Hashdex

HASHDEX RESEARCH

Ethereum
A Definitive Guide for Investors

AUGUST, 2022

VERSION: 1.1.0

Index

Introduction

Investor interest in crypto assets continues to surge. This emerging asset class is becoming increasingly accepted as a component of investor portfolios. Financial advisors are working to stay informed on these novel technologies, with the ultimate goal of helping their clients understand and successfully participate in these markets.

Individuals eager to participate in the crypto economy need help navigating the complexity of these assets. Advisors that can help clients navigate the crypto markets will be better positioned to retain and attract clients as crypto becomes an increasingly important part of investor portfolios.

As one of the world's leading crypto-focused asset managers (and Latin America's largest), Hashdex has compiled this Ethereum guide to be a resource for advisors wishing to better understand the investment case for this asset.

Welcome to the Definitive Ethereum Guide for Investors

Content Summary

Ethereum is the first network to enable smart contracts on a blockchain. These smart contracts are used to create new digital assets or tokens that can be issued and transferred over the network.

Ethereum's open-source approach, which allows any developer to access and use its code, has helped it generate a strong base of supporters and serve as the foundation for many successful Ethereum-dependent applications and protocols.

Ethereum's token ether (ETH) is used as the denomination for all value-transfer functions on the network. Each transaction, whether an exchange of currency, information, or the execution of a smart contract, costs a small amount of ETH.

Ethereum is currently being upgraded to "Ethereum 2.0," which will culminate in a revamped blockchain network that uses a Proof-of-Stake (PoS) model instead of Proof-of-Work (PoW) to verify and store transactions. This transition is aimed at eliminating mining and its energy costs, and—together with scaling solutions like sharding—allowing for more transactions to be executed and registered per second, increasing network throughput and reducing transaction fees.

Ethereum remains focused on being the premier smart contract and dApp platform. While there is increasing competition from other base layers, Ethereum is well-positioned to increase scalability and continues to be the most popular network among developers.

[1] The Ethereum Foundation announced in January 2022 it would no longer use the term "Ethereum 2.0." Instead, it now refers to the upgrade as the "consensus layer" (Ethereum 1.0 is the "execution layer") to underscore that these are upgrades to Ethereum, not an entirely new network.

Part 1: Ethereum Overview

Ethereum is a global, open source blockchain platform for running decentralized applications (dApps). The network, launched in 2015, is powered by smart contracts and embedded with a native digital currency, ether (ETH). A smart contract is a piece of cryptographic code that will perform a subset of computations set by a developer. The utilization of smart contracts allows code to be written on Ethereum that sets programmable conditions to transmit value and information. Ethereum-based smart contracts are widely used to create new digital assets or tokens that can be issued and transferred on the network's blockchain. ETH serves three main purposes: (i) to store value, (ii) to settle transactions by allowing users to send or receive payments, and (iii) to facilitate network operations via transaction fees and rewards, which are based on the computational costs of executing the code. Ethereum expanded upon Bitcoin's peer-to-peer (P2P) system by creating a platform capable of deploying smart contracts and more complex structures, such as decentralized applications. The network is supported by the collaborative efforts of a global developer community, which continually makes improvements to the network and applications it can support. Ethereum has secured the largest developer base in the world[2] by making all programming open source.

A short history of Ethereum

Vitalik Buterin, an early Bitcoin contributor and co-founder of Bitcoin Magazine, wrote the original Ethereum whitepaper in 2013[3]. Buterin believed a digital currency's blockchain could facilitate much more than just P2P electronic value transfer. He integrated programming capabilities directly into the Ethereum protocol, allowing developers all over the world to design new decentralized applications. The Ethereum Foundation, created in 2014, is the organization responsible for improving and growing the network.[4]

[2] https://cointelegraph.com/news/ethereum-dominates-among-developers-but-competitors-growing-faster
[3] https://ethereum.org/en/history/#whitepaper
[4] https://ethereum.org/en/foundation/

Ethereum's design follows five key principles[5]

Simplicity

The protocol is designed to be as simple as possible, even sacrificing some optimization to allow an average programmer to make full use of smart contracts and programming specifications.

Universality

Ethereum does not have features, rather it provides a Turing-complete scripting language. This means a programmer can construct any mathematically defined smart contract or transaction.

Modularity

The protocol is modular so that any individual aspect of an application can be altered or replicated without impacting the network. This allows for the expansion of capabilities as well as the sharing of applications across platforms.

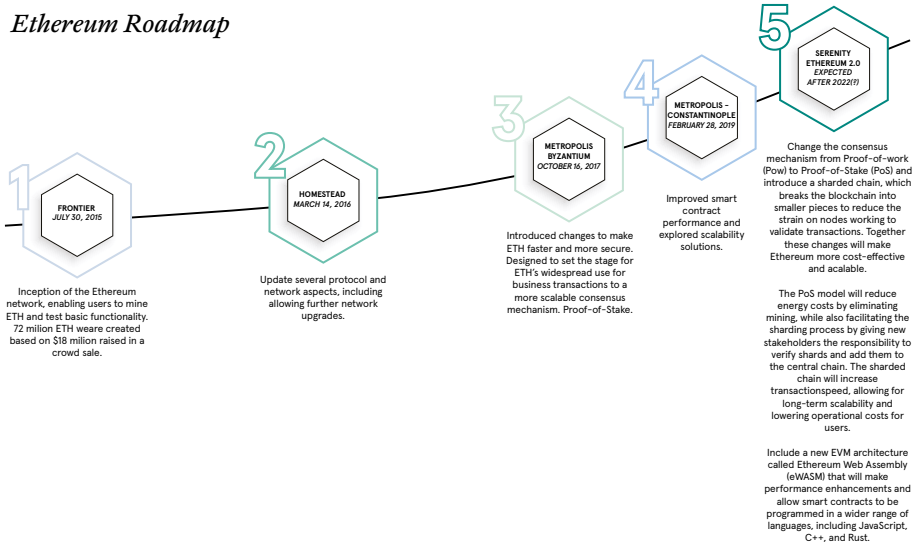
Agility

Details of the protocol are not set in stone. Ethereum is designed to be optimized and improved over to ensure it does not fall behind as blockchain technology advances.

Non-discrimination/ Non-censorship

Ethereum is designed to allow for any specific category of usage. Its regulatory mechanisms do not restrict specific applications.

Ethereum: Stages and Milestones[6]



[5] Ethereum.org
[6] Ethereum.org/en/history

Part 2: Ethereum's Main Features

While Ethereum borrows heavily from Bitcoin's protocol, it has some key differences. The core feature of Ethereum is allowing developers to build and run decentralized consensus-based applications and smart contracts. These applications, executed on a public blockchain, allow for the distribution of computational tasks across a network of nodes in exchange for market-driven fees.

Unlike many crypto asset blockchains, which focus on cataloging and verifying transactions, Ethereum's blockchain allows for smart contracts to be included in its stored data. Examples of use cases for this feature include automated liens which transfer control of loan-financed assets based on payment histories, trustless escrow accounts, and trustless bets or lotteries.

Ethereum uses a Turing-complete programming language named Solidity to facilitate smart-contract capabilities. This design stands in stark contrast to Bitcoin, which has a built-in programming language, Script, that is purposefully not Turing-complete[7]. Additionally, every time an Ethereum-based application is used, smart contracts are compiled, read, and executed by the Ethereum Virtual Machine (EVM). The EVM acts as a decentralized computer, programmatically executing specific functions and deploying smart contracts. Anyone can audit these smart contracts on the public Ethereum ledger, unlike traditional internet applications which have proprietary code. This open-source approach has helped Ethereum become the foundation for many successful protocols such as Uniswap, ChainLink, AAVE, and MakerDAO.

Bitcoin is theoretically also a smart contract platform, but one that is restricted to value transfer transactions of limited complexity. In contrast, Ethereum smart contracts can perform any task a developer assigns. Smart contracts are read and executed by every single node in the Ethereum network through the EVM.

[7] A Turing-complete protocol can be programmed to perform any calculation possible by any other programmable computer, allowing for the execution of arbitrarily complex computations. Source: https://academy.binance.com/en/glossary/turing-complete

Ethereum's token ether is used as the denomination of all value-transfer functions on the network. It is used for Ethereum's "gas function," which is what makes applications run on the network. Each transaction, whether it is an exchange of currency, information, or the execution of a smart contract, costs a small amount of ETH. These fees, referred to as "gas," are based on how much computational energy is needed for a transaction. Gas fees, which are denominated in a tiny fraction of ether called Gwei[8], are used to compensate the miners working to validate transactions and create new blocks.

In recent years, Ethereum developers have worked to improve transaction speeds and lower costs by introducing Layer 2 (L2) applications. L2 is a set of technologies and systems that run on top of Ethereum (L1). They inherit L1 security properties while providing greater transaction processing capacity (throughput), lower transaction fees (operating cost), and faster transaction confirmations. While L2 scaling solutions are secured by L1, L2 enables blockchain applications to handle many more users, actions, or data.

The idea of multiple Ethereum layers has been a major part of its blockchain structure. In addition to being an important aspect of the network's future advancement, longevity, and sustainability, L2 allows Ethereum to be used to build applications such as decentralized finance (DeFi) and blockchain gaming.

Ethereum mining

Ethereum currently uses a PoW consensus model. New blocks are created by miners competing to aggregate and validate transaction requests. Miners earn the right to do this by completing computationally complex problems. Every miner competes to verify the same block of transactions, but only the first miner to do so earns the majority of block rewards. If two blocks are verified at roughly the same time, the one with a lower share of PoW transactions is considered an "uncle block." The uncle block is not added to the blockchain, but its miner still receives discounted rewards. Computing power, also referred to as "hashrate," often determines which node mines a block. This gives mining pools and companies an advantage over individual miners, and also carries increased energy costs.

[8] Each ether is divisible in 18 decimal points. The smallest ETH fraction is called Wei (1 ETH = 1018 Wei), in honor of Wei Dai, who formulated the concepts of all modern cryptocurrencies and is best known as the creator of the predecessor to Bitcoin, B-money. Since one Wei accounts for a very small monetary value, gas fees are usually denominated in GigaWei (109 Wei = 10-9 ETH), or simply Gwei.

[Hashrate is a measure of the computational power used when mining. A higher hashrate equates to faster mining. It is measured by hash calculations per second. Higher hash rates typically correlate with more successful mining operations, as more calculations per second improves the chance of being the first to verify a block and earn the rewards. In the case of Ethereum, hashrate indicates the number of times hash values are calculated for PoW every second. As of June 17, 2021, Ethereum's network hashrate is 1,035.91 Thash/s.9 The network hashrate is the combined rate of all PoW miners operating at a given time.]

The rewards for mining ETH have been steadily decreasing to help control the monetary supply. At the same time, mining difficulty has been increasing at predefined block numbers, which is referred to as a "difficulty bomb." This mechanism was put in place in 2016 to control ETH supply and will increase in difficulty to help facilitate the forthcoming shift from PoW to PoS.[10]

Mining Logistics and Rewards

Miners who successfully confirm a transaction and upload it to the blockchain receive block rewards in the form of ETH. Block rewards began at five ETH and then decreased after the Byzantium and Constantinople hard forks. Currently, one block is mined roughly every 13.2 seconds and the reward is two ETH. Despite the decrease in rewards and increase in difficulty, ETH mining remains profitable. However, it is very difficult for individual miners to earn a profit.

Mining most crypto assets requires expensive equipment and large amounts of energy. ETH is no different. This can make mining difficult for those without a large hashrate, as miners have fixed energy costs even if they are unsuccessful in mining a block. The high energy costs of mining is a key reason for the consensus layer's shift from PoW to PoS.

[9] https://etherscan.io/, accessed April 1, 2022.
[10] https://ethereum.org/en/glossary/#difficulty.

Part 3: Ethereum 2.0 The Concensus Layer

Ethereum 2.0, which the Ethereum Foundation refers to as the "consensus layer," [11] includes several stages, culminating in a revamped blockchain network that uses a PoS model instead of PoW to verify and store transactions. This transition is aimed at eliminating mining and its energy costs. Additionally, the use of sharded chains in the consensus layer update will allow for more transactions to be verified per second, increasing scalability. The phases for the consensus layer rollout are as follows.[12]

Dec. 2020

Phase 0 delivered three main technological implementations to the Ethereum ecosystem: The Beacon Chain, the PoS consensus mechanism (dubbed Casper), and validator nodes. These features went live in a December 2020 trial state, operating in parallel to the legacy Ethereum blockchain. The plan is to anchor the Beacon Chain to the Ethereum blockchain, and then slowly slot all current Ethereum blockchain information into the new PoS blockchain. This process is conceptually similar to Bitcoin blockchain forking, in which new chains break off from the original but retain the original blockchain data. Phase 0 still has very limited functionality, as its primary purpose is to test the PoS validation model. During this phase, the original Ethereum blockchain and PoW model remain active, and all applications and protocols built on Ethereum will continue to operate on the original blockchain.

Late 2021

Phase 1 will be used to test the scalability of sharded chains. In the consensus layer, each individual PoS blockchain is called a "shard." Sharding allows transaction loads to be split across multiple blockchains, multiplying network throughput and speed. Rather than validating all transactions through a single blockchain with limited throughput, users can choose one of many shards in which to send transactions. Each shard, with its own set of randomly selected validators, can process transactions and create new blocks concurrently with other shards. These validators must be randomly selected to prevent collusion between multiple validators.

The Beacon Chain, the center of the consensus layer, will act as the bridge between all shards by maintaining summaries of shard data in one central blockchain. Initially, there will be 64 Phase 1 shards. These shards will not have any smart contract functionality (i.e., an ability to run decentralized applications). Instead, they will test the aggregation and movement of data between shards and the Beacon Chain. The functionality of Ethereum applications will remain in the original PoW model.

[11] The Ethereum Foundation announced in January 2022 it would no longer use the term "Ethereum 2.0." Instead, it now refers to the upgrade as the "consensus layer" (Ethereum 1.0 is the "execution layer") to underscore that these are upgrades to Ethereum, not an entirely new network.
[12] Information via Ethereum.org and CoinDesk Research Report "Ethereum 2.0: How It Works and Why It Matters," July 23, 2020.

2021 - 2022

Phases 1.5 & 2 will introduce smart contracts and programming to the Beacon Chain, giving it essentially the same functionality as the original Ethereum blockchain. Before Phases 1.5/2, Ethereum 1.0 (execution layer) and Ethereum 2.0 (consensus layer) will remain different entities that do not support two-way transfers of value. As a result, ETH earned in these phases will not be transferable or usable in the short term.

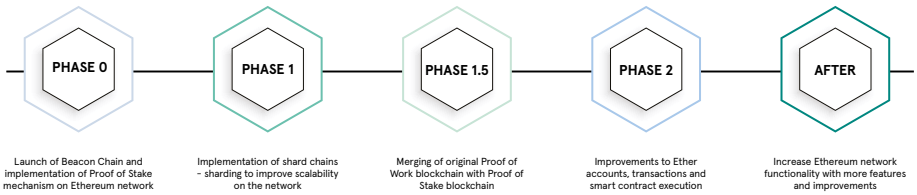
The execution layer (Ethereum 1.0) mainnet[13], contained in a shard chain, will bring smart contract functionality to the consensus layer. Phase 1.5 is slated to begin after the shard system is fully functional and without bugs. Once the original Ethereum 1.0 blockchain is fully tested and successfully docked in the consensus layer ecosystem, Phase 2 will take effect, initiating cross-shard operations and native dApp development. Phase 2 will allow shard chains to handle new transactions and smart contracts, not just process data. Additionally, Phase 2 will enable dApps to be coded in any programming language, not just Solidity.

~ 2023

Phase 3 is the final phase. According to Buterin, Phase 3 is the catch-all term for "basically other stuff that we want to add [to Ethereum 2.0/consensus layer] down the line." This could include adding more shards to the network or new cryptographic technology such as Zero-Knowledge Scalable Transparent Arguments of Knowledge (ZK-STARKs)[14]. These initiatives would increase the privacy of the consensus layer by enabling users to share data without revealing this information to third parties.

It is estimated that each phase of Serenity, the consensus layer's final stage, will take six to eight months. While the tentative project completion date for Serenity is expected in 2023, constant updates and uncertainty about each stage's successful implementation, this timeline may be extended.

The Concensus Layer Update Phases



[13] A mainnet is a blockchain that has been tested and fully developed.
[14] ZK-STARKs are a type of cryptographic proof technology that enables users to share validated data or perform computations with a third party without the data or computation being revealed to the third-party in a way that is publicly verifiable. Source: EthHub https://docs.ethhub.io/ethereum-roadmap/layer-2-scaling/zk-starks/

Validating Blocks in Ethereum's Consensus Layer: Proof-of-Stake

The Ethereum consensus layer's shift to PoS means that network participants will be able to stake their existing ETH to earn the right to validate future blockchain transactions. Once launched, validators will begin earning rewards on staked ETH in the form of annualized interest. Approximately every six minutes—the amount of time estimated for a new Beacon Chain block to be created—rewards will be distributed directly into the accounts of active consensus layer validators. The PoS model's use of sharding is an effort to increase the transaction verification rate. Ethereum 2.0 needs roughly 16,000 validators to buy-in and stake their ETH before PoS can be launched and integrated into the original Ethereum blockchain.

What Ethereum's Consensus Layer Means for ETH

There are many theories regarding how Ethereum's consensus layer will impact ETH and the wider crypto market. While it is too early to be certain, there are several potential near-term outcomes.[15]

Price Factors

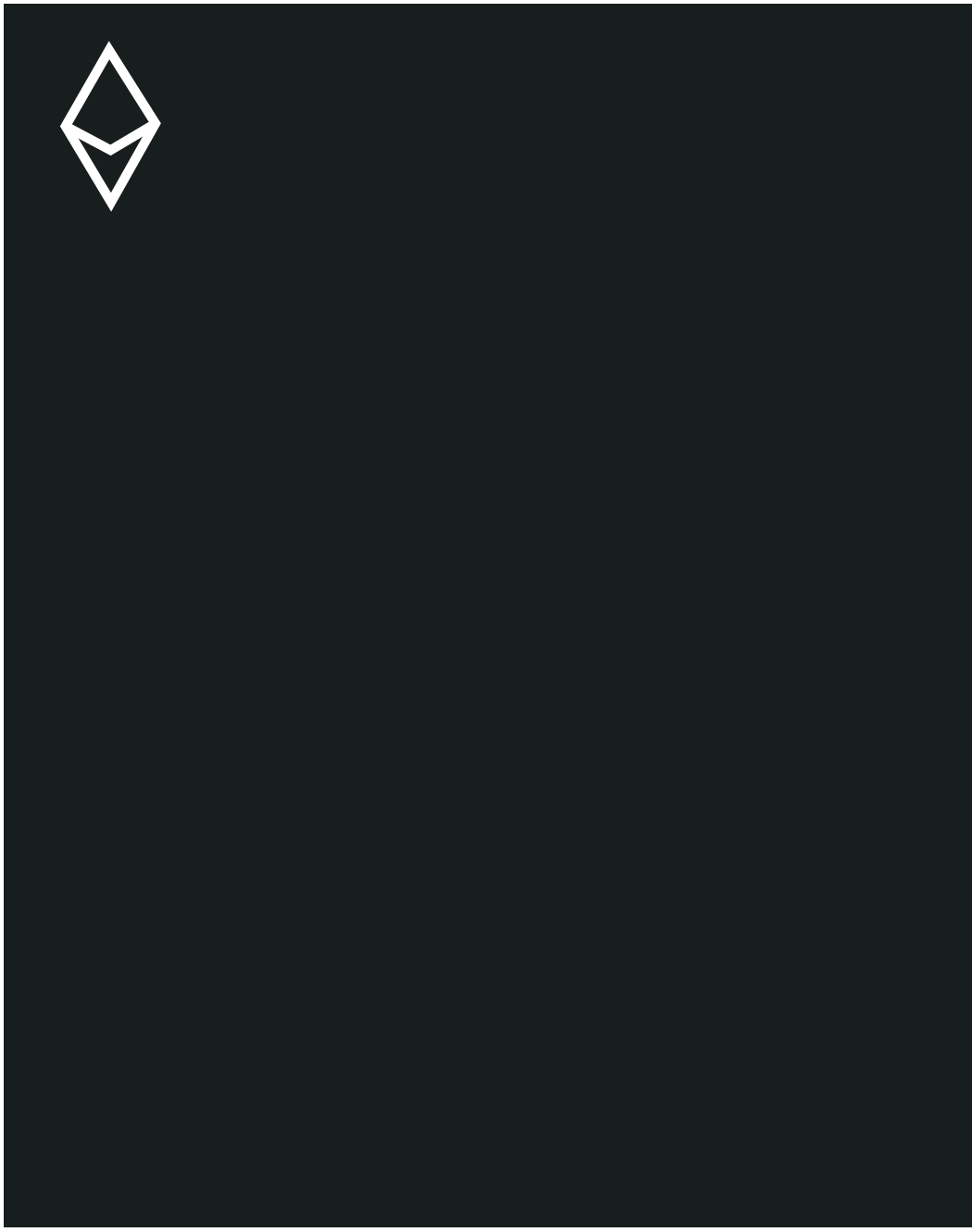
The price of ETH is likely to fluctuate based on a few factors. The first is that as more ETH is issued on the new blockchain its price will decrease due to increased supply. However, it is estimated that new issuance will only be about 0.1% at launch, and then up to 0.45% per year. Outside of this increased supply, nearly 524,000 ETH will be locked away to establish the PoS model for the consensus layer. This reduced liquidity may increase the price of non-staked ETH.

Another price scenario is that a successful launch of the consensus layer may increase the value proposition of both the currency and network. The new PoS model's significant reduction in energy consumption could lead to a better public image and better profit margins for validators. Simultaneously, the faster transaction times due to sharding will make the network more efficient and desirable for developers. However, the opposite could also be true. If the implementation of Phase 0 or Phase 1 fails, the price of ETH could fall as investors and developers lose confidence.

[15] Information provided by CoinShares Research and is speculation intended to present possible scenarios regarding Ethereum 2.0/consensus layer update.

New products staked in ETH

The ETH earned by validators immediately after Phase 1 will not be transferable and will likely spawn a host of DeFi products. Examples may include bond-like assets priced by factoring in future interest earned or redeemable tokens that become valuable upon the completion of the consensus layer update. DeFi applications may also be developed to help ETH stakers earn interest without actually having to validate any shards. These applications will validate shards in exchange for a percentage of the interest earned by stakers, offering more ways to profit from ETH. This will likely increase the crypto asset's usage and value.



Part 4: Investment Thesis and Opportunities

Examining Ethereum as an Investment [16]

The previous sections have outlined the structure, advantages, and risks associated with Ethereum as a blockchain network and ETH as a digital currency. In order to develop an investment thesis for Ethereum, we believe it is important to synthesize both the advantages and disadvantages of the network over the long term. Short-term investment in ETH is more likely to be influenced by specific metrics, market trends, and events. Examples of short-term influences include social media coverage, expanding financial services, and public opinion of the asset.

Structure and Technology

Unlike Bitcoin, Ethereum allows for embedded smart contracts, facilitating programming and the creation of network applications. Smart contracts are safely run in the EVM and allow for programs to be built on the network in layers. This structure allows Ethereum to be decentralized, secure, transparent, and anonymous.

These features have attracted users and investors and continue to drive the network's value. Because Ethereum was the first network to allow smart contract programming on a large scale, it has a significant library of smart contracts and programming examples to help new developers. As the first mover in this space, it also has a large, loyal, and active group of developers. Ethereum is the leading network for GitHub activity across all metrics. This includes total contributors, total project watchers, and total Stars.[17] These factors can add value from an investment standpoint, as can the network's large market share and history of success. These factors, however, are not unique to Ethereum. Over time, its market share and number of active developers will face competition from networks with similar structures and goals as Ethereum.

[16] This is not investment advice. Rather, this is a summary of all previous information, presented through the lens of investment, as opposed to a technical lens.
[17] GitHub Stars are developers recognized for their work by the GitHub community. https://stars.github.com/

Ethereum's Concensus layer and The Future of ETH

Looking ahead, Ethereum plans to upgrade and stay ahead of the competition. This is important because the upgrade to Ethereum's consensus layer addressed many of the concerns and risks investors have in the network. Primarily, investment concerns stemming from sustainability, scalability, and affordability concerns. The current PoW model has received criticism for its energy consumption as well as slow transaction speeds and high gas costs. Despite the success and utility of the blockchain network, these concerns cast doubt on the long-term investment potential of the network, especially since some of Ethereum's competitors have already adjusted their models.

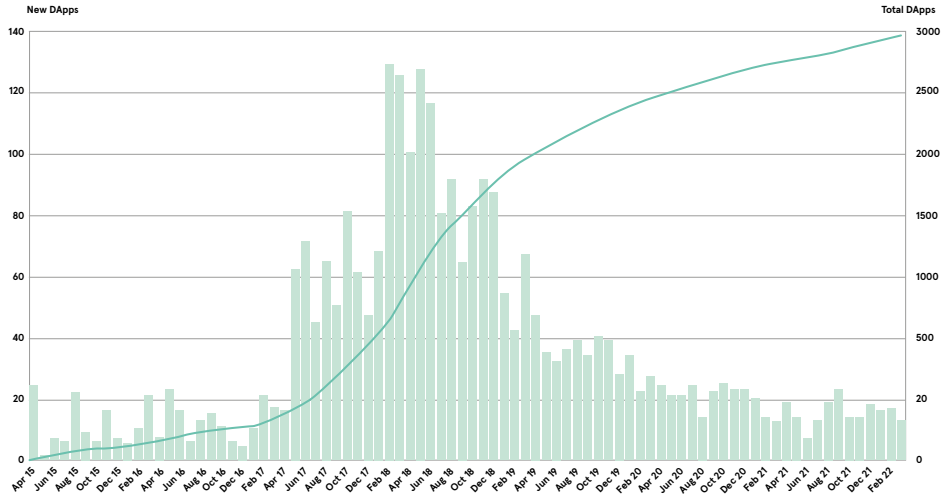
When considering long-term investment in Ethereum, the 2.0 upgrade is an important consideration. If it succeeds and is implemented, the network will have a strong solution to many of its problems and will likely remain the premier smart contract platform. However, if it fails, the network will likely lose considerable market share to competitors. Experts acknowledge the upgrade as ambitious, but there have been no indications of failure or setback. Regardless, investors should be aware of the impact to the network from this upgrade.

Innovation and Verticals

A primary driver of Ethereum's growth is its innovation and continued expansion into verticals such as DeFi, payment systems, and DAOs. Unlike Bitcoin and other purely payment or transaction-based networks, Ethereum attracts users from a variety of industries by creating opportunities and relationships with organizations through its application-building capabilities. The number of applications and organizations that operate on the Ethereum network (and use ETH as gas) is a strong driver of value.

Ethereum currently hosts the most dApps of any blockchain network. A successful consensus layer update would further increase this capability and if Ethereum can maintain dominance in these markets it will retain long-term value. However, it is important to monitor competing platforms, because a long-term investment in Ethereum would be at risk if it becomes just one of countless smart contract platforms.

New DApps per month - Ethereum



Number of Decentralized Applications on Ethereum over time.[18]

Risks

General Digital Asset Risk

Regulation and Legislation

The SEC has identified ETH as one of two digital assets that it does not intend to consider as a "security." However, there are many regulatory concerns related to tokens, DeFi products and protocols, and Ethereum-built businesses that could pose further risks. Should the government take action on these risks and concerns, it could impact the price of ETH. The primary risk remains that government regulations will reduce the ability to buy, sell, and trade crypto assets or attempt to transition them into more centralized assets. If this occurs, the value of ETH will likely decrease, even if the network remains strong.

[18] State of DApps, Number of DApps on Ethereum (All categories), accessed April 5, 2022.
[19] As with all investments, it is important to consider risk. Ethereum's risk profile can be broken down into general digital asset risk and industry specific risk.

Transaction Cost and Scalability

All crypto assets face competitive pressures due to high costs and an inability to scale with usage growth. However, Ethereum is particularly at risk due to its PoW model. Currently, Ethereum can only process roughly 15 transactions per second, and its transaction cost model means price will increase with demand. These high costs and slow speeds diminish the value of the network, as users will leave and products will not run as smoothly.

Environmental Impact and Public Opinion

Ethereum and other PoW blockchains are in the spotlight because of the energy costs of mining. This has negatively impacted public opinion and also inspired regulation, both of which decrease asset value. As Ethereum transitions to PoS, it will face challenges. Previous attempts at securing protocols using PoS have been generally functional, but no system with a market value or adoption level near Ethereum has ever attempted such a radical change in consensus mechanism.

If the PoS model fails, or one or more hard forks occurs, confidence in the network will drop. There is also a risk that energy consumption remains high, which may turn public opinion and could lead to increased regulation, further diminishing value. In the long term, if Ethereum can solve its energy and scalability problems, it will likely increase in value.

Ethereum Network Specific Risk

Competition

Ethereum faces strong competition from newer smart contract platforms, specifically those initiated with PoS models[20] or other scalable, efficient, and inexpensive models. Examples of industry competition include Solana, Polkadot, BNB Chain[21], Cardano, and Cosmos. Ethereum still dominates the market, but its share is slowly eroding as other platforms provide alternatives.

Monetary Policy and Inflation

Currently, ETH does not have a maximum supply cap and there have been very few announcements outlining a possible monetary policy strategy. There is widespread criticism levied towards Ethereum in the crypto community for its tendency to alter Ethereum monetary policy via committee, a mechanism more commonly associated with central banks. Due to the variable nature of its inflation drivers, the lack of clarity on its future issuance model, and frequent developer intervention, there is no reliable way of knowing ETH's future inflation rate. Going forward, if the Ethereum network is unable to establish a strong monetary policy strategy, there may be long-term negative impact.

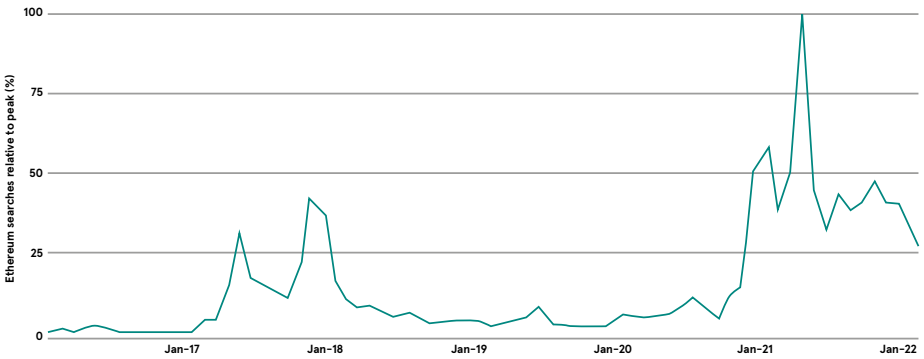
[20] It is important to note that scalability and efficiency is generally associated with lower levels of decentralization and security, as described by the "blockchain trilemma." Source: https://eth.wiki/sharding/Sharding-FAQs.
[21] Previously Binance Smart Chain. Source: https://www.binance.com/en/support/announcement/854415cf3d214371a7b60cf01ead0918

Asset Performance, Important Metrics, and Speculative Value

The price of ETH rose throughout 2021, at one point reaching over $4,600[22]. The ETH rally this year came from technological developments that caused excitement among traders. First, the "Berlin update" rolled out on the Ethereum network in April 2021, an update meant to pave the way for reduced ETH transaction fees. Second, the arrival of Uniswap V3 in May 2021—a decentralized exchange protocol—is expected to further optimize Ethereum trading.

Ethereum comprises around 20% of the total crypto market cap[23]. Google search trends[24] show that Ethereum related searches have been fluctuating, achieving an all-time-high in May 2021 and staying significantly higher than the previous 18 months. This indicates that despite the volatility, its popularity remains high.

Ethereum search trends over time (Google)

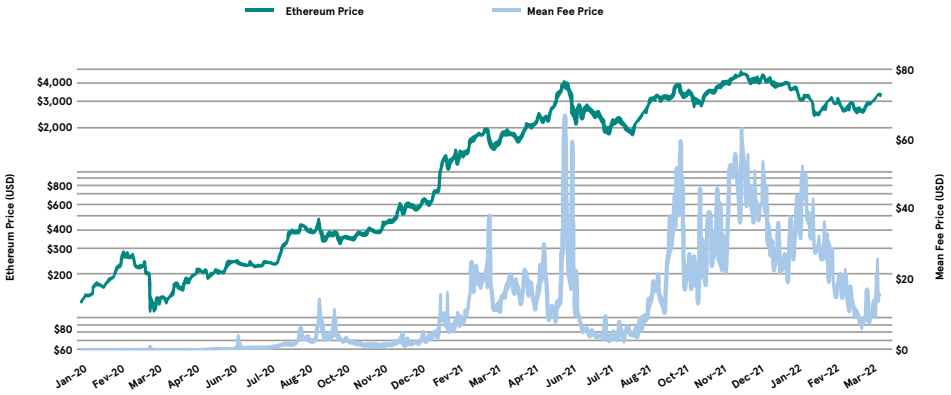


In addition to search trends, there are several other important metrics that provide insight into the ETH's underlying value. These include (i) Price (ii) Transaction Volume (iii) Trading Volume (iv) Monthly Active Developers, and (v) Transaction Fees.

Price and value, specifically any difference between the two, are primary indicators of a good investment. In the case of Ethereum, transaction volume, trading volume, monthly active developers and transaction fees are all good indicators of value in our analysis. This is because they reflect usage, development/improvement, profitability, and long-term sustainability. On the other hand, price is the market determination of value and is often very volatile. By understanding and monitoring the price, it can be compared to underlying value metrics to determine the profitability of investment. As of April 1, 2022, the price of ETH is ~$3,460[25], and still follows similar trends to BTC.

[25] Messari, accessed April 1, 2022. Source: https://messari.io/asset/ethereum

Ethereum price and fee price over time

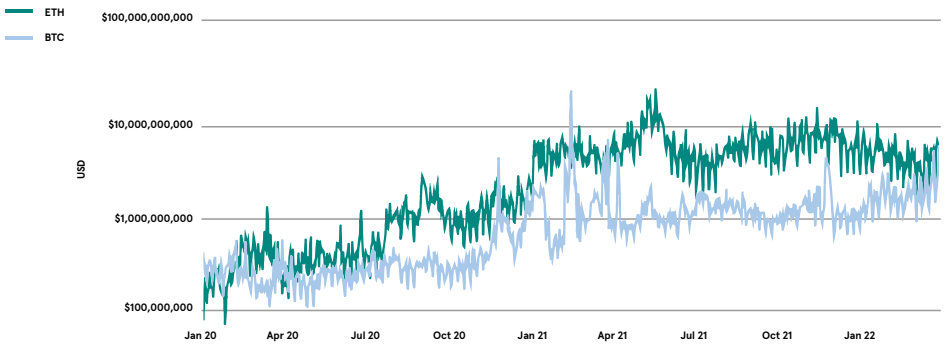


Transaction Volume on Ethereum represents the movement of crypto assets on-chain. By tracking the on-chain volume of ETH and specific ERC-20 tokens[26], investors can gain unique insights about value. "On-chain" means transactions of coins/tokens within the network, not on outside exchanges. This metric provides an estimate of how much usage the network is receiving. The higher the volume the more popular the network. Because ETH is needed to maintain the volume of transactions, its value increases with higher volume.

Additionally, by comparing Ethereum's transaction volume to BTC, it is possible to better understand market trends and intrinsic value. In early 2021, Ethereum's transaction volume surpassed BTC, processing nearly $3 billion more per day. Transaction volume provides insight into both the structure of the network (how it handles large amounts of transactions and its scalability) but also allows horizontal comparisons between networks.

[26] ERC-20 is a standard for tokens on the Ethereum blockchain. It allows for the interoperation of new tokens with Ethereum-based applications.

Total transfer volume of ETH and BTC over time



Trading Volume indicates how many coins or tokens are being bought and sold on specific exchanges. High trading volumes are likely to drive more on-chain activity (e.g., when people deposit and withdraw funds). It is also a good indicator of general interest in the crypto market. Transaction volume may be biased by a few market insiders trading or moving large amounts of assets. However, trading volume may give clearer insights into the general public's interest in an asset.

Monthly Active Developers represents the number of users actively contributing to software and programing improvement and creation on the blockchain. These active developers are integral to the success of a blockchain. This is especially true for Ethereum because of its focus on smart contract implementation. A large community of active developers indicates quality content, strong popularity and usage, as well as scalability and improvement opportunities in the future. If the number of active developers consistently decreases, it likely means there are underlying problems with the network structure, its governance model, or the content/code it contains. As of early 2022, Ethereum still leads all networks with more than 4,000 active developers every month[27].

Transaction fees are the cost incurred to process and verify a blockchain transaction. High gas fees are due to the popularity of Ethereum. Performing any operation on Ethereum requires gas, and gas space is limited per block. If there is too much demand, users must offer a higher gas price to try and out-bid other users' transactions. A higher price can make it more likely that your transaction will get into the next block.

As a metric, transaction fees can be used to understand a platform's popularity. However, it is important to note that while higher transaction fees may indicate popularity, it also may drive users toward cheapest networks. A high average transaction fee that is unaddressed may be a precursor to a drop in price or perceived value.

[27] https://medium.com/electric-capital/electric-capital-developer-report-2021-f37874efea6d

Part 5: Conclusion

Ethereum is responsible for kickstarting innovation in the blockchain industry. It expanded on Bitcoin's model to create an accessible, innovative, and evolving ecosystem. By expanding beyond digital currency transactions, Ethereum has paved the way for entirely new industries. In the end, its goal remains to become the premier smart-contract and dApp platform, with a currency and consensus model (PoS) that allows for scalability and sustainability.

Despite the challenges and risks, Ethereum has continued to make improvements and adapt to global challenges. In the face of environmental and scalability concerns, the network's development of the consensus layer as well as L1 and L2 scalability solutions is a sign that it is evolving as conditions change. While there is increasing competition from outside smart-contract platforms, Ethereum remains the most popular among developers and has consistently high market share. Across the globe, Ethereum has cultivated a strong network of users, developers, enterprises, and investors. Each and every one of them helps build social and technical momentum that has yet to be replicated by any competitors.

Appendix

Key Concepts

Smart Contract Overview

The term smart contract was first described by Nick Szabo in 1995. Szabo described a smart contract as "a computerized transaction protocol that executes the terms of a contract." Essentially, a smart contract is a piece of code which automates the execution of an agreement between two parties based on predetermined inputs[28].

The value of smart contracts can also be understood by viewing them as "commitments." Once a smart contract is built into a platform, it is guaranteed to operate indefinitely and according to its commitment. These commitments are further guaranteed by the autonomous and self-governed nature of their code. This creates value by reducing the need for trust between parties and the risk of human error.

[28] Szabo, N. (1994). Smart Contracts.

In practical terms, smart contracts remove the need for centralized institutions to guarantee transactions. Instead, platforms can use smart contracts to create an autonomous, transparent, and trustless transaction environment that is more efficient and cheaper than traditional options.

Example: Lending assets on a DeFi platform

Many DeFi platforms such as Compound, AAVE, and Curve offer smart contracts that pay interest rates in exchange for users lending their assets on the platform. This allows the platform to distribute crypto loans backed by a large pool of liquid assets, while also allowing users to earn high interest on assets they are not currently using. Smart contracts ensure all parties receive what was promised.

For example, a smart contract on Compound allows a user to deposit assets. The smart contract then records the amount and pays out a given interest rate. When that user wants to withdraw their assets, they can refer back to the original smart contract which will automatically transfer the exact original amount, plus any interest. Smart contracts ensure a trustworthy experience for the user, while the platform can record and automate transactions in a verifiable and transparent way.

Decentralized Application (dApp) Overview

A decentralized application (dApp) is an application built on a network that combines a smart contract with a frontend user interface. In Ethereum, smart contracts are accessible and transparent, like open APIs, so a dApp can even include a smart contract someone else has written.

A dApp has its backend code (smart contracts) running on a decentralized peer-to-peer network. This decentralized network catalogs and verifies all backend transactions, ensuring trust and validity. This stands in contrast to traditional applications where the backend code is running on centralized servers and users have limited access.

A dApp has four main characteristics:
Decentralized: dApps cannot be controlled by any one person.
Deterministic: dApps perform the same function irrespective of the execution environment.
Turing complete: Given the required data, a dApp can perform any necessary computational action.
Isolated: dApps are executed in a virtual environment known as the Ethereum Virtual Machine. If a smart contract has a bug, it will not hamper the blockchain's functioning

Example of Ethereum dApp: Augur[29]

Augur is a decentralized platform built on Ethereum. The platform is designed to create event prediction markets. A user places a bet on the outcome of an event to receive a reward.

The higher the odds of an event happening, the higher the reward. Augur has a user interface and platform (website) on the frontend that allows people to explore betting options. On the backend, the dApp uses smart contracts to safely collect and distribute users' bets and winnings, based on real world outcomes. These transactions and outcomes are all recorded and verified on the Ethereum blockchain, helping ensure the process is decentralized and fair for everyone.

Decentralized Autonomous Organization (DAO) Overview

DAOs are internet-native organizations collectively owned and managed by their members. DAO proposals are voted on to ensure every member in the organization has a voice. All transactions are 100% transparent and verifiable, which helps eliminate issues over trust.

The most common way to form a DAO is via tokens, which have value because they allow participation in governance. Token holders can propose and vote on DAO-related issues.

Example of an Ethereum DAO:

MakerDAO A well-known example of an Ethereum-built DAO is MakerDAO, a DeFi organization. MakerDAO uses the token system of membership. It is completely decentralized and powered by smart contracts, which execute its lending functions. Holders of its token, MKR, govern the community.

The Ethereum Virtual Machinet

Is a virtual sandbox embedded in each node that is responsible for running all smart contracts programmed into the network. The EVM runs all code responsible for maintaining dApps and DAOs on Ethereum. It is essential because it is completely isolated from the network, filesystem, or host computer. All code is run in a separate, secure environment and cannot hurt the blockchain network via malfunction, malware, or bugs in the contracts. The EVM promotes decentralization by running all operations away from any central server or outside control.

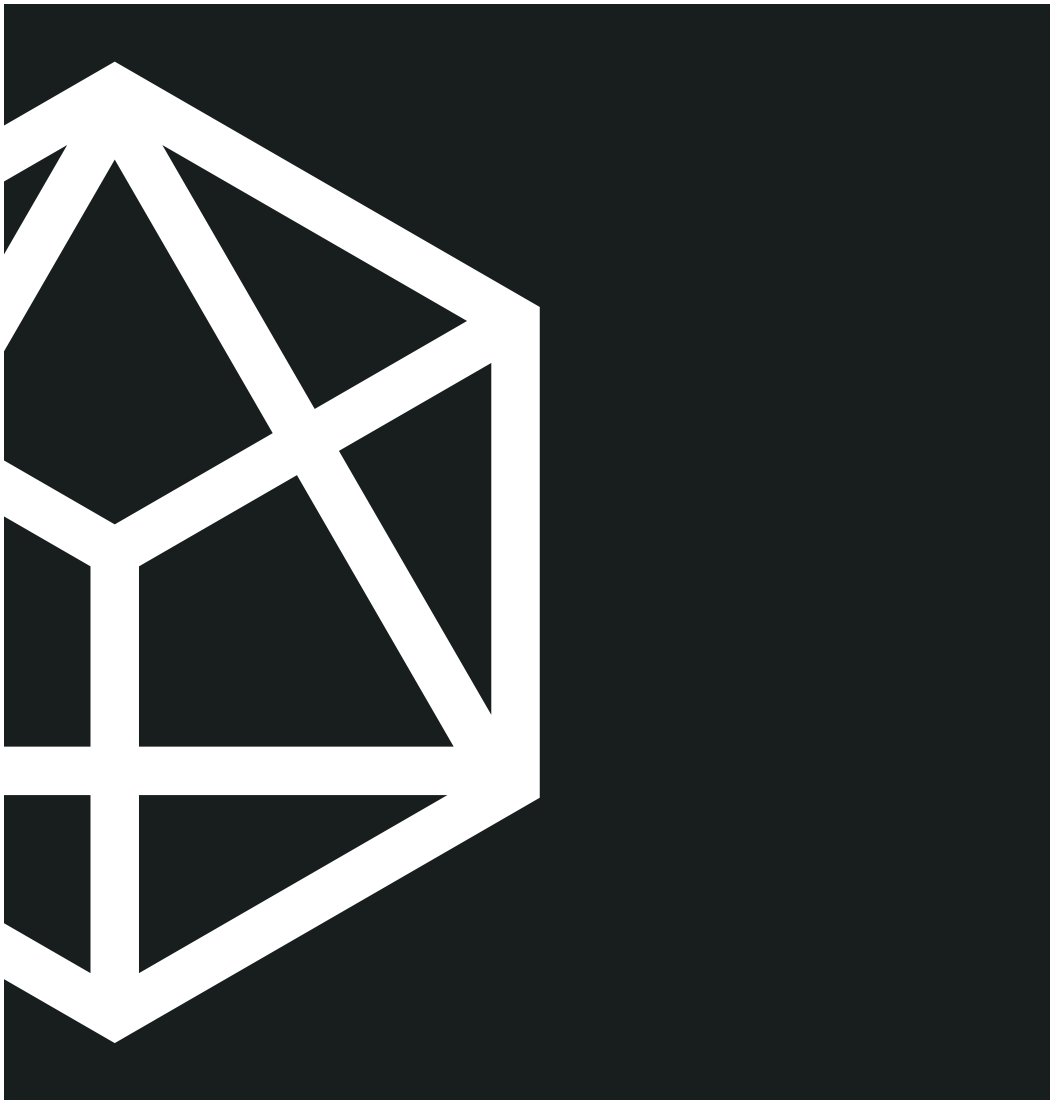
Every time a program is run on the EVM it is assigned a 'gas' cost[30] before the transaction is processed. Once the contracts/code is successfully run in the EVM and validated by the network, it can be added to the blockchain as a trusted transaction.

[29] https://augur.net
[30] Gas fees are denominated in "gwei," a tiny fraction of ether used to compensate the miners working to validate transactions and create new blocks.

The information contained herein ("Information") may not be reproduced or redistributed in whole or in part, in any format, without the express written approval of Hashdex Asset Management Ltd. ("Hashdex") and its affiliates and subsidiaries ("Hashdex Group"). By accepting this document, you acknowledge and agree that all of the Information contained in this document is proprietary to Hashdex Group. While not explicitly referenced within this piece, Hashdex Group manages the Hashdex Nasdaq Crypto Index ETF, Hashdex Nasdaq Ethereum ETF, Hashdex Nasdaq Bitcoin ETF, Hashdex DeFi Index Fund, Hashdex Smart Contract Platforms Index ETF and other investment vehicles focused on digital assets (collectively the "Fund" and each a "Fund") which invests in digital tokens. The Information is not an offer to buy or sell, nor is it a solicitation of an offer to buy or sell, interests in the Funds or any advisory services or any other security or to participate in any advisory services or trading strategy. If any offer and sale of securities is made, it will be pursuant to the confidential offering memorandum of the Fund (the Offering Memorandum). Any decision to make an investment in the Fund should be made after reviewing such Offering Memorandum, conducting such investigations as the investor deems necessary and consulting the investor's own investment, legal, accounting and tax advisors in order to make an independent determination of the suitability and consequences of an investment.

Each Fund seeks to track a relevant index. The performance of each Fund will vary from the performance of the relevant index that it seeks to track. The Information is being provided to you solely for discussion purposes and may not be used or relied on for any purpose (including, without limitation, as legal, tax or investment advice) without the express written approval of Hashdex Group. Certain statements reflect Hashdex Group's views, estimates, opinions or predictions (which may be based on proprietary models and assumptions, including, in particular, Hashdex Group's views on the current and future market for digital assets), and there is no guarantee that these views, estimates, opinions or predictions are currently accurate or that they will be ultimately realized. To the extent these assumptions or models are not correct or circumstances change, the actual performance of Hashdex Group and the Funds may vary substantially from, and be less than, the estimated performance. None of Hashdex Group, the Funds nor any of their respective affiliates, shareholders, partners, members, directors, officers, management, employees or representatives makes any representation or warranty, express or implied, as to the accuracy or completeness of any of the Information or any other information (whether communicated in written or oral form) transmitted or made available to you.

Each of the aforementioned parties expressly disclaims any and all liability relating to or resulting from the use of the Information or such other information. Except where otherwise indicated, the Information is based on matters as they exist as of the date of preparation and not as of any future date and will not be updated or otherwise revised to reflect information that subsequently becomes available, or circumstances existing or changes occurring after the date hereof. Investing in financial markets, the Funds and digital assets, including Bitcoin, DeFi tokens, and Ethereum, involves a substantial degree of risk. There can be no assurance that the investment objectives described herein will be achieved. Any investment in the Funds may result in a loss of the entire amount invested. Investment losses may occur, and investors could lose some or all of their investment. No guarantee or representation is made that Hashdex's investment strategy, including, without limitation, its business and investment objectives, diversification strategies or risk monitoring goals, will be successful, and investment results may vary substantially over time. Nothing herein is intended to imply that the Hashdex Group's investment methodology or that investing any of the protocols or tokens listed in the Information or the Funds may be considered "conservative," "safe," "risk free," or "risk averse." Neither historical returns nor economic, market or other performance is an indication of future results. Certain information contained herein (including financial information) has been obtained from published and non-published sources. Such information has not been independently verified by Hashdex Group, and Hashdex Group does not assume responsibility for the accuracy of such information. Hashdex Group does not provide tax, accounting or legal advice. Certain information contained herein constitutes forward-looking statements, which can be identified by the use of terms such as "may," "will," "should," "expect," "anticipate," "project," "estimate," "intend," "continue" or "believe" (or the negatives thereof) or other variations thereof. Due to various risks and uncertainties, including those discussed above, actual events or results, the ultimate business or activities of Hashdex Group or the Funds or the actual performance of Hashdex Group, the Funds, or digital tokens may differ materially from those reflected or contemplated in such forward-looking statements. As a result, investors should not rely on such forward- looking statements in making their investment decisions. None of the Information has been filed with the U.S. Securities and Exchange Commission, any securities administrator under any state securities laws or any other governmental or self-regulatory authority. No governmental authority has opined on the merits of the offering of any securities by the Funds or Hashdex, or the adequacy of the information contained herein.



Hashdex

#InVolWeTrust

Hashdex Team

hashdex.com