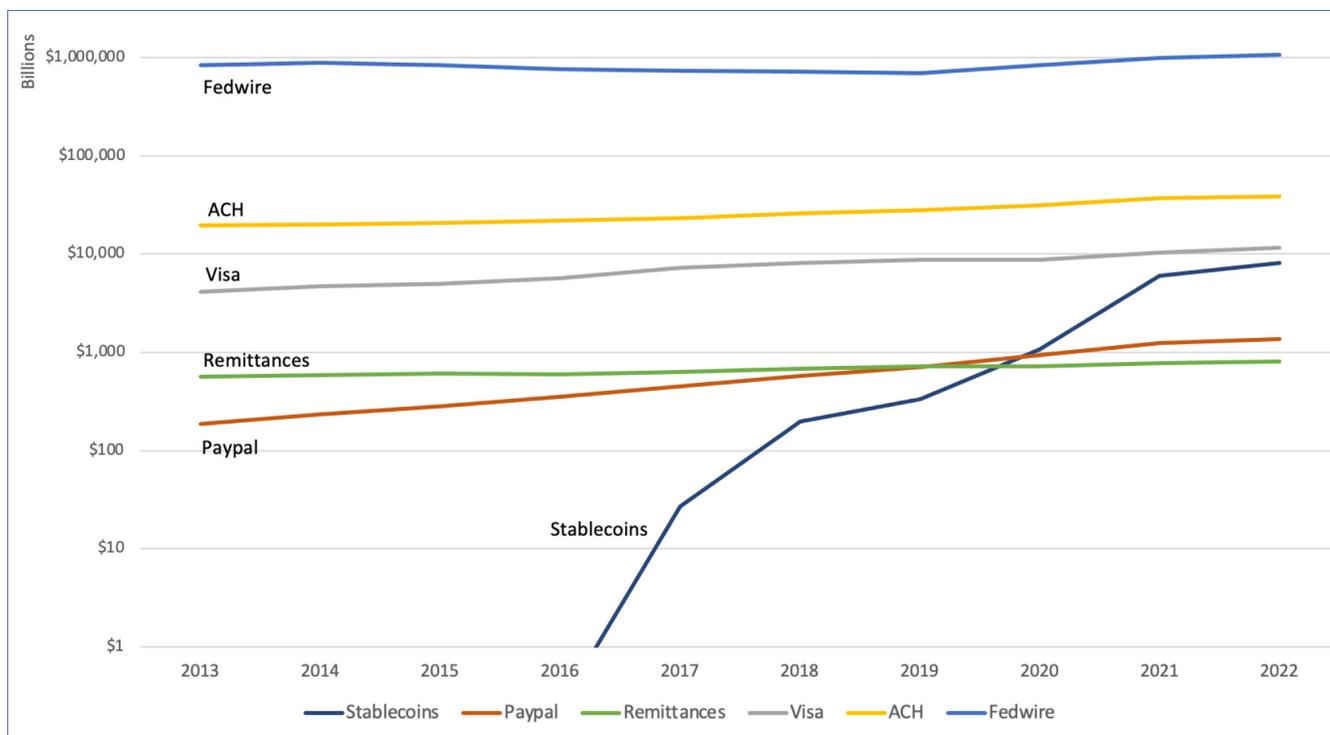
Stablecoins, typically pegged to fiat currencies like the US dollar, offer a stable value alternative in the volatile cryptocurrency market. Their primary aim is to provide a consistent store of value and mitigate fluctuations inherent to other cryptocurrencies. These digital assets are either [backed by fiat currencies or other cryptocurrencies](#) or controlled through algorithmic mechanisms.

While stablecoins, with a collective value exceeding [\\$128 billion](#), represent a modest fraction of the total cryptocurrency market cap, [they disproportionately dominate onchain transaction volumes](#). This dominance is even more pronounced when comparing stablecoins to traditional settlement networks, indicating a significant shift in the digital transaction landscape. Below is a chart that exemplifies this shift, with the caveat that the chart represents all stablecoins, not only those on Ethereum. We break this down for Ethereum and some L2s in section 4. Readers should also take note that the chart is logarithmic, meaning the industry still has a ways to go before stables are on par with Fedwire.

Stablecoins are particularly impactful for international money transfers. They simplify the remittance process by eliminating numerous intermediary stages often linked with extra costs and delays. Their benefits include faster transaction times, reduced fees, and heightened transparency, contrasting sharply with the traditional remittance system's inefficiencies. These advantages are particularly poignant considering the anticipated expansion of the global remittance market, projected to approach [\\$1 trillion by 2026](#).

According to John Liu, Head of Product at AWS, "Stablecoins are a more efficient way of doing wire transfers, for example. Transactions don't take several days or cost over \$15. When big companies like Paxos and Circle are developing the settlement use case by integrating with existing centralized companies rather than removing them – they're being made more efficient."

Annual Volume of Stablecoins vs Other Financial Systems



Source: https://niccarter.info/wp-content/uploads/token2049_niccarter_090923.pdf

Observations and Trends (continued)

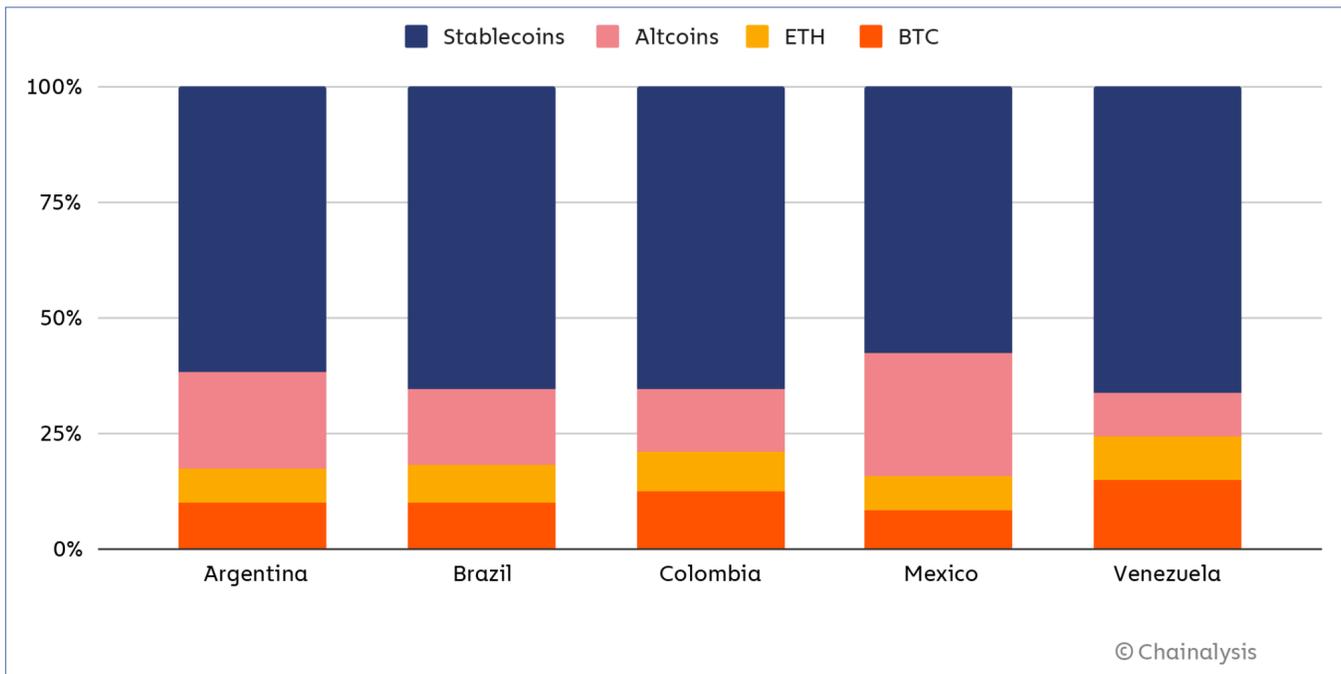
In Appendix 2 of this report, Rene Reinsberg of Celo draws attention to the surging demand for stablecoin on and off-ramps in the Global South, indicating a broader geographic adoption and the need for inclusive financial solutions. This demand reflects a larger trend of financial democratization and access, particularly in emerging economies.

As mentioned in Section 1, where discussing Project Mariana, Central Bank Digital Currencies (CBDCs) are a significant developing narrative, and we'd be remiss to not discuss them. Central bank money, often referred to as public money, represents the liabilities held by a central bank. It is issued by a public institution and forms the backbone of a nation's monetary system. In contrast to this traditional concept, a CBDC emerges as a digital evolution of central bank money. Designed to function akin to physical cash, a CBDC exists solely in a digital format. Distinct from cryptocurrencies, which are decentralized and more loosely regulated, CBDCs are centralized digital currencies issued and regulated by central banks and recognized as legal tender (there are exceptions, such as [Bitcoin in El Salvador](#)). This digital form of central bank money blends the reliability of traditional currency with the efficiencies of modern digital technology.

While they promise enhanced payment efficiency and novel monetary policy tools, they also pose significant challenges, including potential threats to financial privacy, the risk of centralization, and cybersecurity concerns. CBDCs' ability to track financial activities raises [serious privacy concerns](#), with potential vulnerabilities to cyberattacks that could lead to financial or data losses. Furthermore, CBDCs could disrupt financial markets, possibly reducing credit availability and challenging both traditional banking and the rise of cryptocurrencies. The controversy revolves around a central storage of financial information and its potential to wield excessive control.

Case in point, [Brazil's pilot CBDC](#), slated to use Hyperledger Besu, is the only example of Ethereum infrastructure we could find being used for CBDCs. However, Brazil's CBDC contains functions allowing a central authority to [freeze funds](#) or alter balances. Hyperledger Besu is EVM compatible, but as this is a private-permissioned use of Ethereum, transactions would not settle on Ethereum Mainnet.

Total Value Received by Country by Asset Type Jul 2022 - Jun 2023



Source: <https://www.chainalysis.com/blog/latin-america-cryptocurrency-adoption/>

Observations and Trends *(continued)*

Finality, a fintech firm featured in Appendix 1, is pioneering in this domain by creating tokenized versions of major currencies (via Hyperledger Besu), collateralized by cash held at central banks. While wholesale CBDCs entail central banks tokenizing central bank money to use for wholesale payments, deposit tokens are tokenized versions of a commercial bank's money kept at an account at a central bank.¹¹ Jake Hartley of Finality articulates this fusion of traditional banking safety and Ethereum's distributed ledger:

"We are fundamentally focused on institutional DeFi, backed by a robust shareholder base. For the first time, we're melding the institutional quality and safety of central bank money with the capabilities and resilience of distributed ledger technology, particularly Ethereum... While stablecoins like USDC are pegged to assets like commercial bank reserves, they are not risk-free. Our system removes this risk by anchoring the digital asset to central bank money, making it bankruptcy-remote."

NFTS ARE TRANSITIONING FROM SKEPTICISM TO PRACTICAL, IMPACTFUL APPLICATIONS IN VARIOUS INDUSTRIES

"NFTs have been an important development in terms of enterprise adoption... they're not about reinventing a business but becoming familiar with the core concept and idea of Web3."

– Alex Tapscott, Business Author

"In my experience, blockchain pilots often don't lead to anything because they are positioned as experiments. For existing enterprises, blockchain solutions are additive to their current IT infrastructure to create value across an ecosystem. The pilots have not replaced any existing infrastructure and, therefore, have not reduced costs; further, the ROI for ecosystem value happens on a longer time horizon. In short, when companies need to reduce spend, shutting (or slowing) their blockchain pilots has the least impact on their current state of business. The successful pilots have focused on customers and growth by doing something that hadn't been done before rather than improving something that already works – even if it works poorly. Starbucks Odyssey is a good example of a net new way of customer interaction."

– James Canterbury, Principal at Ernst & Young (EY)

"In Web3, loyalties and engagement use cases are gaining traction, especially in public-facing businesses. These businesses are using NFTs to secure buy-in and recognize their potential for community building. Brands today also want to enable their audience space to experiment, which is a refreshing mindset compared to three years ago when the question was, 'How do I control my IP?'"

– John Liu, Head of Product at AWS

Non-fungible token (NFT) integration into mainstream platforms and everyday life marks a significant shift in how traditional Web2 companies leverage blockchain technology.

By far, the largest current use for NFTs is for art and collectibles. However, that shouldn't be understated, as the technology is proving valuable to several high-profile brands as well as fledgling artists and creators.

As mentioned in a previous section, major Web2 entities like [Reddit](#) and [X \(Twitter\)](#) have embraced NFTs, recognizing their potential to enhance brand value and customer engagement. Others, like Instagram (Meta), have [discontinued NFT utilities](#) on their platforms.

Ethereum has been the most popular blockchain for NFT collections since the beginning of NFTs. In June 2023, Ethereum had a market share of 84% and a trading volume of \$0.84 billion. In April 2023, Ethereum's NFT trading volume was \$514 million, [about 70%](#) of the total market's trading volume. That said, much of the NFT activity [has migrated](#) to Polygon's Ethereum sidechain and Ethereum's various L2s, such as Arbitrum. In fact, according to Footprint Analytics, Ethereum makes up nearly 99% of transaction volume despite only accounting for [45% of unique users](#) (with the caveat that Polygon also makes up nearly 45%, while Optimism and other EVM-compatible Layer 1s [like BNB Chain](#) almost complete the pie).¹²

At the enterprise level, Deutsche Telekom's strategy (see Appendix 2) exemplifies NFT utilization in brand loyalty programs. They offer comprehensive solutions involving blockchain technology, one-click wallets, and token creation for external brands. They acknowledge the challenges in layering these new systems over legacy infrastructure but see significant potential in digital ownership and Web3 applications.

¹¹Finality International's recent \$95 million funding round led by major financial institutions speaks to the growing interest in deposit tokens as a viable alternative to both stablecoins and CBDCs. Source: <https://www.sygnum.com/future-finance/crypto/why-you-need-to-pay-attention-to-deposit-tokens/>

¹²<https://cryptoslate.com/>

Observations and Trends *(continued)*

In the gaming industry, NFTs offer the potential to alter the dynamics of digital asset ownership and control. Their application could allow players to manage in-game assets, enable open market trading of these assets, and support cross-platform compatibility. Additionally, dynamic NFTs (dNFTs) could introduce evolving and upgradable game assets. The use of fungible tokens might contribute to more sustainable game economies. Moreover, blockchain technology's security features could be utilized to protect these digital assets. We have yet to see this in a AAA game (in fact, over [75% of all Web3 games](#) have failed to gain mass traction), but all it would take is one success in this sector to see a meaningful portion of the industry to tag along.

Nowhere does skepticism for NFTs burn brighter than among the gamer community, so any changes in sentiment in that community will be a clear signal that NFTs are shedding their previous reputation as a place of scams, cash grabs, and [wash trading](#).

In addition, some companies are finding it more ideal to use other blockchain-based technologies for use cases otherwise attributed to NFTs. Rubey (see Appendix 1) chose not to use NFTs for its art tokenization platform, instead opting for security tokens based on Tokeny's permissioned ERC-3643 token standard. This decision was influenced by the desire to fit within the existing legal framework governing securities, thus providing a safer option for investors. However, it is also a clue that there are more tokenization options than NFTs available to brands as well as entities such as state-run museums for revenue generation and creating a sense of community ownership.

PRIVACY REMAINS A PRIORITY AND A CONCERN, BUT IT'S SLOWLY BEING SOLVED

"Enterprises aren't begging for speed; they care about decentralization once you explain it, but it's not the deciding factor. The real one is privacy."

– Sonal Patel, Consensus Mesh

Privacy remains a paramount concern, particularly in the context of Ethereum's application in business and financial systems. As a result, many opt for private chains, which pose their own set of challenges, including the complexities of maintaining nodes and establishing trust among participants.

Rudi Araújo from Circularise notes how the inherent transparency of a public ledger was a double-edged sword for its company's goals: "It would have been too revealing, exposing sensitive client information." In response, Circularise adapted its strategy, using Ethereum as a consensus layer while integrating zero-knowledge proofs (ZKPs) to ensure privacy. ZKPs enable users to prove specific details, such as location or account ownership, without revealing underlying data. This shift to using privacy-enhancing technologies like ZKPs enabled Circularise to maintain a shared global state on public Ethereum without compromising sensitive data, except when partners need to validate shared information.

Privacy concerns are similarly prominent in discussions about Central Bank Digital Currencies (CBDCs). [A study](#) by the Bank for International Settlements (BIS) found that privacy protections significantly increase the willingness of participants to use a CBDC, by up to 60%, particularly for privacy-sensitive transactions. This finding is critical for the design and adoption of digital currencies like a potential digital dollar.

Thus, it is clear that privacy concerns reach beyond the Ethereum ecosystem, and any solutions to these issues will give Ethereum, as a public blockchain settlement layer, a great deal of credit. ZKPs are the most salient of the solutions being developed, with many utilizations of ZKPs already providing a greater level of control over private data for companies implementing it (see the Circularise and Sage case studies in Appendix 1 and Rene Reinsberg's interview in Appendix 2) and more complex privacy solutions on public blockchains are entering proof-of-concept phase.

Concerning ZK implementations, it is ironic that the technology is currently primarily utilized for its scaling efficiencies, and its adoption has played a major role in scaling the Ethereum network by removing pressure from the Mainnet without sacrificing security. However, as has been described, there have been developments as of late in unlocking the real potential of ZK technology to introduce privacy controls while settling on public Ethereum. Upcoming technical privacy solutions also include [homomorphic encryption](#), multiparty computation, and [privacy pools](#), but these have years of development work ahead and thus will not be discussed at length in this report.

Observations and Trends *(continued)*

SECURITY IS ALSO A MAJOR CONCERN, BUT MOSTLY AFFECTS BRIDGES, L2S AND ABOVE

“People are beginning to understand the relationship between decentralization and security. Those who look closely can see that last year’s failures that led to the crypto winter were failures in the centralized parts of the ecosystem, failures in the parts where there wasn’t decentralization, and there wasn’t transparency. And I can imagine that message has resonated among some of these decision-makers and definitely the community as a whole. The importance of decentralized technologies has definitely been brought to the forefront, and we’re seeing this manifest in enterprise conversations.”

– Steven Goldfeder, Offchain Labs

It’s important to recognize that despite the negative press from recent events surrounding the blockchain industry, all of these incidents were failures of centralized forces and vulnerabilities above the execution layer; Ethereum Mainnet has never been compromised. The collapse of FTX, in particular, underscores the [risks of centralized systems](#). Incidents like these were not failures of blockchain technology or decentralization but rather results of centralized control and human error. These events are a stark reminder of the need for decentralized approaches, emphasizing transparency and distributed control available with blockchain implementations. The various exploits discussed in Section 1 highlight the need for higher security standards at the smart contract and application level – especially where it relates to crosschain bridging of assets when compared to rollups – but also reflect the relative robustness of Ethereum’s execution layer.

Further, outside of these failures of centralization and poor security measures at the application layer, it’s critical to not lump consumer DeFi and crypto speculation into the same bucket as Ethereum Mainnet, as there really is no direct connection. Similarly, equating scams and fraud surrounding consumer-level activities to a vulnerability in Ethereum’s base layer is completely unfounded. Thankfully, this common misconception is slowly being dissolved among the business community, especially outside of the US, as was echoed by Goldfeder (see Appendix 2). It is also worth noting that nearly all of the exploits of the past 18 months were associated with “cross-chain” applications

rather than Layer 2 or rollups, and this point was stressed by every technical expert we spoke to.

Cross-chain technology focuses mainly on enabling interoperability and facilitating communication among various blockchains. In contrast, multi-chain technology emphasizes scalability and flexibility, allowing for the coexistence of numerous blockchains within a unified ecosystem. [The difference](#) is crucial, though there are overlaps within projects. It is also part of why the Ethereum ecosystem has leaned heavily into a rollup-centric narrative, acknowledging the trade-offs of interoperability versus security with adjacent Layer 1 ecosystems.

Ethereum’s strength in interoperability and composability is due to its seamless data and value exchange across diverse blockchains and applications, both within and outside its ecosystem. Its smart contract functionality, akin to public APIs, combined with a commitment to open-source standards, accelerates innovative app development, including cross-chain and DeFi services, and reduces development time through code reuse and integration. Layer 2 solutions such as ZK rollups that inherit the security of the Ethereum Mainnet are increasingly acknowledged as a major improvement upon the more vulnerable cross-chain applications that came before.¹³

THE WELL-PUBLICIZED SCAMS AND FRAUDS OF 2022-2023 HAVE SLOWED ADOPTION AND AFFECTED BUSINESS EXPERIMENTATION WITH BLOCKCHAIN, BUT NOT UNIFORMLY

“The current ‘crypto winter’ has somewhat benefited us. When we started this venture two years ago, the landscape was filled with expensive JPGs. Many people wondered why they should care about concepts like blockchain, the metaverse, and NFTs, especially when they didn’t align with the interests of major players. So, this period has helped clarify and refine people’s understanding of Web3.”

– Markus Schorn, Deutsche Telekom

“The crypto bear market has been an enabler of enterprise experimentation, too, simply because without the noise of the bull market, enterprises have more room to experiment, to fail, to invest, and just to do stuff

¹³Rollups rely on centralized sequencers to coordinate transactions on the Layer 2 chain. Although sequencers can’t alter transactions, they can censor or re-order them. Rollups generally plan to decentralize in some way, such as introducing shared sequencers.

Sources: <https://l2beat.com/scaling/summary>, <https://bridgeharris.substack.com/p/a-primer-on-shared-sequencers>

Observations and Trends *(continued)*

outside of the harsh glare of the public eye. There may have been a slowdown in enterprise activity when it comes to financial applications. But when it comes to technology investment in innovation around Web3, the enterprise side of the story continues to be really robust.”

– Alex Tapscott, Business Author

As we discussed in Section 1, in 2022-2023, the blockchain industry continued to face reputational challenges with fraud, investment scams, and exploits of applications built on top of L1 infrastructure. The need for improved security at the application layer and higher awareness of security practices at the consumer level, as well as more regulatory clarity for the industry as a whole, has never been more apparent. However, all of these incidents again point to the fact that the issue is not one of the underlying technology. On the contrary, many businesses have shifted focus from the initial frenzy around high-value digital assets to a more substantive appreciation of the underlying technologies, leading to a more informed and strategic approach to these technologies, aligning them more closely with long-term value creation and practical utility.

While at first glance, it would seem that enterprise activity and business adoption within the Ethereum ecosystem has dried up, the reality is that many projects have taken a step back to recalibrate and prepare a new approach. Some projects never left the industry, while others have since entered the fray for the first time. And in general, several businesses have taken a breather to reassess the regulatory landscape, as many adoption issues stem from reactions from regulators rather than business decision-makers. In some cases, this may require businesses to relocate their operations to more friendly jurisdictions.

Beyond privacy and security solutions, which we have discussed in the previous sections, businesses are beginning to acknowledge the major benefits of inheriting the security possible through public blockchains like Ethereum.

Ethereum's ability to ensure the traceability and provenance of assets through immutable transaction records is becoming increasingly valuable to businesses, particularly where strict privacy controls are unneeded or where such issues are being resolved with ZK technologies (refer to the Sage and Circularise case studies in Appendix 1). Businesses can leverage this aspect for better accountability and trust-building with stakeholders.

The growing recognition of the need for transparency in business operations is not limited to the blockchain industry. It is a sentiment echoed globally, as seen in the evolving public discourse in countries like Norway. Our case study with BRØK captures this shift in societal attitude towards corporate transparency.

Jon Ramvi, Web3 consultant at Symfoni and Tech Lead for the BRØK project, told us: “In Norway, there's a growing focus in the public debate on the necessity of making shareholder registers continuously and publicly available for companies. This shift in focus is a reaction to heightened concerns about ownership transparency. In my view, mandating such transparency through a blockchain-based solution could mark a significant step towards more open and accountable business practices.”

We can also look to experimentations in the supply chain, particularly regarding financial applications. Marc Taverner, CEO of XEROF, succinctly encapsulates Ethereum's role in enhancing supply chain finances. He states, “By leveraging Ethereum-based ERC-20 stablecoins like USDT and USDC for international settlements, we significantly improve payment speed and reduce fees. This efficiency allows international companies to overcome financial constraints in scaling their supply chains.”

XEROF's use of Ethereum enables swift conversion and clearance of large fiat amounts into stablecoins, reducing conversion times to just a few hours and facilitating faster payments to suppliers. This approach marks a fundamental shift in supply chain finances, offering substantial improvements over traditional finance structures, especially in frontier markets. XEROF is also covered in Appendix 1.

We see parallels in other enterprise-level applications of Ethereum, such as with the Sage and Rubey examples listed in Appendix 1. It is reasonable to expect similar applications for traceability and automation to take hold once the benefits align for entities in the supply chain. Many of the blockers are regulatory, as discussed later in this report, while other challenges are closely associated with the switching costs of implementing nascent technology to an existing highly complex system.

James Canterbury, Principal at EY, provides insight into the ongoing development of blockchain in supply chain management. He suggests, “While blockchain offers

Observations and Trends *(continued)*

promising solutions for global traceability and inventory management, the integration of product tokens into consumer wallets is still a work in progress. The key lies in resolving digital identity issues to enable seamless asset transfers under privacy and enhance blockchain's utility in the supply chain.”

DIGITAL IDENTITIES ARE A DEVELOPING NARRATIVE IN WEB3 AND WILL SHAPE BUSINESS DECISIONS

“In Web3, loyalties and engagement use cases are gaining traction, especially in public-facing businesses. More public-facing brands like Nike and Adidas already integrate NFTs into their marketing strategy. Companies in this space are asking, ‘What is the way that I can engage with digital consumers and secure buy-in, to say ‘Yes, I’m willing to share my personal information as long as I can contribute to your community, and as long as I know who’s using my information.’ Brands today also want to enable their audience space to experiment, which is a refreshing mindset compared to three years ago when the question was, ‘How do I control my IP?’”

– John Liu, Head of Product at AWS

“Web3 basically starts with the premise that you should own your own data and identity. So, it transforms Internet Users into Internet Owners in the sense of owners of their identity and online assets.”

– Alex Tapscott, Business Author

We have mentioned how the Rubey case study in Appendix 1 identifies the potential in tokenized assets for revenue generation for state-run museums, creating a sense of community ownership. This exemplifies that there is a growing recognition of the value of community building in a Web3 setting, where it is increasingly expected that all stakeholders of a project enjoy a sense of ownership that can be verified onchain.

There is potential for blockchain technology like NFTs to reshape digital identity and privacy control. Token gating is seen as a key innovation. Token gating is a way to limit access to goods, experiences, and offerings to those who have specific tokens. These tokens can be NFTs or other forms of tokens on a blockchain, which makes it easier to record, verify, and authenticate their transfer and ownership.¹⁴ Examples include the Starbucks Odyssey

program and several of the NFT projects by Web2 brands mentioned in previous sections.

Deutsche Telekom views Web3 as leveling the playing field in internet development (see Appendix 2). Their approach to Web3-based loyalty programs reflects this, seeing digital ownership as integral to new systems. They recognize the challenges in integrating these systems with legacy infrastructure but are committed to overcoming them for the benefit of a more equitable Web3 space.

Joseph Lubin (see Appendix 2) predicts a significant shift in social network value towards blockchain-based systems. He envisions a future where [social graphs](#), embodied in technology like NFTs, become webs of trust, enabling monetization and varied applications. This shift could revolutionize reputation management, turning identity and reputation into valuable, computable digital assets.

One of the base concepts of that new web of trust is decentralized identifiers (DIDs), which represent an approach to digital identity that shifts from centralized data storage to a decentralized model. DIDs offer enhanced privacy and security, addressing the challenges posed by data breaches and fraudulent identities.

For companies, DIDs mitigate risks associated with sensitive user data storage, aligning with privacy-centric regulations like GDPR.¹⁵ In the IoT sphere, they provide secure identity and access management, which is crucial for the growing number of connected devices.

For individuals, DIDs represent a leap towards self-sovereign identity, where people control their own identity data, stored securely on their devices, and share it at their discretion. This model is particularly beneficial for the 1.1 billion people without formal identification, as it enables access to essential services and economic participation.¹⁶

DIDs also empower users to monetize their data, creating a more equitable digital landscape. Blockchain technology like Ethereum facilitates this by offering decentralized public key infrastructure, decentralized storage solutions, and enhanced manageability and control over personal data. In sum, DIDs on Ethereum and blockchain hold the promise of a more secure, inclusive, and user-controlled digital identity ecosystem.¹⁷

¹⁴Source of the definition of “token gating”: <https://www.lcx.com/how-will-nft-token-gating-revolutionize-the-digital-world/>

¹⁵<https://gdpr-info.eu/>

¹⁶<https://www.worldbank.org/en/news/press-release/2017/10/12/11-billion-invisible-people-without-id-are-priority-for-new-high-level-advisory-council-on-identification-for-development>

¹⁷<https://consensys.io/blockchain-use-cases/digital-identity>

Observations and Trends *(continued)*

The launch of a decentralized [digital identity protocol](#) in Buenos Aires using zero-knowledge proofs also exemplifies the practical applications of decentralized identity in government services. It utilizes Matter Lab's ZK rollup, zkSync Era, which inherits 100% of Ethereum's security and thus showcases the Ethereum ecosystem's capability to enhance personal data protection and digital identity management.

A GLOBAL PERSPECTIVE ON REGULATION REVEALS DIVERSE CHALLENGES AND OPPORTUNITIES FOR BUSINESSES

Regulatory developments across different regions significantly impact Ethereum's integration and use. As was discussed in Section 1, regulatory uncertainty in the US continues, though moderate progress has been made at least on the topic of institutional DeFi and weeding out several bad actors from the ecosystem.

However, these developments are also steering jurisdiction-specific or localized blockchain regulation, as evidenced by platforms like Tokeny in Switzerland, which align the blockchain services they provide to clients with regional regulatory frameworks. We briefly covered the importance of Europe's MiCaR regulations coming into effect in Section 1.¹⁸

Jake Hartley, Business Development Director at Fnality International, observes a growing understanding among regulators about blockchain's benefits. "The UK Treasury even tailored its policies in 2021 to facilitate such innovations, marking a significant milestone for the project as the world's 'first fully regulated DLT-based payment system.'"

Hartley also spoke to the challenges of getting institutions and regulators to align, "The tech part is relatively straightforward. The real complexity lies in navigating legal and regulatory frameworks. For years, we've worked closely with regulators and central banks to get to production." That is aligned with reflections from James Canterbury of EY on the challenges of adapting systems entrenched in regulations, emphasizing the necessity of regulatory stability over time.

Similarly, our case study of BRØK in Appendix 1 highlights the impact of regulatory hurdles on token standard adoption in Norway. The current legal framework

necessitates tokenizing share ownership receipts, a workaround awaiting legal updates for direct share tokenization. Ramvi points out the archaic nature of share numbering laws, advocating for legal updates to accommodate digital tokens.

The case study on Rubey discusses private-permissioned security tokens within existing legal frameworks. Rubey's method, using Tokeny's ERC-3643 token standard, ensures investor safety and complies with securities laws. Their system connects digital identities to wallets, creating whitelisted wallets through KYC processes.

Businesses are adapting to these changing regulatory landscapes by showing a preference for EVM-compatible chains and an increasing interest in public utilization of Ethereum, including Layer 2 solutions. Despite initial hesitations, there is a growing trend towards public blockchain adoption, driven by the need for compliance and transparency. This trend is observable globally, with significant movements in Asia and Europe, particularly in financial centers like Singapore and Hong Kong, as they align with emerging blockchain regulations.

Regulatory uncertainty in some parts of the world has not slowed down the United Arab Emirates, which has seen a [surge in institutional crypto investment](#), with over \$35 billion in cryptocurrency value received since June 2022. The predominance of institutional investments and significant activity on decentralized exchanges position the UAE as a key player in the global crypto ecosystem.

In sum, the regulatory environment (outside of the US) for blockchain is evolving toward a clear trend of greater understanding and acceptance. However, the understanding by regulators will differ from one region to the next. Businesses must navigate these changes, balancing innovation with compliance, to harness the full potential of Ethereum and blockchain technologies in various jurisdictions.

THE ETHEREUM ECOSYSTEM IS VERY WELL-COORDINATED, DEMONSTRATING THE POTENTIAL OF DAO-BASED GOVERNANCE

"I find it remarkable how well Ethereum has been able to continue to improve upon itself, even though it's an open-source network that has no central authority governing it. The Merge is a great example. I liken it to swapping

¹⁸ <https://www.coindesk.com/learn/mica-eus-comprehensive-new-crypto-regulation-explained/>

Observations and Trends *(continued)*

out the engines on a 747 traveling 600 miles an hour over the ocean while carrying two billion dollars worth of cargo, all without upsetting the drink cart or the in-flight entertainment system. This kind of success is reassuring to enterprises.”

– Alex Tapscott, Business Author

The success of the Ethereum Merge stands as a testament to the power of decentralized collaboration. This groundbreaking achievement was not the product of a single entity or centralized authority but rather the result of collective efforts from various teams, developers, and companies, all operating within the open-source ethos of the Ethereum network. The coordination required for such a feat was immense.

What makes this collaboration even more remarkable is the inherent diversity and autonomy of the contributors. Teams from different backgrounds, with varying skill sets and perspectives, came together, united by a shared vision for Ethereum's future. This collective endeavor, functioning without a centralized command, mirrors the principles of a decentralized autonomous organization (DAO).

In this sense, the Merge serves as a practical illustration of how decentralized networks can effectively govern and upgrade themselves despite the absence of a traditional hierarchical structure. It's a clear demonstration that decentralized systems can not only match but potentially exceed the capabilities of their centralized counterparts in both innovation and execution.

As Alex Tapscott told us: “With a DAO, anybody who uses an application or service can earn a share of that service by being an early contributor. That means that you can launch on Day Zero with services in 50 different countries... If the corporation was the killer app for the industrial age, I view DAOs as the killer app for this new digital age.”

DAOs govern a vast array of sectors, from DeFi protocols to virtual worlds, indicating their versatility and appeal across different domains. Their treasuries, often consisting of cryptocurrencies like USD Coin (USDC), exhibit substantial volatility and market correlation, underscoring the need for robust treasury management strategies.

Working with DAOs can be advantageous for companies that cannot hold tokens directly but want to utilize certain aspects of blockchain, such as Shell's interactions with Bitcoin. DAOs have also been directly involved with a

publicly traded US company for the first time, with the launch of Coinbase's Base L2, which funnels a portion of revenue to the Optimism Collective.

However, [recent analyses](#) and real-world instances have revealed significant challenges in this idealized model. A prominent issue is the concentration of governance tokens, where often less than 1% of holders control the majority of voting power. This concentration raises questions about the effectiveness and democratization of the DAO governance process, as it potentially marginalizes smaller token holders and contradicts the decentralized ethos DAOs aim to uphold.

As DAOs continue to evolve, they face the challenge of balancing decentralization with effective governance. This includes navigating issues like concentrated power and the complexity of collective decision-making.

UPCOMING TECHNOLOGICAL DEVELOPMENTS ARE SET TO IMPROVE ETHEREUM ON MANY LEVELS

The following section can be used as a reference. It is not absolutely necessary to understand all of these technological developments, but we have aimed to provide a brief overview of those that we believe will impact Ethereum's usefulness for businesses in the coming years.

Sharding and blobspace (EIP-4844):

Post-Merge, a [common misconception](#) was that gas fees, which are payments made per transaction, would reduce. However, the Merge does not directly impact gas fees as they depend on block space demand. While the PoW-based Ethereum network was capable of handling on the order of 45 transactions per second (tx/s), this capacity hasn't changed immediately post-Merge. Ethereum's roadmap for increased transaction throughput and lower transaction cost now focuses on Layer 2. Currently, Layer 2 rollups can increase throughput by 10-100x.

A critical step towards achieving greater scalability is Ethereum's [EIP-4844](#) update, commonly referred to as proto-danksharding. This update introduces a novel transaction type utilizing “blobs” — large data blocks that are instrumental in enhancing transaction throughput while simultaneously reducing transaction costs. These blobs, designed to be of manageable size, will prevent excessive disk usage, striking a balance between scalability and

Observations and Trends *(continued)*

practicality. This also enhances the efficiency of rollups by providing them with more space at lower costs, thus complementing Layer 2 solutions. With [proto-danksharding](#), the capacity of Ethereum-based rollups is expected to increase by another 10-100x, and with full danksharding, the network's capacity is expected to exceed 100,000 transactions per second. This anticipated performance would significantly surpass the transaction capacity of networks like Visa, which can handle approximately 24,000 transactions per second.

Account Abstraction (ERC-4337):

[Account abstraction](#) is a method of simplifying user interactions with Ethereum wallets and smart contracts, making them more accessible and user-friendly, particularly for those unfamiliar with blockchain intricacies. This innovation may be crucial for mainstream adoption, as it reduces barriers to entry, making Ethereum-based applications more approachable for a broader audience.

Visa has [demonstrated interest](#) in leveraging account abstraction to address the challenges associated with setting up automatic recurring payments on a blockchain like Ethereum, especially for self-custodial wallets where the user has sole control over the wallet and private keys.

Mainstream users face challenges in transitioning from Web2 to Web3 due to the fragmentation of those two worlds. The industry's goal in terms of onboarding users from Web2 should be to enable users to enjoy the benefits of Web3 seamlessly without conscious awareness of using it. Account abstraction may be an optimal solution to UX issues in Web3 and potentially help businesses better serve clients who are not deeply knowledgeable about the underlying technology.

EigenLayer and Restaking:

EigenLayer is a middleware built on the Ethereum network. EigenLayer allows protocols to use Ethereum's secure trust network without establishing their own validator set. This

is done by "renting" Ethereum's security. Protocols can use EigenLayer to launch at a lower cost, freeing up startup capital. EigenLayer's contribution to Ethereum is notable in data availability and cost reduction for L2s.

EigenLayer also extends the security and utility of staked Ethereum (ETH) or Liquid Staking Tokens (LSTs) through a process called "[restaking](#)." This allows stakers to reallocate their staked assets and stake their ETH on multiple protocols simultaneously. Data availability protocols that use EigenLayer as a root of trust, such as EigenDA, can further increase Layer 2 throughput.

Shared Sequencers:

[Shared sequencers](#) can improve efficiency and transaction speed by providing decentralization-as-a-service to rollups. They order transactions across rollups and commit them to the L1. By distributing the transaction ordering process among multiple parties (as it applies to all rollups linked to the shared sequencer set), shared sequencers can enhance the decentralization and scalability of the Ethereum network.

Multi-Party Computation (MPC) Wallets:

[MPC wallets](#) are a type of cryptocurrency wallet that allows multiple parties to access and manage crypto assets on a blockchain. MPC wallets use MPC technology and smart contracts to provide enhanced security, flexibility, and control over digital assets on Ethereum and EVM-compatible blockchains. Circle, the issuer of USD Coin (USDC), has also [released a beta version](#) of a MPC wallet solution designed for DeFi app developers, Web3 gaming creators, e-commerce platforms, and various blockchain-based applications, enabling the creation of tailor-made wallets to meet the specific needs of their user base. Other companies that offer MPC wallets include [Revolut](#) (in partnership with [Fireblocks](#)), [Coinbase](#), and [Bitget](#).

Further technical upgrades on Ethereum's roadmap are outlined at <https://ethereum.org/en/roadmap/> ■

Section 4

Assessing the Business Readiness of the Ethereum Ecosystem

We've looked at various events that have happened in the ecosystem and seen what people are building. This section aims to take a more data-driven approach to answer the question: Is Ethereum ready to onboard businesses?

In the first report, which was released last year, we introduced the Ethereum Business Readiness Framework. To review the full framework, please visit pages 25-40 in the previous report linked [here](#).

In this report, we took some time to review the most important part of the assessment, the spider charts, and provide some commentary on where we were right and wrong in our observations from the 2022 report. One change since last year is we are now providing a single spider chart as we believe that most of these ratings are applicable across many use cases, and this simplifies the comparison year-on-year.

ETHEREUM BUSINESS READINESS SPIDER CHART – 2023

The core idea is that depending on what is important to your business, you can use this chart to compare different metrics to help you choose a solution that is right for you.

Our metrics are defined as follows:

Network cost: Costs to use the network, generally measured by transaction fees (“gas” fees on Ethereum).

Network decentralization and security: The degree to which a given network is decentralized. Decentralization has a very large impact on security in blockchain networks, and is generally measured by the number and independence of nodes. Other non-technical aspects of decentralization (like governance) are not addressed here, but are also important.

Network scaling: The speed and capacity of a given network type. This is measured by transactions per second (TPS) as well as susceptibility to network congestion.

Privacy: The degree to which transaction information is private on the network. Most public blockchains are highly transparent. Other types of blockchains may offer more privacy but generally with trade-offs regarding security.

Environmental sustainability: The energy consumption required to run the network. Proof-of-Work blockchains, like Bitcoin, use a lot of electricity. Other consensus mechanisms, like the Proof-of-Stake mechanism used by Ethereum Mainnet post-Merge, do not.

Usability: How easy it is for a business to use a particular network or architecture. Usability has many facets. Here, we focus on ease of implementation or use of the network for business purposes, not end-user experience.

Interoperability: The ability to communicate between different components within the Ethereum ecosystem, generally with the intention of transferring digital assets or data. Here, we do not address interoperability between different Layer 1 blockchains and their ecosystems.

Regulation/compliance: The degree to which the network or architecture can be used in regulatory-compliant ways. This is a very important factor for many businesses, but is also highly use-case-dependent. We generally refer to digital assets, including digital financial assets, and not cryptocurrencies.

Ecosystem resources: Availability of resources (developers, services, tools, applications) that support businesses in implementing blockchain-based solutions.

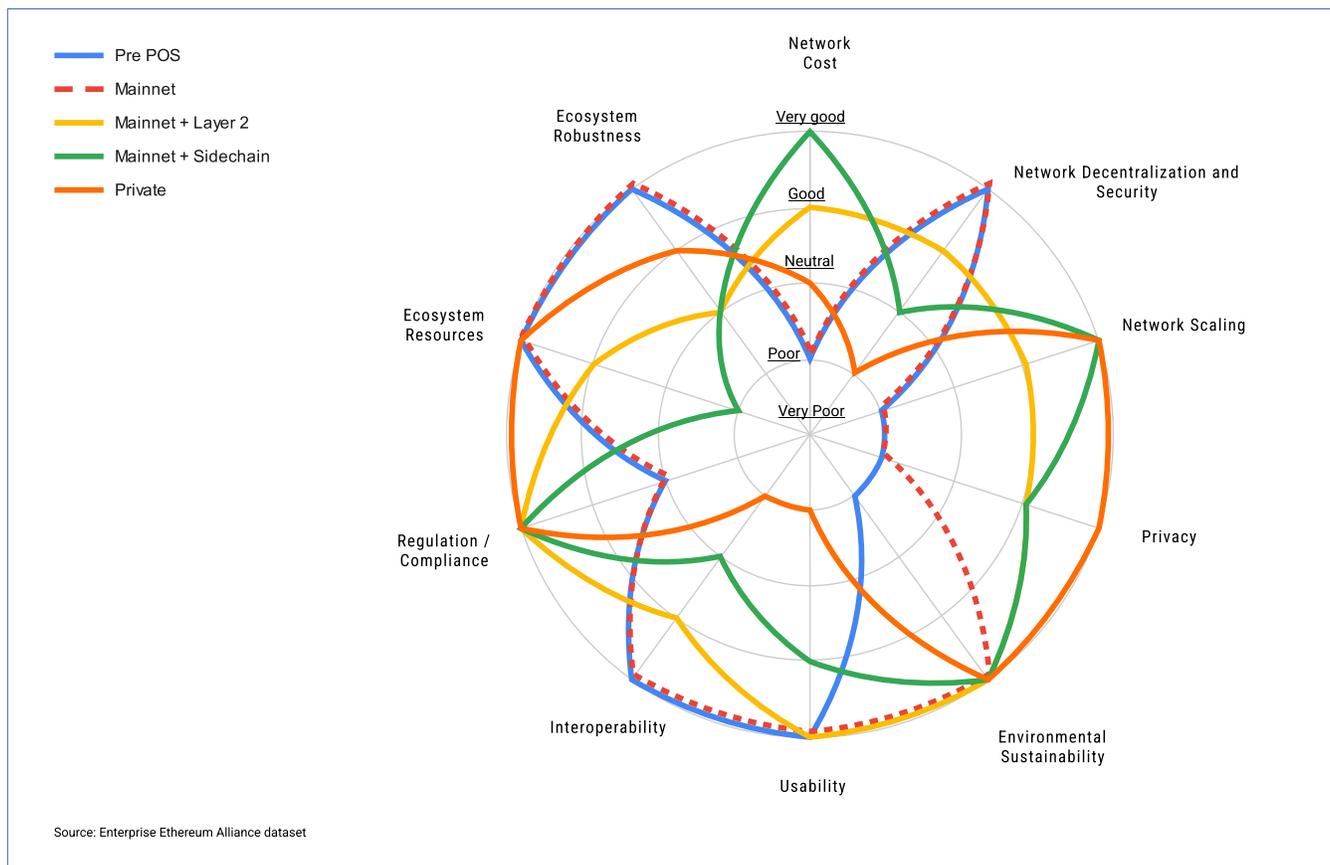
Assessing the Business Readiness of the Ethereum Ecosystem (continued)

Ecosystem robustness: The expected "staying power" of the ecosystem, as measured both by past performance and expectations as to the ability of the ecosystem to prudently govern, maintain and evolve the technology, as well as expected availability of resources over a longer-term horizon.

With the above metrics in mind, below we present our business readiness assessment for Ethereum in 2023 and discuss the changes from our first report.

One important fact to note, especially for readers of our first edition, is that we've updated our terminology to reflect recent changes. What we previously referred to as "Mainnet" has been renamed to "Pre-POS" (pre-Proof-of-Stake) to account for the completion of the Merge. Consequently, what was once labeled as "MN Post Upgrade" is now simply referred to as "Mainnet."

Comparison of Various Metrics Across Network Archetypes



Assessing the Business Readiness of the Ethereum Ecosystem *(continued)*

Below are some comments on the key areas:

Network Cost:

- We have moved the Private category from “Very Good” to “Neutral” because by running private infrastructure, there are costs for hosting and maintaining the network.
- Transaction costs on the Mainnet remain high and have not shown any change since our previous report.
- We have found that L2s are more cost-effective, a conclusion supported by data presented later in this report. Additionally, our observations indicate that sidechains tend to be even more affordable than L2s. You can see live data via [L2fees](#) but also the Polygon PoS chain [here](#).
- We anticipate a substantial improvement in the cost and scalability of L2 solutions with the implementation of EIP-4844 (Dencun upgrade), which is expected in Q1 2024. However, achieving the optimal level of 10 in these areas might require the full implementation of Danksharding, which is expected to occur at a later stage.

Network Decentralization:

- The rating for Layer 2 solutions (L2s) has been downgraded from “Very Good” to “Good”, with the potential for further reduction. This adjustment reflects the slower-than-anticipated progress in L2 development. According to data from L2BEAT, a significant degree of centralization is evident in most of the L2s currently available. While there's potential to revise this metric back to “Very Good” in the future, it would require observing substantial improvements in these areas.

Scaling/Capacity:

- Mainnet has not undergone significant changes to enhance its transaction processing capabilities. Therefore, it maintains a “Poor” rating in this metric, as it has not achieved the necessary improvements to warrant a “Good” score.

Privacy:

- The scores in this metric remain unchanged, as they are still accurate. If businesses need true privacy, they must still consider private chains. Because privacy-

focused L2s and sidechains are in development, we have left this category’s score as “Good”.

Environmental Sustainability:

- The move from PoW to PoS has been successful, and the network is now significantly more sustainable as a result.
- We’ve promoted L2s and sidechains, as they are also mainly PoS and thus enjoyed similar improvements.

Usability:

- This is unchanged from last year as it was already rated high, and there are only more applications being built.

Interoperability:

- We’ve observed that Ethereum with L2s is more interoperable than Ethereum with sidechains because L2 bridges are simpler and more secure than cross-chain bridges.

Regulation & Compliance:

- This is unchanged from last year as it still holds true that it is easier to build a compliant solution on a private chain vs. a public chain, and regulations around this have still not been fully clarified.

Ecosystem Resources:

- This is unchanged as the amount of resources, aka tooling and infrastructure, has only developed more.

Ecosystem Robustness:

- Also unchanged as the various ecosystems have shown that they are robust and continue to operate as expected.

HOW MUCH VALUE IS ETHEREUM MAINNET SETTLING TODAY?

As part of assessing if Ethereum is “business ready,” we have compared Ethereum in the following section to businesses that perform similar activities (settle value). This section is not an exhaustive analysis. However, we hope it can act as a starting point for other ecosystem participants and data companies in the space to track this metric.

In traditional capital markets and payments, one of the most used metrics is “value settled,” otherwise known as

Assessing the Business Readiness of the Ethereum Ecosystem *(continued)*

volume. Traditionally, centralized companies have been the main (and often the only) way to facilitate value exchange. However, Ethereum is a decentralized network that can be used as a computing platform as well as an exchange platform, combined with the ability to settle transactions. Thus, we believe this metric will be interesting to track over the coming years and decades. If the blockchain industry continues growing and settling more value, a “flipping” may occur where more value is consistently settled on decentralized networks than centralized ones.

We are also interested in this metric because we believe that most value in the global economy happens either B2B or C2B (consumer to business), as these entail one party paying for goods or services from the other. This means we should be comparing the amount of value settled onchain vs. traditional payment rails, as this would be a good proxy for large-scale adoption of the technology.

Before answering this question and observing where the industry stands today, there are some important things to mention:

- The monolithic vs. modular approach deserves mention here, as we believe that L2s built on top of Ethereum and ultimately settle on Ethereum Mainnet and, therefore use Ethereum as a security layer. In a monolithic blockchain architecture, the entire blockchain protocol – including consensus, security, and execution – is integrated into a single layer. This approach, while simpler, can often lead to scalability and efficiency challenges. On the other hand, a modular approach decouples these components into separate layers, allowing for more flexibility and scalability. L2s (Layer 2 solutions), which are built on top of the Ethereum network, exemplify this modular approach.²⁰
- In evaluating the metric of value settled on Ethereum, it's important to recognize that we're adopting a broad perspective. While comparing Ethereum's transaction volume to that of Visa and Mastercard provides a useful benchmark, there are key differences to consider. Visa and Mastercard predominantly handle global retail payments, characterized by a high volume of smaller transactions. In contrast, transactions involving ether (ETH) and stablecoins on the Ethereum network tend to differ significantly in nature. They are

likely fewer in number but larger in value, reflecting less frequent but more substantial transactions. This disparity in transaction characteristics suggests an area for in-depth analysis in future research, to better understand the nuances of Ethereum's transaction patterns compared to traditional payment networks.

- Our analysis has been focused on a select group of L2 solutions currently leading in terms of transaction volume and Total Value Locked (TVL). This targeted approach allows for a more detailed examination of the most active L2 platforms. Looking ahead, it will be particularly interesting to monitor and analyze these metrics in greater depth during the next bull market phase. It's important to note that we have excluded Polygon's L1 network from this analysis, as it does not classify as a traditional L2 solution.
- The data used in this report, indicated with an asterisk (*), is current up to the cut-off date of November 30, 2023.

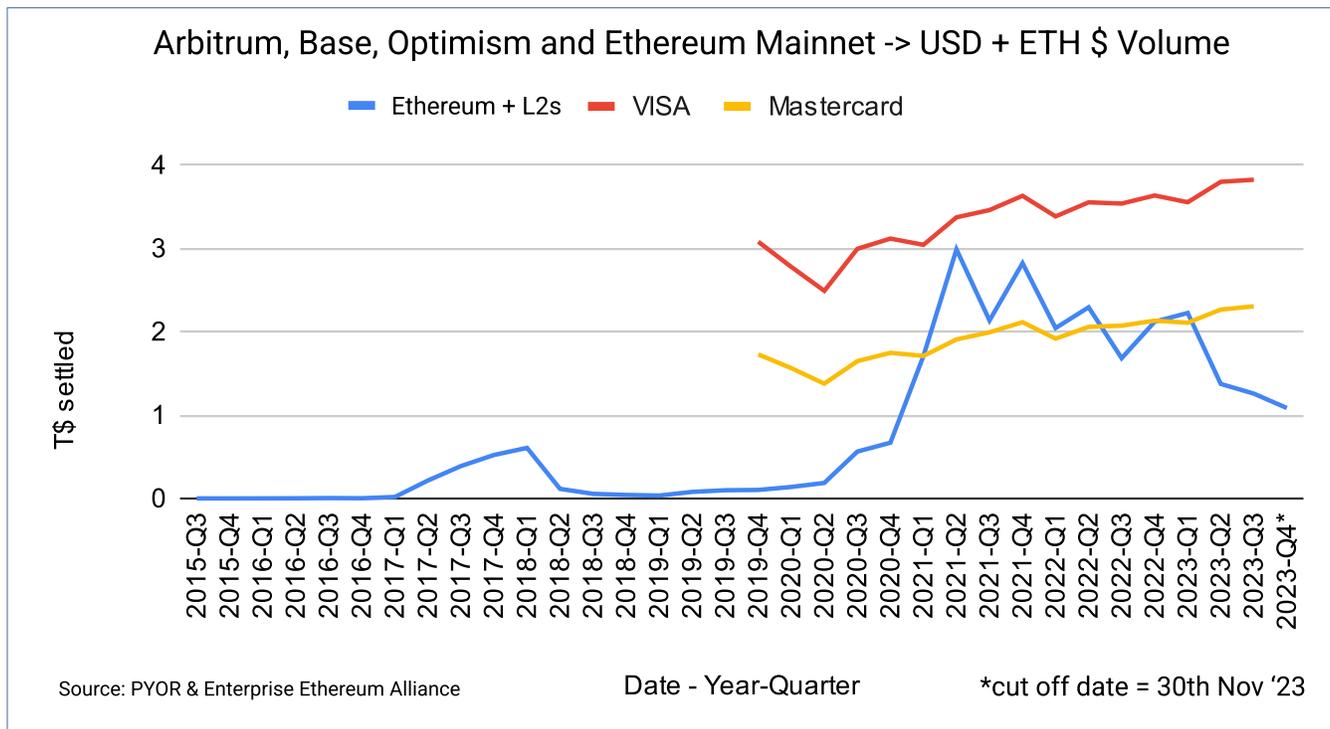
With the assistance of [PYOR](#), we have successfully gathered data on transactions involving ETH and major stablecoins (USDC, USDT, DAI, PAXG) on the Ethereum Mainnet and the most utilized L2 networks, namely Arbitrum, Base, and Optimism. PYOR's refined methodology has been developed to prevent double-counting during transactions that pass through smart contracts, thereby aiming to maximize the accuracy of this metric. ETH \$ volume from that day is a calculation of the close price.

It's important to clarify that our data collection excludes various other tokens within the Ethereum ecosystem, including many ERC-20 tokens. This exclusion is due to the complexity they add to the calculation process and the fact that, in the context of the enormous transactional scale we are examining, they do not significantly alter the overall data. Our preliminary investigation supports this decision. We anticipate that future research by other researchers may delve into these additional aspects of the Ethereum ecosystem.

By consolidating our data into a single metric for comparison with Visa and Mastercard, the following chart illustrates the significant impact the recent bear cycle has had on the US dollar value settled.

²⁰<https://usa.visa.com/solutions/crypto/monolithic-vs-modular-blockchain.html>

Comparison of Ethereum + Key L2s to Payment Networks



Source: [Visa](#) and [Mastercard](#) from yCharts. ETH + Stables from PYOR.

This analysis reveals that during the last bull market, Ethereum and its L2 solutions settled more value than Mastercard, though not as much as Visa. However, as we transitioned into late 2022 and into 2023, there was a notable decline in the value settled. This trend, discussed in other sections of this report, highlights the significant influence of market cycles on the settlement value within the Ethereum ecosystem, more so than in typical retail payment systems. Additionally, the fluctuating price of ETH (calculated based on its value on the day of settlement) plays a major role in this variability.

Breaking down the total dollar value settled in the Ethereum ecosystem further into stablecoins and ETH by quarter, it becomes evident that stablecoins have consistently dominated the total value settled onchain, with their prominence increasingly evident over time.

A more insightful way to illustrate this trend is by representing it as a percentage of the total dollar value settled onchain for any given quarter:

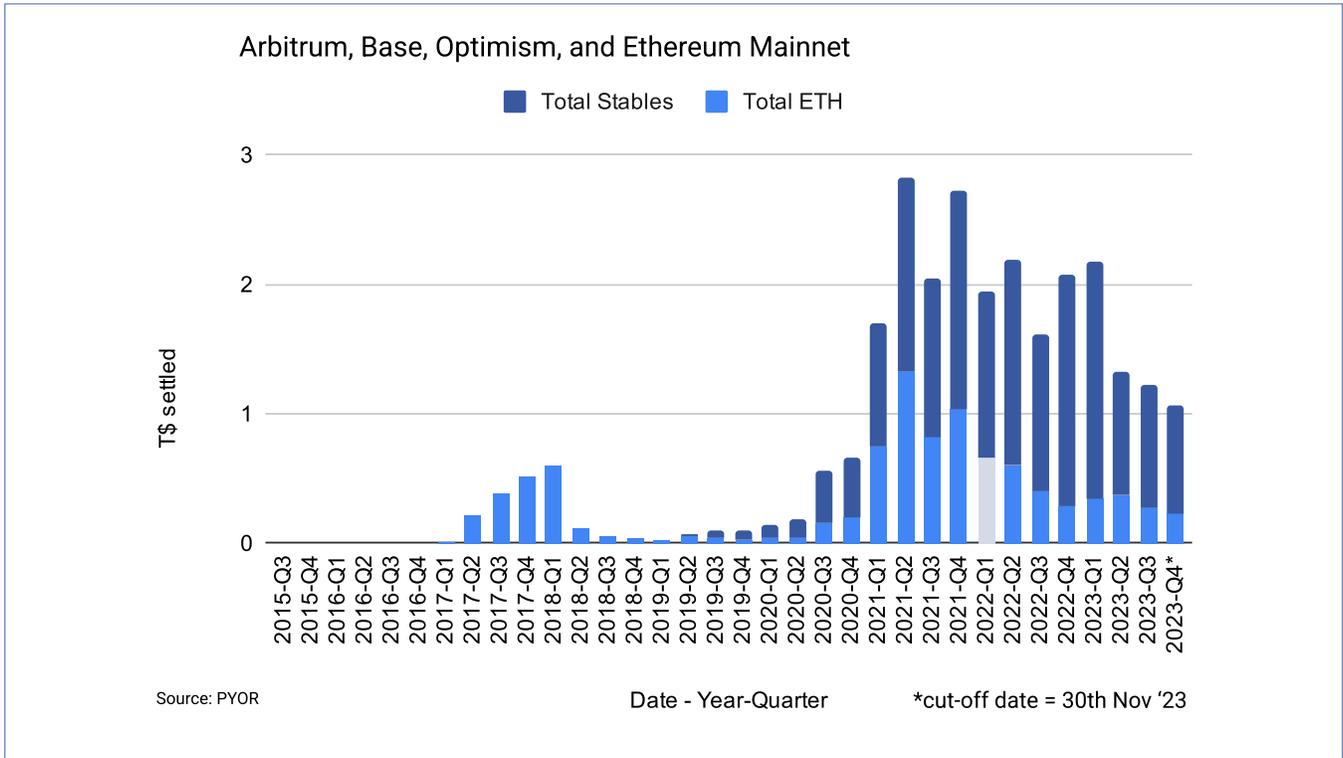
According to Krishna Hedge, Co-founder PYOR:

“While value settled in aggregate has declined over the last few quarters, the shift in mix from ETH to stablecoins deserves more attention. For consumers, value transferred via stablecoins offers a similar utility to value transferred via Visa/Mastercard for real-world use cases. Over the last couple of years, crypto use cases like NFT trading have declined and are probably a driver of the decline in ETH value transferred.

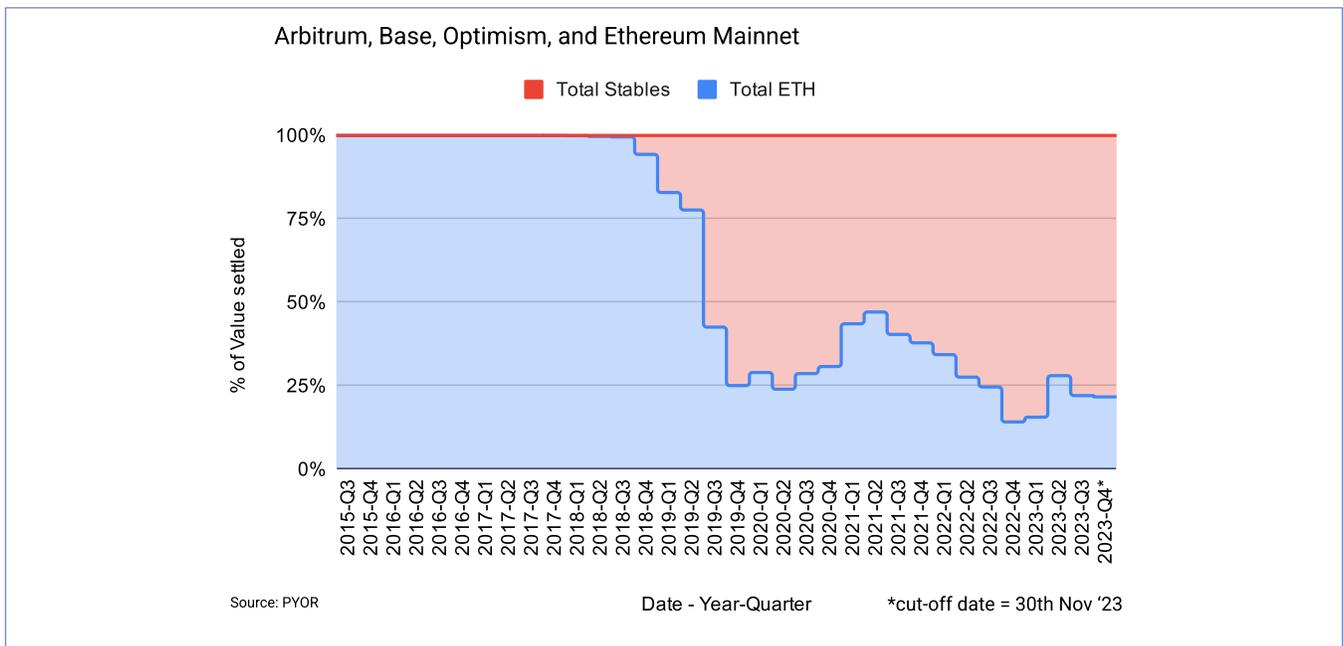
Further, looking into aspects like number of unique wallets involved and the velocity of transactions (i.e, how much time does value stay at a particular address before moving), it is clear that the nature of value settled on the Ethereum blockchain has moved towards underlying real-world applications. As we move into 2024, we will monitor these indicators closely since they proxy broad-based adoption of Ethereum for a value transfer use case.”

Assessing the Business Readiness of the Ethereum Ecosystem (continued)

\$ Settled Stables vs ETH



% Settled Stables vs ETH



Assessing the Business Readiness of the Ethereum Ecosystem (continued)

MONETARY VALUE OF SETTLEMENTS: LAYER 2 NETWORKS VS. MAINNET

We also explored the distribution of transaction activity between L2 networks and the Ethereum Mainnet, especially given the growing importance of L2s in the narrative of Ethereum's evolution.

Our analysis reveals that despite a significant number of transactions on L2s being conducted in ETH or stablecoins, the majority of the transactional value is still settled on the Mainnet.

This leads us to conclude that, as of now, L2 networks have not overtaken the Mainnet in terms of the total dollar value settled.

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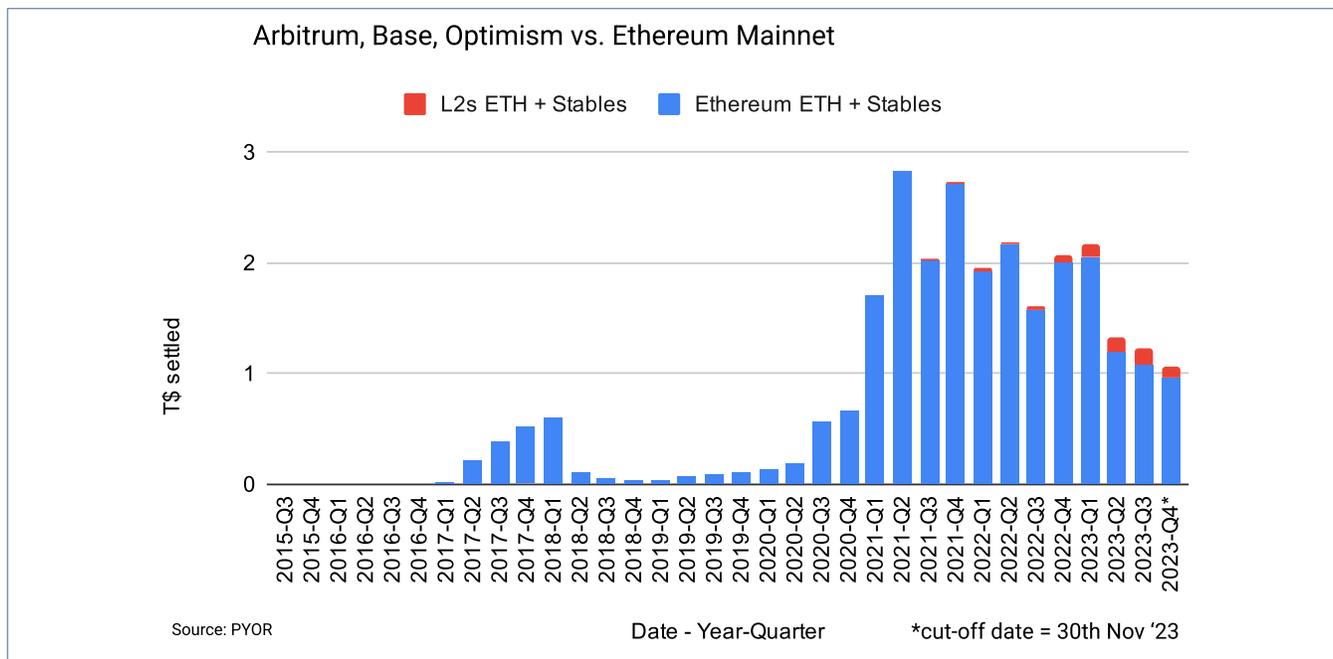
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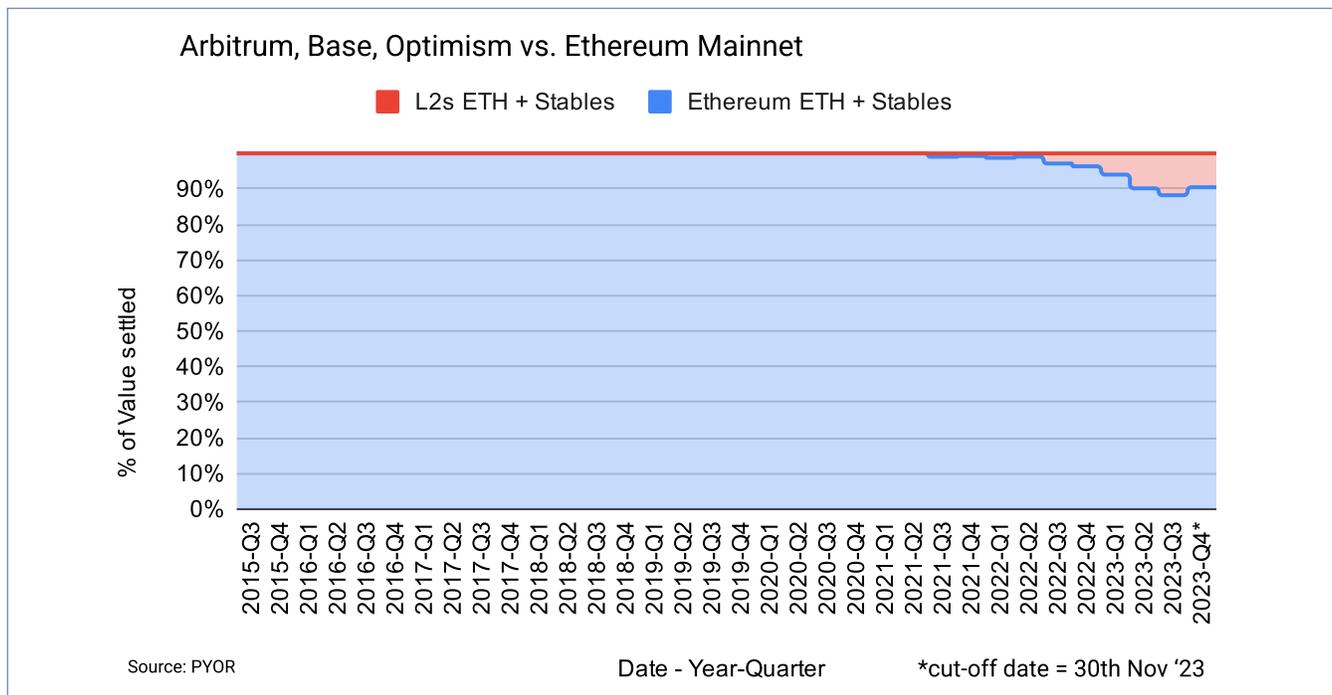
Analyzing the data on a percentage basis, we observe a significant uptrend. In Q3 2023, the figure reached nearly 10%, a substantial increase from just 2% in the same quarter of the previous year. This metric will undoubtedly be intriguing to monitor in the upcoming years, as it may indicate evolving trends in the ecosystem.

When we examine the numbers, it becomes evident that Ethereum is evolving into a powerful decentralized financial platform, increasingly comparable to traditional retail payment networks in terms of settlement capabilities.

\$ Settled Between Mainnet vs L2s



% Settled Between Mainnet vs L2s



A NOTE ON TRANSACTION FEES

A recurring theme in our analysis is the cost of transactions, particularly pertinent when evaluating the business use of public blockchains compared to traditional payment networks.

In traditional payment networks, transaction costs typically consist of a base fee ranging from \$0.05 to \$0.25 plus a percentage of the transaction value. In contrast, L2 solutions have been increasingly competitive, with average fees approaching \$0.16 and most likely will go lower. This development positions L2s as a viable option for payment

processing in terms of cost efficiency. However, a notable difference is that these costs are borne by the user rather than the merchant, which could present challenges in terms of usability.

In many instances, transferring tokens, whether they represent securities or other high-value RWAs, can be as cost-effective as conducting similar transactions in TradFi. While the expenses associated with such TradFi transactions are significant, the lack of transparency in this sector makes it challenging to determine exact costs. However, it's crucial for those familiar with TradFi to note that these costs are becoming increasingly lower.

Assessing the Business Readiness of the Ethereum Ecosystem *(continued)*

Below is a table detailing the fee structures of traditional payment networks:

Fee Structures of Traditional Payment Networks

Payment network	Average credit card processing fees
Visa	1.15% + \$0.25 to 3.15% + \$0.10
Mastercard	1.15% + \$0.05 to 3.15% + \$0.10
American Express	1.10% + \$0.10 to 3.15% + \$0.10
Discover	0.05% + \$0.22 to 2.40% + \$0.10

Data taken from: <https://www.fool.com/the-ascent/research/average-credit-card-processing-fees-costs-america/>

Below is a table detailing the median transaction fees across major cryptocurrency networks:

Median Transaction Fees Across Mainnet and L2s

Network	Median Fee per transaction (Q3 2023)
Ethereum	\$4.69
Arbitrum	\$0.16
Optimism	\$0.16
Base	\$0.13

Data on "Median Fee per Transaction" covering the period from July 1, 2023, to September 30, 2023, as sourced from [Bitwise's Q3 2023](#) report, page 23.

Assessing the Business Readiness of the Ethereum Ecosystem *(continued)*

IS ETHEREUM A CHALLENGER TO TRADITIONAL VALUE NETWORKS?

In short: Yes

When we examine the numbers, it becomes evident that Ethereum Mainnet is evolving into a powerful decentralized compute platform, increasingly comparable to traditional retail payment networks regarding settlement throughput. This will only increase as Ethereum continues to not only be the security layer for its own network but also for others, something that our data shows is only just starting.

However, when we shift our focus to entities primarily engaged in private capital markets, a different picture emerges. We see that JPMCoin, a private network based on Ethereum, is also settling significant value at \$1B a day, which is more than most public blockchains in existence. It is not included in this section of our analysis as we are focused on highlighting Public Mainnet.²²

To illustrate this point further but also outline the future space for graphs, one final data point worth noting compares the value settled by Ethereum with that of the Depository Trust & Clearing Corporation (DTCC) in 2022. DTCC settled \$462 trillion of securities, according to their 2022 numbers. This means that Ethereum settled only 2.33% of the settlement volume handled by the DTCC in the same year.²³

Thus, based on our data analysis, we conclude that while Ethereum is progressing as a settlement network, it still has considerable ground to cover before it can be recognized as the predominant global settlement platform. However, employing these high-level metrics is beneficial in illustrating the extent of the ecosystem's advancement towards this goal. For a young technology, Ethereum's progress has been quite impressive.

²²Including data on the transaction volume of JPM Coin, operated by JPMorgan, may slightly change this picture. JPM Coin, introduced in 2019 for institutional blockchain-based wholesale payments, is noteworthy for its compatibility with the EVM. As reported by CoinDesk, JPM Coin recently achieved a milestone of processing \$1 billion in daily transactions. This figure, however, is relatively small compared to JPMorgan's total daily transaction volume of \$10 trillion. Such inclusion could provide a more comprehensive perspective on the scale of blockchain-based settlement systems in relation to traditional financial institutions. Source: <https://www.coindesk.com/business/2023/11/10/jpmorgan-adds-programmable-payments-to-jpm-coin/>

²³<https://www.dtcc.com/settlement-and-asset-services>

Section 5

Conclusion

To conclude, we find that the Ethereum ecosystem as a whole has continued its evolution as a viable decentralized compute platform for large-scale business use. The Ethereum Mainnet has become an important settlement layer in an evolving world and the preferred base layer in the blockchain space. Ethereum's embrace of a "rollup-centric" architecture, with a myriad of Layer 2s and other solutions means that businesses can choose from a great many options. On the other hand, this also makes the ecosystem more complex.

When we wrote our report last year, we concluded that the Ethereum ecosystem was indeed "ready for business" but not necessarily "out-of-the-box" ready. This year, we find that the ecosystem has evolved in many ways and is now supporting large-scale business use in significant sectors. This is good news for those looking to employ this technology to, among other things, gain the benefits of decentralization. However, it does come with some caveats. With this in mind, we would like to leave our readers with the following takeaways:

ETHEREUM HAS BECOME A VERY POWERFUL, BUT ALSO COMPLEX, ECOSYSTEM FOR BUSINESS USE

In our report last year, we said the pieces for the safe and productive use of Ethereum as a business platform, but that there were no comprehensive frameworks for businesses that pulled them all together. In other words, while Ethereum had all the pieces of the puzzle, they did not necessarily all fit well together. This year we can say that while many of the core pieces now do fit together, the overall puzzle itself has gotten larger as the ecosystem has grown.

This is not the case on the base layer. As we have written, we think a good case can be made for the fact that Ethereum has become the preferred base layer in the blockchain space. Businesses that have been working with

the technology and have stuck with it through the recent difficult times understand blockchain very well.

With Mainnet as the anchor of security and trust in the ecosystem, the discussion has shifted from what L1 to use to deciding what Ethereum L2s to use and how. This has introduced fragmentation and complexity into the space. This, in turn, means businesses will have to research and decide what kind of features they want, what level of decentralization is desired, how they can assess the security risks, and so on. The flip side is that thanks to this growing ecosystem, businesses will find they have more choice in features and applications.

EVM HAS EMERGED AS A DE-FACTO STANDARD

We believe that the case can also be made that EVM has become a de-facto standard within the blockchain industry. Certainly, when companies first get into blockchain, they cannot ignore Ethereum. The Ethereum ecosystem boasts the most dApps of any ecosystem, has the most developers, and settles the most volume. Retail adoption of cryptocurrencies is mostly done via Ethereum-compatible tokens (based on some ERC standard). Ethereum has the most TVL (total value locked) of any protocol.

This does not mean that Ethereum is the only game in town or that other Layer 1s are not viable options for businesses. Rather, it means that when building in blockchain, EVM has

Conclusion *(continued)*

to be taken into account, the same way that, for instance, Microsoft Word compatibility must be considered when building a Word Processor. And we have seen this in action. A number of Layer 1s, as we have reported here, have chosen to become Ethereum Layer 2s. Similarly, other Layer 1s, like Avalanche, Binance Smart Chain, and Solana, have chosen to be EVM compatible in order to leverage the advantages of the Ethereum ecosystem.

WHILE THE SPEED OF BUSINESS ADOPTION ON ETHEREUM HAS SLOWED DOWN, IT HAS ALSO GAINED DEPTH

Finally, if we look across the ecosystem, we do see that, compared with last year, business adoption of Ethereum upon face value has slowed. This is due, above all, to the dampening effects of the crypto winter. Yet, it has by no

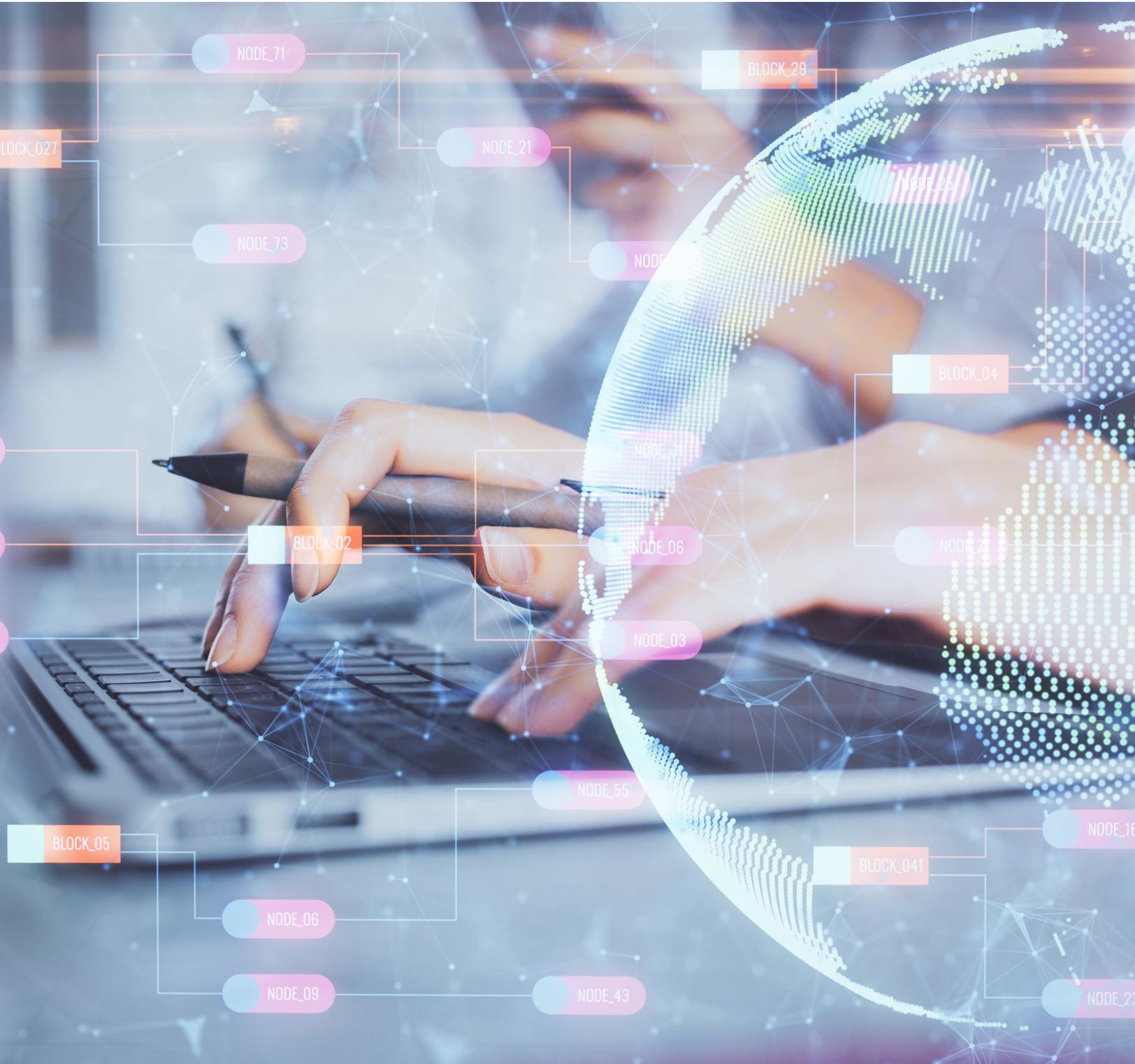
means stopped. And there are indications that, in the areas where it is being deployed, it has gained depth.

We are starting, for example, to see real business value being put on public chains, whether via the tokenization of real-world assets, institutional DeFi, or global brands embracing NFTs.

At the same time, as we learned during our research, companies seem to be touting blockchain less, even if they use it. Part of this may be fear of lingering reputational issues on the back of the scandals of 2022. But part of it is likely due to the mainstreaming of the technology. We believe people are using Ethereum and blockchain to solve real problems, not simply to appear innovative. There probably is no greater indication of the arrival of this technology than that. ■

APPENDIX 1: STORIES

Selected case studies & project snapshots



CASE STUDY: Avelia by Shell

An Ethereum-powered digital book-and-claim solution for scaling sustainable aviation fuel (SAF) usage.

Description	Avelia aims to bring together airlines, corporates, and sustainable airline fuel (SAF) suppliers in a trusted ecosystem to scale the use of SAF and help decarbonize the aviation industry. It provides clear and transparent tracking of the environmental attributes associated with SAF delivered into the aviation fueling network.
Target users	Airlines, corporates, and SAF suppliers.
Technology	The Energy Web Chain, an EVM-compatible Layer 1 blockchain developed with the support of the Energy Web Foundation (EWF)
Benefits	Aggregates SAF demand (providing confidence to SAF investors), opens up direct access to SAF for corporations looking to reduce emissions associated with their air travel (even when SAF is not available at the specific airport), and provides transparent tracking of SAF's environmental attributes.
Product Type	Digital book-and-claim solution for SAF.
Launch Date	June 2022
Production Phase	In production, processing live transactions
Notable partnerships	Shell, Accenture, Amex GBT, Energy Web Foundation, Google, Delta Air Lines, and Emirates.
Milestones/Achievements	<ul style="list-style-type: none"> • Since Avelia's launch in June 2022 to date (mid-November 2023), Shell Aviation has injected over 3.4 million gallons of SAF into the existing fuel network at six airport locations around the world, abating over 30,000 tCO₂e, the equivalent of around 50,000 flights from London to New York • Emirates, Google and Bank of America are among the 20 corporate customers and airlines that have joined Avelia • Launched as one of the world's first EVM-compatible, blockchain-powered digital SAF book-and-claim solutions for business travel
Next steps	Continue to expand the platform's user base, increase SAF supply and use, and drive industry change towards decarbonisation.

Case Study: Avelia by Shell *(continued)*

Avelia, a blockchain-powered digital book-and-claim solution for sustainable aviation fuel (SAF), was developed by Shell, Accenture, and American Express Global Business Travel (Amex GBT) to address the urgent need for decarbonization in the aviation industry. Launched in June 2022, Avelia has quickly gained traction as one of the world's first digital SAF book-and-claim solutions for business travel, offering around 1 million gallons of SAF at its inception. This innovative platform has the potential to power almost 15,000 individual business traveler flights from London to New York.

"Aviation is quite a hard-to-abate sector, which means it's very hard actually to reduce the embedded carbon in the fuel for aviation," explains Vikram Seth, Blockchain and Web3 Innovation Manager at Shell. "One of the best ways to address this is by using an alternative, more bio-based fuel or SAF. However, producing SAF is expensive, and due to its high cost, the market for it is still small. This has hindered its adoption. Avelia aims to address this by enabling airlines and other stakeholders to fund SAF production, thereby promoting its adoption and contributing to the decarbonization of the aviation sector."

By leveraging blockchain technology, Avelia provides clear and transparent tracking of the environmental attributes of SAF delivered into the aviation fueling network. This level of transparency is crucial for ensuring the integrity of SAF's environmental claims and fostering trust among stakeholders.

"Essentially, what we're doing with Avelia is providing a digital red thread through a booking claim system," Seth continues. "This allows a supplier to input SAF into the global supply system, and in turn, an airline can fund that. Due to the nature of fuel blending and distribution, the supplied SAF might not directly fuel the plane of the airline that bought it. That's why we're introducing a token system. When an airline pays for SAF, they receive a token as proof of their contribution to the overall supply, ensuring recognition for funding sustainable fuel even if it doesn't directly power their aircraft."

As Rohit Gupta, Shell's Blockchain Technology Lead, explains, the information contained in the token is very specific, and can be used in different contexts. "Since we're talking about real world tokenization on a blockchain, users can be sure that only the attributes that were created at the time of delivery of the fuel batch get circulated. This allows the airlines, which combust the fuel directly, to offset Scope 1 attributes. Corporates who are using it for business travel activity can reduce their Scope 3 emissions."

Amex GBT's world-leading travel management services are integrated into Avelia, enabling the platform to aggregate global business demand for SAF. This aggregation of demand is expected to increase SAF supply and use, ultimately helping to accelerate the aviation industry's transition to net-zero emissions. Shell, Accenture, and Amex GBT are the platform's first customers, and they actively encourage other corporations to join Avelia and purchase the environmental attributes of SAF to drive industry change.

In 2023, Google joined the Avelia program as well, marking a significant milestone for decarbonizing aviation and the adoption of enterprise Ethereum. This partnership highlights major corporations' growing interest and commitment to supporting the transition to a more sustainable aviation industry while utilizing appropriate technology to do so. Additionally, Shell Aviation announced a new SAF supply agreement with Delta Air Lines in 2023. Under this agreement, Shell Aviation will supply up to 10 million gallons of neat SAF at Delta's Los Angeles International Airport (LAX) hub over two years. Delta will utilize Avelia for its book-and-claim blockchain SAF solution, further demonstrating its growing influence in the industry.

Avelia's underlying technology is based on The Energy Web Chain, an EVM-compatible Layer 1 blockchain also employed in another SAF initiative, SAFc. SAFc is a blockchain registry for SAF backed by McKinsey, JP Morgan, Microsoft, Meta, and several other prominent companies. Energy Web's Ethereum-based blockchain technology in Avelia and SAFc showcases

Case Study: Avelia by Shell *(continued)*

its versatility and potential for widespread adoption in sustainable aviation fuel.

As Avelia continues to process live transactions and expand its user base, the platform is poised to drive industry change toward decarbonization. The platform's transparent tracking of SAF's environmental attributes and ability to aggregate global business demand for SAF is expected to increase SAF supply and use, ultimately accelerating the industry's transition to net-zero emissions.

Avelia represents a pioneering effort to harness the power of blockchain technology in pursuing a more sustainable aviation industry. By bringing together key stakeholders and providing a transparent, secure platform for tracking and trading SAF, Avelia is poised to play a crucial role in the industry's transition to net-zero emissions.

Commentary and Key Takeaways for Businesses

Initiatives like Avelia demonstrate the potential of enterprise Ethereum in addressing sustainability challenges across various industries, including aviation. Avelia, an Ethereum-based blockchain-powered digital book-and-claim solution for sustainable aviation fuel (SAF), was developed by Shell, Accenture, and American Express Global Business Travel (Amex GBT). This platform highlights the versatility of Ethereum-based infrastructure in fostering collaboration and driving industry-wide change.

Avelia's approach to aggregating global business demand for SAF showcases how blockchain technology can tackle complex challenges in various sectors. The involvement of major corporations like Shell, Accenture, Amex GBT, Google, and Delta Air Lines highlights the growing interest and commitment of the business community in supporting sustainable initiatives.

Avelia exemplifies how blockchain technology, specifically Ethereum-based applications, can be leveraged to create innovative solutions for pressing environmental issues. We encourage businesses to explore the potential of blockchain in their respective industries and consider how it can be used to drive sustainable change and create a more environmentally responsible future.



Case Study: Blocksquare

Real estate investment through ERC-20-compatible tokenization on Ethereum Mainnet.

Description	Blocksquare provides a suite of tools and protocols for real estate professionals to tokenize property, allowing asset-backed tokens to be easily created, bought, and sold. They focus on enabling small and medium-sized enterprises (SMEs) in the real estate sector to adopt blockchain for enhanced liquidity and asset management.
Target users	Real Estate Developers, Asset Managers, SMEs in Real Estate, Individual Investors
Technology	<ul style="list-style-type: none"> • The Property Factory smart contract generates a PropTokenContract for each property with customizable revenue tokenization. Each PropToken is listed in the Property Registry with property IDs. • ERC-20 tokens on Ethereum for real estate. Each asset gets its own BSPT with a max of 100,000 tokens (1,000 tokens = 1% asset capital). Features on-chain valuation and legal enforcement via IPFS-stored corporate resolution
Benefits	<ul style="list-style-type: none"> • Instant settlement of property rights • Streamlined legal framework compliance • Reduced costs for Blocksquare and its clients • Increased liquidity in real estate investments • Lower barriers to entry for investors • Simplified real estate asset management
Product Type	Real estate tokenization platform
Launch Date	April 2018
Production Phase	Mature, with several tokenized properties and active investing.
Notable partnerships	<ul style="list-style-type: none"> • Blocksquare works to refine its legal solutions with a wide network of partners, including Deloitte, Wolf Theiss, DLA Piper, CMS, Andersen, and other national firms. • Integration with various property management software solutions.
Milestones/Achievements	<ul style="list-style-type: none"> • Successfully registered on the national registry of Slovenia, putting their home country on the map for RWAs by allowing for legal compliance and direct execution through court mechanisms. • Tokenized over 80 properties on Ethereum as of 2023 • Facilitated over \$75M in asset transactions • Received a 100,000 USD equity-free award from CVVC in Zug, Switzerland, at the CV Summit competition in 2019
Next steps	<ul style="list-style-type: none"> • Expansion into additional EU member countries, such as Austria and Germany, while continuously refining their blockchain technology infrastructure. • Introduce more advanced liquidity solutions and form partnerships with larger institutional investors.

Case Study: Blocksquare *(continued)*

One of the major challenges in real estate investment today is the entry barrier; the minimum investment required is often beyond the reach of an average individual. Here, Ethereum's smart contracts offer an elegant solution. Using Ethereum to tokenize real estate assets, Blocksquare fractionalizes these high-value assets into smaller, more accessible parts.

"We chose Ethereum because it allows us to create smart contracts that automate a majority of compliance requirements, significantly reducing administrative workload," Blocksquare Co-Founder Denis Petrovcic explained. "This practice has opened up investment opportunities to a wider range of people, achieving liquidity rates that are unheard of in traditional real estate investments."

Petrovcic reiterated some fundamental reasons why Ethereum was the top choice for Blocksquare's applications: "Using Ethereum's public ledger, all transactions are transparent and immutable. This instills trust among our investors, as any data alteration would require altering all subsequent blocks, which is computationally impossible."

Blocksquare's Property Factory smart contract is the core mechanism that generates a "PropTokenContract," an ERC-20 backward-compatible token designed to tokenize specific real estate properties and their revenues. Each PropToken contract is listed in Blocksquare's Property Registry, a smart contract displaying the identification data of all tokenized properties. This works in conjunction with Blocksquare Property Tokens (BSPTs), which are standard ERC-20 smart contracts on Ethereum for real estate assets. Each asset gets its own BSPT with a cap of 100,000 tokens (representing a predefined percentage of royalties of all net revenues, including those generated by 3rd party sales), with 1,000 tokens equating to 1% of the asset's capital.

The tokens also feature on-chain valuation, backed by a legally enforceable corporate resolution stored on IPFS (a global, peer-to-peer network for decentralized file storage and sharing, replacing traditional web protocols with HTTP-accessible gateways). Due to AML laws, users must complete a one-time KYC process on Blocksquare's platform. The PropToken "transfer function" uses data from a Whitelisting Contract, allowing token transfer restrictions based on the issuer's criteria, which could impact liquidity. This compatibility allows the platform to offer a wide range of services, from token creation to asset management, designed to increase liquidity and lower entry barriers for investors. As of 2023, Blocksquare has tokenized over 80 properties and has facilitated over \$75 million in asset transactions, all deployed on Ethereum Mainnet.

"We chose Ethereum Mainnet for its security and decentralization, as we see higher risks when considering real estate assets to be placed on Layer 2 solutions at this time," Petrovcic clarified. "To that end, all of Blocksquare's tokenization, transactions, and notarization processes occur on the Ethereum Mainnet."

Blocksquare leverages key partnerships with legal firms like Deloitte, Wolf Theiss, and DLA Piper, as well as property management software providers, to ensure compliance and simplify asset management. By developing its legal solutions in-house, the company stays at the forefront of real estate tokenization. That is interesting to note, as it means all of these companies have at least 3rd-order connections to Ethereum at this stage and simultaneously reaffirm Ethereum's growing presence within real-world asset (RWA) tokenization.

Finally, Ethereum's vibrant ecosystem has enabled Blocksquare to easily integrate with other decentralized platforms and services, further elevating its functionality. "The rich array of development tools and widespread community support has sped up our development cycle

Case Study: Blocksquare *(continued)*

by 30%," Petrovic stated, emphasizing the collaborative benefits of building within Ethereum's ecosystem.

By leveraging Ethereum's smart contracts, scalability solutions, and a wide array of development tools, Blocksquare has successfully navigated the complexities of

the real estate market while solving fundamental problems that plague traditional systems. It is an illuminating example of how Ethereum's blockchain technology can radically improve conventional business models, offering both incrementally better and disruptive solutions.

Commentary and Key Takeaways for Businesses

The case of Blocksquare offers valuable insights into Ethereum's readiness for business applications, particularly within the real estate sector. Blocksquare's use of both private and public Ethereum usage demonstrates the flexibility and versatility of Ethereum's technology stack. The platform's successful tokenization of real estate assets, worth over \$75 million, is a testament to Ethereum's ability to provide robust, scalable solutions that meet the demands of enterprise-grade applications. This indicates that Ethereum has matured enough to support complex business operations, aligning with enterprise security, scalability, and compliance requirements.

While Ethereum continues to stack up viable cases of companies utilizing the technological infrastructure to tokenize high-value assets such as real estate and other RWAs, businesses still have to navigate a complicated web of legal and regulatory requirements, often necessitating partnerships with legal firms and compliance experts. We think Blocksquare is a good example of how companies leverage Ethereum smart contracts' power to streamline legal and compliance processes.



Case Study: BRØK

Transparent cap table management in Norway, harnessing a Layer 2 public Ethereum to enhance company share ownership and compliance.

Description	BRØK is a blockchain-based solution designed to tokenize receipts of shares for unlisted companies in Norway, offering a scalable and transparent record-keeping system on public-permissionless Arbitrum One, an Ethereum Layer 2 solution, with a smart contract-enhanced registry maintained by government and service providers.
Target users	Unlisted Norwegian companies, service providers handling cap tables, government agencies overseeing corporate ownership, and potentially foreign investors interested in Norwegian ventures.
Technology	Ethereum's blockchain technology on Layer 2 (Arbitrum) for scalability, employing smart contracts, and considering transitioning from the ERC-1400 to the T-Rex standard (ERC-3643) for tokenizing shares.
Benefits	<ul style="list-style-type: none"> • Reduced administrative burden • Increased transparency in stock transactions and ownership • GDPR Compliance • Efficient and accurate record-keeping • Real-time auditing capabilities • Streamlined taxation, reporting processes, and management of shareholder information
Product Type	Blockchain-based cap table management platform that utilizes tokenization for share ownership and transfer and to track unlisted stock ownership.
Launch Date	TBD
Production Phase	Prototype: The first company has begun initial tests.
Notable partnerships	<ul style="list-style-type: none"> • Symfoni (the consultancy developing BRØK) • Norwegian government agencies for registry maintenance • Service providers for cap table management • Arbitrum
Milestones/Achievements	The successful prototype implementation of the ERC-1400 Ethereum security token standard and GDPR compliance.
Next steps	Addressing scalability challenges for broader implementation, aligning with EU laws, and potentially transitioning to the T-Rex standard (ERC-3643) once regulations are aligned.

Case Study: BRØK *(continued)*

In Norway, there is a compelling movement to mandate unlisted companies to adopt a capitalization (cap) table management solution to promote transparency in ownership.

BRØK, developed by the Ethereum-focused consultancy Symfoni, applies blockchain technology where shares are tokenized to ensure more efficient record-keeping. Leveraging the Ethereum blockchain on Layer 2 Arbitrum, this project aims to make a significant leap in transparency, auditability, and composability for share management. It features a smart contract-enhanced registry maintained cooperatively by the Norwegian government and third-party service providers, introducing a public governance layer in corporate ownership structures.

“In Norway, there’s a growing focus in the public debate on the necessity of making shareholder registers continuously and publicly available for companies,” Jon Ramvi of Symfoni, in the role of BRØK Technical Lead, notes in a discussion with the EEA. “This shift in focus is a reaction to heightened concerns about ownership transparency. In my view, mandating such transparency through a blockchain-based solution could mark a significant step towards more open and accountable business practices.”

Service providers in this Layer 2 blockchain ecosystem facilitate the data entry for company cap tables. Companies engage these providers who, upon being issued stocks, must secure approval from the government before transferring them to the rightful owners for self-custody. This mechanism echoes the operations of cryptocurrency exchanges where assets can be transferred to personal wallets, yet here, it introduces a third, government-controlled layer. Ramvi adds, “The government has a smart contract that acts as a registry and can enforce control when necessary. We’ve set up a system where they can whitelist, blacklist, or force transfer tokens, ensuring that the ownership records are always accurate and up to date.”

The whitelisting process is a means to regulate which assets are recognized, enhancing the real-time auditing capability of the blockchain essentially eliminating the need to manually update the cap tables — a stark contrast to the manual updates required in traditional systems like Excel. However, while the technology is ready, there are still regulatory hurdles that remain.

“For regulatory reasons, we’re currently not tokenizing the shares directly, but rather the receipts that confirm one’s share ownership,” Ramvi explains. “It’s primarily due to

the current wording in the laws. Think of it like tokenizing a proof of transaction, which represents the shares. This way, it remains compliant while we await revisions in the legal framework that will allow for direct tokenization of the shares themselves.”

The BRØK project operates on the Ethereum blockchain using the ERC-1400 token standard. Still, they are considering transitioning to the T-Rex standard (ERC-3643) due to its more active development. These preliminary discussions will move forward once they identify a way to accommodate existing regulations.

Norwegian law requires the numbering of individual company shares to ensure proper tracking and identification of ownership. This system allows for the accurate recording of share transactions and allocating rights and benefits to the appropriate shareholders. While traditionally effective in preventing errors and misunderstandings in share transfers and ownership changes, it is a historical legacy from when shares were physical pieces of paper.

Ramvi elaborates, “The law as it stands is archaic, with requirements that shares be individually numbered, a system that dates back over fifty years. This doesn’t mesh with the new digital reality of tokens, which by nature are fungible and don’t carry unique identifiers. We need to see a legal update that acknowledges and accommodates the fluidity and flexibility of modern technology. Thankfully, due to the growing focus in the public debate in Norway on the necessity of making shareholder registers continuously and publicly available, things could move swiftly.”

BRØK also recognizes the benefits of private permissioned systems but built its project on public permissionless Ethereum and Arbitrum due to the inherent transparency and composability. “Using public Ethereum and Layer 2 solutions like Arbitrum enhances transparency and trust,” Ramvi says. “The blockchain may be public and permissionless, but we’ve designed smart contracts with roles and rules to ensure compliance and control.”

Despite the risks associated with public blockchains, such as the potential for illegal activities to be recorded, the emphasis on compliance with laws remains paramount, especially concerning KYC processes embedded in smart contracts.

“Even on a public blockchain, our system respects the law,” Ramvi explains. “Everything is auditable in real-time,

Case Study: BRØK *(continued)*

and changes are immediate, which is a significant step up from the annual reporting we're used to. Our vision is 'report once only' — or even better, no reporting at all. Transactions on the blockchain could serve as immediate, automatic reports to the government, simplifying taxation and ownership tracking significantly."

BRØK is also a case of public blockchain's composability benefits. "Tokenization could open up Norwegian companies to foreign investors. It could simplify the process, making cross-border investments more secure and easier to manage," Ramvi adds.

Commentary and Key Takeaways for Businesses

BRØK's efforts in Norway to push for government and enterprise-level adoption of public Ethereum solutions can potentially benefit all Norwegian companies in terms of transparency, cost and time efficiencies, and the composability of tokenized assets. Jon tells the EEA, "We are looking at scaling BRØK to serve potentially 400,000 companies. This would require aligning with EU laws, and it's worth it for the transparency and efficiency gains."

This case illustrates the necessity of a forward-thinking mindset. In Norway, political events have pushed regulatory hurdles to a head, and in the end, this benefits blockchain adoption. Jon's perspective is enlightening, "To get the full benefits of blockchain, you've got to lean into it fully. Running on a private chain can be costly. There are public solutions like Arbitrum that are more cost-effective and scalable, without sacrificing control."

This highlights a crucial point for businesses: a strategic evaluation of scalability, cost, and control should dictate the decision between private and public blockchain solutions. Once companies understand the nuance of the different options available to them and the recent advancements made on both the technological and regulatory front, the decision is leaning increasingly toward public blockchain solutions.

Further Reading:

<https://github.com/brreg/brok>

<https://www.ledgerinsights.com/norway-stock-ownership-public-blockchain/>



Case Study: Circularise

Using public Ethereum and zero-knowledge proofs (ZKPs) to balance transparency and privacy in supply chain management.

Description	Circularise is an end-to-end traceability solution for raw materials built on Ethereum and with ERC-1155 for product traceability. The company is preparing to implement a ZKP privacy solution on Ethereum Mainnet to enhance its enterprise services further.
Target users	Manufacturers, suppliers, and auditors in multi-tiered supply chains.
Technology	Supply chain management platform.
Benefits	<ul style="list-style-type: none"> • Automate data verification to reduce auditing costs • Transparency and privacy.
Product Type	Blockchain platform for supply chains.
Launch Date	July 2016
Production Phase	In development, shifted strategy to exploring Layer 2 and ZKPs for scalability and privacy.
Notable partnerships	<ul style="list-style-type: none"> • Rare Earth Sustainability Project for traceability of rare earth metals • €11M funding from several VCs and EU grants • Pilot with SABIC for Scope 3 emissions • DPP showcase with LyondellBasell • Collaborations with Porsche, Borealis, Covestro, and Domo Chemicals for automotive plastics traceability.
Milestones/Achievements	<ul style="list-style-type: none"> • Raised more than €12.5M in funding, with a notable Series A round in November 2022. • Led C-SERVEES project to improve sustainability in e-product value chains. • Secured €1.5M from the EU Commission for blockchain material tracing. • Granted its first patent for its Smart Questioning technology, which utilizes ZKPs to allow suppliers to control which data they want to share.
Next steps	Investigating ZKPs for privacy solutions; looking to automate auditing features further.

Case Study: Circularise *(continued)*

Circularise, a Netherlands-based startup established in 2016, is building for the regenerative circular economy by leveraging Ethereum for end-to-end traceability for materials and products. The core problem Circularise aims to solve is the lack of accessible, proprietary, or complete material data, which hinders trust and confidentiality in supply chain sustainability efforts.

The company supports improved resource use, provenance verification, and the assessment of carbon footprints. Still, the next critical step is enabling supply chain participants to share sensitive data without compromising privacy.

Circularise initially ventured into product traceability, employing Ethereum's ERC-1155 standard for account balancing. Each user is linked to a managed account with a wallet containing tokens that point to physical batches. This approach offers a high degree of transparency and traceability, allowing for simultaneously tracking multiple products and providing real-time and historical data at every stage of the supply chain.

However, the transparency proved to be a double-edged sword. "It would have been too revealing, exposing sensitive client information," says Rudi Araújo, the Technical Lead at Circularise. As a result, the company pivoted its strategy, opting to use Ethereum as a consensus layer while exploring the implementation of ZKPs for privacy. This patented Smart Questioning technology allows Circularise to maintain a shared global state via public Ethereum without disclosing specific data unless supply chain partners wish to validate the data they are exchanging.

The company is currently tracking the balance of credits for circular materials. "We're using a global state tracking system on Ethereum to maintain these balances according to specific rules. It's about pinning these rules to an ultimate source of truth," Araújo explains. The ZKP implementation is still in development, and its success will be measured by its ability to automate data verification, thereby reducing auditing costs."

Automating data verification in supply chains is challenging, considering the intricacies involved. "The complexity of

supply chains is staggering. Any given supply chain has multiple tiers, from raw material extraction to private partners—up to 20, averaging around seven. Some large suppliers involve thousands of participants to produce a final product," Araújo continues. Given this complexity, the role of blockchain becomes pivotal. "It's not just about collecting data; it's about the credibility and verifiability of that data. Blockchain allows us to automate this process, making it as seamless and human-independent as possible. That's especially crucial when considering the labor-intensive nature of traditional auditing methods."

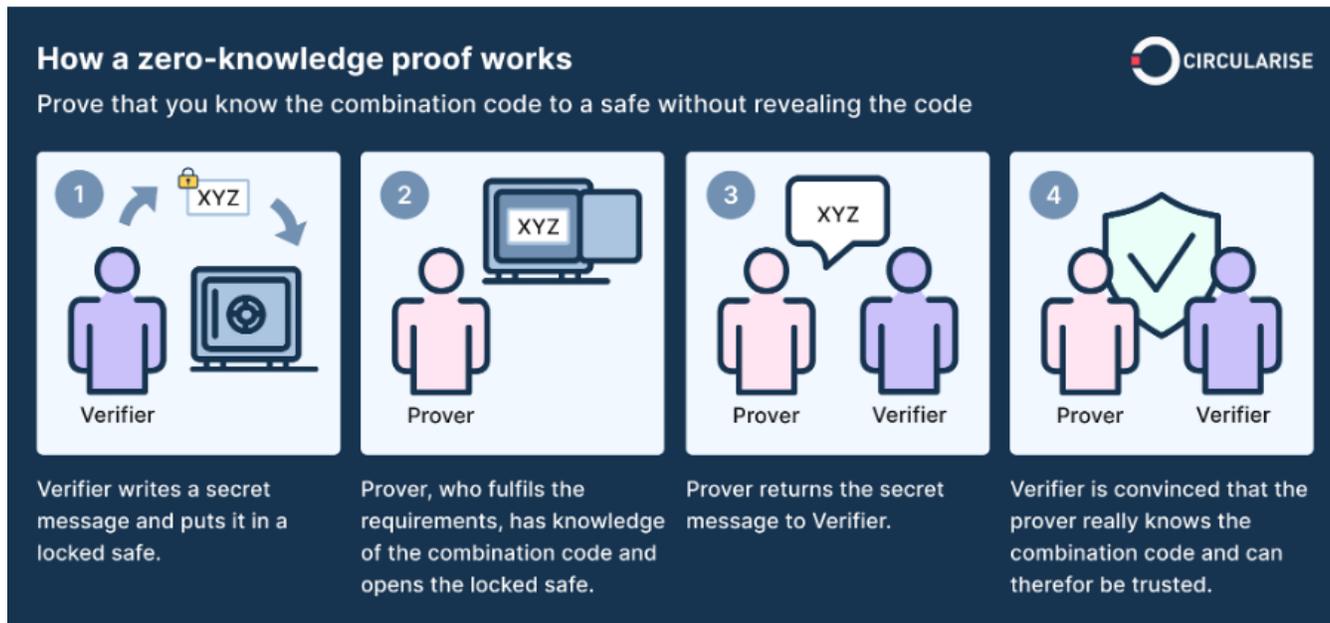
Circularise faces challenges with Ethereum Mainnet, primarily concerning scalability and privacy. "Running our operations solely on Mainnet is too expensive, and even if it were cheap, our customers wouldn't want their data to be public," Araújo notes. As mentioned, the company is exploring Layer 2 solutions and ZKPs to address these issues.

The ZKP implementation has progressed; "We have conducted pilot projects with several supply chain actors and are in the early stages of onboarding the first few clients in a real-world production environment."

While it is not sure exactly when Circularise's ZKP privacy solutions will be fully implemented, this is another clue that multiple companies are on the verge of bringing their ZKP-based solutions into production on Mainnet. "Mina and others are already making significant strides in privacy solutions. At Circularise, we're actively exploring various avenues in this fast-evolving space, particularly in zero-knowledge proofs," Araújo says. "But it's important to note that the industry is not at a point where you can simply plug in a ZKP solution for privacy and expect it to 'just work.'"

Circularise offers clients ZKP-based privacy solutions via Digital Product Passports, which are fingerprints of data derived from on-chain commitments. "Any data point you see in these passports can be publicly verified as originating from the master data on-chain," says Araújo.

Case Study: Circularise (continued)



Commentary and Key Takeaways for Businesses

Circularise’s journey offers valuable insights into the practicalities and challenges of implementing Ethereum and EVM-compatible technologies in supply chain management. The company’s pivot from using smart contracts for transparency to using Ethereum as a consensus layer highlights the need for a balanced approach to transparency and privacy.

The project’s success criteria focus on automating data verification, which has the potential to reduce auditing costs significantly. As Rudi pointed out, when looking at the significant amount of manual labor and steps an auditor must go through, it’s possible to remove half or more of those steps by verifying it on-chain.

However, while blockchain can potentially increase the perceived value of a product by proving regulatory compliance, many businesses still need to be convinced of its immediate value. Changes to the status quo can economically incentivize companies not to withhold information about the quality or source of their products, leading to more widespread, meaningful blockchain adoption.

Circularise’s ZKP privacy developments also speak to a trend we’ve observed: several companies across the enterprise level of various industries appear to be set to bring their respective ZKP-powered solutions to Mainnet.

While the technology holds promise for automating and streamlining various aspects of supply chain management in a way that provides speed, accuracy, and security affordably and preserves privacy where needed, its full potential is yet to be realized. Companies interested in similar implementations should be prepared for a landscape that is still evolving, both in terms of technology and regulatory frameworks.



Case Study: Finality

Wholesale markets using Ethereum's Hyperledger Besu and ERC-2020 for DLT-based payment systems backed by central bank money.

Description	A consortium of banks using Ethereum's Hyperledger Besu and ERC-2020 to launch multi-jurisdictional DLT-based payment systems backed by central banks.
Target users	Global wholesale financial market participants, primarily banks.
Technology	Ethereum, specifically Hyperledger Besu, and an adapted version of ERC-20 called ERC-2020.
Benefits	Real-time settlement, 24/7 availability, reduced settlement risk, and institutional-grade credit quality.
Product Type	Wholesale payment system, distributed financial market infrastructure.
Launch Date	Went live in late 2023, starting with the Sterling Finality Payment System in the UK.
Production Phase	In production.
Notable partnerships	A consortium of banks and market participants with shareholders in each jurisdiction targeted in the initial launch.
Milestones/Achievements	First fully regulated DLT-based payment system.
Next steps	Global expansion, introducing new use cases.

Case Study: Fnality (continued)

The financial world is rapidly adapting to new technologies like digital currencies and blockchain. One big hurdle is creating a digital form of wholesale cash as trustworthy as central bank money - the ultimate risk free asset that underpins global finance. Existing issues like slow cross-border payments, expensive fees, and complicated regulations are major incentives for banks and other financial institutions to embrace these new technologies where appropriate.

Fnality is leading a project to merge the reliability of central bank money with the versatility of decentralized ledger technology (DLT), specifically Ethereum. Formed by a consortium of major banks, the project is designed to establish a series of DLT-based wholesale payment systems. Each system is to be regulated by its respective central bank and aims to enable real-time wholesale payments through settlement balances directly held at the central bank. “We’re moving from the build phase to the run phase,” says [Jake Hartley](#), Business Development Director at Fnality International. “We are fundamentally focused on institutional DeFi, backed by a robust shareholder base. For the first time, we’re melding the institutional quality and safety of central bank money with the capabilities and resilience of distributed ledger technology, particularly Ethereum.” This new system is called a “Fnality Payment System,” where participants use settlement balances held directly at central banks to enable real-time wholesale payments. “The technology allows for real-time settlement, a significant improvement over current cross-border payment timeframes, or the T+1 or T+2 settlement periods common in markets like the US equities market,” says Hartley.

The target users for this initiative are global wholesale financial market participants, primarily banks. The technology stack is built on the Ethereum protocol, specifically using Hyperledger Besu, which has been adapted to accommodate the ERC-2020 standard, which is an adaptation of the well-known ERC-20 token standard designed to enable the issuance of regulated electronic money on blockchain networks, and its practical usage in real financial applications.¹

One of the most compelling features of the Fnality Payment System is its real-time settlement capability. Unlike traditional systems, where transactions can take days to settle, Fnality promises near-instant settlement,

24/7. “This ensures that the requisite liquidity is in place, and that transactions proceed on an instant, real-time, atomic basis,” explains Hartley.

Fnality’s brand of blockchain-based real-time settlement also reduces risk. “While other cash-on-ledger solutions such as stablecoins are backed by assets like commercial bank reserves, they are not risk-free. Our system removes this risk by anchoring the digital cash asset to central bank funds, in a bankruptcy-remote construct,” says Hartley.

“There’s a growing understanding among regulators of the benefits and necessity of such systems,” Hartley explains. In April 2021 the Bank of England published their [Omnibus Accounts Policy](#), a vital enabler of new payment and settlement models in central bank money, and in August 2022, the Sterling Fnality Payment System was [recognized](#) and designated by HM Treasury, bringing it into the regulatory remit of the Bank of England and the Payment Systems Regulator due to its likely systemic importance.

Fnality has been cooking with DLTs for a long time. Giulia Secco, who has been involved in the project since its inception, shared some historical context: “The project was initiated in 2016 to explore the applications of DLT and blockchain in a regulated environment. Initially incubated in a blockchain company called Clearmatics, the venture gained traction when banks like UBS, Santander, and others joined the consortium.” Over time, it became clear that to comply with jurisdictional regulations, it would be necessary to establish a legally independent entity. This was how Fnality was born.

Hartley underscored the challenges, “The tech part is relatively straightforward. The real complexity lies in navigating legal and regulatory frameworks. For years, we’ve worked closely with regulators and central banks to get to production.”

Finally, Hartley emphasized the importance of interoperability: “We’ve long recognized that this is an ecosystem play. Being interoperable is crucial for building this ecosystem and facilitating the convergence of traditional finance (TradFi) and decentralized finance (DeFi). We have completed various case studies and proofs of concept, including for [real-time settlement of tokenised securities](#), [real-time cross-border FX swaps](#), and [real-time repo transactions](#), each of which evidences the potential

¹ERC-2020 E-Money Standard Token: <https://eips.ethereum.org/EIPS/eip-2020>

Case Study: Finality (continued)

inherent in leveraging DLT to facilitate traditional financial activity and achieve faster, safer and more efficient exchange of value in global wholesale markets.

Going forward, the project aims to scale up its live systems, introducing new use cases and expanding its network, thereby solidifying its position as a foundational layer at the intersection of traditional and decentralized finance. “Our next steps involve global expansion and the rollout of payment systems in multiple currencies,” outlines Hartley.

Further reading:

- [Finality commences initial phase of Sterling payment operations in a world-first for both wholesale finance and digital asset markets](#)
- [Seamless exchange of value for banks and businesses in future financial markets](#)

Commentary and Key Takeaways for Businesses

Finality’s case underscores the industry trend toward integrating decentralized technologies like blockchain into traditional financial infrastructures. “There will be a foundational trust layer at the intersection of traditional finance (TradFi) and decentralized finance (DeFi). This convergence is widely viewed as inevitable,” Hartley proposed.

This innovation opens up new horizons for real-time, secure, and globally interoperable business transactions, particularly those in the banking and financial sectors. However, the journey is not without its challenges. Regulatory navigation is significant, requiring careful planning and engagement with authorities. The ability to marry technological innovation with regulatory compliance could be the linchpin for success in future financial market infrastructures.

Hartley pinpointed the unique value proposition: “What we’re offering is the missing ingredient for digital asset markets at an institutional level. Various projections suggest that a significant portion of assets will be tokenized by 2030. However, what’s lacking is an on-chain cash asset with the credit quality of central bank money, and that’s precisely what our system provides.”



Case Study: Opera MiniPay Wallet

MiniPay leverages the Opera Mini browser and Celo blockchain to simplify mobile payments and drive financial inclusion in Africa.

Description	MiniPay is a partnership between Opera and the Celo Foundation that aims to make mobile payments more accessible and secure for people in Africa. Integrated within the Opera Mini browser, the platform uses blockchain technology to offer a non-custodial wallet and leverages phone numbers for easy transactions.
Target users	Mobile users in Africa, especially those with limited access to traditional banking systems and those already using the Opera Mini browser.
Technology	Opera Mini browser and Celo, an EVM-compatible blockchain transitioning to an Ethereum layer 2 (as of this report)
Benefits	Increased financial inclusion, enhanced security, simplified user experience, and cross-border transactions enabled through a globally recognized blockchain and access to the broader DeFi ecosystem.
Product Type	Mobile Payment Platform
Launch Date	2023
Production Phase	In production – launched in October
Notable partnerships	Opera and Celo Foundation and a selection of partners in Africa.

The mobile payment landscape in Africa is rife with both opportunities and challenges. While services like Mpesa have made significant strides in providing financial access, the underlying technology remains centralized and confined within national borders. MiniPay is a partnership between Opera and the Celo Foundation aimed at resolving some of these issues while making a considerable push toward financial inclusion in Africa.

Charles Hamel, Product Director at Opera, explained the project's historical background: "Opera has been leading the web3 browser wallet innovation for several years. We looked at our user base, which is enormous in emerging markets and especially in Africa. So we asked, 'How can we integrate this in a way that's meaningful for that region but separated from the speculation aspect of crypto in general, instead providing something that people want, which is access to dollars?' Stablecoin activity and infrastructure

has, in our view, reached the point where mainstream usage of an app like MiniPay can become a reality."

As Hamel explains, MiniPay also benefits from the fact that Opera Mini is a very lightweight application with data saving technology built-in. "People make an active choice to get Opera Mini because they know that if they use that app, their data will stretch for longer, so they can browse more for less. The MiniPay wallet was built with that same principle in mind."

MiniPay is integrated into the Opera Mini browser, which is already a household name in many African countries (used by millions). It aims to simplify the crypto experience to a point where even those not interested in blockchain can use it. "MiniPay is a wallet that lives inside Opera Mini. That wallet is essentially a dollar stablecoin wallet that feels like a web2 experience – You enter the app, and there's a

Case Study: Opera MiniPay Wallet *(continued)*

familiar interface with one button to sign in with Google – but it is actually a noncustodial web3 experience,” Hamel explained. The first sign-in creates a wallet and saves the user’s keys in their Google Drive.

“One of the problems with noncustodial products is that people lose their keys; it’s not so much hackers or nefarious actions. It’s more often human error. People forget to back it up, or accidents happen,” Hamel said, stressing that this is one of the greatest blockers for adoption and makes people cautious; the UX has yet to reach the usable level for them.

One of the ways MiniPay simplifies the user experience is through the use of phone numbers for transactions. Charles noted, “The only thing we ask from the user when they start is to sign into Google and validate their phone number, and for that we use Celo’s [SocialConnect](#), a

privacy-preserving way to map phone numbers to wallet addresses.”

MiniPay also utilizes Celo’s [FiatConnect](#) (an open on-/off-ramp API standard), and users can add as little as \$1 and transact at very competitive rates. Unlike mobile payment systems, MiniPay offers an added layer of security and efficiency thanks to blockchain technology. “The difference is that the actual value transfer is not in a telephone operator’s private database. It’s on this global public blockchain,” Charles stated.

As for expansion, Charles stressed the importance of focusing on a dollar-based stablecoin for now: “We want to keep it simple. This is still in the early stages. There’s a high cognitive cost to introducing more currencies, and right now, we want to do simple.”

Commentary and Key Takeaways for Businesses

MiniPay’s strategy of integrating an Android-based non-custodial wallet into a regionally prevalent mobile browser like Opera Mini reflects large-scale simplified access to resources on a public blockchain. For context, as of this writing, the EVM-compatible Celo blockchain has begun migrating to the Ethereum Mainnet as a layer 2.

It also sheds light on a key issue many businesses in the blockchain space face: the UX is a blocker for attracting and maintaining users. MiniPay has attempted to solve this by ensuring the interface is as user-friendly as possible and minimizing the steps required to transact. This ease of use is a significant factor in adopting such technology by people not particularly interested in blockchain or cryptocurrencies.

MiniPay allows for seamless transactions using phone numbers, keeps its product lightweight, and utilizes the speed and affordability of a soon-to-be Ethereum layer 2 with the security features of public Ethereum. The strategy is appropriate for regional needs, abstracting away the tech while bootstrapping into an already-established network.



CASE STUDY: Roxpay

Roxpay offers scalable blockchain solutions for pay-per-use assets.

Description	Roxpay is a Zurich-based fintech firm specializing in scalable solutions for pay-per-use assets. Using Polygon, the company offers data validity, software, automated payments, and sustainable finance options. With its first pilot project, Roxpay aims for CO2-neutral road transportation, merging technology with social impact.
Target users	<ul style="list-style-type: none"> • Logistics companies • Retail and institutional investors • Industrial companies transitioning to pay-per-use models
Technology	Polygon network, explicitly focusing on pay-per-use assets and supply chain integration.
Benefits	<ul style="list-style-type: none"> • Streamlined pay-per-use invoicing and payments • Financing solutions to bridge the cash flow gap in pay-per-use models • Investment opportunities in stable yield assets for both retail and institutional investors • A pay-per-use model enabled through blockchain alleviates the need for upfront machine investments • Enhanced customer reach, revenue, relationship strength, service offerings, and profit margins
Product Type	B2B software platform specializing in blockchain-based pay-per-use asset management and financing solutions.
Launch Date	The first pilot is going live at the beginning of October with plans for rapid scale-up.
Production Phase	Roxpay is live with two trucks and has a backlog of hundreds of vehicles for future deployment.
Notable partnerships	<ul style="list-style-type: none"> • The commitment of 1,500 gas stations in Switzerland to provide green methanol • Extended talks with financial institutions and blockchain-associated platforms for payment solutions and tokenization • Nexmobility and Whitecell Power • Unannounced partnerships with a German and Swiss company
Milestones/Achievements	<ul style="list-style-type: none"> • Nearly half of Switzerland's gas stations are on board to commit to their green methanol solution • Built and launched MVP in record time • Generated interest from major logistics companies globally
Next steps	<ul style="list-style-type: none"> • Roxpay aims to move to Ethereum's Mainnet to capitalize on its larger Total Value Locked (TVL) • Implement on-chain payments • Expand use cases to other industries and products by the beginning of 2024

Case Study: Roxpay *(continued)*

The logistics and industrial sectors face significant asset management, regulatory, and sustainable financing challenges. Similarly, companies using pay-per-use (PPU) assets grapple with the same issues and cumbersome payment processes. Moreover, there is a growing concern about reducing CO2 emissions in the transport sector, making the search for green solutions urgent. The need for adequate technology to bridge the financing gap created by the PPU model has led to some attractive solutions.

Roxpay has introduced a blockchain-powered platform designed to address these issues. Built first on the Polygon network for its lower transaction fees, the platform provides tools for PPU assets and, soon, sustainable finance solutions tailored to companies employing PPU assets. It streamlines the payment process and provides a secure and transparent layer through blockchain technology.

Concerning the benefits of using Ethereum for streamlined pay-per-use invoicing, Roxpay CEO David Marchand quickly points out the impact of scaling solutions. “Ethereum’s Layer 2 scaling technologies can drastically lower transaction fees and speed up confirmation times. This was vital for making microtransactions in our invoicing system more viable,” he explains.

Marchand is also excited about the financing solutions Roxpay can offer. “By building on Ethereum, we tap into this rich DeFi ecosystem. We’re not just talking about the biggest TVL here; we’re talking about offering our users more efficient and flexible financing options,” says Marchand.

Investment opportunities are another area where Ethereum shines, according to Marchand. “We can tokenize real-world assets like vehicles and pay-per-use assets. That opens up a whole new investment avenue for our users. Plus, it helps us solve those tricky financing challenges we often face in pay-per-use models,” he adds.

As for implementing a pay-for-use model, Ethereum’s scalability is a standout feature. “Honestly, the high transaction throughput really wins the day. Users can trust that their payments and usage tracking will happen efficiently and reliably,” notes Marchand. And it’s not just

about scalability. “When you look at the reduced gas fees and the resulting user-friendly experience, it’s clear that Ethereum is enabling real-world applications to succeed.”

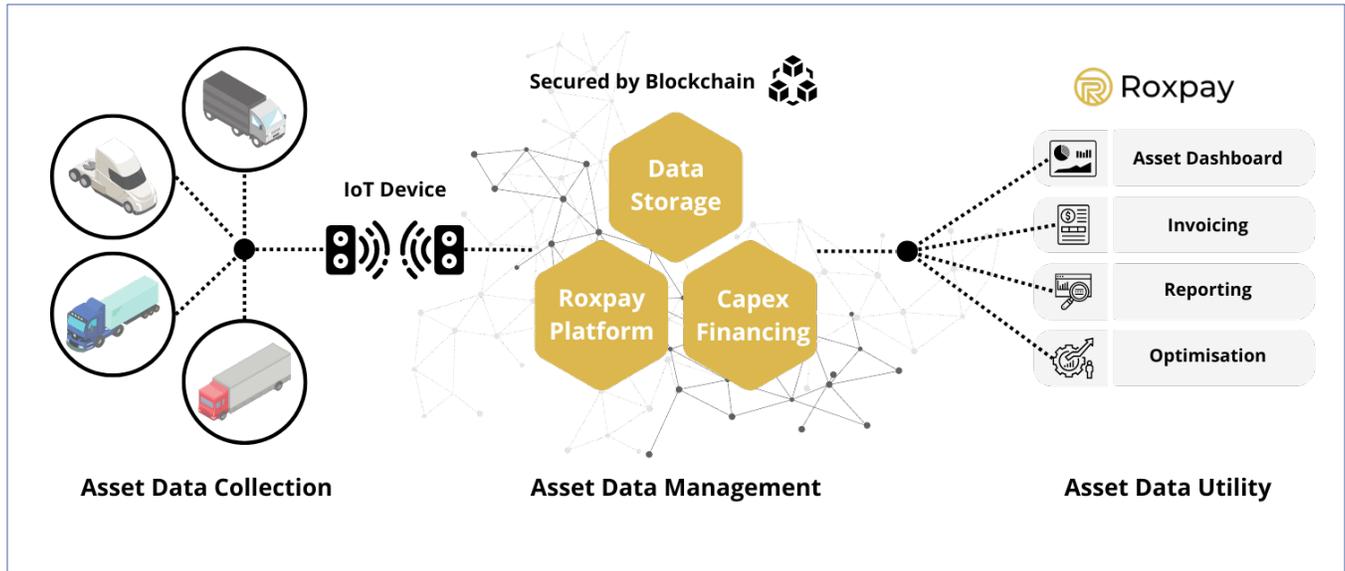
Roxpay’s initial use case involves electric trucks powered by green ethanol. The platform receives daily truck data and then calculates, invoices, and automates payments, making the entire process machine-to-machine. This eliminates any human error, providing a unique selling point for the product. Roxpay’s close partners, Nexmobility and Whitecell Power, also focus on green solutions. They are building green range extenders for electric commercial vehicles, from LCVs to Heavy Trucks, powered by green methanol. This feature allows electric trucks to have a driving range of 1,000-1,500 km, significantly more than the 200-300 km range of current electric trucks. And these vehicles can be refueled within 10 minutes. The range extenders are based on their own fuel cell technology or innovative clean combustion engines, depending on application and preference.

“The MVP is operational, with our first two trucks already on the road,” reports Marchand. “A logistics client has told us that the on-chain storage of usage data significantly boosts their confidence in the data’s security and reliability. By utilizing a public blockchain, they trust the automatic, machine-to-machine daily payment execution, eliminating the need for manual intervention. They also appreciate the credibility and stability that building on Ethereum/Polygon brings, which, in turn, aids in customer acceptance and drives adoption.”

This use case has a lot of potential. Roxpay and its partners have secured commitments to 1,500 major gas stations in Switzerland. They are in talks with several other potential partners for additional payment solutions and tokenization.

Companies interested in using Roxpay’s solutions can use a step-by-step onboarding process that configures blockchain technology for their specific asset management needs. Compliance and monitoring are achieved through the blockchain’s immutable records, supporting integration and operation.

Case Study: Roxpay (continued)



Commentary and Key Takeaways for Businesses

Roxpay’s platform addresses multiple critical issues in the logistics and industrial sectors, from financing to sustainability. Given the rapid scale-up plans and ongoing collaborations, combined with the time and cost savings that public Ethereum makes feasible, we think business models like Roxpay could considerably impact their respective industries. Roxpay’s pilot project further displays how these technologies can enhance the adoption of other appropriate technologies, advancing important societal goals while abiding by specific regulations (ESG).

To that end, we predict that the industry will take notice of the cost and time-saving advantages, as well as the provenance factor of utilizing public Ethereum and EVM-compatible Layer 2 solutions like Polygon in the supply chain of companies operating PPU models and beyond. The industry can gain more than operational efficiency by automating invoicing and payments while adding a secure and transparent layer through public Ethereum. It opens the door for scalable and sustainable asset management solutions, something that has been a longstanding challenge.

Roxpay is one of many cases where companies offering enterprise-type services are implementing public Ethereum on the back end to better serve customers in a way they couldn’t before, and it’s also an exciting example of an enterprise startup scaling a real-world use-case with public Ethereum as a business-critical layer.

It’s also important to note that side chains like Polygon serve as an on-ramp for companies to begin taking advantage of public Ethereum and open the door for further Mainnet deployment as their existing implementations mature.



CASE STUDY: Rubey

Fractionalized art investment through tokenized securities on private-permissioned Ethereum.

Description	Rubey is an art tokenization platform aimed at democratizing investment in museum-quality artworks starting from 150 euros, making art accessible to a retail audience.
Target users	Retail investors, museums, governments.
Technology	Tokeny's Ethereum-based security tokenization platform
Benefits	<ul style="list-style-type: none"> • Retail accessibility to high-value art investments • Increased liquidity in traditionally illiquid assets • Increased revenue for government-owned museums • Regulatory compliance, ensuring investor protection
Product Type	Art tokenization platform.
Launch Date	2019 (Proof of Concept)
Production Phase	In production and expanding.
Notable partnerships	<ul style="list-style-type: none"> • The Royal Museum of Fine Arts Antwerp (KMSKA) • Autoworld Museum Brussels • One of the four largest banks in Belgium
Milestones/Achievements	<ul style="list-style-type: none"> • Successful proof of concept with a €1.41 million artwork tokenization • Seed capital was raised early in the year following the proof of concept
Next steps	<ul style="list-style-type: none"> • Continue to develop relations with other museums in Belgium and abroad • Embarking on larger projects, including tokenizing a batch of early supercars in partnership with a museum • Preparing to launch a high-value, confidential art tokenization project • Develop educational initiatives to explain blockchain benefits to investors

Case Study: Rubey (continued)

Rubey emerged with a vision to democratize the high-end art market, making it accessible to retail investors. It recognized the potential of blockchain technology, particularly Ethereum and Polygon, to transform the opaque and exclusive art investment world.

With an initial focus on Europe's distinct museum model, where a significant portion of the art is government-owned, Rubey embarked on a proof of concept in partnership with the Royal Museum of Fine Arts Antwerp (KMSKA), [tokenizing a €1.41 million artwork](#) by James Ensor. This endeavor wasn't solely about art but also about navigating the complex legal and financial terrain, ensuring investor protection, and adhering to regulatory standards.

The platform devised a method to tokenize artworks into one million virtual fractions represented by security tokens. Unlike the more common utility tokens or NFTs, these art security tokens (ASTs) – [based on Tokeny's permissioned ERC-3643 token standard](#) and the digital identity system ONCHAINID – were designed to fit snugly within the existing legal framework governing securities, thus providing a safer haven for investors.

The standard connects a digital user identity to the user's wallet, creating whitelisted wallets. Candidate Rubey investors need to go through Rubey's KYC process, and only when they are verified will their wallet become whitelisted. By protocol, only whitelisted wallets can, therefore, hold Rubey ASTs.

The artwork now has about 250 "owners" who are private and public investors, with the lowest-priced tickets priced at €500 on average. The success of this proof of concept not only validated Rubey's innovative approach to democratizing art investment but also beckoned a more substantial engagement with museums and banks, paving the way for larger projects.

"Rubey's unique art tokenization approach makes cultural heritage available again to the public via museums," says Maarten Van Doorslaer, Co-founder of Rubey. "Otherwise, it is kept in a private cellar or freeport. Additionally, this facilitates a contemporary approach to community

building for museums. Every token holder shares a unique connection with Ensor or the KMSKA."

The technological backbone of Rubey's tokenization process was supported by Tokeny, a company specializing in issuing and managing tokenized securities on the blockchain. This partnership alleviated the technological burden, allowing Rubey to concentrate on its core mission. The choice of Ethereum and Polygon as the underlying blockchain infrastructure (via Tokeny) was crucial. Ethereum's public nature fosters transparency, a trait highly cherished in the art world, where it is often difficult to establish provenance and prevent fraud. Polygon's Layer 2 scaling solution expedited transaction speeds, reducing the traditional settlement times from days to mere minutes.

Van Doorslaer explained the company's efforts to educate its users about blockchain: "Our main goal is to explain to our investors and users that we embrace blockchain as a technology and that it is not difficult to understand. On the contrary, it's an excellent technology to support our operations, as it allows for process automation and is highly secure."

By utilizing Tokeny's platform, Rubey abstracts away much of the complicated interactions with the underlying blockchain technology for users and Rubey's operators while still preserving – and encouraging – the option for users to whitelist (KYC) their own web3 wallets for partaking in Rubey's investment offerings.

"At the moment, we still offer a digital wallet solution to our token holders, but soon, we will discontinue that feature and encourage users to start using their own digital wallets," Van Doorslaer said.

Rubey's endeavor extends beyond just tokenizing art; it's about reimagining how cultural heritage is valued and funded. "Future projects include tokenizing batches of early supercars and other museum-worthy artworks, all in collaboration with museums," Van Doorslaer continued. "We are also in contact with financial organizations and family offices. We believe Art Security Tokens deserve a place in every investor's portfolio. Works of art correlate

Case Study: Rubey *(continued)*

less with other financial assets, making it intriguing for investment diversification. Why opt for Art Security Tokens instead of buying art or collectible cars yourself? Well, as an investor, you don't have to purchase an entire piece, which diversifies risk, and you can sell tokens intermittently without the need for Rubey to sell the artwork, thus getting more liquidity."

"Through the use of Tokeny's Ethereum and Polygon-based tooling, our art security tokens not only democratize high-end art investment in a transparent and compliant manner but also represent an impactful venture into preserving and appreciating cultural heritage," Van Doorslaer said.

Within the broader trend of tokenized real-world assets (RWAs), where blockchain technology is also being leveraged to unlock the liquidity of illiquid assets, Rubey reveals excellent potential in tokenizing high-end art or other forms of cultural heritage. The long-term vision hints at a meta-project where governments could tokenize a portion of their cultural assets to cover maintenance costs while retaining ownership and public access. For instance, tokenizing historical monuments could open new avenues for funding their preservation.

Commentary and Key Takeaways for Businesses

Rubey's journey from a proof of concept toward larger upcoming projects highlights the transformative potential of blockchain in the art and cultural heritage sector. It's a narrative of innovation, legal and financial prudence, and a step towards a future where the appreciation of high-end art and cultural heritage is not confined to a privileged few but shared with a broader audience who become co-owners.

We find Rubey's approach to asset tokenization particularly compelling as it bridges the traditional art world with modern blockchain technology. The case underscores the potential of Ethereum-based solutions in unlocking liquidity and democratizing access to high-value assets. This project serves as a testament to how public-permissioned Ethereum infrastructure can be utilized to adhere to existing legal frameworks, thus providing a secure and transparent platform for retail investors.

We also appreciate the emphasis on education and transparency that Rubey extends to its investors, underscoring the importance of making blockchain technology accessible and understandable to a broader audience. This initiative promotes inclusivity and fosters trust, which is critical for mainstream adoption. Through strategic partnerships and a clear vision, Rubey showcases how Ethereum can bring tangible benefits to the art sector and the wider community.



Case Study: Sage Management

Using public Ethereum and ConsenSys Linea's zkEVM to make secure, private, and scalable solutions for various telecom company operations functions.

Description	Sage Management uses public Ethereum and Linea's zkEVM to optimize telecom company operations functions, focusing on cost savings, efficiency, privacy, and scalability. Sage's usage of these technologies is being trialed on Ethereum's Goerli testnet through MEF's Project Wolf Town for Service Level Agreement (SLA) automation and Project Soft Owl for streamlining order and billing processes.
Target users	Telecom carriers, enterprises, government agencies, and potentially any industry worldwide.
Technology	Public Ethereum and a version of Linea zkEVM deployed in an enterprise-grade environment for telecom data management.
Benefits	Optimize operations, manage inventory, rate orders in real-time, boost revenue, cut waste, save on telecom bills, automate SLA credits, reduce disputes, correct billing errors, and enhance telecom equality with privacy, security, and scalability.
Product Type	Enterprise-grade telecom cost management on public Ethereum and zkEVM Linea.
Launch Date	Pilot: 2023; Mainnet: 2024
Production Phase	Pilot (MEF Project Wolf Town & Soft Owl)
Notable partnerships	<ul style="list-style-type: none"> • Sage Management Alliance Partner program • MEF Accelerator program
Milestones/Achievements	<ul style="list-style-type: none"> • Involved with MEF Project Wolf Town and Project Soft Owl • Participated in MEF's Global NaaS Event in October 2023
Next steps	<ul style="list-style-type: none"> • Convert Sage's zkEVM-powered DApp supported through Project Wolf Town to Ethereum Mainnet. • Implement mutually endorsed product inventory digital cooperatives for multi-party business automation. • Develop a Multi-Party Business Automation-as-a-Service model, allowing even small carriers to streamline integration with customers globally.

Case Study: Sage Management *(continued)*

In telecom, 70% of wholesale invoices between carriers have inaccuracies, and 20% of all orders issued also have errors. The error rate is astronomical when talking about billions (in dollars) exchanged monthly between carriers. As a result, large telecom companies consistently have \$50-100 million in active disputes against each other. In these situations, pinpointing the exact details of the event or assigning responsibility is nearly impossible.

“The sheer number of disputed invoice charges takes a toll on both sides,” explains Sage CEO Tiffany Brown. “Buyers spend time finding, submitting, and managing these disputes, while sellers must invest resources in receiving, researching, and resolving them.”

Consequently, losses are often split, and tensions run high, leaving all parties unsatisfied. This friction hinders the formation of solid business relationships, keeping the industry perpetually at odds and hampering long-term planning for both parties. “The money tied up in these disputes can linger for months or even years, creating financial uncertainty for both the buyer’s final costs and the seller’s revenue streams,” Brown continues.

Sage has developed blockchain solutions scheduled to go live on the Ethereum Mainnet to fix these problems. “Smart contracts with real-time mutual endorsement can eliminate these disputes and free up valuable resources for both parties,” Brown adds.

Among other things, smart contracts can be used to eliminate uncertainties and confirm the pricing of services at the time of order or service outage.

“Until recently, we were limited to expensive private blockchains due to privacy concerns,” says Scott Johnson, President of Sage. “But with an enterprise-grade zkEVM solution on top of public Ethereum, we can finally onboard carriers of all sizes and budgets to a secure blockchain-anchored solution while keeping proprietary data private. It’s a dream two decades in the making, and based on what we’re seeing in the pilot, it will be a game-changer in solving these long-standing industry issues.”

Sage benefits from Linea’s zkEVM scalability and public Ethereum’s security, making it cost-effective and secure for large carriers. “Our choice to use Ethereum is driven by the simplicity and transparency of Solidity smart contracts and Ethereum’s wide adoption,” Brown says.

However, a key advantage to Sage’s implementations is the privacy controls in a public setting. “It allows us to run smart contracts in a restricted setting while enabling secure, private transactions on Layer 2. Essentially, we can execute confidential transactions, create verifiable proofs of those transactions, and publish them on a public network for anyone to verify while keeping tight controls on who has access to the underlying data. The Layer 2 solution is the most cost-effective way to do that rapidly and accurately.”

The Sage team believes public blockchain solutions can virtually eliminate invoice audits and disputes. “We are working ourselves into extinction now,” quips Brown. “Errors in orders, inventory, billing, ticketing, and outage tracking are rampant. Previously, every time a circuit went down, we’d have to manually investigate after the fact because the involved parties couldn’t agree on the specifics. This led to revisiting old invoices and even having technicians recall events from years past. Blockchain technology changes that, allowing for real-time transparency and accuracy by securing mutually agreed-upon information the moment it occurs.”

Sage’s use of Ethereum began recently, in Q1 2023, with the MEF Wolf Town Accelerator.

In collaboration with MEF (a global industry association of network, cloud, and technology providers), Sage participated in [Project Wolf Town](#) to develop an Ethereum-based solution automating the real-time generation and enforcement of SLA credits, a type of compensation offered to customers when services fall short of agreed-upon standards. Global digital infrastructure companies have joined this use case, featuring built-in and agreed-upon SLA logic to minimize disputes and ensure trust.

Through their efforts with MEF, Sage has recalibrated its inFuse application – a wholesale carrier SaaS platform – to facilitate mutual endorsements on public Ethereum for specific telecom billing events, such as orders and trouble tickets. The new platform will be a DApp on Ethereum Mainnet, set to launch in early 2024.

The solutions borne of Project Wolf Town could be a milestone in the complex global telecom landscape, particularly for regions like Latin America (LATAM). [Orchest](#), one of the three carriers involved in this blockchain-powered initiative, is a LATAM carrier aiming to bring telecom equality and quality to a global scale.

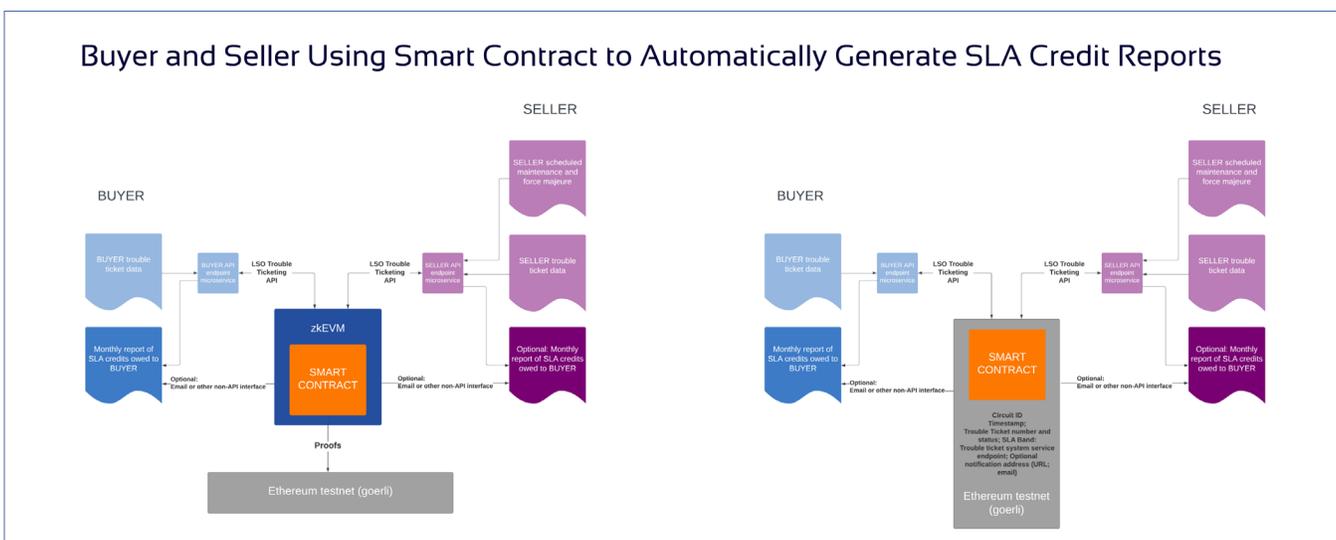
Case Study: Sage Management (continued)

“In regions like LATAM, SLAs are often overlooked due to data constraints,” says Sage’s SVP of Blockchain, April Taylor. “Wolf Town demonstrates automatic SLA objectives by calculating real-time credit for service lapses. This isn’t just about penalties; it enables carriers to improve their services. Providers will be incentivized to prevent outages and have the visibility necessary to make network improvements.”

“Blockchain solutions like these are democratizing market and technological access for carriers of all sizes,” Brown adds. “Before, you had to be a big player or be stuck in outdated legacy processes and systems. This new approach not only lowers the cost barrier but also protects your sensitive data. It’s a level playing field now.”

Sage’s DApp will aim to automate Service Level Agreement (SLA) credits to make the whole process quicker, more accurate, and more trustworthy for service providers and clients. Everything will happen in real-time, which means any issues or fulfillments are immediately noted, reducing mistakes and ensuring everyone is held accountable. Plus, because agreements and events will be recorded using smart contracts, there will be fewer arguments and more accessible resolutions related to service quality.

Lastly, the system will combine preferred business blockchain technology with the security of Ethereum, creating a reliable environment where both parties can monitor and verify SLA compliance, eliminating concerns about data manipulation or incorrect reporting.



Commentary and Key Takeaways for Businesses

Sage Management is a model for using public Ethereum and Layer 2 technologies like Linea’s zKEVM. This approach effectively balances security, transparency, and privacy in complex, high-value transactions.

By automating service agreements and billing through initiatives like Project Wolf Town, Ethereum-based solutions address a significant problem in the telecom industry: invoicing errors and the financial disputes they cause. These efforts not only save resources but also reduce tension between carriers. This could be a turning point for wider Ethereum adoption in telecom, particularly in areas where traditional methods have proven inefficient or unreliable.

The case study highlights Ethereum’s suitability for enterprise-level applications, demonstrating its value through specialized tooling and Layer 2 solutions that meet the telecom industry’s needs for scalability, real-time processing, and privacy. It also shows how Ethereum can enhance transparency, reduce disputes, and increase overall efficiency. Businesses should pay close attention to public releases from projects like these, as they offer valuable insights into the realized benefits of adopting such technologies.



Case Study: Tokenchampions

Tokenizing football players' image rights on public-permissioned Ethereum.

Description	Tokenchampions is a Luxembourg-based investment fund that tokenizes and manages the image rights of professional football players.
Target users	Primarily Europe, focusing on European division football players
Technology	Public-permissioned Ethereum facilitated by Tokeny's platform (ONCHAINID) for token issuance, KYC, and AML compliance.
Benefits	<ul style="list-style-type: none"> • Fixed interest returns for token holders • Direct investor engagement, bypassing 3rd-party brokers • Global accessibility thanks to the lower costs per investment that tokenization enables • Enablement of a user-friendly self-service platform, streamlining the KYC and asset custody process
Product Type	Tokenized securities
Launch Date	December 9, 2021
Production Phase	Operational with ongoing token sales, player contracting, and image rights management.
Notable partnerships	Tokeny
Milestones/Achievements	Tokenization of football player image rights via Tokeny's EVM-compatible platform to directly engage global investors with as low as €100, streamline compliance, and create a user-friendly, purpose-built blockchain investment platform.
Next steps	Expanding to training and tokenizing image rights of individual new football players, with a special focus on female football players.

Case Study: Tokenchampions *(continued)*

Tokenchampions, a Luxembourg-based investment fund, has devised an innovative strategy to capitalize on the commercial potential of football players' image rights. Leveraging Ethereum-based security tokens, the fund transforms these valuable rights—which often account for a significant portion of a player's income—into an affordable investable asset.

Football Clubs (professional football teams, such as FC Barcelona), for instance, need to secure these rights to broadcast matches or utilize players' images for promotional purposes. Recognizing the commercial potency of image rights, Tokenchampions devised a mechanism to acquire these rights from players through contractual agreements, thereby creating a tangible asset that could be tokenized and offered to investors as fractional ownership, representing a portion of the asset (in this case, the image rights of football players). This makes it more accessible for more investors, as they don't need to invest a large amount upfront.

"Through automation and digital signatures, we streamlined the onboarding process," explains José Antonio Pedraza Pérez, CIO of Tokenchampions. "This allowed us to attract investors from across multiple European countries, accepting investments as low as €100. Without blockchain technology, we might have been limited to engaging investors with significantly higher minimum investment requirements, potentially as high as €10,000, thus narrowing our market."

Pedraza continues, "This setup works mainly in Europe due to the fund's location and the players being part of European division teams. Football players have various income sources, one significant part of which comes from image rights, as clubs need these rights to broadcast matches or use players' images. Almost 15% of a player's income can be related to image rights."

The process begins with a contract that spans five years between Tokenchampions and the football players. This contract, representing the acquisition of image rights, is then tokenized, forming a security token.

"The contracts last five years, mirroring the token's five-year maturity," Pedraza says. "The income from club payments and sponsorships related to image rights comes to us until we recover the initial investment, after which we share the subsequent income with the players. This arrangement also benefits the players, who get financial security and professional image management, which is

crucial, especially for players new to European football facing challenges managing their new-found income and public image."

The tokenization process is facilitated through a strategic partnership with Tokeny, a platform specializing in Ethereum-based security tokens (ERC-3643). Tokeny's technology streamlines the onboarding process for investors, managing essential elements such as KYC and Anti-Money Laundering (AML) checks. Moreover, Tokeny's digital wallet technology simplifies token storage for investors, alleviating the need for them to grapple with additional blockchain-related complexities like managing cryptographic keys through other wallet solutions.

Tokenization also allows for a transparent and immutable record of transactions. This transparency builds trust among investors, as they can clearly see and verify transactions and ownership records. Through tokenization, every transaction related to the image rights and the distribution of returns is recorded on the blockchain, ensuring fair and transparent dealings.

"The key value in our partnership with Tokeny is having a straightforward way to start working with Ethereum," Pedraza tells the EEA. "We are football experts, not technology experts. Tokeny has eased our path into this new tech arena, demonstrating that all sorts of conventional business models can be enhanced through blockchain technology."

Tokenchampions uses a portion of the fees it generates in tokenizing image rights to extend a suite of services to nurture the players' careers and safeguard their image rights' value. This includes managing players' public images, advising on social media conduct, and even offering training facilities. It is unique that fans can invest in the future of their favorite players at such an affordable price point. Pedraza continues, "Our next phase is to train our own players from the start, especially focusing on female football players. We are exploring tokenizing the image rights of individual players from the start, allowing investors to bet on one particular player they believe in. This is a way of investing in the career of a rising football player, supporting her training and progress to become a professional player. When she becomes a professional player and starts receiving a salary from a professional club, investors start seeing returns from the image rights we manage."

Case Study: Tokenchampions *(continued)*

Tokenchampions is a compelling illustration of how Ethereum can be harnessed to create novel investment opportunities within traditional frameworks. Pedraza continues, “Our partnership with Tokeny has facilitated our journey into blockchain. Their platform has made onboarding for new investors much easier, especially with its KYC and AML features. Doing these operations on top of Ethereum also means transactions are quicker, easier, and more efficient. Initially, we considered offering

securities tied solely to the Luxembourg fund, which likely would have attracted a local investor base centered around Luxembourg. However, with these tokenization solutions, we’ve expanded our reach globally. This has allowed us to welcome investors from around the world, a feat made possible by the inclusive and borderless nature of blockchain but also by the regulatory clarity you get with Tokeny’s services.”

Commentary and Key Takeaways for Businesses

Tokenchampions’ use of public Ethereum for tokenizing football players’ image rights presents a practical example of how blockchain technology can significantly enhance traditional investment structures. In this case, automation and digitization of the onboarding process enabled investments as low as €100. According to Pedraza, this feat would have required a minimum investment of possibly €10,000 using traditional methods. The public-permissioned Ethereum infrastructure facilitated by Tokeny’s platform provided essential KYC and AML checks, giving investors and stakeholders a reliable and secure environment. The case study demonstrates a positive impact on key performance indicators such as cost efficiency and investor reach, which are paramount for a business aiming for scalability and broader market penetration.

However, this success story also comes with specific considerations. While facilitating lower investment entry barriers and greater transparency, the tokenization process requires robust compliance checks, particularly given the EU’s stringent GDPR regulations. Businesses need to be aware of such regulatory hurdles when leveraging public Ethereum and solutions like Tokeny, which implement a public-permissioned tokenization structure (in this case, ONCHAINID and ERC-3643).

That said, Tokenchampions is also a prime example of how enterprise-level Ethereum usage can directly affect the consumers and users downstream of these companies and may soon reveal the benefits of fostering a more community-oriented ecosystem within industries (e.g., between fans, sports clubs, and athletes). It also begins to lower the barriers between investors and active members of said ecosystems while remaining within the bounds of the law.

Read more: <https://tokeny.com/tokeny-powers-the-first-compliant-tokenization-of-football-players-image-rights/>



Case Study: Tokeny

Enterprise-grade EVM-compatible tokenization platform for digital assets like RWAs, compliantly and seamlessly onboarding and connecting issuers to the blockchain.

Description	Tokeny is an enterprise-grade platform that enables companies and financial actors to compliantly issue, transfer, and manage assets on EVM-compatible networks, emphasizing tokenized securities/RWAs but tailored to any permissioned use cases.
Target users/clients	Financial institutions/stalwarts, incumbents, investment banks, funds, asset managers, blockchain projects, and distributors
Technology	<ul style="list-style-type: none"> • ERC-3643: the token standard for permissioned tokens. • Any EVM blockchain
Benefits	<ul style="list-style-type: none"> • No-code to low-code solutions: Assets-agnostic, jurisdictions-agnostic, and multi-chain (EVM). Providing a white-label tokenization platform or APIs to plug in any legacy system. • On-chain compliance: Only investors qualified by issuers or authorized agents can interact with tokenized securities; Issuers retain control of digital securities (e.g., mint/pause/recover tokenized securities); • Cover entire lifecycle: Providing an all-in-one solution for onboarding, issuance to servicing, and secondary trading; • Interoperable with all applications in the same network, such as exchanges, marketplaces, DEXs, and DeFi protocols. Multi-chain capabilities. • UX for traditional players: Hide blockchain complexity from traditional players, such as Built-in self-custody wallet and gas tank.
Product Type	Enterprise-grade tokenization platform for digital assets on EVM blockchains.
Launch Date	2017
Production Phase	Operational and actively serving clients.
Notable partnerships/Integrations	Blockchain integrations: Polygon, Ethereum, Avalanche Euronext, Inveniam, Apex Group, PwC, ABN AMRO, Fireblocks, Ledger.
Milestones/Achievements	<ul style="list-style-type: none"> • Creator of open-source ERC-3643, the market token standard for tokenization • Worked with over 100 customers worldwide across various asset classes: funds, debt, equity, real estate, art, etc. • Achieved SOC2 Type I Compliance and received a 10 on 10 security audit score for smart contracts • Chosen by the Principality of Monaco as its tokenization solution partner • PoC for major French banks (BNP Paribas CIB, CA CIB, and Caisse des Dépôts) • Powered ABN AMRO's digital bond on Polygon
Next steps	<ul style="list-style-type: none"> • Help the ERC3643 Association accelerate the adoption of RWA tokenization by launching a free, decentralized application for deploying ERC3643 tokens. • Pursue further security certifications to become more enterprise-grade • Continue scaling connectivity of our solutions to integrate with more applications such as DeFi protocols (decentralized exchanges, lending protocols, etc.)

Case Study: Tokeny (continued)

Tokeny defines its mission as to simplify capital markets. Tokeny's founder, Luc Falempin, encountered the inefficiencies and complexities of traditional equity investments a decade ago. It was during this time that he stumbled upon blockchain technology through Bitcoin, witnessing its potential to revolutionize the way we exchange value.

Six years ago, the Initial Coin Offering (ICO) boom brought blockchain technology in front of the public, showcasing how ownership can be easily owned and transferred in a shared infrastructure, Ethereum. Together with Daniel Coheur, a seasoned capital market expert with experience at Clearstream Banking (owned by Deutsche Boerse), they created Tokeny to bring the same efficiency, transparency, and interoperability to the capital markets through compliant tokenization.

Their vision was to build a toolbox that allows any company and institution to quickly issue, manage, and transfer regulated securities on a blockchain compliantly and without technical hurdles. Today, they offer a turnkey enterprise-grade tokenization platform, allowing companies to issue any type of asset, irrespective of jurisdiction, on any EVM network.

"Major asset managers are leveraging our all-in-one and plug-and-play tokenization solutions to improve traditionally complex and time-consuming asset transfer processes drastically," says Falempin. "What used to take weeks of procedures, paperwork, and coordination can now be achieved in mere hours or even seconds, thanks to blockchain and smart contracts. This demonstrates the power of blockchain's real-time, decentralized ledger updating capabilities, which satisfy all legal requirements while eliminating complex procedures."

Tokeny's tokenization process entails converting real-world assets and securities into digital tokens on an EVM blockchain. These tokens represent ownership and legal rights of the underlying assets, making traditionally illiquid assets more accessible, tradable, and transparent. The benefits of tokenization are numerous, as showcased by some of Tokeny's highlighted clients:

1. Saving compliance and administrative costs

Consider BlocHome, a prime example of how tokenization can revolutionize the real estate market. By tokenizing real estate, BlocHome managed to reduce compliance costs by a staggering 90% thanks to on-chain compliance and a fully

digital process. The operational efficiency allowed them to serve hundreds of investors with the same-sized team that previously could only manage a few dozen, thanks to the elimination of manual and paper-based processes.

2. Broadening Investors' Reach

Rubey stands as an art tokenization success story, making the co-ownership of a museum-grade masterpiece accessible to a broader range of investors. It enables issuers to expand their investor base for fundraising and allows retail investors to diversify their portfolios with assets that were previously out of reach. You can read more about Rubey in their respective case study in this report.

3. Enhancing Efficiency and Transparency

ABN AMRO, a Dutch bank, took a leap into tokenization on Polygon. They issued digital bonds, delivering a fully digital experience for their clients. This shift not only improved operational efficiency but also ensured enhanced transparency in the process, as all stakeholders could have a real-time view of the digital bond.

4. Expanding Global Distribution And Improved Liquidity

Enegra showcases the global reach that tokenization can offer. The team issued equity and enabled the trading of tokenized equities on four different centralized exchanges.

5. Democratizing Investment Access

Terazo's tokenized funds, India's first regulated tokenization project, allow qualified primary investors the opportunity to invest in Oryx, a \$50 million greenfield development, from \$100,000 and allow secondary investors with as little as \$1,000. It democratizes access to the premium project while improving the liquidity of the funds.

Interoperability: The Missing Piece of the Puzzle

While tokenization offers immense promise, one significant challenge within the industry is the need for better interoperability, particularly with private-permissioned blockchains. Falempin tells the EEA, "I firmly believe that on-chain finance will thrive within the Ethereum Virtual Machine ecosystem, where most blockchain activity and the most active developer community reside."

Case Study: Tokeny (continued)

As competition in the tokenization industry intensifies, Tokeny asserts that the real competition lies in fragmented legacy systems that perpetuate inefficient markets. A common token standard is essential to avoid rebuilding silos and fragmented systems.

“Standardization is the next big thing for the industry,” Falempin says. To support real-time, transparent, and interoperable finance, Tokeny open-sourced its T-REX (token for regulated exchanges) protocol, now recognized as ERC-3643 by the Ethereum community. To ensure the quality of the smart contract code, Tokeny hired the smart contract auditing firm Hacken, which granted the ERC-3643 smart contract a perfect 10/10 security score. “Now, the industry has a free and high-quality standard to build their tokenization projects upon.”

The ERC-3643 standard ensures only investors whitelisted by token issuers or their compliance agents can become token holders. The whitelisting process happens entirely on-chain and is identity-based, via anonymous and verifiable credentials, to meet both compliance and

privacy needs. Issuers can also recover tokens, pause tokens, conduct batch operations, etc. Thanks to native interoperability, tokens can freely interact with other platforms for distribution and innovative financial services.

In collaboration with 40 other companies, including financial institutions such as Apex Group and Invesco, global law firms like CMS and DLA Piper, as well as other tokenization providers and blockchain companies, Tokeny formed a non-profit organization, [ERC3643 Association](#) to promote the adoption of ERC3643.

Dennis O’Connell, President of the ERC3643 Association, states, “Collaboration is the sole path towards achieving liquidity and interoperability. Each player must ensure that their technology can communicate effortlessly with one another, avoiding the creation of silos that mirror the fragmented systems of the traditional world. The only way to achieve this is through standardization, and the ERC-3643 protocol is the key to this by enabling all participants to interact in a seamless and compliant manner.”

Commentary and Key Takeaways for Businesses

Tokeny has made significant strides in bridging the technological gaps in the industry concerning regulations around tokenization and securities. This will be made evident to readers of this report, who will find several of Tokeny’s clients mentioned. We think this reflects the current regulatory environment, with tokenized securities being a stepping stone for more companies to adopt blockchain, build with EVM-compatible technology, and settle on public networks.

Tokeny’s efforts to open-source code and develop a more community-oriented effort among builders also speak to a trend. Enterprises are finding the composability, transparency, and security offered by public and public-permissioned settings to be more cost-effective and innovative than private-permissioned and legacy systems. “Embracing the ERC-3643 standard, we’re uniting the industry to create a fluid digital marketplace of securities, streamlining distribution, and opening up a world of innovative financial services,” O’Connell asserts.



CASE STUDY: XEROF

Optimizing international payments and settlement in global supply chains with Ethereum and ERC-20 stablecoins.

Description	Leveraging the Ethereum blockchain and ERC-20 stablecoins like USDT and USDC to facilitate faster, cost-effective international (cross-border) payments.
Target users	<ul style="list-style-type: none"> • International companies • Commodity traders • Supply chain clients • Entities involved in large global purchases and cross-border payments
Technology	<ul style="list-style-type: none"> • Ethereum Mainnet • ERC-20 stablecoins USDT and USDC (for international settlements and transactions)
Benefits	<ul style="list-style-type: none"> • Accelerated cash flow and reduced transaction times from days to a two-to-four-hour window • Substantially reduced fees and increased operational fluidity by minimizing the constraints and delays associated with traditional finance structures
Product Type	<ul style="list-style-type: none"> • Swiss-licensed financial services provider specializing in international payments with cryptoassets.
Launch Date	2020
Production Phase	Operational and regulated as a Swiss Virtual Asset Service provider under Financial Services Standards Association (VQF) supervision.
Notable partnerships	<ul style="list-style-type: none"> • Engel & Völkers • Century 21 • Berkshire Hathaway • Several of Switzerland's premier private banks
Milestones/Achievements	<ul style="list-style-type: none"> • Implemented blockchain-enhanced international settlement solutions that reduce transaction times to less than half a day • Has expanded its cross-border payments arm to become the preferred payments processor for international companies paying global suppliers in stablecoins, fiat, and other digital currencies
Next steps	<ul style="list-style-type: none"> • Expanding the reach of their services beyond their current clientele • Further integration with stablecoins and blockchain technology to refine and enhance service offerings

Case Study: XEROF (continued)

The supply chain has been lauded as one of the sectors most able to benefit from applying blockchain and cryptoasset technologies. Improvements to its logistics and finance operations have been hampered by traditional, outdated supply chain management models. Stakeholders across the board face enduring issues, from extensive processing times and paper-heavy documentation to a glaring absence of real-time data. These challenges severely impede operational fluidity and add needless expenses, pushing entities to seek innovative solutions that could revolutionize the supply chain. One of those solutions is to save time, money, and resources by streamlining the international settlement of cross-border payments.

Swiss-licensed financial services provider [XEROF](#) took on this challenge and today leverages the Ethereum blockchain to bring velocity and efficiency back to the financial layer of the supply chain. The company employs ERC-20 stablecoins such as USDT and USDC to facilitate start-to-finish international settlements, ensuring suppliers and vendors can receive seamless and secure transactions. Their efficiency allows these international companies to transcend many of the significant financial constraints of scaling their supply chain.

“The application that we are satisfying for our commodity traders and supply chain clients is the most critical one in the supply chain: the movement of cash and capital,” says Marc Taverner, CEO and co-founder of XEROF. “By exchanging their cash and capital into an accessible stablecoin, we can improve their payment speed while reducing their fees. That is only possible because we transact those stablecoins on the Ethereum blockchain.”

XEROF’s usage of Ethereum-based stablecoins shows that one of the most groundbreaking improvements web3 can make to supply chains is simply the velocity of money—optimizing the circulation of cash and capital curtails associated fees, presenting significant time and cost savings. For XEROF’s wide roster of international clients, this is exclusively possible in many of their most important regions using ERC-20 stablecoins via the Ethereum blockchain.

Within this framework, XEROF enables the swift conversion of substantial volumes of euros, US dollars, and other fiat currencies into stablecoins, with conversion and clearance times scaled down to a remarkable two to four hours. Once converted, clients employ these stablecoins to fulfill payments to their suppliers on the Ethereum blockchain, expediting their liquidity access and minimizing payment

costs. The cost-savings and time-savings significantly outshine the capabilities of many traditional finance structures, especially in frontier markets.

“By leveraging the Ethereum blockchain, we can efficiently convert and clear millions of US dollars or euros into stablecoins,” says Taverner. “Being able to pay their partners and suppliers promptly means our clients can build stronger business relationships and more efficient operations across the entire value chain. This makes a huge difference, especially in a challenging global economic climate. Saving on foreign exchange costs, not to mention currency exchange slippage, pays dividends for overall financial stability for these enterprises.”

To make this happen, XEROF has adopted similarly streamlined and efficient operations as well. Once wired amounts are notified, the funds are rapidly cleared in XEROF’s US-dollar and euro bank accounts. Subsequently, liquidity providers are near-instantly approached for quotes to acquire stablecoins on the Ethereum blockchain, ensuring clients swiftly receive the converted amount in their wallets. The clients can then utilize these tokens to settle payments to their suppliers and customers.

“The reality is that extensive transactions experience substantial delays, often taking several days to clear, particularly when the involved parties are in frontier markets,” Taverner explains. “Most raw goods consumed in the West originate from areas where facilitating payments is strenuous, impacting diverse commodities integral to the supply chain. For instance, transferring funds from a US-based entity to a textile provider in Pakistan can incur delays of up to three weeks due to numerous inquiries. Our approach markedly reduces these delays, introducing unparalleled efficiency to international settlements.”

Typically, a supply chain sees funds moving between partners in T-1 to T-5, with T representing a single business day. XEROF, however, operates at T-0.5, a substantial improvement where even on an exceptional day, others might operate at T-1. XEROF’s efficiency marks a fundamental dynamic shift in supply chain finances.

“Our aim was to improve the speed at which assets, specifically cash and capital, can be transferred. The swift movement of capital along the supply chain, using blockchain, allows for more immediate reinvestment.” Taverner also touches upon the urgency of solutions like these compared to other blockchain use cases for the supply chain: “The speed of payment is a universal

Case Study: XEROF *(continued)*

concern for every participant in the supply chain, from the boardroom to the factory floor.”

From a regulatory standpoint, XEROF signals what is possible with Ethereum in blockchain-favorable jurisdictions, such as Switzerland. XEROF champions meticulous management and relies on its Swiss precision to maintain its security. To make their operations possible, XEROF oversees the number of wallets and, as a Swiss custody provider, safeguards them appropriately by segregating funds. This ensures that client assets are “off the balance sheet,” making them untouchable by the company except for client use.

Taverner explains, “We are diligent in managing our fund flows for client assurance and security. When we receive funds, such as in USDT, it goes directly into the client’s segregated wallet. This wallet is not on our balance sheet, which means these are client funds that cannot ever be used for another purpose. Only when the client wishes us to move those to one of their suppliers do we move these funds - and our clients have visibility in the entire process.”

Commentary and Key Takeaways for Businesses

XEROF demonstrates how global-scale economic activity, such as transactions in the supply chain, significantly improves when parties involved utilize ERC-20 stablecoins via public Ethereum. Supply chain cross-border payments are an effective, worthwhile, and overall practical application of the Ethereum ERC-20 standard. The network’s settlement layer is ideal for aligning counterparties, sharing data, and achieving critical scale, which has traditionally been challenging.

Even compared to the best-case scenarios in traditional models, the reduction in time for fund movement accentuates Ethereum’s transformative impact on capital velocity within supply chains.

Businesses seeking to adopt Ethereum and ERC-20 stablecoin payments for their operations should note that while XEROF specializes in transactions worth millions of US dollars, the fundamental improvements brought to the supply chain using a public distributed ledger system can positively impact every participant in the supply chain, from the executive suite to the suppliers to the creators and consumers of these products as well.



APPENDIX 2: VOICES

Selected Interviews





Steven Goldfeder

Offchain Labs

“Fast forward to today, and we’re seeing a ton of interest from enterprises all across the board.”

How has the enterprise conversation changed over the years?

It used to be that you would go to enterprises and say, “Hey, we’re a public blockchain, we’re decentralized.” But in reality, they wouldn’t really care about the nuances of decentralization. They would be talking about some sort of consortium solution instead. And not to put those down, but it almost felt like someone sold them technology that ticked a box on their list. Back then, when we talked about security and decentralization, those arguments often fell on deaf ears or ears that maybe weren’t ready yet. And you can understand some of their concerns, for example, that everything was public and open. A lot of that model didn’t really jibe with their business requirements.

Fast forward to today, and we’re seeing a ton of interest from enterprises all across the board. They’re excited about Ethereum, and more importantly, they want to leverage Ethereum’s security and decentralization in an economically viable way for their product that will make sense for their customers.

So many things that were blockers before are now instead simply seen as problems to solve. They understand that Ethereum is the blockchain that they want to use. They understand the importance of security and that security depends on decentralization. They also understand the importance and value of the community around Ethereum. And their excitement includes and goes beyond DeFi and NFTs. Even when I am on enterprise calls, people seem to appreciate that. They like the energy and excitement in this space.

So Ethereum is the starting point, and then the problems start to seem surmountable. People say, “We need to solve this. Can we build a KYC Layer 2? Can we build a KYC smart contract inside an existing Ethereum or Layer 2 environment?” And these become, I think, really interesting

conversations. I think there are a lot of good answers to questions like those.

To what do you attribute this change?

On the nontechnical side, I think it’s just the obvious dominance of the Ethereum community. People on the outside look in and see, for instance, the interest of so many different Layer 1 blockchains in becoming Layer 2 blockchains, in effect asking, “How do we build on Ethereum?” Even though it’s not directly relevant to some of those decision-makers, I think they feel the sense of Ethereum becoming more and more solidified and consolidated as the central hub for doing exciting things.

On the other hand, people are beginning to understand the relationship between decentralization and security. We push this often at Offchain Labs. And I think that those who look closely can see that last year’s well-publicized industry failures were failures in the centralized parts of the ecosystem, failures in the parts where there wasn’t decentralization and there wasn’t transparency. And I can imagine that message has resonated among some of these decision-makers and definitely the community as a whole. The importance of decentralized technologies has definitely been brought to the forefront, and we’re seeing this manifest in enterprise conversations.

Do enterprises really understand decentralized business models, or are they trying to recreate Web2 in Web3?

I don’t love the term “Web3” because I feel like people think it conflicts with Web2. But that’s not how I see it at all.

I don’t think of Ethereum as replacing the Internet. Ethereum complements the Web2 structures that we already have on the Internet. We have to find places where these two things work best together. For example, financial infrastructure. I think there will always be a

Steven Goldfeder, Offchain Labs *(continued)*

centralized financial system simply because of efficiency and how the infrastructure is well-suited for many real-life use cases. But understanding how it can benefit from decentralization and how blockchain technology can work in the background in such a way that it doesn't replace the endpoints but instead replaces the network in between: those are conversations that we're seeing happen both in private and in public.

To give an example, previously, the conversation was, 'Let's take this application and put it on the blockchain. Let's take Reddit and put it on the blockchain. Let's put Facebook on the blockchain. Let's put medical records on the blockchain.' Some of these things make sense, but some don't. Now, the conversation is, 'We have our Web2 system, and it's great. Where can blockchain technology supplement this and add to it? Where can it add to the experience? How can it make something possible that couldn't happen today without it?' So, the real challenge today is finding out what this new technology enables that hasn't existed before. It's finding the synergy. And even if it's just using the technology for 5% of existing operations, that's potentially a huge accomplishment.

What are the main blockers to adoption?

The biggest blocker is usability. As an industry, we have a lot of work to do in developing and building up the user experience so that the blockchain can be abstracted away, but we still retain the benefits.

It's extraordinarily difficult to do. On the one hand, you have factual statements, such as, "Not your keys, not your crypto." On the other hand, you have people who (which is most people, actually) are not well equipped to store their own keys.

In today's digital landscape, people are accustomed to password recovery capabilities. Users often rely on the 'forgot password' button, following simple steps to regain account access. However, this seamless experience that people have come to expect implies a certain level of centralization.

There's a fundamental tension in balancing user convenience with security. Solutions include technology like MPC (multiparty computation), which, although nuanced, plays a crucial role in custody security. Additionally, education is crucial. Users must be aware of the risks associated with various methods of key custody. This awareness isn't uniform across all users; for instance,

some people, myself included, may be comfortable with the self-custody of keys, while others are less tech-savvy and may prefer the risk of a custodian. Furthermore, the level of comfort may vary depending on the nature of the application – it's a distinction between casual activities and significant financial transactions.

Next, regulatory clarity is imperative. One thing that I've seen from different enterprises is that they often calculate risks and potential gains before diving into new ventures. Most expect the immediate or two-to-three-year business impact of emerging technologies to be minimal compared to their current operations, especially when dealing with multi-billion-dollar businesses. This is partly due to the industry's nascency and reluctance to disrupt existing business models – they don't want it to cannibalize their business. They need time to develop conviction and strategy. Given some of this preexisting tendency towards reluctance, regulatory uncertainty often leads to a wait-and-see approach among these enterprises.

How is Arbitrum helping to address some of the concerns that enterprises have with the technology?

In the realm of Ethereum, there's a significant development: the ability to create app-specific chains. This innovation caters to diverse application needs, enhancing flexibility and customization.

We've introduced two intriguing programs tailored for enterprises: Arbitrum Orbit and [Arbitrum Stylus](#). And the two technologies are complementary to each other, giving you the ability to create Stylus-enabled Orbit chains.

Arbitrum Orbit empowers enterprises to launch their own chains, leveraging Ethereum's technology while customizing it to their specific requirements. This program is generating considerable interest for its ability to offer "priority lanes" for applications, allowing enterprises to either have exclusive application chains or create open, permissionless systems. Notably, Orbit enables the creation of KYC chains secured by Ethereum, something that several enterprises have expressed interest in, marrying robust security with customizable access control.

Another facet of Orbit is the option to establish consortium chains that maintain data privacy, akin to what's found in bank or industry consortia, yet still secured by Ethereum. This aspect is particularly appealing to enterprises prioritizing data confidentiality while leveraging Ethereum's security.

Steven Goldfeder, Offchain Labs *(continued)*

Arbitrum Stylus, currently in the testnet phase, introduces the ability to write smart contracts in languages other than Solidity, starting with Rust, C, and C++. We believe in the importance of EVM because it's been widely adopted and solidified for a long time and has a ton of people who write code for it. Arbitrum has tier-one EVM support, and that's not going anywhere. Our philosophy is to embrace the security and decentralization ethos of Ethereum while acknowledging that EVM is just a starting point, not the limit, of what can be achieved. The key innovation here is the integration of Rust and C/C++ libraries into Ethereum, facilitating seamless interaction with Solidity contracts all while deriving security from Ethereum.

We recognize enterprises often have a wealth of existing code as well as developers that are experienced in traditional programming languages. With these tools, C, C++, Rust libraries – for example, advanced cryptographic or even machine learning algorithms – can be directly implemented onchain. This approach represents a strategic step towards increasing enterprise adoption of Ethereum, accommodating their existing technical infrastructure and expertise.

Steven Goldfeder is the CEO and co-founder of Offchain Labs, the company building Arbitrum. Steven received his doctorate from Princeton University and is a published author of multiple research papers on computer science, cryptography, blockchain technologies, smart contracts, and more. Steven co-founded Offchain Labs in 2018.



Dan Heyman

Palm NFT Studio

“Utility NFTs are like the early days of email, companies have to figure out what to do with them.”

What are the major trends in the use of NFTs by businesses, as opposed to collectors?

We work with enterprises to think through NFTs as a value driver. For example, what happens if you can connect with the customer’s wallet? What extra value can you start getting in the customer lifecycle and what value does the customer get for giving you information as a customer of yours?

Say you are a big organization like Disney and someone calls the hotline to complain about a Disney+ problem, but they are also a large holder of Disney NFTs. The hotline staff wouldn’t necessarily know that. But if there was a connection into their wallet, they would, and the company would be able to better target its services. We want people to start thinking about the lifetime value of a wallet and an NFT.

This works for brand loyalty. For example if a customer has a bad experience on an airline, they could get an NFT, and that could be more interesting for them than some random gift card. Or for retailers, instead of giving out cheap plastic toys as a promotion, it could be some virtual representation of something – and that could be a better channel for brand loyalty, and a more sustainable one.

Other interesting things are happening with airdrops. When we first airdropped over 500,000 NFTs for DC Comics, the vast majority of the recipients agreed to receive marketing newsletters from DC. Those rates are typically more like 5% for most promotions.

NFTs are not just limited to luxury brands and entertainment franchises. There are also used in loyalty programs of all kinds. Starbucks has rolled out its NFT-based loyalty program. We’re hearing a number of travel companies are also entering the space. Post Covid, nobody knows what travel will be like, and airlines can’t tell now how many people will be in their tiers anymore. You could run a program in parallel where you have a certain tier and that is tied to an NFT, and you then know exactly how many

people are in this tier. Then you can better judge how much value you can give to these people.

NFTs could also make loyalty programs more interoperable. Maybe you can use one from one airline to get one-time perks on another for a specific trip. All parties would get something out of that.

We have heard talk of NFTs as the new CRM. Are you seeing this as well?

There are some interesting players in the market enabling businesses to react quicker to what is going on, projects like Salesforce NFT Cloud or numerous startups. This is important because the question now is “how do I decide to communicate with wallets?” and “how do I use the information a wallet confers to effectively target my offering?”. It is very much like the early days of email, when companies started getting lots of email addresses and had no idea what to do with them. They had to figure that out.

This is the experience aspect of NFTs. And what people are learning is they can for example give velvet rope experiences, translate that to a digital experience. Gucci, for example, flew NFT holders out to the House of Gucci, showed them around, gave them an experience that maybe they only did for Elton John before.

So, this is a model coming up: You sell an NFT with an associated experience. Or you give them a free NFT so that they can buy an exclusive product or experience. But you have to figure out how you work with that so that it feels authentic to the fans.

What are the main challenges today that enterprises face when it comes to Web3?

There are a number of challenges. One is the changing internal discussion.

In the last four months we have spent a lot more time with people that are in the industry who have been appointed

Dan Heyman, Palm NFT Studio *(continued)*

as a Head of Web3, Metaverse, NFTs in a large consumer-facing company, and who lead a small team. There are probably 500 of such teams in the world, and generally they consist of 1-3 people.

Typically, they got their job last May, and probably thought it was the best job going. Then crypto winter and FTX hit and now what they do with their time is much different than it was at the start.

Originally they were talking to vendors about POCs. The last quarter of last year they found themselves doing a lot of FAQs around FTX, and getting a lot of questions from the business about what is going on with NFTs and with crypto in general, or starting every conversation with leadership by having to talk about more sensational projects, like Trump's NFTs.

And they are having to answer a lot of newbie questions, for example lawyers asking to review smart contracts. This is understandable. There is still a lot of education that has to be done in our space.

The other challenge is defining the right strategy moving forward.

Almost all major companies have done some POCs. They did something on OpenSea or Coinbase NFT, or their own collection, and now they are figuring out: What did I learn? Are my consumers ready? Did I give enough value? Or did my providers just do the project and now it is stagnant. Unfortunately, that is the case more times than not. They engaged an NFT firm on a revenue share model, and now there is not enough revenue to pay them so the NFT firm loses interest.

The other thing that has inhibited them is the deficit of Web3 experience in the job market. They have headcount approval but can't fill it. They need expertise on analytics, on Web3 marketing, and related fields, but don't need a full

headcount on any of these. And generalists in Web3 are rare. These types can pick and choose where they go. When it comes to deploying code, most companies aren't there yet. Ask Accenture to build you a CRM and they can do it right away. Ask them to build you a secondary marketplace for NFTs, they don't have those teams to deploy. The tech is there, but not a lot of people have the deployment chops yet.

What would you advise large enterprises or brands looking at NFTs and Web3?

It's really that you have to combine the best of both the old and the new worlds, have a foot in each camp.

For example, we encourage brands not to think about this as something totally different. Don't think of it purely as Web3. This is another avenue for fan engagement, something you already know.

On the other hand, you need to work with Web3 experts too. There is no shortage of brands that have entered the space in inauthentic ways and they have been appropriately criticized for it. Enterprises need to use the technology thoughtfully in a way that enhances their core business.

It's this combining of the best of both worlds that we are trying to achieve with our business these days. We work a lot more with traditional marketing agencies. These people are now fielding a lot more serious Web3 conversations, so want to be their vetted delivery partners. They know more about customers than we ever will, and we know the tech and the space.

At the end of the day, NFTs present a novel opportunity to engage customers via true digital ownership. This could be for loyalty, collectibles, games and other use cases we probably haven't conceived yet. But just like every brand and IP has an email marketing strategy and a social media strategy, so too will every brand and IP have an NFT strategy in the coming years.

Dan Heyman is a blockchain industry veteran with experience building and leading organizations through the design, development, and implementation of enterprise-grade blockchain protocols.

Prior to co-founding Palm, Dan was the Co-Founder of PegaSys, which is now ConsenSys's Protocol Engineering division. During his 3+ years at PegaSys, Dan built out a team that worked across Ethereum 1.0, Ethereum 2.0 and Enterprise Ethereum blockchain protocols, the last of which serves as the foundation for the Palm blockchain.

Dan is a Member of the Board of Directors of the Enterprise Ethereum Alliance.



Joseph Lubin

Consensys

Credit: Kyle Depew Photography

“The next major phase of ecosystem development is going to result in the establishment of the next generation social fabric for our planet.”

When it comes to business adoption of Ethereum and blockchain, what are some of the most important recent developments?

There has been enormous growth lately in stablecoins that are backed by US dollars or US treasuries, which some people are calling cryptodollars. That niche has pretty significant product market fit. I think it's around a 130 billion dollar market cap. These volumes are similar to eurodollars a few decades ago when there was a need for different countries to hold dollars. So I think that one of the most important developments businesses should be watching is how the US is looking to bring these cryptodollars under the tent now. There should be legislation pretty soon to make this all legitimate from the perspective of the US regulatory infrastructure. I think that's going to enormously expand the use of crypto and digital assets. This will be significant for Ethereum and for other networks as well.

And in terms of longer-term trends?

If you look at the big picture of Ethereum, we've been through two major phases in our ecosystem so far. One was the decentralized trust phase. The other we can call the decentralized finance phase.

The decentralized trust phase involved setting up Ethereum and figuring out smart contracts, building all that infrastructure, figuring out primitive wallet approaches, and thinking about what tokens might be useful for. Then, in the decentralized finance phase, you had ICOs and the standardization of tokens and then DeFi and NFTs, basically trying to run lots of diverse experiments to figure out what people might do to democratize finance – in terms of both creation of financial instruments and flow patterns by builders, as well as permissionless access to them by the end user.

And we're about to launch into a third major phase, which is the utilization of Web3 primitives and components and constructs. A few of the most important ones are around self-sovereign identity and reputation. So DIDs and Ethereum addresses and soulbound tokens and ENS and other things for identity. And also attestations and badges and NFTs and delegations for reputation. And these kinds of things will enable people and organizations to establish their self-sovereign identities and build out their social graphs.

What will be the role of these social graphs?

Social graphs will be essentially webs of trust, and they will be much richer in terms of how they're defined than a social graph owned by Meta, for instance. So I'll be able to establish a bunch of different social graphs, that I own and control, with different characteristics. I'll be able to monetize those things. I might have a social graph housed in an NFT. I might want to lend or lease out my social graph for different purposes or merge it with somebody else's for different purposes.

And pretty soon this next major wave of activity in our ecosystem will start to look really attractive to software developers who will build content platforms or content tools or functional widgets or analytics tools that I can add to my social graph. So the next major phase of ecosystem development is actually going to result in the establishment of the next generation social fabric for our planet – and that's the social, financial, economic, and political fabric that will be the next generation global economy or system of the world.

The reputation industry will be one of the largest economic niches in the new economy. You will have dashboards where you can track different aspects of your reputation,

Joseph Lubin, Consensys *(continued)*

things that people said about you or your conduct, things that you said about other things out in the world, etcetera. You'll be able to dispute claims made by others or vouch for claims. Identity and reputation will be computable digital assets that can be valued and monetized. A financialized world of social capital will develop with many financial instruments similar to those already in use.

You will be able to monetize your own social graph if you want. Or you'll be able to enable people to monetize your social graph. So, let's say your social graph is embodied in an NFT, and let's say you convinced me to join your social graph. And you send out content, and you have little widgets that do interesting, useful things. And let's say I add some useful content to your social graph. Your NFT that embodies your social graph might mint a cute little NFT and give it to me, and they might talk to one another. And every time I add something that either you deem is of value or one of your AI allies deems is of value, you'll send some tokens to my NFT in my wallet. An insightful friend recently suggested that he believes that trillions of dollars of Web2 social network value are going to be destroyed over the next ten years and replaced by these more decentralized overlapping webs of trust social graphs.

How do you see the ecosystem evolving going forward, for example, in terms of the architecture?

What we're going to see going forward is that you'll have a small number of Layer 1 protocols, you'll have Ethereum, you'll have Bitcoin, and there might be some other major L1s, likely with the same or similar architecture as Ethereum, though monolithic L1s might continue to exist to subserve certain niches. There'll be lots of Layer 2s, and there'll be a giant number of Layer 3s and Layer 4s, etc.

And there will be different degrees of decentralization depending on the use case. You might not need extreme or rigorous decentralization for your supply chain, for instance, if you are a powerful anchor like Walmart. You need sufficient decentralization. And you can get pretty remarkable decentralization using roll up technology or validiums or volitions that are a little less decentralized but still quite decentralized by inheriting the security guarantee of Layer 1 Ethereum. And so all of these Layer 2s and Layer 3s etc., gain nearly the full security guarantee that you have on Layer 1 Ethereum, but they partition things so that

you're roughly on your own chain. Then you can layer on characteristics like privacy and permissioning as desired.

I believe the architecture will be that it will be permissionless at Layer 1. So, miners and validators will not be directly regulated. You need a fully permissionless base layer so that, let's say, nation-states can interact with one another on a system that neither one of them owns. We definitely need that base trust layer to be rigorously decentralized. And then, you can have permissioning and regulation on top of that for different use cases. There certainly can be permissioning and regulation around investment contracts/securities, and probably many other things. But if you try to build a blockchain that's permissioned at the foundation, then you can't build anything that's permissionless above it, and you destroy the essential value proposition of decentralized protocol technology. If that happens, the meta-game becomes a jockeying by powerful actors to retain or take centralized control of the next system of the world, and humanity will have squandered an opportunity to set itself free from persistent tyrannical control or excessive top-down control.

Everyone has been talking about AI this year. How will AI and crypto interact?

There are a lot of interesting ways that AI can help crypto, and crypto can help AI.

The first billion users of blockchain will likely be humans. But with AI, I will start adding new intelligences to who I am. And there'll be lots of different narrow artificial intelligences that constitute me. And I'm going to want my coordinating intelligent agent or AI ally to know me well, to do my bidding out on the Internet. It should be able to use its own MetaMask according to its allowance and go out and transact, for example. Or perhaps it will monitor DAOs that I'm involved with and take part in votes that I care about. So maybe when we hit two billion users of blockchain, many of them will be AIs and devices.

On the other hand, we have the problem that powerful AI in the hands of nefarious humans can be the most powerful tool for centralizing control in the history of the planet. So we really need these things to be built via decentralized organizations and in a transparent way. And you can build systems that have decentralized compute and storage, that

Joseph Lubin, Consensys *(continued)*

source and clean up data in a decentralized fashion, and that separately establish and conform to values acceptable to each different population of users.

A lot of the primitive tools that can play a part in this were developed in our ecosystem. Decentralized storage, for example, or zero-knowledge techniques. Zero-knowledge, for instance, can be used to demonstrate that you're using a specific version of an AI that was trained in the

way that was advertised. So you may not need access to the weights. You can run an inference engine and receive a zero-knowledge proof that the thing processing your data is what you thought it was. You can potentially tune systems to your own use case without being the creator of the foundational AI or having to surrender your own intellectual property.

Joseph Lubin is a co-founder of Ethereum and the founder and CEO of Consensys, the leading blockchain and web3 software company. Since 2014, Consensys has been at the forefront of innovation, pioneering technological developments within the web3 ecosystem. Through its product suite, including the MetaMask platform, Infura, Linea, Diligence, and the NFT platform, Consensys has become a trusted collaborator for users, creators, and developers.



Rene Reinsberg

Celo

“Ethereum has matured tremendously, and its Mainnet is robust enough to support our objectives.”

Celo recently made waves when its community approved a proposal to move from a Layer 1 to becoming an Ethereum L2. Why did Celo make this move?

From the outset, Celo was designed to be EVM-compatible. Our vision was never to rival Ethereum but to create a blockchain ecosystem that addresses particular needs the network wasn't fully equipped to handle in its earlier days, such as financial inclusivity in the Global South.

Celo has the most users with a wallet on the African continent, and we see a strong value proposition for someone wanting to build for that audience. The growing user base in specific regions can be a compelling reason for new projects to target these markets.

Now, Ethereum has matured tremendously, and its Mainnet is robust enough to support our objectives. So, it's a natural progression for us to move to being a Layer 2 solution on Ethereum. Today, if you're building on Celo, you can use the same infrastructure, tooling, and broader infrastructure of the Ethereum ecosystem. This shift is invigorating for the Celo Foundation and the community, especially given the technological advancements like EigenLayer's work decreasing data availability costs on Ethereum.

Do you think this reflects a broader trend?

I think at this point, the argument can be made that, at least in the enterprise space, EVM has won, and the industry is reaching a consensus that Ethereum is the core settlement layer. Moving forward, you'll have Layer 2s for scaling, throughput, and specific areas of applications. From the enterprise conversations I've had, while many don't know which Layer 2 they'll build on or if they'll build their own scaling solution altogether, they do know that they'll want to be on Ethereum, with the Layer 2 providing the functionality they need. Celo is a good example: if you build on Celo, you get the robust Celo ecosystem and technical advantages

unique to Celo, but ultimately, you have Ethereum security, which is a powerful combination.

Overall, the conviction that the Ethereum ecosystem is the “place to be” has increased a lot - which makes sense. Ethereum has a sound roadmap outlining how the network can achieve scale, the largest number of active developers building, and holds the mindshare of Web3.

What are some of the important developments lately in the Celo ecosystem?

We're deeply invested in regenerative finance (ReFi). Leveraging the benefits of Ethereum, we aim to create a financial infrastructure with positive externalities for the planet, climate, and individuals. Much of the Celo Foundation's work now is targeted towards the Global South, where the community around Celo is the fastest-growing, particularly in Africa, Southeast Asia, and Latin America.

Our ReFi efforts, especially use cases for the Global South, focus mainly on creating user-friendly applications with direct, real-world impact. For example, we've been instrumental in developing [FiatConnect](#), an open-standard protocol that makes fiat to crypto on- and off-ramping seamless. In Kenya, companies have built services allowing a seamless transition from [M-Pesa](#) to an on-chain stable asset on Celo. The demand for on- and off-ramps, driven by other apps in these markets, has significantly contributed to the growth of Celo infrastructure.

Our mobile-first approach has garnered interest from projects like [Opera](#), whose browser is an industry leader in Africa. Opera partnered with us to launch [MiniPay](#), an ultralight self-custodial stablecoin wallet built on Celo. MiniPay is directly integrated into the Opera Mini Android app, bringing the benefits of decentralized applications and stablecoin payments to Opera Mini's 100+ million

Rene Reinsberg, Celo *(continued)*

active users in Africa. This partnership utilizes the latest innovations around account abstraction to offer a seamless user experience, including removing the “Wallet Connect” feature to enable onboarding via Google accounts. Most importantly, I believe it will enrich the local financial ecosystem, empowering communities and democratizing finance.

How has Celo been received by the corporate sector? Is there enterprise involvement in your ecosystem?

Today, demand primarily stems from companies wanting to run validators and participate in running the Celo protocol. Telcos are interested in Celo, for example, due to the mobile-first infrastructure and unique features like the SocialConnect protocol. Deutsche Telekom has been actively participating [for years](#), running validators, providing oracles, engaging in community discussions, and through the T-Challenge [accelerator program](#). More recently, Telefónica [joined the network as a validator](#), as did [Google Cloud](#).

Most corporations are not yet at the stage where they are ready to build a product and launch it to users. They are engaging, but they are earlier in the funnel. I think many enterprises want to get involved as a way to get their engineering, tech, and IT teams, their tech teams into the flow of blockchain as they explore how it can benefit their businesses.

This is understandable, most large corporations cannot justify launching a product that isn't guaranteed to be a major revenue generating right away. As a nascent technology, blockchain is not there yet, but these enterprises are engaging in different ways, like exploratory pilots and participation as network validators. This is because they believe in the future, some blockchain protocols will serve as the foundation of the next generation of the internet, so they are finding ways to get

involved while they gain an understanding of the use cases they want to build.

What kind of use cases are enterprises interested in when it comes to Celo?

One of the preeminent use cases for enterprises within the Celo ecosystem is climate impact efforts. Tokenized carbon credits are a prominent example, with many corporations exploring how they can move their ongoing offsetting practices onchain. While carbon offsets are one key example, there's also significant progress made in adjacent areas.

One that is top of mind, since I was recently in Barcelona for Smartcon, is plastics. There is a company called [Plastiks](#) that has created a tokenized plastics recovery certificate standard, which essentially puts a market price on plastic recovery. FC Barcelona worked with Plastiks to launch an [NFT collection](#) on Celo where each digital collectible comes with a tokenized plastics recovery certificate attached to it that people could trace and follow the efforts in real-time. The collaboration allows Barcelona to acknowledge the use of plastic bottles at their games and combat potential pollution stemming from those sales. From a short-term perspective, this can be compared to a voluntary tax. Looking at the longer term, these efforts can also change people's behavior. Similar to voluntary carbon markets, making voluntary plastic recovery markets commonplace presents a significant opportunity for environmental impact efforts. While the payments use case expands on solutions built on traditional rails for more efficient and accessible solutions, voluntary plastic and carbon markets onchain are reinvented in Web3. Bringing these activities onchain eliminates the double spend problem, increases traceability, and can build the trust necessary to popularize these efforts. Based on the progress made to date and forward-looking conversations with leaders throughout industries, I think companies are beginning to see this difference.

Rene Reinsberg is a co-founder of Celo and currently President of the Celo Foundation. Celo's emerging Ethereum Layer 2 is at the center of an ecosystem of technologies, organizations, and individuals that all share a mission of building a regenerative financial system that creates the conditions for prosperity for everyone. Previously, he co-founded Locu (acquired by GoDaddy). Rene started his career in global capital markets at Morgan Stanley and also worked at McKinsey, the World Bank, TechnoServe, and General Catalyst. He holds graduate degrees from Germany's WHU and MIT.



Markus Schorn Jens Herrmann

Deutsche Telekom



“Easy composability with the digital ownership baked in. That is one of the superpowers of blockchain.”

Deutsche Telekom has been highly active in the blockchain space for quite a while, which might surprise people. Can you tell us when you started and why?

Markus: We’ve been involved in defining Web3 since 2018, starting with our team in Berlin. Perhaps influenced by Berlin’s vibrant Ethereum community, we experimented with putting self-administered e-scooters on the blockchain back in 2018. It was too early for such an integration, and interest waned during the first and second ‘crypto winters.’ However, we continued to work on blockchain topics, and today, Deutsche Telekom MMS runs validators for major blockchain networks.

Jens: We’re a cloud provider in Europe using our own infrastructure and helping blockchain networks in physical decentralization. Initially, we started by running oracles for Chainlink as our first major blockchain project. From there, we moved on to staking, particularly as early adopters of the Flow blockchain, where we ran some of the first Flow validators for projects like Dapper Labs and Top Shots. This early involvement created significant momentum. After staking, we further expanded our blockchain activities by transitioning into indexing. Overall, our journey has evolved from running oracles to staking and finally to indexing, each step contributing to our growing expertise and presence in the blockchain space. We are part of the Helium ecosystem, engaging in decentralized clearing and settlement with ClearX. Celo was our first strategic investment in a token, making us at that time one of the very few companies of our size to manage crypto assets.

What specific technologies is Deutsche Telekom focusing on and why?

Jens: To start, we run validators for major and minor blockchains, including Ethereum, Polygon, Celo, Flow, Q, Energy Web, The Graph, MutiversX, Aleph Zero, and so on. We support Chainlink’s oracle node network, enabling DeFi apps to access external data. That said, we focus primarily

on EVM-compatible public blockchains, as we want to support building a new internet on open infrastructure. Markus: At the moment, we focus on Ethereum-compatible platforms. We see Ethereum as the current standard, and enterprises are still grappling with the possibilities that Ethereum offers. We’re particularly excited about what we’re building with Celo, a mobile-first blockchain and a future layer-two protocol on Ethereum that uses mobile phone numbers as identifiers on the blockchain for digital assets. This opens doors for us into the future of tokenized real-world assets, where users can send digital assets straight to mobile phones. Here, we want to be a part of it.

You seem very committed to providing basic blockchain infrastructure services. Why?

Markus: We’ve learned over the last few years that our service provides a unique selling point. EVMs require decentralization for optimal functioning. It wouldn’t be ideal if all of Ethereum ran on AWS. So, it is very valuable to have a second or even third credible option for cloud infrastructure. Being a telecommunications company gives us unique advantages in maintaining high uptimes, which we also apply to running validators. This sets us apart from some other cloud providers, and it’s been good business for us. Notably, it establishes our credibility in the blockchain and Web3 communities, demonstrating our early and committed support for public, decentralized networks. This credibility will also be beneficial when we introduce future services.

Jens: First, running decentralized networks is in our heritage as a telecommunications company; it’s in our DNA. Second, we’re motivated by the uneven benefits reaped by big tech companies. Web3 provides an opportunity to level the playing field. I see Web2 and Web3 as a natural progression in the development of the Internet. We’ve been providing infrastructure services for years, starting from phone lines and transitioning to the Internet. It’s essential for us not only to participate in future developments

Markus Schorn and Jens Herrmann, Deutsche Telekom *(continued)*

but also to guide them. This is why understanding how blockchain ecosystems and key elements like digital wallets function is crucial. That's why we're actively exploring what roles we can play in this evolving landscape.

What enterprise-level blockchain use cases are you excited about?

Jens: Currently, our focus is on assisting other companies in transitioning into the Web3 space. For example, with Celo, the mobile number acts as the wallet address. In the past, even storing an encrypted mobile number on a blockchain wouldn't meet our privacy standards. So, we have to innovate and look into 'one-click wallets.' The future of mass-market wallets may not be MetaMask only but rather wallets included in mainstream apps built by brands and companies. We want to make it easier for brands to incorporate wallets into their native applications. We've built a prototype that accomplishes this with just one click.

Markus: What we've discovered through our experiments is that digital ownership is integral to these new systems. One challenge for corporations is dealing with legacy systems when implementing new engagement schemes, which usually require substantial effort and cost. However, if these legacy systems generate something simple like a QR code, you can bridge that code to a blockchain. This allows you to introduce advanced features and gamification outside the legacy system while maintaining the ownership status on the blockchain. This approach of layering over legacy systems will significantly change the game, especially for Web3 use cases. When talking to enterprise clients, especially those outside the Web3 space, do you find a growing level of understanding, or do you still need to educate people?

Jens: There's still a need for education and explanation in this space. We have been working on this internally for quite some time. We've held sessions across the group and for senior executives. The need for education also extends to our B2B customers; the level of understanding varies depending on whom you're speaking to.

Markus: Interestingly, the current 'crypto winter' has somewhat benefited us. When we started this venture two years ago, the landscape was filled with expensive JPGs. Many people wondered why they should care about concepts like blockchain, the metaverse, and NFTs, especially when they didn't align with the interests of major players. So, this period has helped clarify and refine people's understanding of Web3.

What unique and innovative decentralized business models do you see businesses exploring or adopting, and how do they differ from traditional models?

Jens: They are really a couple. For example, clearing and settlement is a promising decentralized business model, allowing parties to settle directly among themselves without an extra service provider in between. Decentralized physical infrastructure networks are also very interesting. Instead of only building out infrastructure on our own, telcos or infrastructure providers can additionally engage with users, incentivizing them to set up network infrastructure. Is it a model that will fly in the future? No one knows for sure right now. But we think it's important to try and understand how the mechanics can work.

Markus: And then there is the more colorful stuff, the loyalty programs, etc. What is interesting is composability. There are so many opportunities. For example, we are working on a way to incentivize employees to do more online training, and we thought we could incentivize them by giving them reward tokens. That's a simple enough idea. But what could these reward tokens be? It could be planting trees via an on-chain carbon offset protocol or digital rewards onchain. So, you could mint a learning token that could be swapped into a carbon offset token. And because it's on the same chain, it's so easy to plug it all together. You do not have to build huge backends because this is natively part of the blockchain. Easy composability with the digital ownership baked in. That is one of the superpowers of blockchain.

Markus Schorn is a bestselling author and special adviser on emerging technologies and business models. He is an expert in digital transformation and innovation within various industries and revenue models.

Jens Herrmann brings over 18 years of experience in and passion for technology, business, and entrepreneurship to his work in blockchain, Web3, and the metaverse. His focus includes driving and advising for major advancements in telecom blockchain projects, data trends, and challenges in decentralization.



Vikram Seth

Shell

“Our key pillars are traceability, trust, and transparency. It's very clear that that can only be delivered by public blockchains.”

We don't usually associate companies like Shell with blockchain. How long has Shell been in this space?

Shell has had a blockchain team since 2016. We are one of the earlier energy companies involved in the space. We were a founding member of the Energy Web Foundation as well as conveners of various blockchain initiatives in the energy sector. Shell has been involved in exploring how blockchain and Web3 can be applied as a solution to various problems, particularly in the context of the energy transition to a lower-carbon and sustainable energy system.

What was your original focus, and how have you evolved?

Our focus initially started off very much around improving existing processes. How can we do what we are doing better, cheaper, faster using blockchain? After that we started looking at ways to use blockchain to enter new markets. And the third piece is where we are now. In the age of Web3, NFTs, the Metaverse and DeFi, this third space is about looking at new business models. Brand new ways of doing things, new sources of customers, exploring and tapping into business opportunities from avenues that weren't on the table before.

Can you give examples of the new kinds of business models you are talking about?

Take the energy transition. We are seeing a shift from centralized to much more decentralized energy production. When producing oil and gas, economies of scale have typically been very important. There are large oil & gas fields which require heavy capital investment. In the energy transition we are moving towards solar panels on everybody's roof. We are also looking at electric vehicles that might become energy storage devices, so used both for consumption as well as storage and dispatching. This transition means a potentially significant scope for decentralization on the energy production side. Another example is large national grid structures, where power

transmission has been primarily in one direction from power producers to power consumers. Now societies are building two-way systems, where “prosumers” can produce power as well and sell it to the grid. Whilst this decentralization is taking place in the energy system, we have a similar decentralization occurring on the web. So Web3 & Blockchain technologies can offer unique advantages in managing decentralized systems. We see these two shifts marrying very closely.

Then comes the sustainability piece. When a company makes sustainability claims, they are saying something to the market, regulators and customers about, for example, the origin or carbon-intensity of their energy products (chemicals, fuels or electrons). These claims need to be substantiated with transparent verification. Blockchain can bring a layer of certainty to customers that the products they purchase are from, say, renewable sources, or that the carbon credit scheme they signed up for represents the removal of carbon from the atmosphere and is not double counted. As blockchain can track renewable energy from source to consumption it can give customers additional insight into its low carbon attributes.

Are you working on any specific projects in terms of sustainability?

Yes. Avelia, a platform to accelerate the adoption of sustainable aviation fuel (SAF), is one of our flagship projects, and is about just this type of use case. Avelia tracks when SAF is injected into the complex, global jet fuel network and when it is consumed by an airline or corporate flier. It allows these buyers to claim the use of SAF that they have paid for, even though it may not be physically available at a specific airport but is burned elsewhere in the sky. Avelia uses Energy Web Chain, which is an EVM-compatible public blockchain. Using public blockchain is an important aspect, because the philosophy we have within our team is to focus on public verifiability in order to really enable transparency and traceability.

Vikram Seth, Shell *(continued)*

We have other projects and PoCs as well in the space. We strongly believe that leveraging emerging digital technologies such as blockchain will help accelerate the energy transition, whilst ensuring trust in our sustainability claims and those of our customers.

What other projects are you working on?

Another major project that has recently gone live is Falcon, which we co-developed with Wipro and piloted in our operations. Falcon is a platform for industrial supply chain management, which was built with Wipro and launched on the Polygon chain. Falcon essentially eliminates the need for a physical paper trail for heavy industrial equipment which makes traceability and auditability difficult. Instead, Falcon uses digital product passports to make data more accessible and trustworthy. In addition, we've also worked on the traceability of sustainable chemical products. We ran a couple of PoCs with two different players to show if plastic is produced from a bio-based source or a circular source (recycled) differentiating it from a virgin plastic. Here we are using blockchain to provide traceability through every point in the supply chain, from material source to end-customer.

You recently announced a partnership with Gitcoin. What was the aim there?

This initiative is focused on regenerative finance or ReFi. ReFi is explicitly exploring how Web3 infrastructure and governance models can support sustainable, or regenerative economies. This space is really quite nascent, and we were asking ourselves how we can work with and support startups that are building the enabling solutions.

The collaboration with Gitcoin came about because we love what Gitcoin is doing, it's a novel way of funding using the wisdom of the crowd to support projects in many areas, including climate action. We felt their approach was most appropriate given the early stage of maturity of ReFi. Shell provided grant funding to Gitcoin for four of their climate

rounds, and projects can opt-in if they want to receive a share of these funds. It's the community which is deciding which projects to fund, and by how much.

This by the way is the first time that Shell has worked with a DAO.

Turning to Ethereum, what are the most important developments you see in the business Ethereum ecosystem today?

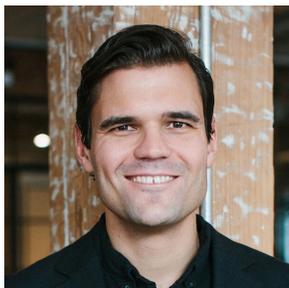
Key Ethereum developments are the switch to proof-of-stake consensus mechanism, moving away from proof-of-work, and the increasing enterprise shift from private to public blockchains.

Initially we did a lot of work with private chains. Naturally, we are focused on data security and privacy and therefore initial efforts consisted in de-risking the technology and proving compliance. But, our key pillars are traceability, trust, and transparency. And it's very clear that can only be delivered at scale by public blockchains. With solutions such as zero-knowledge proofs, we can see greater ability to use public blockchains while maintaining security and privacy of data where needed.

Another advantage to using a public blockchain is the ability to gather a larger ecosystem of players. These ecosystems are far more likely to form around a public, permissionless setup than in a private chain with a walled garden.

And when talking about public blockchains, one factor that really speaks for Ethereum is the number of EVM-compatible chains. That makes for a larger ecosystem, but also by definition provides some level of interoperability. That is also something key for us to consider. Because we want to ensure that as we apply Web3 to the decentralized energy system of the future, our different solutions can talk to each other if we want them to.

Vikram Seth serves as Head of Blockchain & Web3 at Shell, where he plays a pivotal role in integrating blockchain and Web3 technologies into the energy sector. With over a decade of experience in this industry, Vikram is deeply committed to leveraging these technologies for global sustainable development. He has a particular focus on using DeFi, cryptocurrency, and NFTs in projects aimed at sustainable and regenerative development.



Alex Tapscott

Business Author

“In this next cycle, the technology will be ready for primetime.”

Alex, why did you write a book on Web3?

Every so often, a new technology comes along that changes the economic order of things in society in some pretty profound ways. Today, we actually have a number of these technologies. Things like AI, IoT, robotics, AR/VR, blockchain, and Web3. Of all these, I think Web3 is the least well-understood. That is why I wrote the book.

Where do you think Web3 is going to have the most impact?

As we lay out in the opening chapters of the book, the primary impact will be on assets, on individuals, and on organizations. Let me explain.

When looking at assets, a lot of people hear about Web3 and think ‘crypto.’ But cryptocurrencies are only one of dozens of new types of tokens being made possible through Web3. We see tokens as containers for value in the same way that a website is a container for information. A token can contain anything of value: money, stocks, bonds, titles or deeds, art, collectibles, or even votes in an election. Because tokens are programmable, they are a tabula rasa for us to imagine anything of value digitally. All industries are going to be impacted by that.

In terms of individuals, in the past, we all made this Faustian bargain where we provided data about ourselves in exchange for access to some Internet service. Web3 basically starts with the premise that you should own your own data and identity. So, it transforms Internet Users into Internet Owners in the sense of owners of their identity and online assets.

Web3 also enables new organizational structures. Ronald Coase famously pointed out that we have companies because bundling everything together inside a firm brings down transaction costs. As technology has evolved, it has become easier and easier to unbundle the firm. That’s why we have companies like Apple today with R&D in California and hundreds and hundreds of subcontractors. Web3

extends that with a toolkit that not only lowers the cost of search and coordination but also the cost of trust.

It is a new platform that allows individuals to collaborate and become owners of the applications or services they’re using or building. In Web3 language, we call this kind of collaboration a Decentralized Autonomous Organization or DAO.

Do you really think DAOs will reshape the organizational landscape?

Yes.

Just look at the companies in Silicon Valley. They have always known that if you want to attract the best people, you need to offer them equity. That made Silicon Valley the Galapagos of the early web, with all these unique conditions to drive evolution and innovation. But this method doesn’t scale globally. With a DAO, anybody who uses an application or service can earn a share of that service by being an early contributor. That means that you can launch on Day Zero with services in 50 different countries. So, I really do believe that DAOs are going to be where a lot of software, networks, and new companies get built.

That doesn’t mean overnight that Exxon Mobil or JP Morgan is going to become a DAO. I just think that going forward, this will be seen as a better way to organize capability and to scale. If the corporation was the killer app for the industrial age, I view DAOs as the killer app for this new digital age.

Is there a danger that Web3 gets “captured” by large corporations the way Web2 has?

I think it’s a real risk. The issue is that the user experience of Web3 will always be challenging for a big part of the population. In Web3, if you’re using an application or service, and you’re earning a share of that, that means you’re holding some token, and that token needs to be held

Alex Tapscott, Business Author (continued)

in a wallet. And that wallet needs to be protected with a password. And that requires a person to be comfortable with the concept of tokens, wallets, and passwords.

Many people are already comfortable with this, and an ever larger share of the population will be. Part of this is geographic: a lot of people in the Global South and in non-Western countries are already comfortable with this. And part of it is generational: younger people tend to be more comfortable. These are two big tailwinds.

But that doesn't mean capture isn't possible.

What use cases do you like for Web3 right now?

One compelling area of innovation in Web3 that we talk about in the book is gaming. That's mainly because, in gaming, we already have product-market fit for virtual assets. Gamers have been spending billions of dollars on virtual goods for many, many years. The only difference is that these virtual goods are assets that they buy but they don't actually own. They don't control them, they can't resell them, they don't participate if the value of the assets goes up.

But I think if you're going to buy assets, you might as well also really own them, right? And we didn't really have a medium to express those digital property rights before. But now we do. That's an opportunity in a market where hundreds of millions of people are already spending billions of dollars buying and selling virtual assets.

And this can carry over to the metaverse. Considering how much time we already spend online, I don't think it is a stretch to believe that even more of our entertainment, economic activity, and social life will be taking place online when we have an even more immersive environment. But the risk is that we end up with some virtual Disney World, an environment that's controlled by one or another company.

If we can incorporate digital property rights in the metaverse in the same way that we can do it for gaming environments, I think we can create something that is more akin to a shared virtual space that individuals can live and thrive in.

Are there industrial use cases for Web3?

Yes. Quite a few.

One we like is DePIN, or Decentralized Physical Infrastructure. We look at a number of different case studies in the book. There is the Render network, which allows individuals to rent out their CPUs to TV and film studios for rendering 3D content, and earn a native token. There is also the Hive network, which is a decentralized real-time mapping platform.

Hive is interesting. It's like a crowdsourced version of Google Maps, where individuals can mount a dashcam, gather street-level data, and get paid for it in a token. If the quality can match Google Maps, then this becomes not only interesting for individuals but also for enterprises. Companies like UPS or FedEx would be more than happy to mount dashcams on their trucks and earn while contributing to the mapping network. They could also save the cost of the Google Maps data they are currently paying for through the API.

You are very close to the Ethereum ecosystem. Do you think – as we at the EEA maintain – that Ethereum is “ready for business”?

There are developments that I think are making business adoption of Ethereum easier.

For one, I find it remarkable how well Ethereum has been able to continue to improve upon itself, even though it's an open-source network that has no central authority governing it. The Merge is a great example. I liken it to swapping out the engines on a 747 traveling 600 miles an hour over the ocean while carrying two billion dollars worth of cargo, all without upsetting the drink cart or the in-flight entertainment system. This kind of success is reassuring to enterprises.

It's also hard to overstate how important the move to Proof-of-Stake has been. Many large corporations have stringent ESG policies. And these companies have been reluctant to do anything on Ethereum or Bitcoin because of the carbon footprint of Proof-of-Work mining. With Proof-of-Stake, they no longer have this concern.

Alex Tapscott, Business Author (continued)

I also think the rise of NFTs has been an important development in terms of enterprise adoption just because it's provided an easy playing field to start toying around. If you look at a lot of these projects from Starbucks or PepsiCo or LVMH, they're interesting, but they're not about reinventing a business. What they are doing is becoming familiar with the core concept and the idea of Web3.

The crypto bear market has been an enabler of enterprise experimentation, too, simply because without the noise of the bull market, enterprises have more room to experiment, to fail, to invest, and just to do stuff outside of the harsh glare of the public eye.

There may have been a slowdown in enterprise activity when it comes to financial applications. But when it comes to technology investment in innovation around Web3, the enterprise side of the story continues to be really robust.

What recent technological developments in Ethereum do you think are significant from an enterprise adoption perspective?

I think that account abstraction is a really important concept. Today, if you have a private key and you lose it, you lose all your assets and all your information. That's not a system a lot of people will want to be involved in, certainly not businesses. Account abstraction offers a form of social consensus, of key reclamation, that's really easy to understand and that allows you to protect your assets. That's something that can be very powerful for onboarding a lot more users.

I'm also really interested in the introduction of zero knowledge technology, and just the idea of zero knowledge in general. I think that is critical. People often think that blockchains are private because you don't have to register on them, but of course, we know that isn't true. Transactions can be traced. Being able to prove that something happened without revealing the identities of the parties or the value involved will find a lot of different applications in a lot of industries. For businesses using blockchain, it adds privacy, usability, and scalability.

I also think that all the rollups on Ethereum that connect to Mainnet are very good for Ethereum. Some people say that if there is more value trading hands at the L2 level then there will be less demand for the L1. I don't think it works like that. I think, in the end, that anything that makes the

Ethereum ecosystem more valuable is good for Ethereum. And rollups do that.

How do rollups fit into the overall Ethereum picture?

One way to think about it is to see the Mainnet as the dispute resolution mechanism. If you and I have a contract, which is what an L2 is, then as long as everything works out, we don't need the L1. But if there is a dispute, that's where the dispute resolution process comes in. In the non-blockchain world, we would go to court. In Ethereum, we go to the Mainnet.

Another way is to think of Ethereum as the electrical grid of a city. The more houses and businesses that are connected to the grid, the more electric vehicles that charge from it, the more demand there is for the electricity from that grid. But you can't just have energy flowing unregulated through the system. You need substations located throughout the city to regulate the flow and bring it to businesses and individual homes.

In this analogy, Ethereum is the main grid, and the L2s are the substations. They are an important part of the scalability story.

In our last report, we also maintained that there has been a major shift towards public blockchain in the business and enterprise communities. Do you agree?

Yes. I believe that is a combination of the fact that public blockchains have become more useful, and private chains have proven themselves to be not always so useful.

When we wrote "Blockchain Revolution" in 2016, many companies were looking at the technology and thinking 'this is interesting, but it's not ready for the enterprise.' And so you had the rise of private blockchains. Since then, a lot of water has gone under the bridge. Many of the private consortia have failed, and the main chain has become much more robust.

Today, you have a lot of Fortune 500 companies who feel comfortable launching projects on Ethereum. Paypal and MasterCard, Starbucks, companies like these are doing stuff via L2s or Mainnet. It is like in the early days of the Internet when people liked the idea of being able to share information, calendars, documents, and so forth, but they didn't like the idea of being open on an anarchic web.

Alex Tapscott, Business Author *(continued)*

So, they built their own Intranets. And those Intranets still exist today.

But most of the value that was created from network effects occurred on the public Internet. And as the public Internet gained users, it became more robust for enterprises. And I see something similar happening with Ethereum.

Where do you see adoption going in the next 3-5 years?

I think Ethereum continues to be the leading L1. I don't think that changes. I do think there are a lot of things that need to be improved upon. The user experience, the wallet experience, account abstraction, and all the things that just

make it easier for the average person to use these tools will grow the utility and value of the underlying platform.

If the first wave of adoption was in finance with DeFi, I think the next wave will come from all sorts of different places – from social, from creative industries, from gaming, from infrastructure. By the time that happens in this next cycle, and I think we are about to embark upon it, the technology will be ready for primetime.

Alex Tapscott is a well-known voice in the blockchain and Ethereum space. In 2016, he was co-author with his father, Don, of "Blockchain Revolution," one of the most influential early books on business blockchain.

On September 19 of this year, Alex released a new book, "Web3: Charting the Internet's Next Economic and Cultural Frontier". Alex is also a part of the Blockchain Research Institute, which is an EEA member.