

DELPHI DIGITAL

Entering The Ethereum Long-Term Economics & Analysis

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The Purpose

One of the most exciting aspects of this rapidly evolving world of “crypto” is the open source ethos it was built upon. It has swept up people from vastly different backgrounds, beliefs, and geographies in its move towards a more transparent and equitable world. Some industry participants are technical gurus; some are cryptography experts; some have backgrounds in psychology or sociology; others can be found debating the ideals of Keynesian economics in the deep corners of the web.

Such a wide spectrum of expertise will inevitably lead to some dispute, but it also presents an incredible opportunity for all of us to contribute to a movement much bigger than ourselves. It allows us to collectively push the boundaries on new ideas, business models, and social constructs far beyond the possibilities any one individual or team ever could.

Our goal with this report is to spark greater discussion around the future of Ethereum and the critical challenges it is likely to face over the coming years, especially as it transitions to Serenity. While a lot of technical attention has been given to this subject, we wanted to expand upon the preliminary discussions surrounding Ethereum’s long-term sustainability and future economics.

We hope the suggested improvements in this report serve as a catalyst for many more conversations around the long-term viability of Ethereum. The beauty of this space is there is no perfect solution most of the time. There will always be tradeoffs and there will always be people on opposing sides. We may see things very differently from our vantage point, but if we’re able to elevate the quality of the conversation in some small way, then we can rest assured we’ve done our job.

Until next time,

*The **Delphi Digital** Team* 

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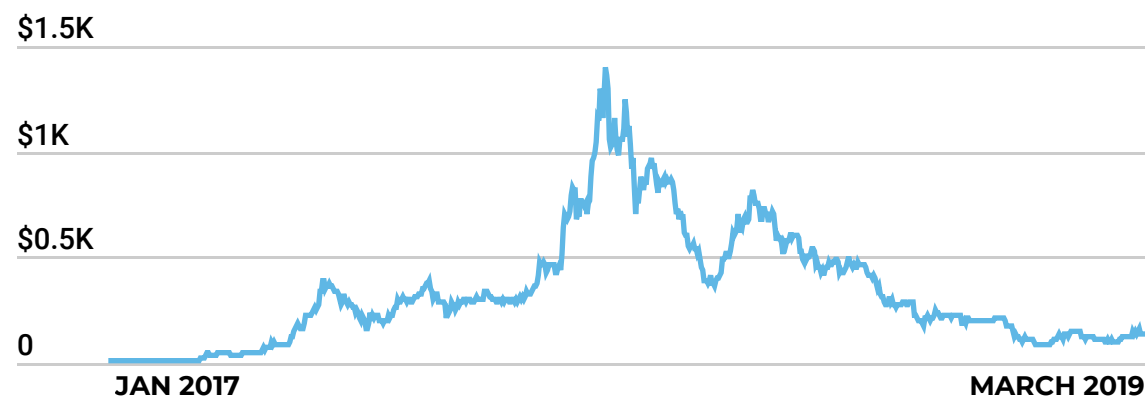
Executive Summary



Ethereum is an open-source, public blockchain-based computing platform that empowers smart contract functionality and decentralized applications.

ETH is the native currency of Ethereum. It acts as "fuel" for powering the network and is used to facilitate the processing of transactions via smart contracts for DApps.

| Details | |
|--------------------|----------------------|
| Ticker | ETH |
| Price (USD) | \$137.96 |
| Market Cap | \$14,503,610,486 USD |
| Circulating Supply | 105,136,977 ETH |
| Maximum Supply | - |
| 90 Day ADTV | \$2,853,764,456 |



Data as of March 7th, 2019

Sources: [CoinMetrics](#)

Key Takeaways:

- Ethereum continues to boast one of the most active developer communities despite the rising competition for smart contract platforms.
- A diversified and profitable validator network is crucial for the security and longevity of the network. Active discussions are on-going and the economics behind Serenity remain open-ended.

Value Drivers:

- As the usage and complexity of applications built on Ethereum grows, the aggregate fees paid to the network could grow substantially, improving its security and incentivizing more developers to build more and more applications on top of it.
- The demand for ETH may be amplified if the economics behind Serenity's proof-of-stake model present an attractive yield for validators, especially in its early days.

Key Concerns:

- The Ethereum community has strong ambitions for the world's largest distributed smart contract platform, but the trade-off between ETH issuance and network security may challenge its long-term viability.
- Aside from the many moving parts involved in the Serenity upgrade (moving from proof-of-work to proof-of-stake, sharding, cross-shard communication, etc.), we believe the currently proposed issuance model for ETH after this transition may not provide enough yield to incentivize prospective validators.

Thematic Overview

This report is broken out into five main sections, with an appendix in the back. Below, you can find an overview of each.

Short-Term Outlook

We begin by taking a look at how ETH has traded after each of its last five hard forks given the most recent Constantinople update. Afterwards, we dive into our own analysis of the amount of ETH raised through token sales as well as how much of this ETH has been sent to exchanges. We take into account the growth in DeFi to approximate how much selling pressure is left.

Long-Term Economics

We spend a majority of this section gauging the long-term economic viability of the currently proposed Serenity model. We compare the net yield users can expect with other viable alternatives to properly assess whether or not the yield is attractive enough. Finally, we present adjustments we believe can help make the model more sustainable and, in turn, the network more secure.

Roadmap & Scaling

We take a look at Ethereum's ambitious roadmap and provide a high level overview of where development currently is and what still needs to be done. We also assess the scaling solutions currently being developed for Ethereum. Finally, we go over the network's transition to Serenity.

Ethereum's Vision

We utilize the Ethereum's Vision section to give some context around the problems Ethereum is attempting to solve and the opportunities it presents. We explore the benefits a transparent, open-source network accessible to anyone may provide, including the potential for new asset types and business models to emerge that previously did not exist.

Key Risks & Mitigants

After going over some of the technical risks our team has identified, we walk through our long-term value concerns. This includes risks such as competition, high velocity, proof of stake security, and more. We also discuss the chances of ETH becoming a store of value and how this compares/contrasts with Bitcoin.

It is important to note that investing in Ethereum is risky and any decision made should be evaluated in the context of an individual investor's capability and appetite to take risk. No investment decision should be made solely based on the content and opinions expressed in this report.

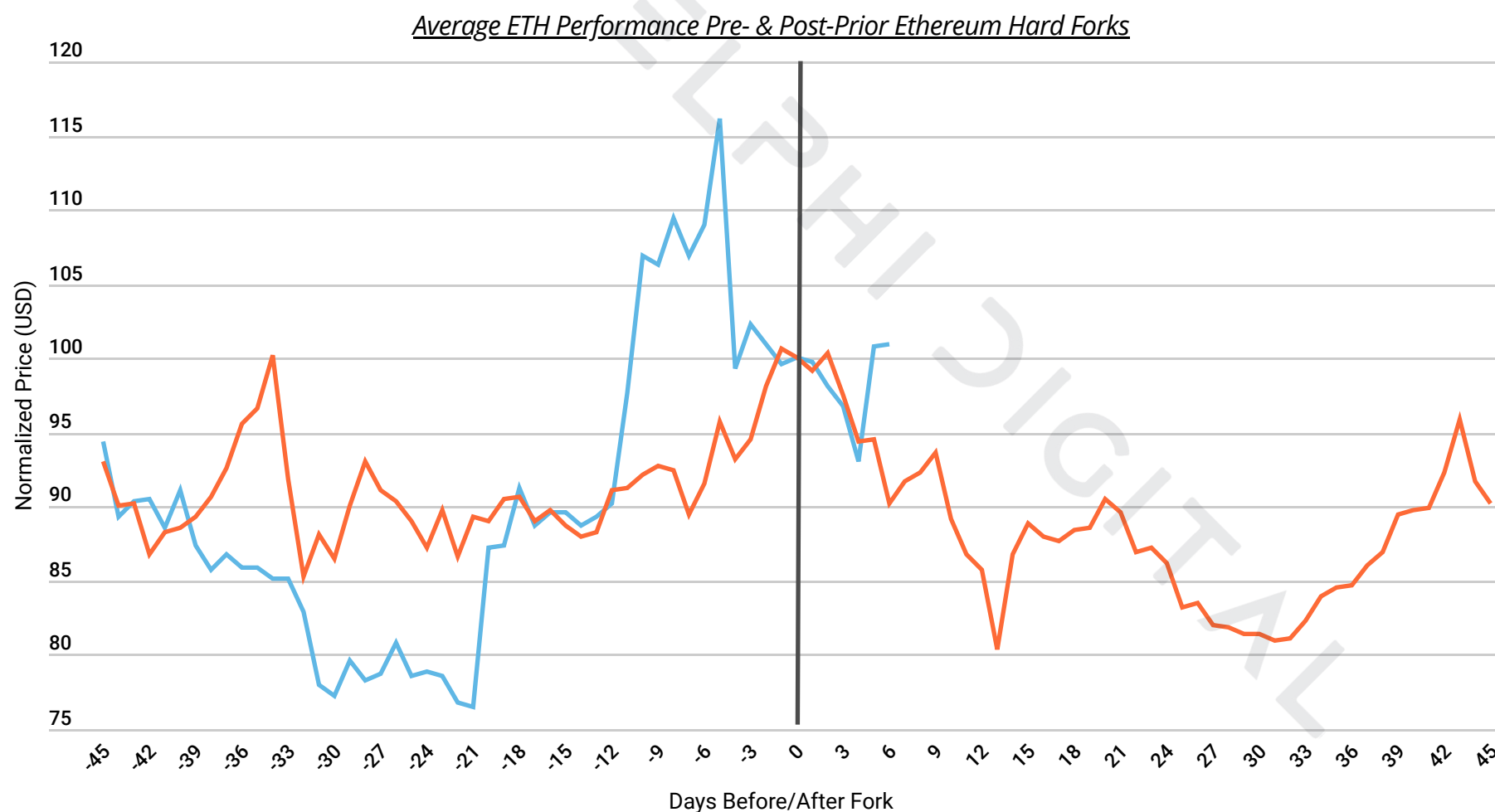
Short-Term Outlook



Buy the Rumor, Sell the Fork

The price of ETH has declined after each of the last five hard forks, falling nearly 19%, on average, over the following 30 days. The largest price drop came after the Homestead fork in March 2016 when ETH fell over 35% from \$12.50 to \$8 by mid-April. The most recent hard fork prior to last week's, Byzantium, resulted in a significantly smaller 30-day loss (<1%), which may be attributed to (i) the reduction in block rewards (5 ETH to 3) and (ii) the hysteria surrounding crypto assets in Q4 2017. It's also important to note the average block time dropped from ~25 to 15 seconds as a result of the difficulty bomb delay, so less ETH was distributed more often.

The performance of ETH was generally in line with its historical average heading into the Constantinople & St. Petersburg hard fork, rising nearly 30% in the 30 days preceding it. Interestingly, ETH's post-fork performance started to track its historical average, falling 6% through Monday, but has since rebounded to similar levels just before the fork. On average, ETH declined roughly 8% in the week following past hard forks. One of the most notable changes implemented last week was the reduction in block rewards from 3 ETH to 2 ETH. However, the block time has fallen back to ~15 seconds because of the delay in the difficulty bomb. It's important to note we have a very limited sample size of prior hard forks and each occurrence has its own nuances.



Data as of March 5th, 2019

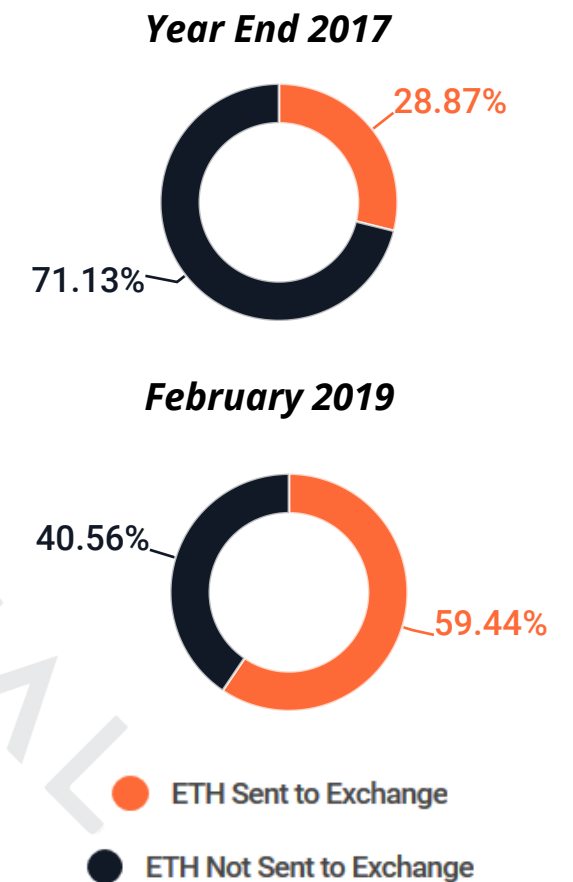
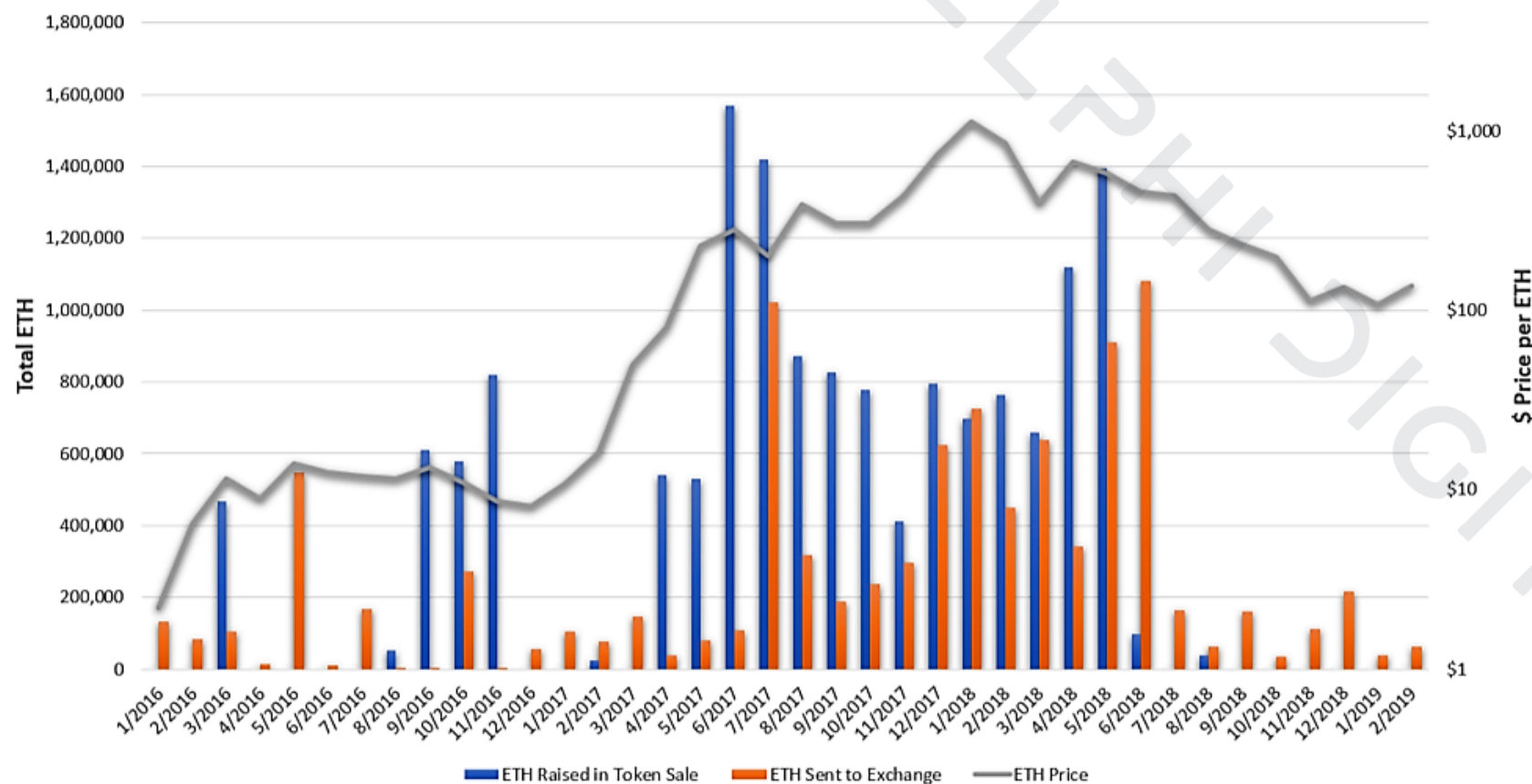
Sources: [Etherchain](#)

Treasury Liquidations

The amount of ETH raised through token sales had a significant impact on the demand for ETH in 2017 and 2018. However, the number of new token sales cooled off in the second half of 2018, and their disappearance led to a lack of fundamental buying pressure for ETH. This was further exacerbated by projects selling ETH they had raised to fund their development efforts. Our team performed a proprietary analysis on 54 of the largest token sales using tools from Bloxy. While others have conducted similar analysis on ICO treasuries, they typically only capture total outflows, and had a number of inconsistencies in terms of the total amount of ETH raised. As a result, we decided to start fresh and only include data we could verify on-chain.

Below is a breakdown of the amount of ETH these projects raised over time. We also isolated the amount of ETH that was eventually sent to an exchange address as it is reasonable to assume that ETH sent to exchanges was liquidated. What makes this analysis unique is that we've been able to assess the amount of ETH sent to an exchange 8 'hops' deep. For example, if a project sent ETH from their treasury to an advisor, who then sent it to a friend, who then sent it to an exchange, that would represent 3 'hops' and would be captured by our analysis. Most transfers to an exchange happen at 4-5 hops deep, so we felt 8 was adequate for this exercise.

For the 54 token sales analyzed, a total of 16.25 million ETH was raised, of which 9.66 million ETH ended up being sent to an exchange at some point. June 2018 was an inflection point where the amount sent to an exchange significantly dwarfed any new inflows. This also marked the start of a -76% decline in the price of ETH.



Data as of February 25th, 2019
Sources: [Bloxy](#)

For additional information on our approach, reach out to team@delphidigital.io

De-Fi Growth

In the absence of token sales, Ethereum has found a new use case which has seen significant demand and growth in recent months. In 2018, we saw many applications launch which were focused on giving their users the tools to manage and use Ethereum-based money or assets. The rise of Decentralized Finance (or "DeFi" as it is often called) is starting to see some adoption.

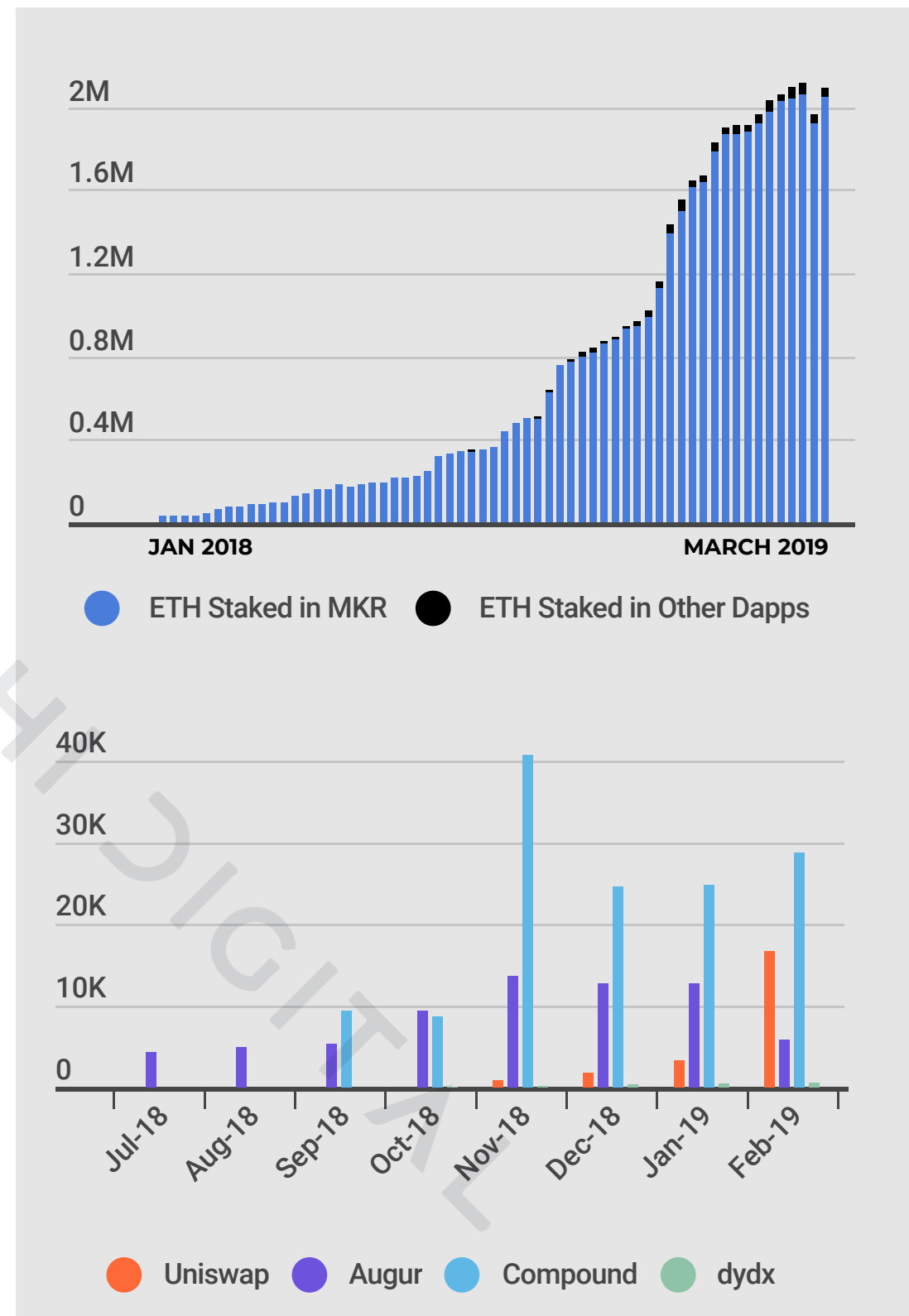
Over 2 million ETH are currently being staked in DeFi Apps as of March 3rd, 2019. The first chart on the right shows how close to 98% of the ETH currently locked by DeFi apps can be attributed to MakerDAO. Compound and Uniswap also recently launched in Q4 2018 and have already seen notable growth (as seen in the second chart). While we expect total ETH staked to continue to grow, we believe MakerDAO's dominance across DeFi apps will fall as more projects launch and slowly gain adoption.

Below, you can see the most recent stats for some of the most popular DeFi apps which are currently live.

| Name | Total ETH Locked Up | Total USD Locked Up |
|----------|---------------------|---------------------|
| MakerDAO | 2,046,555.73 | \$267,873,679.11 |
| Compound | 28,586.08 | \$3,741,632.01 |
| Uniswap | 13,898.17 | \$1,819,131.47 |
| Augur | 5,812.92 | \$760,853.10 |
| dydx | 868.45 | \$113,671.42 |

Data as of March 3rd, 2019

Sources: Etherscan ([MakerDAO](#), [Compound](#), [Augur](#), [Uniswap MKR-ETH](#), [Uniswap DAI-ETH](#), [dydx](#)), [Mike McDonald](#), [Year In Ethereum](#),



Potential Selling Pressure

With factors such as token sales, decentralized finance, and inflation in mind, our team modeled out fundamental net buying pressure on a monthly basis. To evaluate buying pressure over time, we began with our list of the 54 largest token sales, which represent the vast majority of ETH raised (~16.25m ETH). Moving forward, we accounted for no new ETH raised in token sales. This is a conservative adjustment given the decline in ICOs, however, as the average raise over the past 3 months has been ~50k ETH, according to Bloxy. We also add a portion of the buying pressure from new ETH staked in De-Fi. We chose to include 50% because we find it reasonable to assume some portion of what has been staked was already owned and is not the result of new demand.

We evaluated potential future selling pressure in two ways: (i) solely focus on the current ETH balance in the project's address(es) or (ii) the total amount of ETH not sent to an exchange. The latter represents a broad category that may include ETH sold through OTC brokers, held in an unidentified project wallet, held in their treasury, paid to an employee, etc. Below we include both scenarios. Post Constantinople, issuance was decreased, helping to alleviate additional selling pressure from miners.

Buying Pressure:

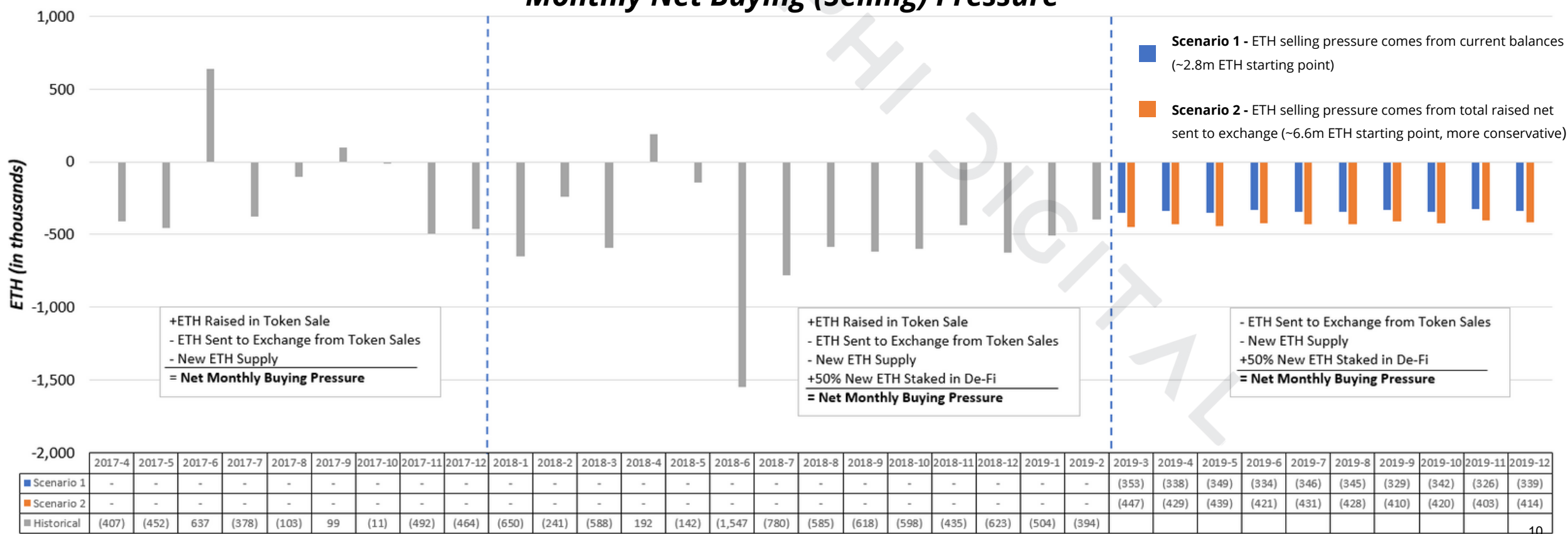
- ETH purchased to participate in a token sale
- ETH purchased to stake in De-Fi

Selling Pressure:

- ETH sent to an exchange address that was from a token sale
- Miners sell all of the new ETH supply to fund operations

| Projected 2019 Assumptions | |
|--|---------------------------------|
| ETH Raised in New Token Sales | 0 |
| Monthly Growth of ETH staked in De-Fi | 275,627 ETH (prior 6 mo. avg) |
| % of De-Fi Growth from New Purchases | 50% |
| New ETH Supply Sold by Miners | 100% |
| Monthly Liquidation Rate of Token Sale ETH | 2.5% (2018 rate for 2017 sales) |

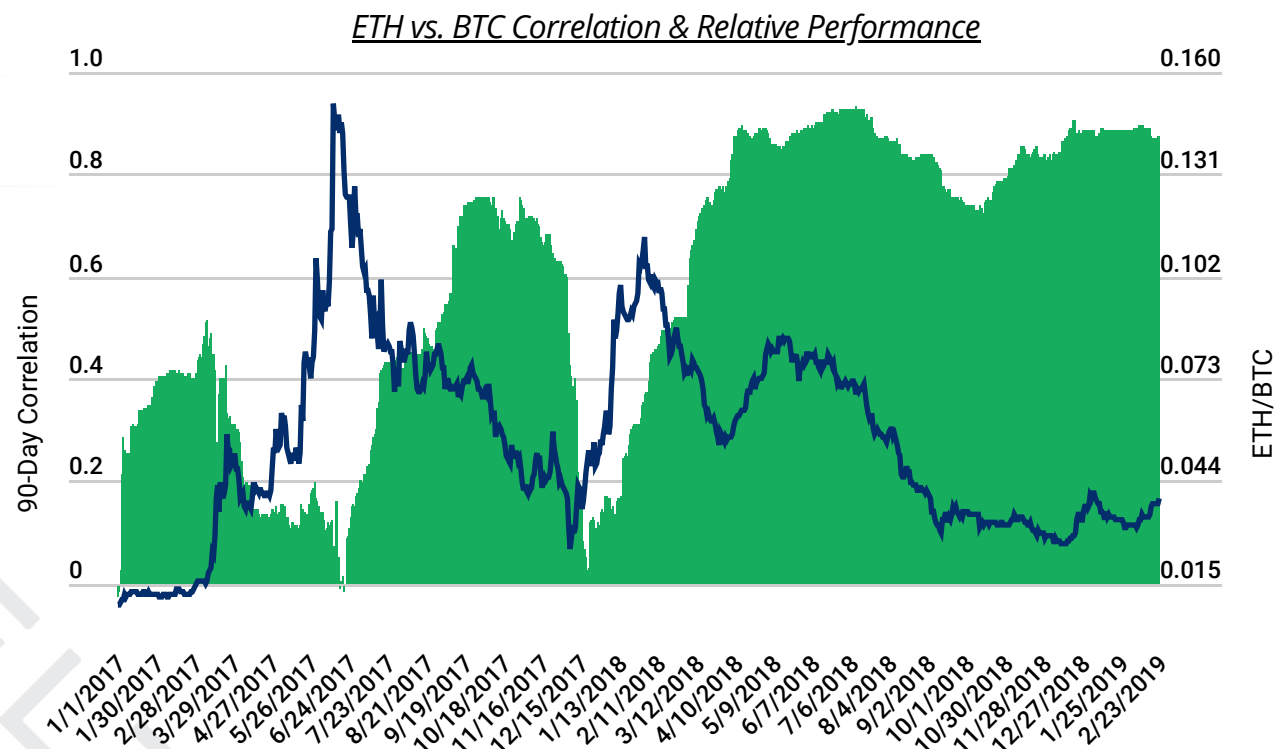
Monthly Net Buying (Selling) Pressure



Elevated Correlations

Intra-market correlations between crypto assets remain near extreme levels. The relationship of price movements between crypto assets tends to fall during periods of strong returns in the crypto market. Correlations more broadly are hovering near their highest level on record as every segment of the publicly traded market has fallen victim to the post-bubble price crash.

The correlation between ETH and most large crypto assets is no different. The 90-day correlation between BTC and ETH, for example, is approximately 0.9. The correlation between BTC and ETH has been above 0.8 more than 75% of the time over the last 12 months.



ETH Correlations with Other Large Crypto Assets

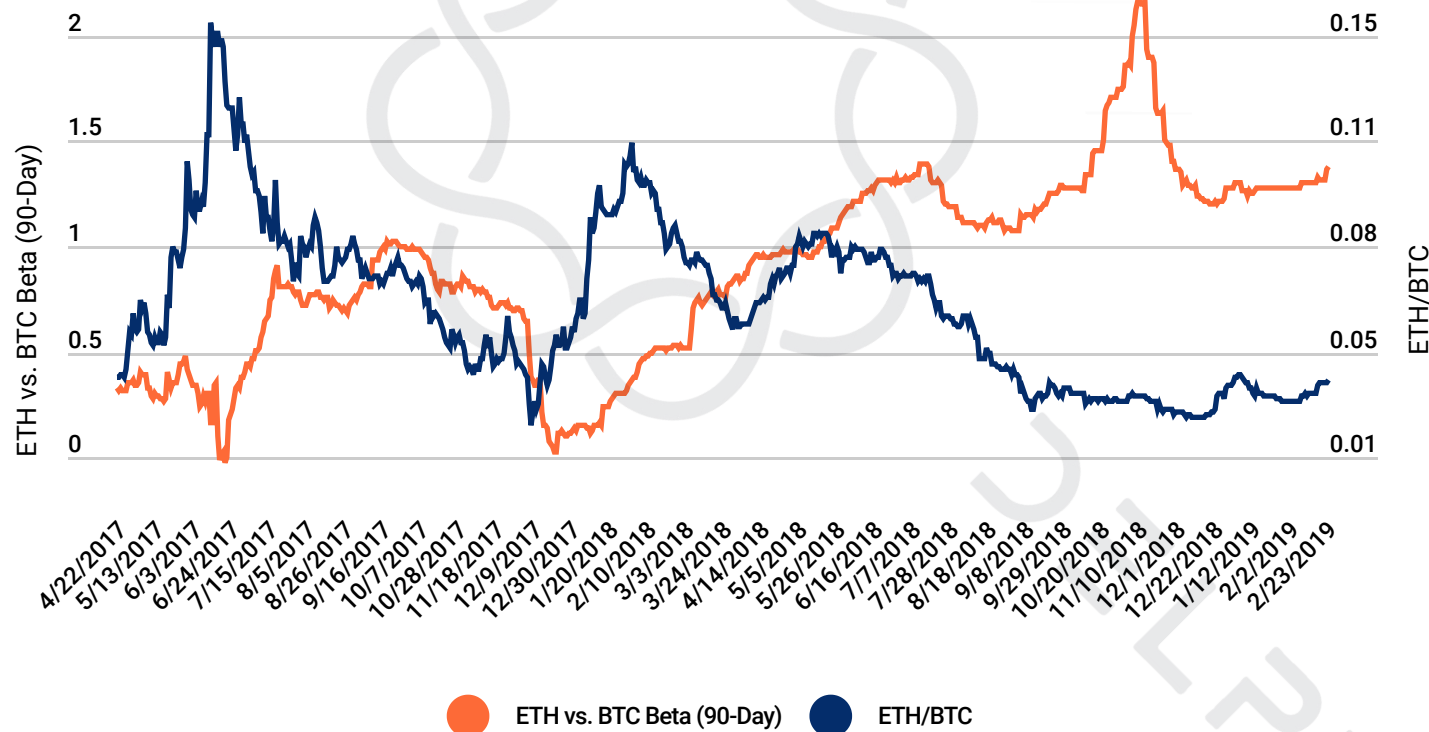
| | 90-Day Correlations | | | | | | | | | | | | | | | | |
|------|---------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| | BTC | XRP | ETH | EOS | XLM | LTC | BCH | TRON | ADA | XMR | IOTA | BNB | DASH | NEM | ETC | NEO | |
| BTC | 1.00 | 0.88 | 0.87 | 0.84 | 0.92 | 0.84 | 0.74 | 0.68 | 0.91 | 0.92 | 0.76 | 0.73 | 0.87 | 0.75 | 0.79 | 0.90 | BTC |
| XRP | 0.88 | 1.00 | 0.87 | 0.83 | 0.89 | 0.78 | 0.67 | 0.61 | 0.88 | 0.86 | 0.75 | 0.67 | 0.77 | 0.75 | 0.76 | 0.87 | XRP |
| ETH | 0.87 | 0.87 | 1.00 | 0.84 | 0.86 | 0.82 | 0.72 | 0.64 | 0.89 | 0.89 | 0.76 | 0.67 | 0.80 | 0.73 | 0.79 | 0.89 | ETH |
| EOS | 0.84 | 0.83 | 0.84 | 1.00 | 0.83 | 0.82 | 0.66 | 0.54 | 0.86 | 0.80 | 0.71 | 0.67 | 0.77 | 0.60 | 0.71 | 0.81 | EOS |
| XLM | 0.92 | 0.89 | 0.86 | 0.83 | 1.00 | 0.79 | 0.70 | 0.67 | 0.89 | 0.87 | 0.76 | 0.71 | 0.81 | 0.76 | 0.76 | 0.88 | XLM |
| LTC | 0.84 | 0.78 | 0.82 | 0.82 | 0.79 | 1.00 | 0.63 | 0.56 | 0.85 | 0.81 | 0.68 | 0.65 | 0.71 | 0.65 | 0.67 | 0.81 | LTC |
| BCH | 0.74 | 0.67 | 0.72 | 0.66 | 0.70 | 0.63 | 1.00 | 0.54 | 0.72 | 0.75 | 0.70 | 0.48 | 0.81 | 0.64 | 0.64 | 0.60 | BCH |
| TRON | 0.68 | 0.61 | 0.64 | 0.54 | 0.67 | 0.56 | 0.54 | 1.00 | 0.75 | 0.63 | 0.54 | 0.57 | 0.52 | 0.64 | 0.57 | 0.71 | TRON |
| ADA | 0.91 | 0.88 | 0.89 | 0.86 | 0.89 | 0.85 | 0.72 | 0.75 | 1.00 | 0.88 | 0.76 | 0.69 | 0.80 | 0.75 | 0.78 | 0.90 | ADA |
| XMR | 0.92 | 0.86 | 0.89 | 0.80 | 0.87 | 0.81 | 0.75 | 0.63 | 0.88 | 1.00 | 0.75 | 0.68 | 0.87 | 0.76 | 0.77 | 0.88 | XMR |
| IOTA | 0.76 | 0.75 | 0.76 | 0.71 | 0.76 | 0.68 | 0.70 | 0.54 | 0.76 | 0.75 | 1.00 | 0.54 | 0.75 | 0.65 | 0.67 | 0.69 | IOTA |
| BNB | 0.73 | 0.67 | 0.67 | 0.67 | 0.71 | 0.65 | 0.48 | 0.57 | 0.69 | 0.68 | 0.54 | 1.00 | 0.60 | 0.54 | 0.57 | 0.73 | BNB |
| DASH | 0.87 | 0.77 | 0.80 | 0.77 | 0.81 | 0.71 | 0.81 | 0.52 | 0.80 | 0.87 | 0.75 | 0.60 | 1.00 | 0.69 | 0.71 | 0.78 | DASH |
| NEM | 0.75 | 0.75 | 0.73 | 0.60 | 0.76 | 0.65 | 0.64 | 0.64 | 0.75 | 0.76 | 0.65 | 0.54 | 0.69 | 1.00 | 0.73 | 0.74 | NEM |
| ETC | 0.79 | 0.76 | 0.79 | 0.71 | 0.76 | 0.67 | 0.64 | 0.57 | 0.78 | 0.77 | 0.67 | 0.57 | 0.71 | 0.73 | 1.00 | 0.80 | ETC |
| NEO | 0.90 | 0.87 | 0.89 | 0.81 | 0.88 | 0.81 | 0.60 | 0.71 | 0.90 | 0.88 | 0.69 | 0.73 | 0.78 | 0.74 | 0.80 | 1.00 | NEO |

Data as of March 3rd, 2019

Sources: [Binance](#), [Bitfinex](#), [Kraken](#)

High Beta Risk-Reward

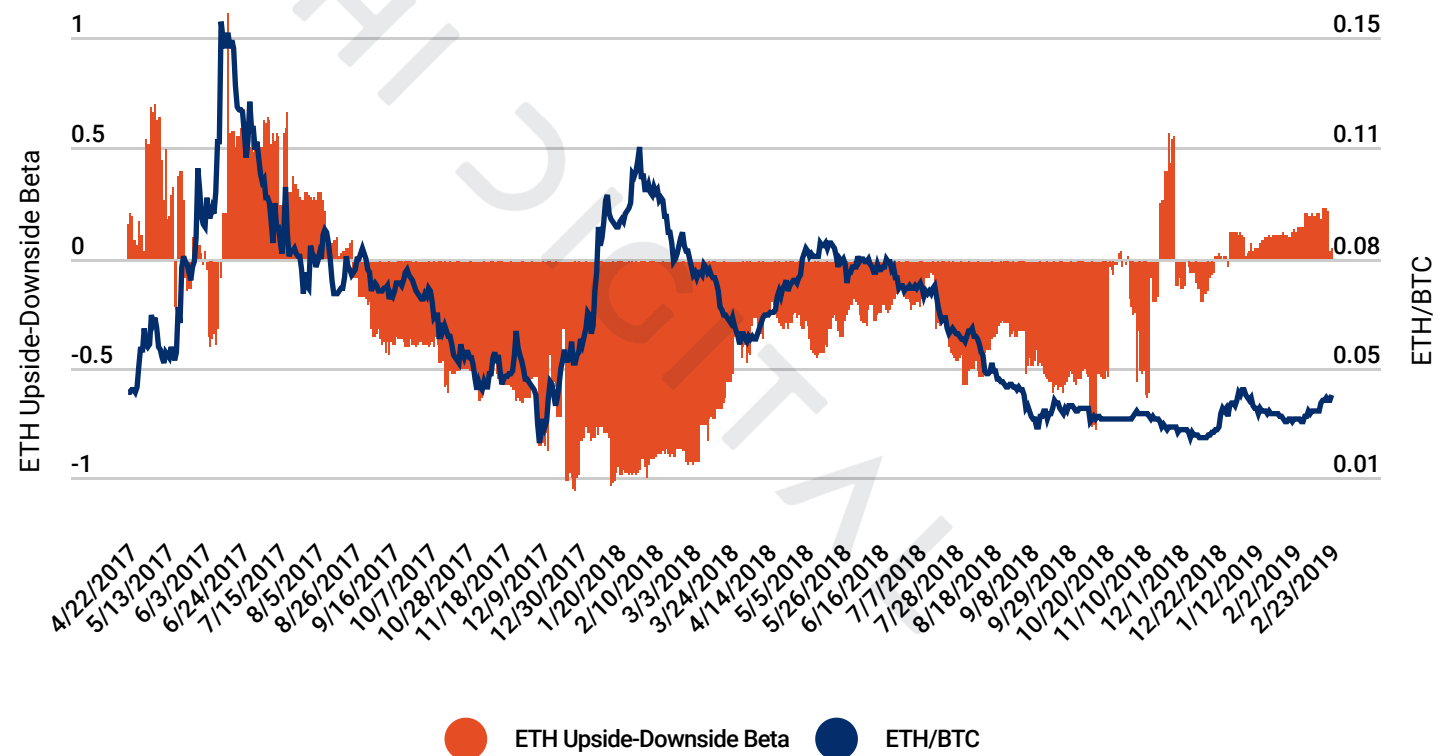
ETH vs. BTC 90-Day Beta & Relative Performance



More dispersion among returns could give ETH a bid as ETH tends to outperform BTC when intra-market correlations drop. ETH has also been significantly more volatile than BTC over the last six months. It's 90-day beta relative to BTC is currently 1.5, substantially higher than its historical average (though price history is limited).

Comparing ETH's upside beta to its downside beta we see ETH has been more volatile on days when BTC returns are negative than days when they are positive for much of the last 18 months. We are, however, beginning to see upside volatility pick up for ETH. Given the extremely high intra-market correlations we previously discussed, this is a trend we are monitoring closely as ETH may be poised to outperform if BTC rallies.

ETH Upside-Downside Beta vs. BTC & Relative Performance

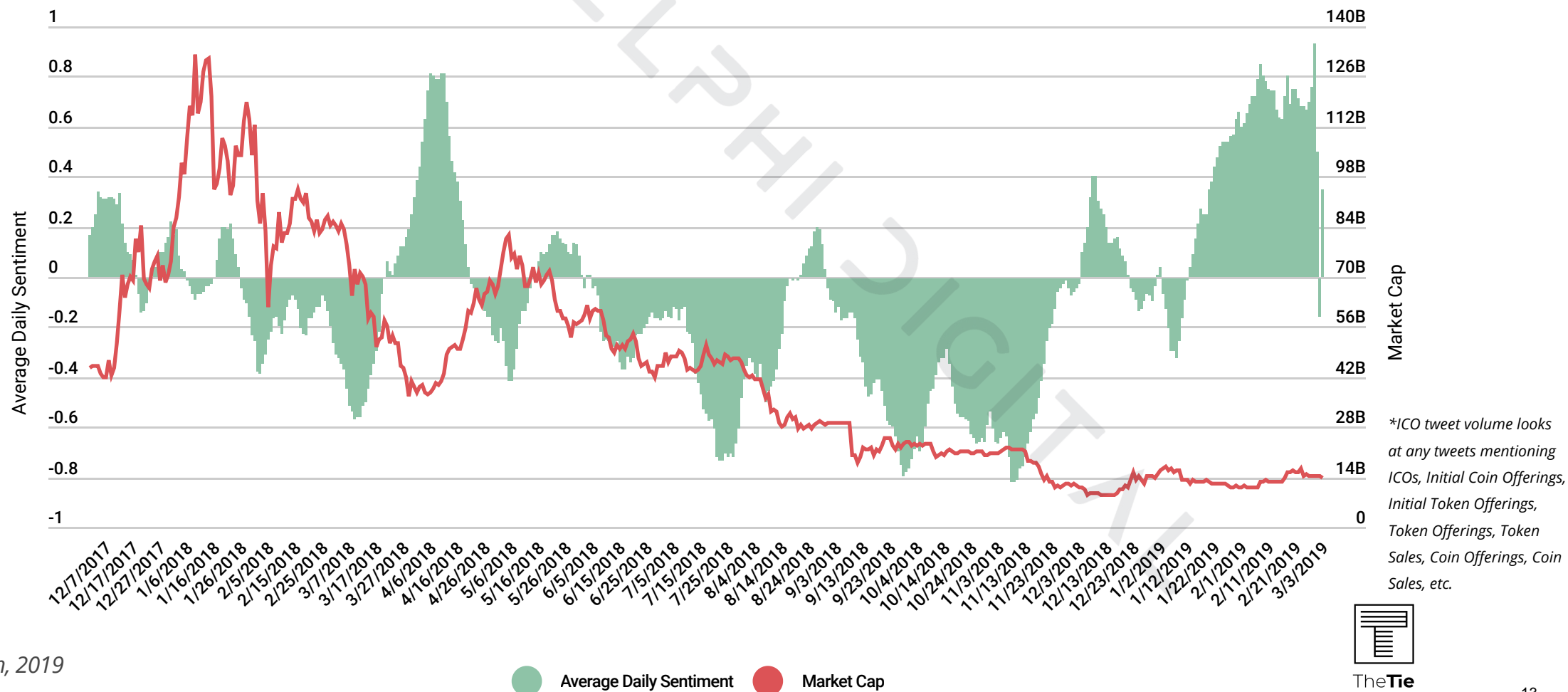


ETH Sentiment

There has been a very strong correlation between Ethereum and ICO tweet volumes since at least 2017, according to cryptocurrency analytics platform TheTIE.io, one of our partners for analyzing sentiment data in the crypto market. While the correlation between Ethereum and Bitcoin tweet volumes over the last two years was 0.64 and the correlation between ICO and Bitcoin tweet volumes was just 0.24, the correlation between Ethereum and ICO tweet volume was 0.8, signifying a strong relationship between the two.* ICO tweet volume has been trending downward for a majority of the last 12 months.

Conversely, a more bullish sign for ETH in the near-term is that sentiment on Ethereum is now experiencing its most prolonged period of positivity since 2017. Analysis provided by The TIE has found that average daily sentiment score is a very strong indicator of Ethereum price movement. Beginning in early January 2019, Ethereum average daily sentiment score began to turn positive and has remained strongly positive since then. The last time such a prolonged period of positive average daily sentiment occurred on Ethereum was in March-April 2018, when the market value of ETH more than doubled from \$36 billion to \$84 billion.

Ethereum Average Sentiment Score vs. Market Cap



Data as of March 5th, 2019

Sources: [TheTie.io](https://thetie.io)

Trader Positioning

The recent price appreciation in ETH can be partly attributed to the usual price rally heading into last week's Ethereum hard fork. Another catalyst, however, could be the recent short covering that resulted, at least in part, from the rally higher in ETH.

The ratio of margin long positions to short positions on Bitfinex hit a 9-month low back in December, just before ETH surged from ~\$85 to over \$150 in a matter of a few weeks. The ratio of longs to shorts was hovering near the lower end of its historical range in early February before ETH's most recent jump from \$125 to over \$160. This indicator is currently sitting at a five-month high.

Total margin short positions for ETH on Bitfinex reached an all-time high (measured in ETH) just before its December price bottom. The ratio of margin longs to shorts also touched its lowest level since March 2018, shortly before the previously mentioned price surge in ETH over the following 3-4 weeks. We can see that a substantial decrease in margin shorts (inverted in bottom chart) coincided with the February price spike, likely stoking ETH's gains further.

These indicators do not represent the entire market, but do serve as decent proxies for trader positioning and sentiment.

Margin Longs/Shorts Ratio vs. ETH Price



ETH Price vs. ETH Margin Short Positions (Inverse)



Long-Term Economics



Introduction

Given that the purpose of this section is to explore the potential long term value of Ethereum, we focused our analysis on the long term economics that the Serenity upgrade will bring, specifically gauging the long-term economic viability of the currently proposed model. We also present adjustments we believe can help make the model more sustainable and, in turn, the network more secure. For additional information on Serenity, please refer to the "Roadmap & Scaling Solutions" section of this report.

- 1 Serenity Economics Overview
- 2 Breaking Down Inflation
- 3 Current Base Validator Yield
- 4 Gas Dependence & Analysis
- 5 Net Yield
- 6 Staking Alternatives
- 7 Our Concerns
- 8 Our Proposal

While we attempt to walk through each of our key assumptions, we understand this section can be hard to follow due to the numerous variables we have to address. Please feel free to reach out to our team if you have any questions.

Serenity Economics Overview

In Ethereum's current state, miners earn a fixed reward of 2 ETH from each block reward and a variable reward in the form of transaction fees paid to the network. When Ethereum changes consensus algorithms from Proof of Work to Proof of Stake in the Serenity upgrade, the network fees component will continue, but the **fixed block reward shifts to a variable issuance model**. It's variable because it's determined by the amount of ETH staked, where incremental issuance will increase at a decreasing rate as more of the overall ETH supply is staked, much like a square root function. This implies that each validator's reward follows an inverse square root function as **issuance increases at a slower rate than staking**, meaning there's less issuance reward available for each validator.

Going through the entire model isn't necessary to understand the drivers of the issuance mechanism because it's primarily determined by two factors: (i) the amount of ETH staked and (ii) the Base Reward Quotient. The sliding issuance scale is a function of ETH staked because part of the issuance calculation requires taking the square root of the total amount of ETH staked. This value is then multiplied by the Base Reward Quotient to arrive at the Reward Quotient. The Base Reward Quotient can be thought of as a plug value that determines the overall issuance trajectory, but still maintains a proportionate payout across each staking level. **We focus on the amount of ETH staked and the Base Reward Quotient to arrive at the actual issuance rate since the remaining calculations use constants outside these two variables.** The currently proposed Base Reward Quotient is 1024, but we'll dive deeper into this metric later on.

The table on the right shows the currently proposed varying levels of reward yield and issuance based on the amount staked. The reward yield is purely from block rewards and does not include any gas fees. Issuance yield is based on an expected supply of 114.1 million in 2021. For perspective, ETH's issuance rate after the hard fork in March is 4.8% while BTC's is 3.8% (expected to drop to 1.8% after the block reward halvening in May of 2020).

| Serenity Specs | |
|-------------------------|------|
| Validator Deposit (ETH) | 32 |
| Shards | 1024 |
| Slot Time (in seconds) | 6 |
| Epoch Length (in slots) | 64 |
| Base Reward Quotient | 1024 |

| Total Network Stake (ETH) | Base Validator Yield % | Issuance Rate |
|---------------------------|------------------------|---------------|
| 5,000,000 | 3.59% | 0.16% |
| 10,000,000 | 2.54% | 0.22% |
| 15,000,000 | 2.07% | 0.27% |
| 20,000,000 | 1.79% | 0.31% |
| 25,000,000 | 1.60% | 0.35% |
| 30,000,000 | 1.46% | 0.38% |
| 35,000,000 | 1.36% | 0.42% |
| 40,000,000 | 1.27% | 0.44% |
| 45,000,000 | 1.20% | 0.47% |
| 50,000,000 | 1.13% | 0.50% |
| 55,000,000 | 1.08% | 0.52% |
| 60,000,000 | 1.04% | 0.54% |
| 65,000,000 | 0.99% | 0.57% |
| 70,000,000 | 0.96% | 0.59% |
| 75,000,000 | 0.93% | 0.61% |
| 80,000,000 | 0.90% | 0.63% |

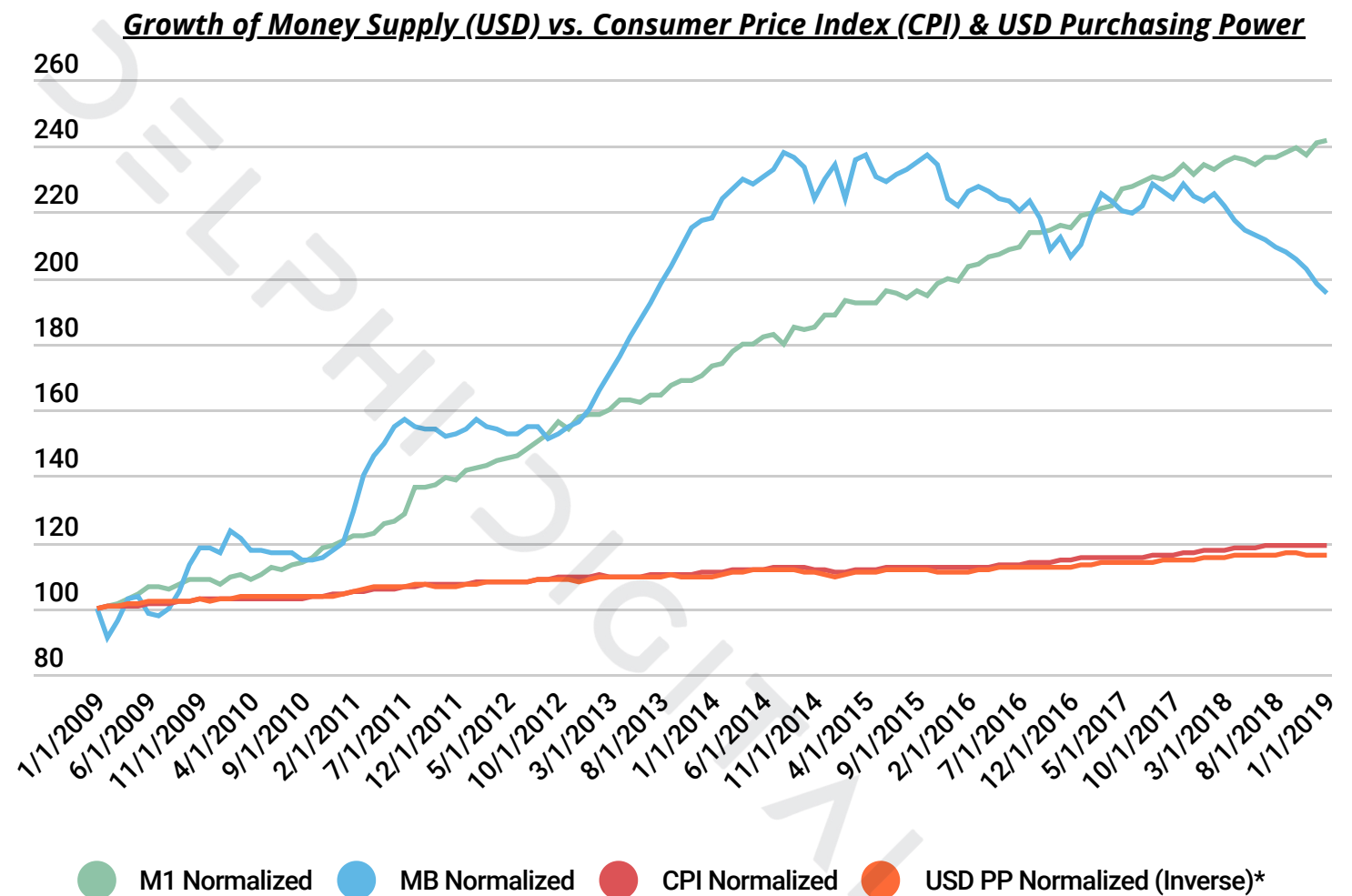
10M ETH staked is commonly used in forums and discussions around Serenity's economics.

Breaking Down Inflation

A few concepts we've often seen conflated are issuance, inflation, and the unknowingly referenced dilution. **Issuance rate** is an annualized equivalent of newly issued coins divided by the current supply. **Dilution**, often cited as inflation, measures the percent increase in current supply on a YoY basis. **Inflation** refers to the decline in purchasing power of money measured by a price index like the CPI. Considering virtually no goods are priced in cryptocurrency currently, calculating the inflation rate (or more importantly the future implied inflation rate) of ETH is very difficult. For example, if we think about Ethereum as an economy, we could measure the change in gas costs over time as a rough proxy for changes in purchasing power. If gas fees increase steadily over time, we could argue our purchasing power has decreased as it costs more to use the network. In other words, the price of consuming the same amount of products or services built on Ethereum is higher. Conversely, if gas fees decline over time, our purchasing power increases, all else held equal.

We can visualize this concept through real world examples. The chart on the right shows the increase in M1 money stock and the monetary base (in USD) compared to the rise in consumer prices (CPI) over the last ten years. As we can see, issuance and inflation do not increase on a 1 to 1 basis, and an increase in the supply of money does not necessarily translate to an equal decline in purchasing power.**

Ethereum enacts a systematically tighter monetary policy as the current issuance rate (measuring the expected percentage increase in supply) will be less than the historical dilution rate (which measures percent change in supply over the past year relative to total supply). This type of monetary policy could spur inflation, eroding value for ETH holders, but higher issuance does not guarantee this will occur.



* Consumer Price Index for All Urban Consumers: Purchasing Power of the Consumer Dollar

** There are several reasons why inflation has remained relatively tepid this cycle despite the increase in money supply. This example is only intended to show the relationship between money supply and price inflation.

Current Base Validator Yield

Now we present a **gross yield** matrix based on a spectrum of daily network fees.

| | | <i>Network Fees/Day</i> | | | | | | | | | | |
|-------------------------|------------|-------------------------|-------|-------|-------|-------|--------|--------|--------|--------|--------|--------|
| | | 0 | 200 | 400 | 600 | 800 | 1,000 | 1,200 | 1,400 | 1,600 | 1,800 | 2,000 |
| <i>Total ETH Staked</i> | 5,000,000 | 3.59% | 5.05% | 6.51% | 7.97% | 9.43% | 10.89% | 12.35% | 13.81% | 15.27% | 16.73% | 18.19% |
| | 10,000,000 | 2.54% | 3.27% | 4.00% | 4.73% | 5.46% | 6.19% | 6.92% | 7.65% | 8.38% | 9.11% | 9.84% |
| | 15,000,000 | 2.07% | 2.56% | 3.04% | 3.53% | 4.02% | 4.50% | 4.99% | 5.48% | 5.96% | 6.45% | 6.94% |
| | 20,000,000 | 1.79% | 2.16% | 2.52% | 2.89% | 3.25% | 3.62% | 3.98% | 4.35% | 4.71% | 5.08% | 5.44% |
| | 25,000,000 | 1.60% | 1.90% | 2.19% | 2.48% | 2.77% | 3.06% | 3.36% | 3.65% | 3.94% | 4.23% | 4.52% |
| | 30,000,000 | 1.46% | 1.71% | 1.95% | 2.19% | 2.44% | 2.68% | 2.92% | 3.17% | 3.41% | 3.65% | 3.90% |
| | 35,000,000 | 1.36% | 1.56% | 1.77% | 1.98% | 2.19% | 2.40% | 2.61% | 2.82% | 3.02% | 3.23% | 3.44% |
| | 40,000,000 | 1.27% | 1.45% | 1.63% | 1.82% | 2.00% | 2.18% | 2.36% | 2.55% | 2.73% | 2.91% | 3.09% |
| | 45,000,000 | 1.20% | 1.36% | 1.52% | 1.68% | 1.84% | 2.01% | 2.17% | 2.33% | 2.49% | 2.66% | 2.82% |
| | 50,000,000 | 1.13% | 1.28% | 1.43% | 1.57% | 1.72% | 1.86% | 2.01% | 2.16% | 2.30% | 2.45% | 2.59% |
| | 55,000,000 | 1.08% | 1.21% | 1.35% | 1.48% | 1.61% | 1.75% | 1.88% | 2.01% | 2.14% | 2.28% | 2.41% |
| | 60,000,000 | 1.04% | 1.16% | 1.28% | 1.40% | 1.52% | 1.64% | 1.77% | 1.89% | 2.01% | 2.13% | 2.25% |
| | 65,000,000 | 0.99% | 1.11% | 1.22% | 1.33% | 1.44% | 1.56% | 1.67% | 1.78% | 1.89% | 2.01% | 2.12% |
| | 70,000,000 | 0.96% | 1.06% | 1.17% | 1.27% | 1.38% | 1.48% | 1.58% | 1.69% | 1.79% | 1.90% | 2.00% |
| | 75,000,000 | 0.93% | 1.02% | 1.12% | 1.22% | 1.32% | 1.41% | 1.51% | 1.61% | 1.70% | 1.80% | 1.90% |
| | 80,000,000 | 0.90% | 0.99% | 1.08% | 1.17% | 1.26% | 1.35% | 1.44% | 1.54% | 1.63% | 1.72% | 1.81% |

The low yield immediately stands out, especially after considering these yields don't factor in operating costs. **Establishing a yield that's attractive for more than just initial validators will help secure the network by increasing the cost of taking control of the network, even if price is held constant.** Although early stakers would be able to initially earn that higher yield, it's not as if they lock the yield in by being early. The yield is consistent for all validators on the network.

It's also clear that not only will network fees be the primary driver of higher validator yields, but that the reward structure is not economically sustainable without significant growth in those fees. Block rewards to validators scale by the inverse square root of the total stake (moving down the chart vertically) while network fees scale linearly with growth in gas fees (moving across the chart horizontally).

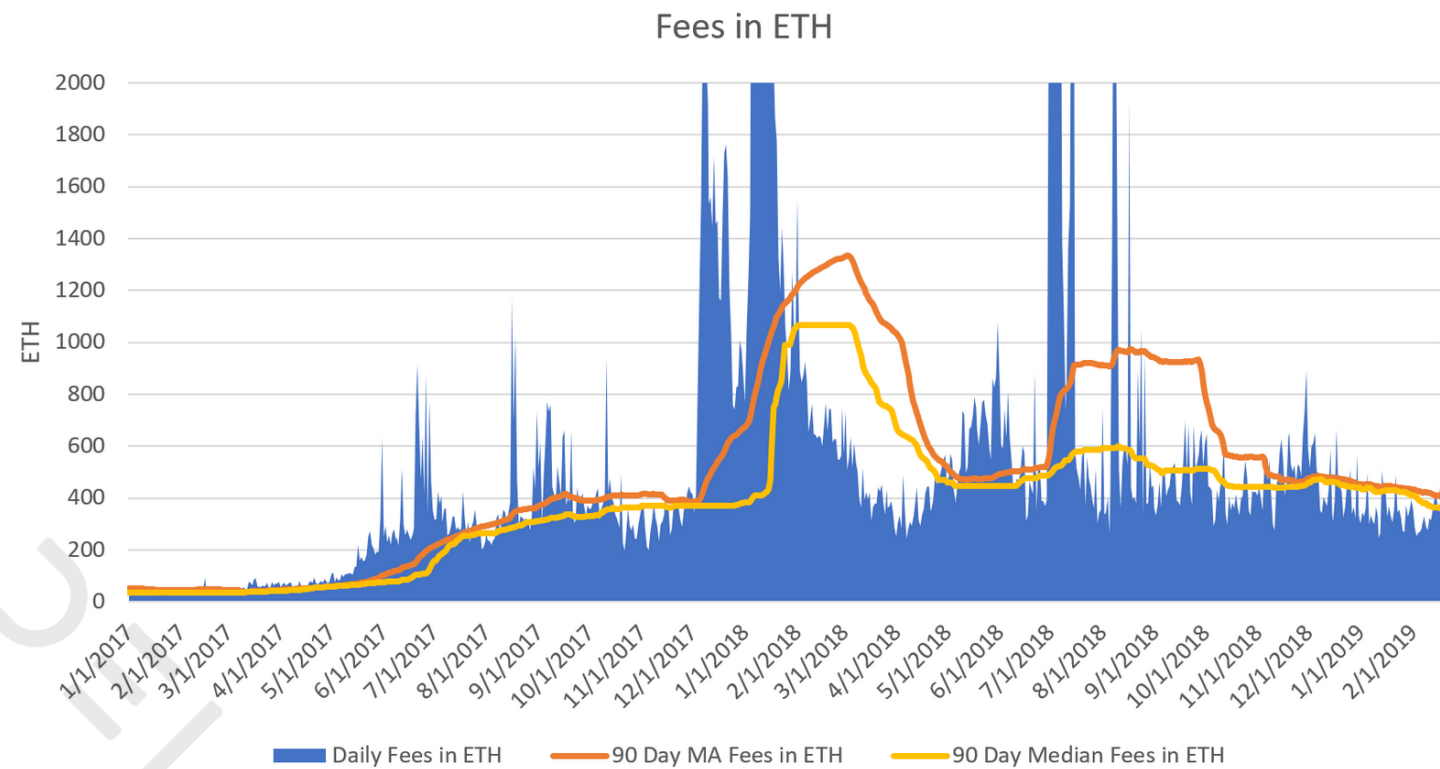
Gas Dependence

We believe the systemic dependence on network fees is a result of the currently proposed block rewards for Serenity being too low. The chart below shows **what portion gas fees make up of total rewards**. It's clear how total rewards, particularly on the higher yield side, really depend on the fee market. This is especially concerning when you realize these are the only economically sustainable yields on the matrix from the previous page. Without significant growth in transaction fees, the network becomes considerably less secure with so few stakers.

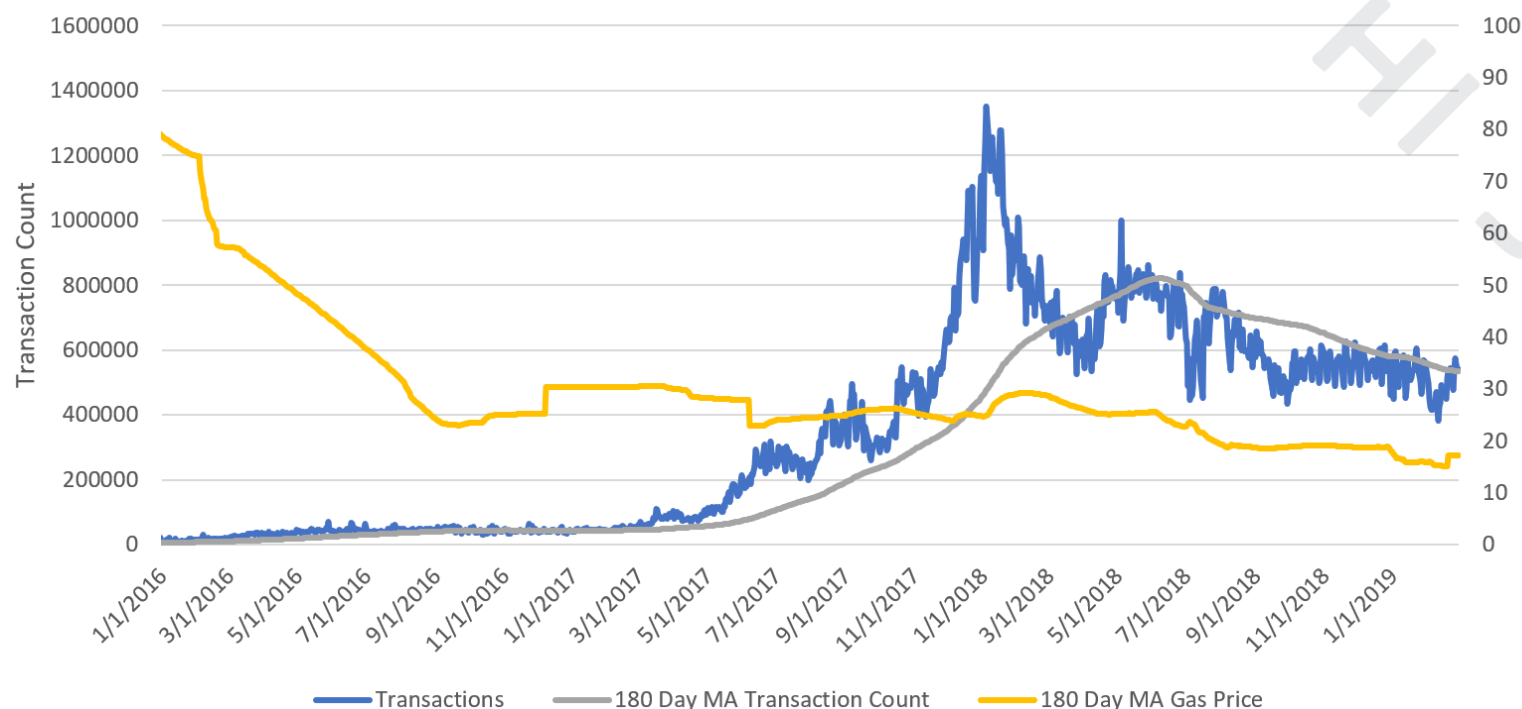
| | | <i>Network Fees/Day</i> | | | | | | | | | | |
|-------------------------|------------|-------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| | | 0 | 200 | 400 | 600 | 800 | 1,000 | 1,200 | 1,400 | 1,600 | 1,800 | 2,000 |
| <i>Total ETH Staked</i> | 5,000,000 | 0.0% | 28.9% | 44.9% | 55.0% | 62.0% | 67.1% | 70.9% | 74.0% | 76.5% | 78.6% | 80.3% |
| | 10,000,000 | 0.0% | 22.3% | 36.5% | 46.3% | 53.5% | 59.0% | 63.3% | 66.8% | 69.7% | 72.1% | 74.2% |
| | 15,000,000 | 0.0% | 19.0% | 32.0% | 41.3% | 48.4% | 54.0% | 58.5% | 62.2% | 65.3% | 67.9% | 70.1% |
| | 20,000,000 | 0.0% | 16.9% | 28.9% | 37.9% | 44.9% | 50.4% | 55.0% | 58.8% | 62.0% | 64.7% | 67.1% |
| | 25,000,000 | 0.0% | 15.4% | 26.7% | 35.3% | 42.1% | 47.7% | 52.2% | 56.0% | 59.3% | 62.1% | 64.5% |
| | 30,000,000 | 0.0% | 14.2% | 24.9% | 33.3% | 39.9% | 45.4% | 49.9% | 53.8% | 57.1% | 59.9% | 62.4% |
| | 35,000,000 | 0.0% | 13.3% | 23.5% | 31.6% | 38.1% | 43.5% | 48.0% | 51.9% | 55.2% | 58.1% | 60.6% |
| | 40,000,000 | 0.0% | 12.6% | 22.3% | 30.2% | 36.5% | 41.8% | 46.3% | 50.2% | 53.5% | 56.4% | 59.0% |
| | 45,000,000 | 0.0% | 11.9% | 21.3% | 28.9% | 35.2% | 40.4% | 44.9% | 48.7% | 52.0% | 55.0% | 57.6% |
| | 50,000,000 | 0.0% | 11.4% | 20.5% | 27.9% | 34.0% | 39.2% | 43.6% | 47.4% | 50.7% | 53.7% | 56.3% |
| | 55,000,000 | 0.0% | 10.9% | 19.7% | 26.9% | 32.9% | 38.0% | 42.4% | 46.2% | 49.5% | 52.5% | 55.1% |
| | 60,000,000 | 0.0% | 10.5% | 19.0% | 26.1% | 32.0% | 37.0% | 41.3% | 45.1% | 48.5% | 51.4% | 54.0% |
| | 65,000,000 | 0.0% | 10.1% | 18.4% | 25.3% | 31.1% | 36.1% | 40.4% | 44.1% | 47.5% | 50.4% | 53.0% |
| | 70,000,000 | 0.0% | 9.8% | 17.9% | 24.6% | 30.3% | 35.2% | 39.5% | 43.2% | 46.5% | 49.5% | 52.1% |
| | 75,000,000 | 0.0% | 9.5% | 17.4% | 24.0% | 29.6% | 34.4% | 38.7% | 42.4% | 45.7% | 48.6% | 51.2% |
| | 80,000,000 | 0.0% | 9.2% | 16.9% | 23.4% | 28.9% | 33.7% | 37.9% | 41.6% | 44.9% | 47.8% | 50.4% |

Gas Analysis

For perspective, the 90 day moving average of daily network fees is ~450 eth at the moment. That's less than half of what we were seeing at the end of the summer and less than a third of the levels from the beginning of 2018. We used a 90 day moving average to smooth out significant spikes. It's interesting to note the contribution that high traffic times have on overall gas fees to the network. Since the start of 2018, the average premium of the 90 day moving average over its median counterpart has been 31%. A key concern is the increased throughput in Serenity will alleviate these spikes in gas price that historically lead to increased network fees.



Transaction Count and Gas Price



When broken down, the decline in network fees is attributable to a decline in transaction count and average gas price. The actual cause has been a general shift in narrative as speculators gradually lost interest throughout the duration of this bear market. On chain transactions spiked in tandem with the peak of the bubble as token speculation was essentially the primary use case of the network.

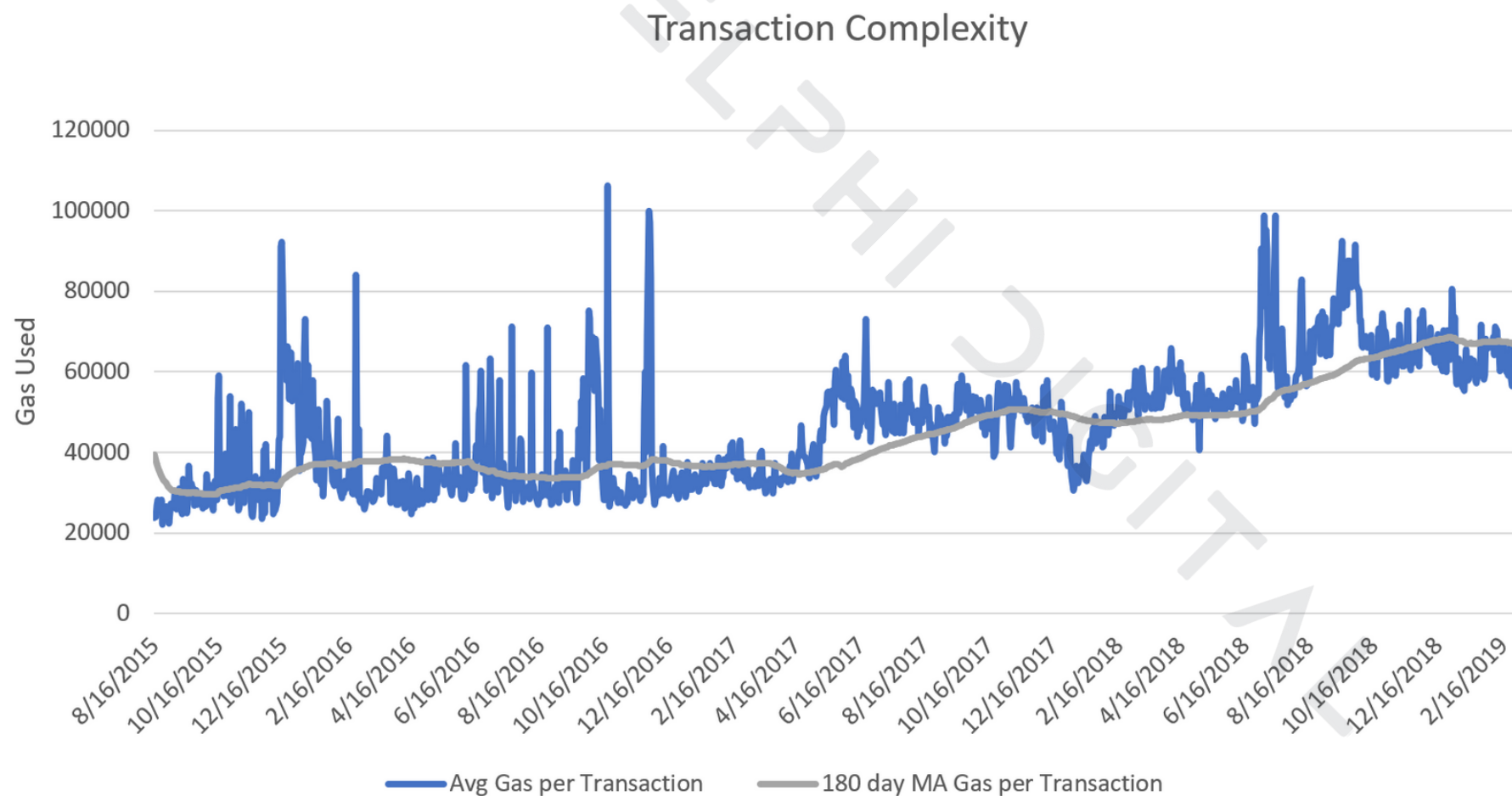
Data as of: March 6th, 2019

Sources: [Etherscan](#)

Gas Analysis

An interesting gradual shift has been the increase in transaction complexity, a metric first introduced by ethereum developer Nick Johnson, which is calculated by dividing the average daily gas spend by the quantity of transactions. A basic transaction on ethereum has a 21,000 gas limit while, more complex smart contracts require a higher limit. This gas price agnostic measure sheds some light on how the network is gradually evolving.

Estimating gas under serenity is difficult. Although gas per transaction will likely increase as more gets built on top of the network, the key issues boils down to changes in gas prices. Serenity's 1,024 shards, will increase throughput relative to its current state by a comparable multiple. This flood of computational capacity will likely reduce competition for faster transaction validation, leading to a steep decline in gas prices. At this point, it's impossible to understand the extent of that decline, but it's unlikely that gas prices will decrease by the same scale as the supply increases. This creates major potential difficulties when it comes to sustainability because network use at today's gas prices already isn't enough to sustain the network.



Data as of: March 6th, 2019

Sources: [Etherscan](#)

Net Yield

In this analysis, we present an array of expected yields according to both hardware and cloud based setups. Our stake value and revenues are based on ETH at \$150 while the cost assumptions piggy back off the validator economics research that our friends at Consensys put together.

The setups we present are required to support one validator (32 ETH), but they are also capable of supporting several without a significant increase in operating costs. Our profitability assumptions are inherently slightly conservative because they assume casual validators are priced out of the ability to benefit from the economies of scale that come from running multiple validators.

The main takeaway here is that at current price levels and proposed Serenity specs, it's likely that altruistic and malicious validators will be the only ones with a reason participate. Although there's certainly some additional margin that can be squeezed out here, staking is still a ways away from being appealing under these conditions.

| Hardware Yield | | | | | | | | | | | |
|----------------------|----------------|-------|--------------------|-------|----------------|-------|-----------------|-------|-------|-------|-------|
| <i>Annual Costs:</i> | Hardware: \$66 | | Electricity: \$131 | | Slashing: \$96 | | <i>Up Time:</i> | | 98% | | |
| | 0 | 200 | 400 | 600 | 800 | 1,000 | 1,200 | 1,400 | 1,600 | 1,800 | 2,000 |
| 5,000,000 | -2.5% | -1.1% | 0.4% | 1.8% | 3.3% | 4.8% | 6.2% | 7.7% | 9.1% | 10.6% | 12.1% |
| 10,000,000 | -3.6% | -2.9% | -2.1% | -1.4% | -0.7% | 0.1% | 0.8% | 1.5% | 2.3% | 3.0% | 3.7% |
| 15,000,000 | -4.0% | -3.6% | -3.1% | -2.6% | -2.1% | -1.6% | -1.1% | -0.6% | -0.2% | 0.3% | 0.8% |
| 20,000,000 | -4.3% | -4.0% | -3.6% | -3.2% | -2.9% | -2.5% | -2.1% | -1.8% | -1.4% | -1.0% | -0.7% |
| 25,000,000 | -4.5% | -4.2% | -3.9% | -3.6% | -3.3% | -3.1% | -2.8% | -2.5% | -2.2% | -1.9% | -1.6% |
| 30,000,000 | -4.7% | -4.4% | -4.2% | -3.9% | -3.7% | -3.4% | -3.2% | -3.0% | -2.7% | -2.5% | -2.2% |
| 35,000,000 | -4.8% | -4.6% | -4.3% | -4.1% | -3.9% | -3.7% | -3.5% | -3.3% | -3.1% | -2.9% | -2.7% |
| 40,000,000 | -4.9% | -4.7% | -4.5% | -4.3% | -4.1% | -3.9% | -3.8% | -3.6% | -3.4% | -3.2% | -3.0% |
| 45,000,000 | -4.9% | -4.8% | -4.6% | -4.4% | -4.3% | -4.1% | -4.0% | -3.8% | -3.6% | -3.5% | -3.3% |
| 50,000,000 | -5.0% | -4.8% | -4.7% | -4.5% | -4.4% | -4.3% | -4.1% | -4.0% | -3.8% | -3.7% | -3.5% |
| 55,000,000 | -5.0% | -4.9% | -4.8% | -4.6% | -4.5% | -4.4% | -4.2% | -4.1% | -4.0% | -3.8% | -3.7% |
| 60,000,000 | -5.1% | -5.0% | -4.8% | -4.7% | -4.6% | -4.5% | -4.4% | -4.2% | -4.1% | -4.0% | -3.9% |

| Cloud Yield | | | | | | | | | | | |
|----------------------|------------|--------|----------------|--------|----------------|--------|-----------------|--------|--------|--------|--------|
| <i>Annual Costs:</i> | EC2: \$876 | | S3 Costs: \$48 | | Slashing: \$48 | | <i>Up Time:</i> | | 99% | | |
| | 0 | 200 | 400 | 600 | 800 | 1,000 | 1,200 | 1,400 | 1,600 | 1,800 | 2,000 |
| 5,000,000 | -16.7% | -15.2% | -13.7% | -12.3% | -10.8% | -9.4% | -7.9% | -6.4% | -5.0% | -3.5% | -2.1% |
| 10,000,000 | -17.7% | -17.0% | -16.3% | -15.5% | -14.8% | -14.1% | -13.3% | -12.6% | -11.9% | -11.1% | -10.4% |
| 15,000,000 | -18.2% | -17.7% | -17.2% | -16.7% | -16.2% | -15.7% | -15.3% | -14.8% | -14.3% | -13.8% | -13.3% |
| 20,000,000 | -18.5% | -18.1% | -17.7% | -17.4% | -17.0% | -16.6% | -16.3% | -15.9% | -15.5% | -15.2% | -14.8% |
| 25,000,000 | -18.6% | -18.4% | -18.1% | -17.8% | -17.5% | -17.2% | -16.9% | -16.6% | -16.3% | -16.0% | -15.7% |
| 30,000,000 | -18.8% | -18.5% | -18.3% | -18.1% | -17.8% | -17.6% | -17.3% | -17.1% | -16.8% | -16.6% | -16.4% |
| 35,000,000 | -18.9% | -18.7% | -18.5% | -18.3% | -18.1% | -17.9% | -17.6% | -17.4% | -17.2% | -17.0% | -16.8% |
| 40,000,000 | -19.0% | -18.8% | -18.6% | -18.4% | -18.3% | -18.1% | -17.9% | -17.7% | -17.5% | -17.3% | -17.2% |
| 45,000,000 | -19.1% | -18.9% | -18.7% | -18.6% | -18.4% | -18.2% | -18.1% | -17.9% | -17.8% | -17.6% | -17.4% |
| 50,000,000 | -19.1% | -19.0% | -18.8% | -18.7% | -18.5% | -18.4% | -18.2% | -18.1% | -17.9% | -17.8% | -17.7% |
| 55,000,000 | -19.2% | -19.0% | -18.9% | -18.8% | -18.6% | -18.5% | -18.4% | -18.2% | -18.1% | -18.0% | -17.8% |
| 60,000,000 | -19.2% | -19.1% | -19.0% | -18.8% | -18.7% | -18.6% | -18.5% | -18.4% | -18.2% | -18.1% | -18.0% |

Net Yield

Considering that validator revenue comes in the form of ETH while costs are denominated in dollars, it's worth examining how profitability varies under different ETH prices. As expected, net yields approach the initial gross yield as the price of ETH rises and profitability margins improve. The results are less draconian at higher price points, but the overarching theme of dependence on network fees remains clear.

Hardware Yield: 10M Staked

| | | Daily Network Fees | | | | | | | | | | |
|-----------|-------|--------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| | | 0 | 200 | 400 | 600 | 800 | 1,000 | 1,200 | 1,400 | 1,600 | 1,800 | 2,000 |
| Eth Price | 100 | -6.6% | -5.9% | -5.2% | -4.5% | -3.7% | -3.0% | -2.3% | -1.5% | -0.8% | -0.1% | 0.7% |
| | 150 | -3.6% | -2.9% | -2.1% | -1.4% | -0.7% | 0.1% | 0.8% | 1.5% | 2.3% | 3.0% | 3.7% |
| | 200 | -2.1% | -1.3% | -0.6% | 0.1% | 0.9% | 1.6% | 2.3% | 3.1% | 3.8% | 4.5% | 5.2% |
| | 300 | -0.5% | 0.2% | 0.9% | 1.7% | 2.4% | 3.1% | 3.9% | 4.6% | 5.3% | 6.0% | 6.8% |
| | 400 | 0.2% | 1.0% | 1.7% | 2.4% | 3.2% | 3.9% | 4.6% | 5.4% | 6.1% | 6.8% | 7.5% |
| | 500 | 0.7% | 1.4% | 2.2% | 2.9% | 3.6% | 4.4% | 5.1% | 5.8% | 6.5% | 7.3% | 8.0% |
| | 600 | 1.0% | 1.7% | 2.5% | 3.2% | 3.9% | 4.7% | 5.4% | 6.1% | 6.8% | 7.6% | 8.3% |
| | 700 | 1.2% | 2.0% | 2.7% | 3.4% | 4.1% | 4.9% | 5.6% | 6.3% | 7.1% | 7.8% | 8.5% |
| | 800 | 1.4% | 2.1% | 2.8% | 3.6% | 4.3% | 5.0% | 5.8% | 6.5% | 7.2% | 8.0% | 8.7% |
| | 900 | 1.5% | 2.2% | 3.0% | 3.7% | 4.4% | 5.2% | 5.9% | 6.6% | 7.4% | 8.1% | 8.8% |
| | 1,000 | 1.6% | 2.3% | 3.1% | 3.8% | 4.5% | 5.3% | 6.0% | 6.7% | 7.5% | 8.2% | 8.9% |
| | 1,200 | 1.8% | 2.5% | 3.2% | 4.0% | 4.7% | 5.4% | 6.2% | 6.9% | 7.6% | 8.3% | 9.1% |
| 1,400 | 1.9% | 2.6% | 3.3% | 4.1% | 4.8% | 5.5% | 6.3% | 7.0% | 7.7% | 8.5% | 9.2% | |
| 1,600 | 2.0% | 2.7% | 3.4% | 4.2% | 4.9% | 5.6% | 6.3% | 7.1% | 7.8% | 8.5% | 9.3% | |
| 1,800 | 2.0% | 2.8% | 3.5% | 4.2% | 4.9% | 5.7% | 6.4% | 7.1% | 7.9% | 8.6% | 9.3% | |
| 2,000 | 2.1% | 2.8% | 3.5% | 4.3% | 5.0% | 5.7% | 6.5% | 7.2% | 7.9% | 8.6% | 9.4% | |

Cloud Yield: 10M Staked

| | | Daily Network Fees | | | | | | | | | | |
|-----------|-------|--------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| | | 0 | 200 | 400 | 600 | 800 | 1,000 | 1,200 | 1,400 | 1,600 | 1,800 | 2,000 |
| Eth Price | 100 | -27.8% | -27.1% | -26.4% | -25.6% | -24.9% | -24.2% | -23.5% | -22.7% | -22.0% | -21.3% | -20.5% |
| | 150 | -17.7% | -17.0% | -16.3% | -15.5% | -14.8% | -14.1% | -13.3% | -12.6% | -11.9% | -11.1% | -10.4% |
| | 200 | -12.7% | -11.9% | -11.2% | -10.5% | -9.7% | -9.0% | -8.3% | -7.5% | -6.8% | -6.1% | -5.4% |
| | 300 | -7.6% | -6.9% | -6.1% | -5.4% | -4.7% | -3.9% | -3.2% | -2.5% | -1.7% | -1.0% | -0.3% |
| | 400 | -5.1% | -4.3% | -3.6% | -2.9% | -2.1% | -1.4% | -0.7% | 0.1% | 0.8% | 1.5% | 2.2% |
| | 500 | -3.5% | -2.8% | -2.1% | -1.3% | -0.6% | 0.1% | 0.8% | 1.6% | 2.3% | 3.0% | 3.8% |
| | 600 | -2.5% | -1.8% | -1.1% | -0.3% | 0.4% | 1.1% | 1.9% | 2.6% | 3.3% | 4.0% | 4.8% |
| | 700 | -1.8% | -1.1% | -0.3% | 0.4% | 1.1% | 1.8% | 2.6% | 3.3% | 4.0% | 4.8% | 5.5% |
| | 800 | -1.3% | -0.5% | 0.2% | 0.9% | 1.7% | 2.4% | 3.1% | 3.8% | 4.6% | 5.3% | 6.0% |
| | 900 | -0.8% | -0.1% | 0.6% | 1.4% | 2.1% | 2.8% | 3.5% | 4.3% | 5.0% | 5.7% | 6.5% |
| | 1,000 | -0.5% | 0.2% | 1.0% | 1.7% | 2.4% | 3.1% | 3.9% | 4.6% | 5.3% | 6.1% | 6.8% |
| | 1,200 | 0.0% | 0.7% | 1.5% | 2.2% | 2.9% | 3.7% | 4.4% | 5.1% | 5.8% | 6.6% | 7.3% |
| 1,400 | 0.4% | 1.1% | 1.8% | 2.6% | 3.3% | 4.0% | 4.7% | 5.5% | 6.2% | 6.9% | 7.7% | |
| 1,600 | 0.6% | 1.4% | 2.1% | 2.8% | 3.6% | 4.3% | 5.0% | 5.7% | 6.5% | 7.2% | 7.9% | |
| 1,800 | 0.8% | 1.6% | 2.3% | 3.0% | 3.8% | 4.5% | 5.2% | 6.0% | 6.7% | 7.4% | 8.1% | |
| 2,000 | 1.0% | 1.7% | 2.5% | 3.2% | 3.9% | 4.7% | 5.4% | 6.1% | 6.9% | 7.6% | 8.3% | |

Hardware Yield: 40M Staked




| | | Daily Network Fees | | | | | | | | | | |
|-----------|-------|--------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| | | 0 | 200 | 400 | 600 | 800 | 1,000 | 1,200 | 1,400 | 1,600 | 1,800 | 2,000 |
| Eth Price | 100 | -7.9% | -7.7% | -7.5% | -7.4% | -7.2% | -7.0% | -6.8% | -6.6% | -6.5% | -6.3% | -6.1% |
| | 150 | -4.9% | -4.7% | -4.5% | -4.3% | -4.1% | -3.9% | -3.8% | -3.6% | -3.4% | -3.2% | -3.0% |
| | 200 | -3.3% | -3.1% | -3.0% | -2.8% | -2.6% | -2.4% | -2.2% | -2.0% | -1.9% | -1.7% | -1.5% |
| | 300 | -1.8% | -1.6% | -1.4% | -1.2% | -1.1% | -0.9% | -0.7% | -0.5% | -0.3% | -0.1% | 0.0% |
| | 400 | -1.0% | -0.8% | -0.7% | -0.5% | -0.3% | -0.1% | 0.1% | 0.3% | 0.4% | 0.6% | 0.8% |
| | 500 | -0.6% | -0.4% | -0.2% | 0.0% | 0.2% | 0.3% | 0.5% | 0.7% | 0.9% | 1.1% | 1.3% |
| | 600 | -0.3% | -0.1% | 0.1% | 0.3% | 0.5% | 0.7% | 0.8% | 1.0% | 1.2% | 1.4% | 1.6% |
| | 700 | 0.0% | 0.1% | 0.3% | 0.5% | 0.7% | 0.9% | 1.1% | 1.2% | 1.4% | 1.6% | 1.8% |
| | 800 | 0.1% | 0.3% | 0.5% | 0.7% | 0.9% | 1.0% | 1.2% | 1.4% | 1.6% | 1.8% | 1.9% |
| | 900 | 0.2% | 0.4% | 0.6% | 0.8% | 1.0% | 1.2% | 1.3% | 1.5% | 1.7% | 1.9% | 2.1% |
| | 1,000 | 0.4% | 0.5% | 0.7% | 0.9% | 1.1% | 1.3% | 1.4% | 1.6% | 1.8% | 2.0% | 2.2% |
| | 1,200 | 0.5% | 0.7% | 0.9% | 1.1% | 1.2% | 1.4% | 1.6% | 1.8% | 2.0% | 2.1% | 2.3% |
| 1,400 | 0.6% | 0.8% | 1.0% | 1.2% | 1.3% | 1.5% | 1.7% | 1.9% | 2.1% | 2.3% | 2.4% | |
| 1,600 | 0.7% | 0.9% | 1.1% | 1.2% | 1.4% | 1.6% | 1.8% | 2.0% | 2.2% | 2.3% | 2.5% | |
| 1,800 | 0.8% | 0.9% | 1.1% | 1.3% | 1.5% | 1.7% | 1.9% | 2.0% | 2.2% | 2.4% | 2.6% | |
| 2,000 | 0.8% | 1.0% | 1.2% | 1.4% | 1.5% | 1.7% | 1.9% | 2.1% | 2.3% | 2.5% | 2.6% | |


Cloud Yield: 40M Staked

| | | Daily Network Fees | | | | | | | | | | |
|-----------|-------|--------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| | | 0 | 200 | 400 | 600 | 800 | 1,000 | 1,200 | 1,400 | 1,600 | 1,800 | 2,000 |
| Eth Price | 100 | -29.1% | -28.9% | -28.7% | -28.6% | -28.4% | -28.2% | -28.0% | -27.8% | -27.6% | -27.5% | -27.3% |
| | 150 | -19.0% | -18.8% | -18.6% | -18.4% | -18.3% | -18.1% | -17.9% | -17.7% | -17.5% | -17.3% | -17.2% |
| | 200 | -13.9% | -13.7% | -13.6% | -13.4% | -13.2% | -13.0% | -12.8% | -12.6% | -12.5% | -12.3% | -12.1% |
| | 300 | -8.9% | -8.7% | -8.5% | -8.3% | -8.1% | -7.9% | -7.8% | -7.6% | -7.4% | -7.2% | -7.0% |
| | 400 | -6.3% | -6.1% | -6.0% | -5.8% | -5.6% | -5.4% | -5.2% | -5.0% | -4.9% | -4.7% | -4.5% |
| | 500 | -4.8% | -4.6% | -4.4% | -4.3% | -4.1% | -3.9% | -3.7% | -3.5% | -3.3% | -3.2% | -3.0% |
| | 600 | -3.8% | -3.6% | -3.4% | -3.2% | -3.1% | -2.9% | -2.7% | -2.5% | -2.3% | -2.2% | -2.0% |
| | 700 | -3.1% | -2.9% | -2.7% | -2.5% | -2.3% | -2.2% | -2.0% | -1.8% | -1.6% | -1.4% | -1.2% |
| | 800 | -2.5% | -2.3% | -2.2% | -2.0% | -1.8% | -1.6% | -1.4% | -1.3% | -1.1% | -0.9% | -0.7% |
| | 900 | -2.1% | -1.9% | -1.7% | -1.6% | -1.4% | -1.2% | -1.0% | -0.8% | -0.6% | -0.5% | -0.3% |
| | 1,000 | -1.8% | -1.6% | -1.4% | -1.2% | -1.0% | -0.9% | -0.7% | -0.5% | -0.3% | -0.1% | 0.1% |
| | 1,200 | -1.3% | -1.1% | -0.9% | -0.7% | -0.5% | -0.4% | -0.2% | 0.0% | 0.2% | 0.4% | 0.6% |
| 1,400 | -0.9% | -0.7% | -0.5% | -0.4% | -0.2% | 0.0% | 0.2% | 0.4% | 0.6% | 0.7% | 0.9% | |
| 1,600 | -0.6% | -0.4% | -0.3% | -0.1% | 0.1% | 0.3% | 0.5% | 0.6% | 0.8% | 1.0% | 1.2% | |
| 1,800 | -0.4% | -0.2% | -0.1% | 0.1% | 0.3% | 0.5% | 0.7% | 0.9% | 1.0% | 1.2% | 1.4% | |
| 2,000 | -0.3% | -0.1% | 0.1% | 0.3% | 0.5% | 0.7% | 0.8% | 1.0% | 1.2% | 1.4% | 1.6% | |

Staking Alternatives & Hedging Costs

One way to gauge if this rate is sufficient would be to examine the opportunity cost of staking. What else can an individual do with their ETH besides staking it, while still maintaining the same exposure? We broke down these options by the most attractive centralized and decentralized alternatives. Another thought exercise we included using that yield to hedge out the price risk using put options.

| Service(s) | Yield | High Level Overview |
|--|--------------|---|
|  BlockFi | 6.00% | <ul style="list-style-type: none"> • BlockFi currently has an Interest Account product where hodlers are able to earn interest in crypto on their assets held at BlockFi. • At the moment, users are able to earn a 6% annual interest rate, paid monthly in kind and compounding. • Requires a minimum balance of 1 BTC or 25 ETH |
|  MAKER +  Compound | 0.67% | <ul style="list-style-type: none"> • Collateralize X amount of ETH and receive 66.7% of that value in DAI (assuming a 150% collateralization ratio) • Lend this DAI for ~2.5% APR using services like Compound • Pay the stability fee of 1.5% APR on this DAI • Achieve a Net Yield of 1.00% on your DAI, but a true yield of 0.67% on your collateral |
| Service | Cost | High Level Overview |

| | | |
|---|---------------|---|
|  Paradigm | 28.00% | <ul style="list-style-type: none"> • Alternatively, you can try using that yield to hedge out price risk using put options and still maintain upside exposure • Given the high Implied Volatility and the nascent nature of the options market for ETH, 3 Month at the money put options are far too expensive to consider. |
|---|---------------|---|

Our Concerns

The variety of scenarios we've shown make it clear that the currently proposed yield will likely be insufficient. While it's plausible to assume that certain stakers, like Vitalik, will stake regardless of the economics, we do not believe this is the most reliable path to long term sustainability. The currently proposed block reward forces economic sustainability to be predicated on a developed fee market, and as we mentioned earlier, having 1024 shards will likely significantly reduce the price of gas. This implies that the amount of gas used will have to grow by magnitudes over the current spend to offset the pending drop in gas prices and still grow the overall network fees substantially. We've extended the network fees portion of our gross yield chart to show just how much they would have to grow before yields became attractive. Important to note that this is just the **gross yield**.

| Total ETH Staked | Daily Network Fees | | | | | | | | | | | | | | | | | | | | |
|------------------|--------------------|-------|-------|-------|-------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| | 0 | 200 | 400 | 600 | 800 | 1,000 | 1,200 | 1,400 | 1,600 | 1,800 | 2,000 | 2,200 | 2,400 | 2,600 | 2,800 | 3,000 | 3,200 | 3,400 | 3,600 | 3,800 | 4,000 |
| 5,000,000 | 3.59% | 5.05% | 6.51% | 7.97% | 9.43% | 10.89% | 12.35% | 13.81% | 15.27% | 16.73% | 18.19% | 19.65% | 21.11% | 22.57% | 24.03% | 25.49% | 26.95% | 28.41% | 29.87% | 31.33% | 32.79% |
| 10,000,000 | 2.54% | 3.27% | 4.00% | 4.73% | 5.46% | 6.19% | 6.92% | 7.65% | 8.38% | 9.11% | 9.84% | 10.57% | 11.30% | 12.03% | 12.76% | 13.49% | 14.22% | 14.95% | 15.68% | 16.41% | 17.14% |
| 15,000,000 | 2.07% | 2.56% | 3.04% | 3.53% | 4.02% | 4.50% | 4.99% | 5.48% | 5.96% | 6.45% | 6.94% | 7.42% | 7.91% | 8.40% | 8.88% | 9.37% | 9.86% | 10.34% | 10.83% | 11.32% | 11.80% |
| 20,000,000 | 1.79% | 2.16% | 2.52% | 2.89% | 3.25% | 3.62% | 3.98% | 4.35% | 4.71% | 5.08% | 5.44% | 5.81% | 6.17% | 6.54% | 6.90% | 7.27% | 7.63% | 8.00% | 8.36% | 8.73% | 9.09% |
| 25,000,000 | 1.60% | 1.90% | 2.19% | 2.48% | 2.77% | 3.06% | 3.36% | 3.65% | 3.94% | 4.23% | 4.52% | 4.82% | 5.11% | 5.40% | 5.69% | 5.98% | 6.28% | 6.57% | 6.86% | 7.15% | 7.44% |
| 30,000,000 | 1.46% | 1.71% | 1.95% | 2.19% | 2.44% | 2.68% | 2.92% | 3.17% | 3.41% | 3.65% | 3.90% | 4.14% | 4.38% | 4.63% | 4.87% | 5.11% | 5.36% | 5.60% | 5.84% | 6.09% | 6.33% |
| 35,000,000 | 1.36% | 1.56% | 1.77% | 1.98% | 2.19% | 2.40% | 2.61% | 2.82% | 3.02% | 3.23% | 3.44% | 3.65% | 3.86% | 4.07% | 4.28% | 4.48% | 4.69% | 4.90% | 5.11% | 5.32% | 5.53% |
| 40,000,000 | 1.27% | 1.45% | 1.63% | 1.82% | 2.00% | 2.18% | 2.36% | 2.55% | 2.73% | 2.91% | 3.09% | 3.28% | 3.46% | 3.64% | 3.82% | 4.01% | 4.19% | 4.37% | 4.55% | 4.74% | 4.92% |
| 45,000,000 | 1.20% | 1.36% | 1.52% | 1.68% | 1.84% | 2.01% | 2.17% | 2.33% | 2.49% | 2.66% | 2.82% | 2.98% | 3.14% | 3.30% | 3.47% | 3.63% | 3.79% | 3.95% | 4.12% | 4.28% | 4.44% |
| 50,000,000 | 1.13% | 1.28% | 1.43% | 1.57% | 1.72% | 1.86% | 2.01% | 2.16% | 2.30% | 2.45% | 2.59% | 2.74% | 2.89% | 3.03% | 3.18% | 3.32% | 3.47% | 3.62% | 3.76% | 3.91% | 4.05% |
| 55,000,000 | 1.08% | 1.21% | 1.35% | 1.48% | 1.61% | 1.75% | 1.88% | 2.01% | 2.14% | 2.28% | 2.41% | 2.54% | 2.67% | 2.81% | 2.94% | 3.07% | 3.21% | 3.34% | 3.47% | 3.60% | 3.74% |
| 60,000,000 | 1.04% | 1.16% | 1.28% | 1.40% | 1.52% | 1.64% | 1.77% | 1.89% | 2.01% | 2.13% | 2.25% | 2.37% | 2.50% | 2.62% | 2.74% | 2.86% | 2.98% | 3.10% | 3.23% | 3.35% | 3.47% |
| 65,000,000 | 0.99% | 1.11% | 1.22% | 1.33% | 1.44% | 1.56% | 1.67% | 1.78% | 1.89% | 2.01% | 2.12% | 2.23% | 2.34% | 2.45% | 2.57% | 2.68% | 2.79% | 2.90% | 3.02% | 3.13% | 3.24% |
| 70,000,000 | 0.96% | 1.06% | 1.17% | 1.27% | 1.38% | 1.48% | 1.58% | 1.69% | 1.79% | 1.90% | 2.00% | 2.11% | 2.21% | 2.31% | 2.42% | 2.52% | 2.63% | 2.73% | 2.84% | 2.94% | 3.04% |
| 75,000,000 | 0.93% | 1.02% | 1.12% | 1.22% | 1.32% | 1.41% | 1.51% | 1.61% | 1.70% | 1.80% | 1.90% | 2.00% | 2.09% | 2.19% | 2.29% | 2.39% | 2.48% | 2.58% | 2.68% | 2.78% | 2.87% |
| 80,000,000 | 0.90% | 0.99% | 1.08% | 1.17% | 1.26% | 1.35% | 1.44% | 1.54% | 1.63% | 1.72% | 1.81% | 1.90% | 1.99% | 2.08% | 2.17% | 2.27% | 2.36% | 2.45% | 2.54% | 2.63% | 2.72% |

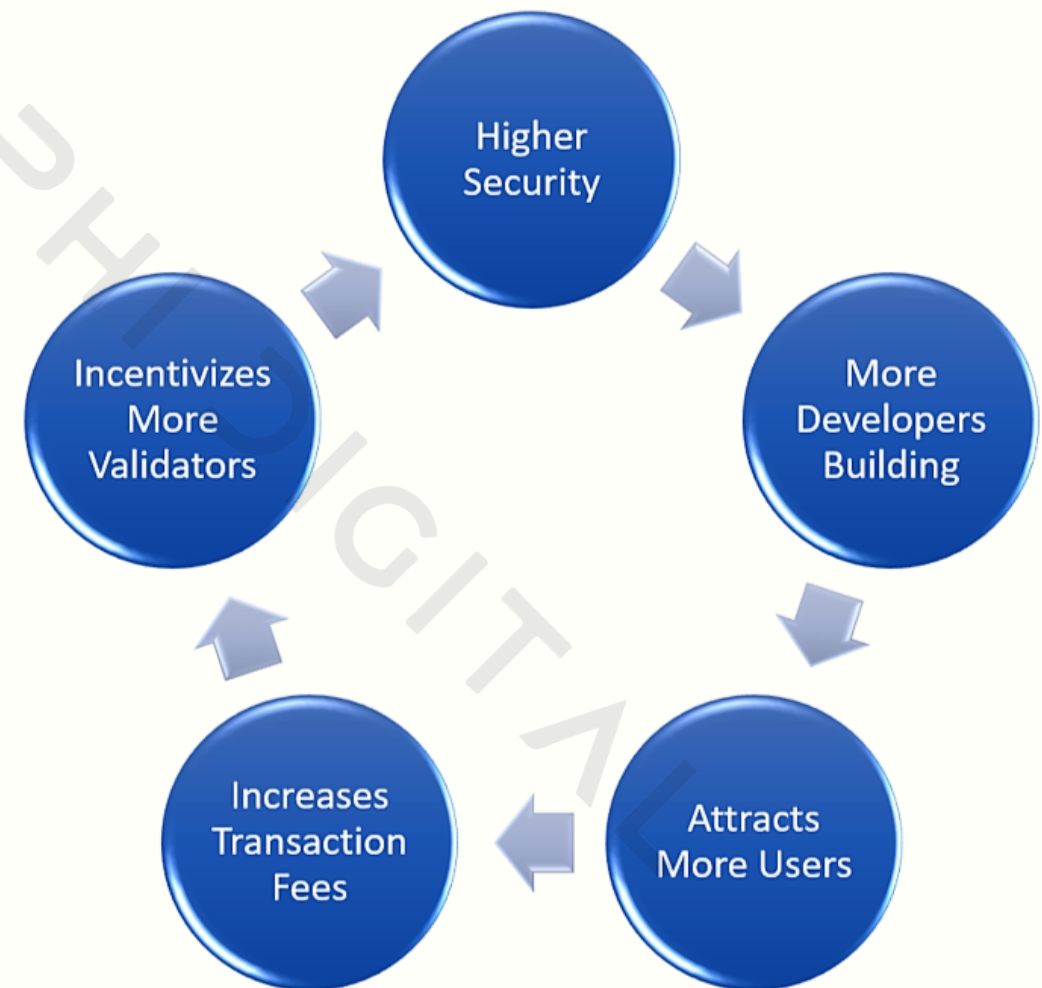
Our Concerns

We absolutely believe that continued Ethereum adoption and building on the platform will help the fee market develop, but it becomes a bit of a chicken or the egg situation. **A diversified and profitable validator network is crucial for the security and longevity of the network, but that's unattainable under the currently proposed specs without significant network fees. At the same time, expansion of network fees will only occur with substantial dapp growth and general adoption, and that's difficult to imagine being built on a network that's not considered secure.**

Referring to the flow chart below, the current proposal effectively relies on high transaction fees as the starting "starting point" that leads to additional validators that further secure the network. We believe it's safer to prioritize security by establishing a more appealing yield, without significant dependence on network fees, to attract validators that will help secure the network. If Ethereum aims to be one of the dominant smart contract protocols in the long run, security must be one of its strongest features. A key part of network security in the proof-of-stake model is the value of the collateral staked by validators.

We recognize the arguments against a higher issuance rate, notably the dilutive effects it has on current holders. However, in this situation, it is at the very least an idea worth exploring, especially given its potentially profound effects on the long-term security of the Ethereum network. We don't believe that security and economic sustainability have to come at the cost of high issuance. It's a false binary.

In our proposed model, we can see how a marginally higher issuance rate can lead to a significant increase in net yield. This would help bolster the security of the network from the beginning, allowing what we believe to be a more natural trajectory to take its course.



Our Proposal

Our opinion is that the currently proposed model focuses too much on the long term dilutive effects of a high issuance rate, potentially at the cost of near term sustainability. We propose that Serenity's block reward starts off at a higher level and then gradually tapers off. This is where the Base Reward Quotient from earlier comes into play. Rather than using a fixed quotient of 1024 in perpetuity, we begin with a Base Reward Quotient of 128, that doubles every 5 years until the year 2036 where it reaches 1024. At that point, it would be fixed at 1024 in line with the currently proposed specs. Below we present an example of the Gross Yield during the first 5 years in our proposed idea.

Base Reward Quotient: 128

2021 - 2016

Daily Network Fees

| Total ETH Staked | Daily Network Fees | | | | | | | | | | |
|------------------|--------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| | 0 | 200 | 400 | 600 | 800 | 1,000 | 1,200 | 1,400 | 1,600 | 1,800 | 2,000 |
| 5,000,000 | 28.69% | 30.15% | 31.61% | 33.07% | 34.53% | 35.99% | 37.45% | 38.91% | 40.37% | 41.83% | 43.29% |
| 10,000,000 | 20.29% | 21.02% | 21.75% | 22.48% | 23.21% | 23.94% | 24.67% | 25.40% | 26.13% | 26.86% | 27.59% |
| 15,000,000 | 16.57% | 17.06% | 17.54% | 18.03% | 18.52% | 19.00% | 19.49% | 19.98% | 20.46% | 20.95% | 21.44% |
| 20,000,000 | 14.35% | 14.71% | 15.08% | 15.44% | 15.81% | 16.17% | 16.54% | 16.90% | 17.27% | 17.63% | 18.00% |
| 25,000,000 | 12.83% | 13.12% | 13.42% | 13.71% | 14.00% | 14.29% | 14.58% | 14.88% | 15.17% | 15.46% | 15.75% |
| 30,000,000 | 11.71% | 11.96% | 12.20% | 12.44% | 12.69% | 12.93% | 13.17% | 13.42% | 13.66% | 13.90% | 14.15% |
| 35,000,000 | 10.85% | 11.05% | 11.26% | 11.47% | 11.68% | 11.89% | 12.10% | 12.31% | 12.51% | 12.72% | 12.93% |
| 40,000,000 | 10.15% | 10.33% | 10.51% | 10.69% | 10.88% | 11.06% | 11.24% | 11.42% | 11.61% | 11.79% | 11.97% |
| 45,000,000 | 9.56% | 9.73% | 9.89% | 10.05% | 10.21% | 10.38% | 10.54% | 10.70% | 10.86% | 11.02% | 11.19% |
| 50,000,000 | 9.07% | 9.22% | 9.37% | 9.51% | 9.66% | 9.80% | 9.95% | 10.10% | 10.24% | 10.39% | 10.53% |
| 55,000,000 | 8.65% | 8.78% | 8.92% | 9.05% | 9.18% | 9.32% | 9.45% | 9.58% | 9.71% | 9.85% | 9.98% |
| 60,000,000 | 8.28% | 8.41% | 8.53% | 8.65% | 8.77% | 8.89% | 9.01% | 9.14% | 9.26% | 9.38% | 9.50% |
| 65,000,000 | 7.96% | 8.07% | 8.18% | 8.30% | 8.41% | 8.52% | 8.63% | 8.74% | 8.86% | 8.97% | 9.08% |
| 70,000,000 | 7.67% | 7.77% | 7.88% | 7.98% | 8.09% | 8.19% | 8.29% | 8.40% | 8.50% | 8.61% | 8.71% |
| 75,000,000 | 7.41% | 7.51% | 7.60% | 7.70% | 7.80% | 7.90% | 7.99% | 8.09% | 8.19% | 8.28% | 8.38% |
| 80,000,000 | 7.17% | 7.26% | 7.36% | 7.45% | 7.54% | 7.63% | 7.72% | 7.81% | 7.90% | 7.99% | 8.09% |

Base Reward Quotient: 256

2026 - 2031

Daily Network Fees

| Total ETH Staked | Daily Network Fees | | | | | | | | | | |
|------------------|--------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| | 0 | 200 | 400 | 600 | 800 | 1,000 | 1,200 | 1,400 | 1,600 | 1,800 | 2,000 |
| 5,000,000 | 14.35% | 15.81% | 17.27% | 18.73% | 20.19% | 21.65% | 23.11% | 24.57% | 26.03% | 27.49% | 28.95% |
| 10,000,000 | 10.15% | 10.88% | 11.61% | 12.34% | 13.07% | 13.80% | 14.53% | 15.26% | 15.99% | 16.72% | 17.45% |
| 15,000,000 | 8.29% | 8.77% | 9.26% | 9.75% | 10.23% | 10.72% | 11.21% | 11.69% | 12.18% | 12.67% | 13.15% |
| 20,000,000 | 7.17% | 7.54% | 7.90% | 8.27% | 8.63% | 9.00% | 9.36% | 9.73% | 10.09% | 10.46% | 10.82% |
| 25,000,000 | 6.42% | 6.71% | 7.00% | 7.29% | 7.58% | 7.88% | 8.17% | 8.46% | 8.75% | 9.04% | 9.34% |
| 30,000,000 | 5.86% | 6.10% | 6.34% | 6.59% | 6.83% | 7.07% | 7.32% | 7.56% | 7.80% | 8.05% | 8.29% |
| 35,000,000 | 5.42% | 5.63% | 5.84% | 6.05% | 6.26% | 6.47% | 6.67% | 6.88% | 7.09% | 7.30% | 7.51% |
| 40,000,000 | 5.07% | 5.26% | 5.44% | 5.62% | 5.80% | 5.99% | 6.17% | 6.35% | 6.53% | 6.72% | 6.90% |
| 45,000,000 | 4.78% | 4.94% | 5.11% | 5.27% | 5.43% | 5.59% | 5.76% | 5.92% | 6.08% | 6.24% | 6.40% |
| 50,000,000 | 4.54% | 4.68% | 4.83% | 4.97% | 5.12% | 5.27% | 5.41% | 5.56% | 5.70% | 5.85% | 6.00% |
| 55,000,000 | 4.33% | 4.46% | 4.59% | 4.72% | 4.86% | 4.99% | 5.12% | 5.25% | 5.39% | 5.52% | 5.65% |
| 60,000,000 | 4.14% | 4.26% | 4.39% | 4.51% | 4.63% | 4.75% | 4.87% | 4.99% | 5.12% | 5.24% | 5.36% |
| 65,000,000 | 3.98% | 4.09% | 4.20% | 4.32% | 4.43% | 4.54% | 4.65% | 4.77% | 4.88% | 4.99% | 5.10% |
| 70,000,000 | 3.83% | 3.94% | 4.04% | 4.15% | 4.25% | 4.36% | 4.46% | 4.56% | 4.67% | 4.77% | 4.88% |
| 75,000,000 | 3.70% | 3.80% | 3.90% | 4.00% | 4.09% | 4.19% | 4.29% | 4.39% | 4.48% | 4.58% | 4.68% |
| 80,000,000 | 3.59% | 3.68% | 3.77% | 3.86% | 3.95% | 4.04% | 4.13% | 4.23% | 4.32% | 4.41% | 4.50% |

Base Reward Quotient: 512

2031 - 2036

Daily Network Fees

| Total ETH Staked | Daily Network Fees | | | | | | | | | | |
|------------------|--------------------|-------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| | 0 | 200 | 400 | 600 | 800 | 1,000 | 1,200 | 1,400 | 1,600 | 1,800 | 2,000 |
| 5,000,000 | 7.17% | 8.63% | 10.09% | 11.55% | 13.01% | 14.47% | 15.93% | 17.39% | 18.85% | 20.31% | 21.77% |
| 10,000,000 | 5.07% | 5.80% | 6.53% | 7.26% | 7.99% | 8.72% | 9.45% | 10.18% | 10.91% | 11.64% | 12.37% |
| 15,000,000 | 4.14% | 4.63% | 5.12% | 5.60% | 6.09% | 6.58% | 7.06% | 7.55% | 8.04% | 8.52% | 9.01% |
| 20,000,000 | 3.59% | 3.95% | 4.32% | 4.68% | 5.05% | 5.41% | 5.78% | 6.14% | 6.51% | 6.87% | 7.24% |
| 25,000,000 | 3.21% | 3.50% | 3.79% | 4.08% | 4.38% | 4.67% | 4.96% | 5.25% | 5.54% | 5.84% | 6.13% |
| 30,000,000 | 2.93% | 3.17% | 3.42% | 3.66% | 3.90% | 4.15% | 4.39% | 4.63% | 4.88% | 5.12% | 5.36% |
| 35,000,000 | 2.71% | 2.92% | 3.13% | 3.34% | 3.55% | 3.75% | 3.96% | 4.17% | 4.38% | 4.59% | 4.80% |
| 40,000,000 | 2.54% | 2.72% | 2.90% | 3.08% | 3.27% | 3.45% | 3.63% | 3.81% | 4.00% | 4.18% | 4.36% |
| 45,000,000 | 2.39% | 2.55% | 2.72% | 2.88% | 3.04% | 3.20% | 3.36% | 3.53% | 3.69% | 3.85% | 4.01% |
| 50,000,000 | 2.27% | 2.41% | 2.56% | 2.71% | 2.85% | 3.00% | 3.14% | 3.29% | 3.44% | 3.58% | 3.73% |
| 55,000,000 | 2.16% | 2.30% | 2.43% | 2.56% | 2.69% | 2.83% | 2.96% | 3.09% | 3.22% | 3.36% | 3.49% |
| 60,000,000 | 2.07% | 2.19% | 2.31% | 2.44% | 2.56% | 2.68% | 2.80% | 2.92% | 3.04% | 3.17% | 3.29% |
| 65,000,000 | 1.99% | 2.10% | 2.21% | 2.33% | 2.44% | 2.55% | 2.66% | 2.78% | 2.89% | 3.00% | 3.11% |
| 70,000,000 | 1.92% | 2.02% | 2.13% | 2.23% | 2.33% | 2.44% | 2.54% | 2.65% | 2.75% | 2.86% | 2.96% |
| 75,000,000 | 1.85% | 1.95% | 2.05% | 2.14% | 2.24% | 2.34% | 2.44% | 2.53% | 2.63% | 2.73% | 2.83% |
| 80,000,000 | 1.79% | 1.88% | 1.98% | 2.07% | 2.16% | 2.25% | 2.34% | 2.43% | 2.52% | 2.61% | 2.71% |

Base Reward Quotient: 1024

2036 - (onwards)

Network Fees/Day

| Total ETH Staked | Network Fees/Day | | | | | | | | | | |
|------------------|------------------|-------|-------|-------|-------|--------|--------|--------|--------|--------|--------|
| | 0 | 200 | 400 | 600 | 800 | 1,000 | 1,200 | 1,400 | 1,600 | 1,800 | 2,000 |
| 5,000,000 | 3.59% | 5.05% | 6.51% | 7.97% | 9.43% | 10.89% | 12.35% | 13.81% | 15.27% | 16.73% | 18.19% |
| 10,000,000 | 2.54% | 3.27% | 4.00% | 4.73% | 5.46% | 6.19% | 6.92% | 7.65% | 8.38% | 9.11% | 9.84% |
| 15,000,000 | 2.07% | 2.56% | 3.04% | 3.53% | 4.02% | 4.50% | 4.99% | 5.48% | 5.96% | 6.45% | 6.94% |
| 20,000,000 | 1.79% | 2.16% | 2.52% | 2.89% | 3.25% | 3.62% | 3.98% | 4.35% | 4.71% | 5.08% | 5.44% |
| 25,000,000 | 1.60% | 1.90% | 2.19% | 2.48% | 2.77% | 3.06% | 3.36% | 3.65% | 3.94% | 4.23% | 4.52% |
| 30,000,000 | 1.46% | 1.71% | 1.95% | 2.19% | 2.44% | 2.68% | 2.92% | 3.17% | 3.41% | 3.65% | 3.90% |
| 35,000,000 | 1.36% | 1.56% | 1.77% | 1.98% | 2.19% | 2.40% | 2.61% | 2.82% | 3.02% | 3.23% | 3.44% |
| 40,000,000 | 1.27% | 1.45% | 1.63% | 1.82% | 2.00% | 2.18% | 2.36% | 2.55% | 2.73% | 2.91% | 3.09% |
| 45,000,000 | 1.20% | 1.36% | 1.52% | 1.68% | 1.84% | 2.01% | 2.17% | 2.33% | 2.49% | 2.66% | 2.82% |
| 50,000,000 | 1.13% | 1.28% | 1.43% | 1.57% | 1.72% | 1.86% | 2.01% | 2.16% | 2.30% | 2.45% | 2.59% |
| 55,000,000 | 1.08% | 1.21% | 1.35% | 1.48% | 1.61% | 1.75% | 1.88% | 2.01% | 2.14% | 2.28% | 2.41% |
| 60,000,000 | 1.04% | 1.16% | 1.28% | 1.40% | 1.52% | 1.64% | 1.77% | 1.89% | 2.01% | 2.13% | 2.25% |
| 65,000,000 | 0.99% | 1.11% | 1.22% | 1.33% | 1.44% | 1.56% | 1.67% | 1.78% | 1.89% | 2.01% | 2.12% |
| 70,000,000 | 0.96% | 1.06% | 1.17% | 1.27% | 1.38% | 1.48% | 1.58% | 1.69% | 1.79% | 1.90% | 2.00% |
| 75,000,000 | 0.93% | 1.02% | 1.12% | 1.22% | 1.32% | 1.41% | 1.51% | 1.61% | 1.70% | 1.80% | 1.90% |
| 80,000,000 | 0.90% | 0.99% | 1.08% | 1.17% | 1.26% | 1.35% | 1.44% | 1.54% | 1.63% | 1.72% | 1.81% |

Our Proposal

This reliance on substantial network fees immediately following the launch of serenity creates a massive systemic risk. Our proposed change helps shift early revenues to be block reward heavy. This provides the network a significant buffer before it has to truly rely on a fee market to develop to support its validators. We illustrate the difference in the charts below by showing **gas as a percent of total rewards** throughout each shift.

Base Reward Quotient: 128

2021 - 2016

Daily Network Fees

| Total ETH Staked | Daily Network Fees | | | | | | | | | | | |
|------------------|--------------------|------|------|-------|-------|-------|-------|-------|-------|-------|-------|--|
| | 0 | 200 | 400 | 600 | 800 | 1,000 | 1,200 | 1,400 | 1,600 | 1,800 | 2,000 | |
| 5,000,000 | 0.0% | 4.8% | 9.2% | 13.2% | 16.9% | 20.3% | 23.4% | 26.3% | 28.9% | 31.4% | 33.7% | |
| 10,000,000 | 0.0% | 3.5% | 6.7% | 9.7% | 12.6% | 15.2% | 17.8% | 20.1% | 22.3% | 24.5% | 26.5% | |
| 15,000,000 | 0.0% | 2.9% | 5.5% | 8.1% | 10.5% | 12.8% | 15.0% | 17.1% | 19.0% | 20.9% | 22.7% | |
| 20,000,000 | 0.0% | 2.5% | 4.8% | 7.1% | 9.2% | 11.3% | 13.2% | 15.1% | 16.9% | 18.6% | 20.3% | |
| 25,000,000 | 0.0% | 2.2% | 4.4% | 6.4% | 8.3% | 10.2% | 12.0% | 13.7% | 15.4% | 17.0% | 18.5% | |
| 30,000,000 | 0.0% | 2.0% | 4.0% | 5.9% | 7.7% | 9.4% | 11.1% | 12.7% | 14.2% | 15.8% | 17.2% | |
| 35,000,000 | 0.0% | 1.9% | 3.7% | 5.5% | 7.1% | 8.8% | 10.3% | 11.9% | 13.3% | 14.8% | 16.1% | |
| 40,000,000 | 0.0% | 1.8% | 3.5% | 5.1% | 6.7% | 8.3% | 9.7% | 11.2% | 12.6% | 13.9% | 15.2% | |
| 45,000,000 | 0.0% | 1.7% | 3.3% | 4.8% | 6.4% | 7.8% | 9.2% | 10.6% | 11.9% | 13.2% | 14.5% | |
| 50,000,000 | 0.0% | 1.6% | 3.1% | 4.6% | 6.0% | 7.4% | 8.8% | 10.1% | 11.4% | 12.6% | 13.9% | |
| 55,000,000 | 0.0% | 1.5% | 3.0% | 4.4% | 5.8% | 7.1% | 8.4% | 9.7% | 10.9% | 12.1% | 13.3% | |
| 60,000,000 | 0.0% | 1.4% | 2.9% | 4.2% | 5.5% | 6.8% | 8.1% | 9.3% | 10.5% | 11.7% | 12.8% | |
| 65,000,000 | 0.0% | 1.4% | 2.7% | 4.1% | 5.3% | 6.6% | 7.8% | 9.0% | 10.1% | 11.3% | 12.4% | |
| 70,000,000 | 0.0% | 1.3% | 2.6% | 3.9% | 5.2% | 6.4% | 7.5% | 8.7% | 9.8% | 10.9% | 12.0% | |
| 75,000,000 | 0.0% | 1.3% | 2.6% | 3.8% | 5.0% | 6.2% | 7.3% | 8.4% | 9.5% | 10.6% | 11.6% | |
| 80,000,000 | 0.0% | 1.3% | 2.5% | 3.7% | 4.8% | 6.0% | 7.1% | 8.2% | 9.2% | 10.3% | 11.3% | |

Base Reward Quotient: 256

2026 - 2031

Daily Network Fees

| Total ETH Staked | Daily Network Fees | | | | | | | | | | | |
|------------------|--------------------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--|
| | 0 | 200 | 400 | 600 | 800 | 1,000 | 1,200 | 1,400 | 1,600 | 1,800 | 2,000 | |
| 5,000,000 | 0.0% | 9.2% | 16.9% | 23.4% | 28.9% | 33.7% | 37.9% | 41.6% | 44.9% | 47.8% | 50.4% | |
| 10,000,000 | 0.0% | 6.7% | 12.6% | 17.8% | 22.3% | 26.5% | 30.2% | 33.5% | 36.5% | 39.3% | 41.8% | |
| 15,000,000 | 0.0% | 5.5% | 10.5% | 15.0% | 19.0% | 22.7% | 26.1% | 29.1% | 32.0% | 34.6% | 37.0% | |
| 20,000,000 | 0.0% | 4.8% | 9.2% | 13.2% | 16.9% | 20.3% | 23.4% | 26.3% | 28.9% | 31.4% | 33.7% | |
| 25,000,000 | 0.0% | 4.4% | 8.3% | 12.0% | 15.4% | 18.5% | 21.4% | 24.2% | 26.7% | 29.1% | 31.3% | |
| 30,000,000 | 0.0% | 4.0% | 7.7% | 11.1% | 14.2% | 17.2% | 20.0% | 22.5% | 24.9% | 27.2% | 29.4% | |
| 35,000,000 | 0.0% | 3.7% | 7.1% | 10.3% | 13.3% | 16.1% | 18.8% | 21.2% | 23.5% | 25.7% | 27.8% | |
| 40,000,000 | 0.0% | 3.5% | 6.7% | 9.7% | 12.6% | 15.2% | 17.8% | 20.1% | 22.3% | 24.5% | 26.5% | |
| 45,000,000 | 0.0% | 3.3% | 6.4% | 9.2% | 11.9% | 14.5% | 16.9% | 19.2% | 21.3% | 23.4% | 25.3% | |
| 50,000,000 | 0.0% | 3.1% | 6.0% | 8.8% | 11.4% | 13.9% | 16.2% | 18.4% | 20.5% | 22.5% | 24.3% | |
| 55,000,000 | 0.0% | 3.0% | 5.8% | 8.4% | 10.9% | 13.3% | 15.5% | 17.7% | 19.7% | 21.6% | 23.5% | |
| 60,000,000 | 0.0% | 2.9% | 5.5% | 8.1% | 10.5% | 12.8% | 15.0% | 17.1% | 19.0% | 20.9% | 22.7% | |
| 65,000,000 | 0.0% | 2.7% | 5.3% | 7.8% | 10.1% | 12.4% | 14.5% | 16.5% | 18.4% | 20.3% | 22.0% | |
| 70,000,000 | 0.0% | 2.6% | 5.2% | 7.5% | 9.8% | 12.0% | 14.0% | 16.0% | 17.9% | 19.7% | 21.4% | |
| 75,000,000 | 0.0% | 2.6% | 5.0% | 7.3% | 9.5% | 11.6% | 13.6% | 15.5% | 17.4% | 19.1% | 20.8% | |
| 80,000,000 | 0.0% | 2.5% | 4.8% | 7.1% | 9.2% | 11.3% | 13.2% | 15.1% | 16.9% | 18.6% | 20.3% | |

Base Reward Quotient: 512

2031 - 2036

Daily Network Fees

| Total ETH Staked | Daily Network Fees | | | | | | | | | | | |
|------------------|--------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--|
| | 0 | 200 | 400 | 600 | 800 | 1,000 | 1,200 | 1,400 | 1,600 | 1,800 | 2,000 | |
| 5,000,000 | 0.0% | 16.9% | 28.9% | 37.9% | 44.9% | 50.4% | 55.0% | 58.8% | 62.0% | 64.7% | 67.1% | |
| 10,000,000 | 0.0% | 12.6% | 22.3% | 30.2% | 36.5% | 41.8% | 46.3% | 50.2% | 53.5% | 56.4% | 59.0% | |
| 15,000,000 | 0.0% | 10.5% | 19.0% | 26.1% | 32.0% | 37.0% | 41.3% | 45.1% | 48.4% | 51.4% | 54.0% | |
| 20,000,000 | 0.0% | 9.2% | 16.9% | 23.4% | 28.9% | 33.7% | 37.9% | 41.6% | 44.9% | 47.8% | 50.4% | |
| 25,000,000 | 0.0% | 8.3% | 15.4% | 21.4% | 26.7% | 31.3% | 35.3% | 38.9% | 42.1% | 45.0% | 47.7% | |
| 30,000,000 | 0.0% | 7.7% | 14.2% | 20.0% | 24.9% | 29.4% | 33.3% | 36.8% | 39.9% | 42.8% | 45.4% | |
| 35,000,000 | 0.0% | 7.1% | 13.3% | 18.8% | 23.5% | 27.8% | 31.6% | 35.0% | 38.1% | 40.9% | 43.5% | |
| 40,000,000 | 0.0% | 6.7% | 12.6% | 17.8% | 22.3% | 26.5% | 30.2% | 33.5% | 36.5% | 39.3% | 41.8% | |
| 45,000,000 | 0.0% | 6.4% | 11.9% | 16.9% | 21.3% | 25.3% | 28.9% | 32.2% | 35.2% | 37.9% | 40.4% | |
| 50,000,000 | 0.0% | 6.0% | 11.4% | 16.2% | 20.5% | 24.3% | 27.9% | 31.1% | 34.0% | 36.7% | 39.2% | |
| 55,000,000 | 0.0% | 5.8% | 10.9% | 15.5% | 19.7% | 23.5% | 26.9% | 30.0% | 32.9% | 35.6% | 38.0% | |
| 60,000,000 | 0.0% | 5.5% | 10.5% | 15.0% | 19.0% | 22.7% | 26.1% | 29.1% | 32.0% | 34.6% | 37.0% | |
| 65,000,000 | 0.0% | 5.3% | 10.1% | 14.5% | 18.4% | 22.0% | 25.3% | 28.3% | 31.1% | 33.7% | 36.1% | |
| 70,000,000 | 0.0% | 5.2% | 9.8% | 14.0% | 17.9% | 21.4% | 24.6% | 27.6% | 30.3% | 32.9% | 35.2% | |
| 75,000,000 | 0.0% | 5.0% | 9.5% | 13.6% | 17.4% | 20.8% | 24.0% | 26.9% | 29.6% | 32.1% | 34.4% | |
| 80,000,000 | 0.0% | 4.8% | 9.2% | 13.2% | 16.9% | 20.3% | 23.4% | 26.3% | 28.9% | 31.4% | 33.7% | |

Base Reward Quotient: 1024

2036 - (onwards)

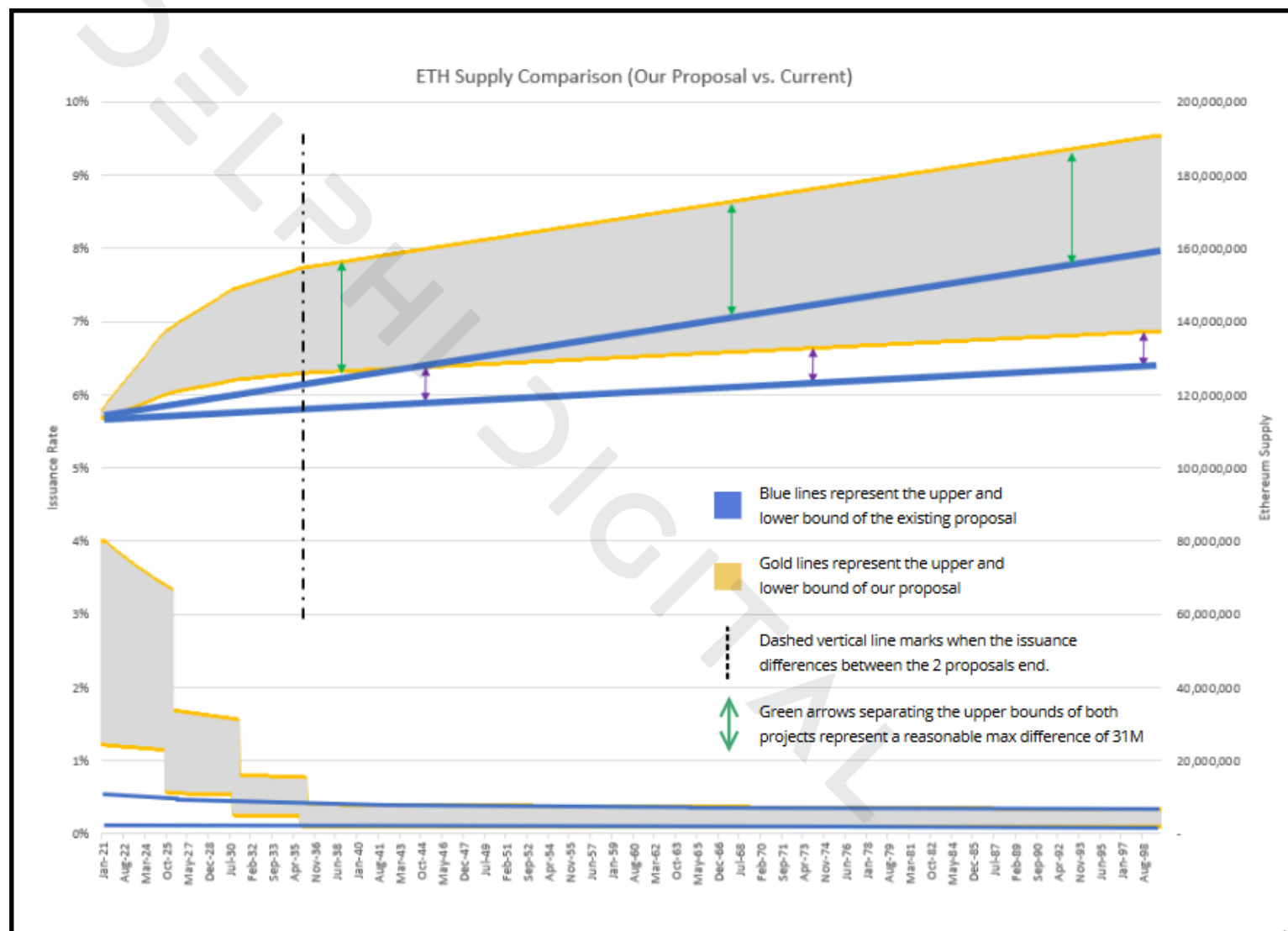
Daily Network Fees

| Total ETH Staked | Daily Network Fees | | | | | | | | | | | |
|------------------|--------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--|
| | 0 | 200 | 400 | 600 | 800 | 1,000 | 1,200 | 1,400 | 1,600 | 1,800 | 2,000 | |
| 5,000,000 | 0.0% | 28.9% | 44.9% | 55.0% | 62.0% | 67.1% | 70.9% | 74.0% | 76.5% | 78.6% | 80.3% | |
| 10,000,000 | 0.0% | 22.3% | 36.5% | 46.3% | 53.5% | 59.0% | 63.3% | 66.8% | 69.7% | 72.1% | 74.2% | |
| 15,000,000 | 0.0% | 19.0% | 32.0% | 41.3% | 48.4% | 54.0% | 58.5% | 62.2% | 65.3% | 67.9% | 70.1% | |
| 20,000,000 | 0.0% | 16.9% | 28.9% | 37.9% | 44.9% | 50.4% | 55.0% | 58.8% | 62.0% | 64.7% | 67.1% | |
| 25,000,000 | 0.0% | 15.4% | 26.7% | 35.3% | 42.1% | 47.7% | 52.2% | 56.0% | 59.3% | 62.1% | 64.5% | |
| 30,000,000 | 0.0% | 14.2% | 24.9% | 33.3% | 39.9% | 45.4% | 49.9% | 53.8% | 57.1% | 59.9% | 62.4% | |
| 35,000,000 | 0.0% | 13.3% | 23.5% | 31.6% | 38.1% | 43.5% | 48.0% | 51.9% | 55.2% | 58.1% | 60.6% | |
| 40,000,000 | 0.0% | 12.6% | 22.3% | 30.2% | 36.5% | 41.8% | 46.3% | 50.2% | 53.5% | 56.4% | 59.0% | |
| 45,000,000 | 0.0% | 11.9% | 21.3% | 28.9% | 35.2% | 40.4% | 44.9% | 48.7% | 52.0% | 55.0% | 57.6% | |
| 50,000,000 | 0.0% | 11.4% | 20.5% | 27.9% | 34.0% | 39.2% | 43.6% | 47.4% | 50.7% | 53.7% | 56.3% | |
| 55,000,000 | 0.0% | 10.9% | 19.7% | 26.9% | 32.9% | 38.0% | 42.4% | 46.2% | 49.5% | 52.5% | 55.1% | |
| 60,000,000 | 0.0% | 10.5% | 19.0% | 26.1% | 32.0% | 37.0% | 41.3% | 45.1% | 48.5% | 51.4% | 54.0% | |
| 65,000,000 | 0.0% | 10.1% | 18.4% | 25.3% | 31.1% | 36.1% | 40.4% | 44.1% | 47.5% | 50.4% | 53.0% | |
| 70,000,000 | 0.0% | 9.8% | 17.9% | 24.6% | 30.3% | 35.2% | 39.5% | 43.2% | 46.5% | 49.5% | 52.1% | |
| 75,000,000 | 0.0% | 9.5% | 17.4% | 24.0% | 29.6% | 34.4% | 38.7% | 42.4% | 45.7% | 48.6% | 51.2% | |
| 80,000,000 | 0.0% | 9.2% | 16.9% | 23.4% | 28.9% | 33.7% | 37.9% | 41.6% | 44.9% | 47.8% | 50.4% | |

Long Term Supply

Two criticisms of this proposal will likely be the impact of increased issuance and the fact that it's a policy that changes over time. The chart below depicts potential supply trajectories (top) and issuance rates (bottom), with the area shaded in grey (and highlighted in gold) representing the range of our proposal and the blue lines representing the upper and lower bound of the existing proposal. We use a lower bound of 5 million and an upper bound of 50 million ETH staked based on our belief that yields at those levels will cause economically rational validators to either join or leave the network. This implies that in order to reach the supply suggested by either bound, the network would have to stake exactly 5,000,000 or 50,000,000, respectively, for the duration of ETH's existence. The likely scenario is that we end up somewhere in the shaded area. Taking a step back, it's important to note that Serenity's issuance mechanism is completely supply agnostic as it's **determined by the quantity of ETH staked rather than the percent of supply**. Since our proposal shifts to the same base reward quotient as the existing proposal starting in 2036, the actual amount of ETH issued by both monetary policies will be identical from that date going forward.

The issuance differences between the two proposals will all take place in that transition period from 2021 to 2036, the end of which is marked by vertical dashed line. This helps us address the concern regarding increased issuance. The longer green arrows separating the upper bounds of both projections represents a reasonable maximum difference of **31 million** in potential supply. In relation to the concern that the monetary policy will shift over time, we believe predictability is more important than a lack of change. Purposeful and predictable change, a feature that helps make Bitcoin a store of value, can be a massive asset for Ethereum. Although issuance remains uncapped (in either proposal), we believe the benefits of maintaining a block reward to support the network at the expense of an issuance rate below 30 bps in the outer years is well worth it.



Roadmap & Scaling Solutions



Roadmap & History

Early Days

- Vitalik Buterin Officially Announces Ethereum (January 2014)
- Gavin Wood Publishes the [Yellow Paper](#) (April 2014)
- ETH Token Sale (July 2014 - September 2014)
- Olympic Testnet (May 2015)

Ethereum 1.0

1. Frontier (July 2015): First live release of the Ethereum network. It allowed developers to experiment, mine ETH, and begin building dApps and tools.

2. Homestead (March 2016): Production release of Ethereum when the first major projects began development on it.

3. Metropolis: Lighter, faster and more secure Ethereum broken down into two releases:

3(a). Byzantium (October 2017)

3(b). Constantinople (February 2019)

4. Istanbul (expected November 2019)

Ethereum 1.x

- (Expected 2019-2021): A series of upgrades for the Ethereum 1.0 Mainnet to ensure the network remains usable up until Serenity.

Ethereum 2.0 - Serenity

Ethereum 3.0

- (TBA) Expected Features include Casper CBC, zk-STARKs, and heterogeneous sharding

Ethereum 2.0 - Serenity

Phase 0 - The Beacon Chain (est. Q4 2019 - Q1 2020):

- Launch of the core system level functionality of the new PoS chain (the beacon chain).
- Validators can submit deposits, join the validator set, and build/finalize the core chain.
- The chain will have Casper finality, an RNG, shuffling into the various validator roles, and simulate crosslinking in the (currently) non-existent shard chains.

Phase 1 - Shard Chains Data (est. 2020):

- Blockchain data sharded, but not execution/state change
- Shard data chains could offer utility for apps that need a high availability data store

Phase 2 - Shard Chains State & Execution (est. 2021):

- Launch of state and execution of state (eWASM) on the shard chains and cross shard transactions.
- Full potential will be reached & scalable layer 1 execution

Serenity Expected Features:

- Proof-of-Stake Consensus
- Faster time to synchronous confirmation (8-16 seconds)
- "Economic Finality" (10-20 minutes)
- Fast VM execution via eWASM
- Higher scalability (Vitalik estimates ~1000x)

In its current form, Ethereum can only process 7-15 transactions per second, and does not have the throughput necessary to support widespread adoption. Below we highlight various scaling solutions being developed for layer 1 and layer 2. Layer 1 solutions directly improve the base layer of the protocol whereas layer 2 solutions are implemented on top of it.

Layer 1

Casper Proof of Stake

- Proof of Stake ("PoS") is a category of consensus algorithms whose security relies on a validator's economic stake in the network. Compared to Proof of Work ("PoW"), which is currently used by Bitcoin and Ethereum, PoS does away with the computationally intensive mining process. Miners are replaced with validators, which can be any network participant willing to post a minimum of 32 ETH as collateral. If a validator acts maliciously, they are penalized by losing a portion, or all, of their collateral. This mechanism helps maintain network security.

Sharding

- Currently each full node stores the entire state of the blockchain and processes all of the transactions. Sharding breaks up the network's computational resources into smaller subsets so that each node no longer needs to store and process everything. There are expected to be 1024 shards based on the current spec.

zk-STARKS

- These are a type of cryptographic proof that allows a user to prove something is true to a third party without having to reveal the underlying information. Implementing zk-STARKs on Ethereum can improve privacy in addition to scalability by allowing computations to move off-chain. Other benefits include no trusted set-up phase (unlike zk-SNARKs), and potential quantum resistance. Ethereum plans to integrate these in "Ethereum 3.0", which is probably at least 4 years away. They can also be implemented in layer 2 solutions.

Layer 2

Plasma

- Plasma is a technique for conducting off-chain operations while relying on the underlying Ethereum blockchain to ground its security. You may also see Plasma (and similar constructs) referred to as 'child chains'. There are a variety of different implementations being developed.

State & Payment Channels

- A portion of the blockchain state is "locked up" into a multisig contract which is controlled by a defined set of participants. Channel participants use off-chain messaging to exchange and sign valid transactions without deploying them to the main chain. Rather than processing each transaction on chain, the blockchain becomes a settlement layer that only processes the final transaction in a series. Bitcoin's Lightning Network is a type of Payment Channel.

Ethereum 1.x

At Devcon IV (October 30, 2018 - November 2, 2018), a group of Ethereum developers met to discuss their concerns over Ethereum's current mainnet, and the fact that Serenity will not be fully implemented for at least 3 years. "Ethereum 1.x" was the result, and represents a series of near term (1-2 years out) upgrades intended to ensure the network remains usable leading up to Serenity. A primary focus is on curbing the growth rate of Ethereum's blockchain size. As seen in the chart to the bottom right, the size of a GETH full node has increased ~12% in just the past 6 weeks.

Areas Of Development

State Rent

- This would essentially charge users a fee to store and maintain data on the blockchain. This would be a significant change and could become a contentious topic, however, we believe the logic behind implementing it is sound. This change would require a hard-fork.

eWASM

- A new virtual machine that expands coding options, while also improving on speed and efficiency relative to the current Ethereum Virtual Machine (EVM). This change would require a hard-fork.

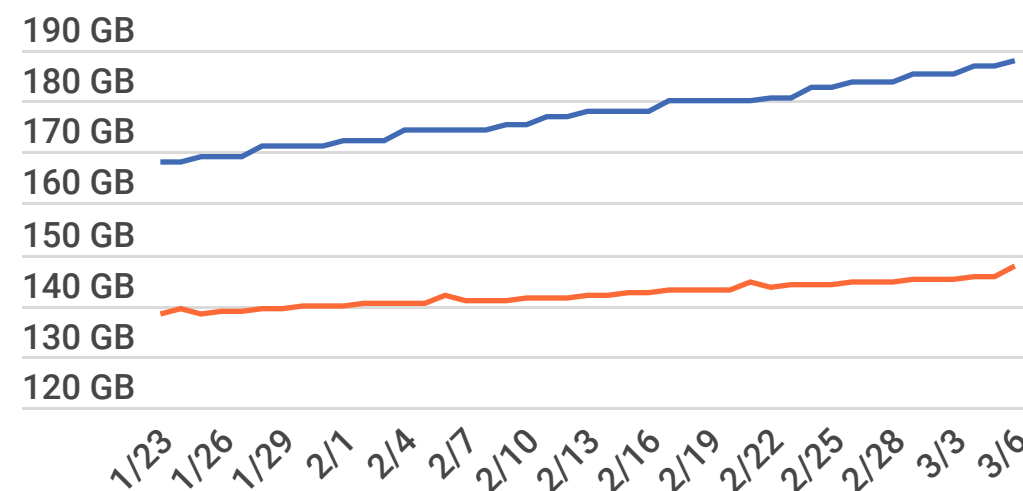
Storage Pruning

- Focused on different ways to compress/trim down the size of the blockchain.

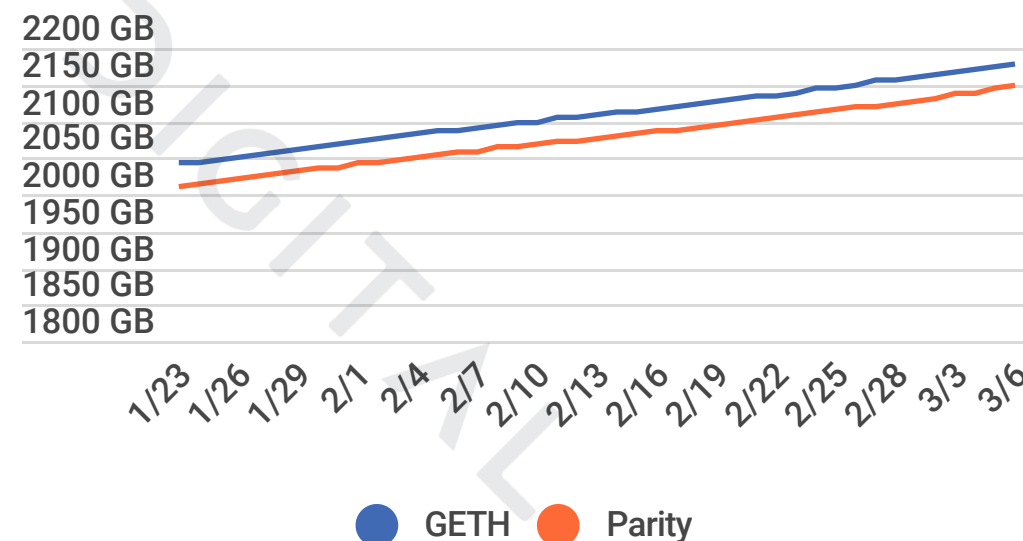
Simulation and Emulation

- Produces data for making projections, benchmarks, and parameter calibrations to provide the community with information on Ethereum's progress and the effects of proposed changes.

Full Node Size by Client



Archival Node Size by Client



Data as of March 6th, 2019

Sources: [EthHub](#), [Etherscan](#), [Github](#), [EthResear.ch](#)

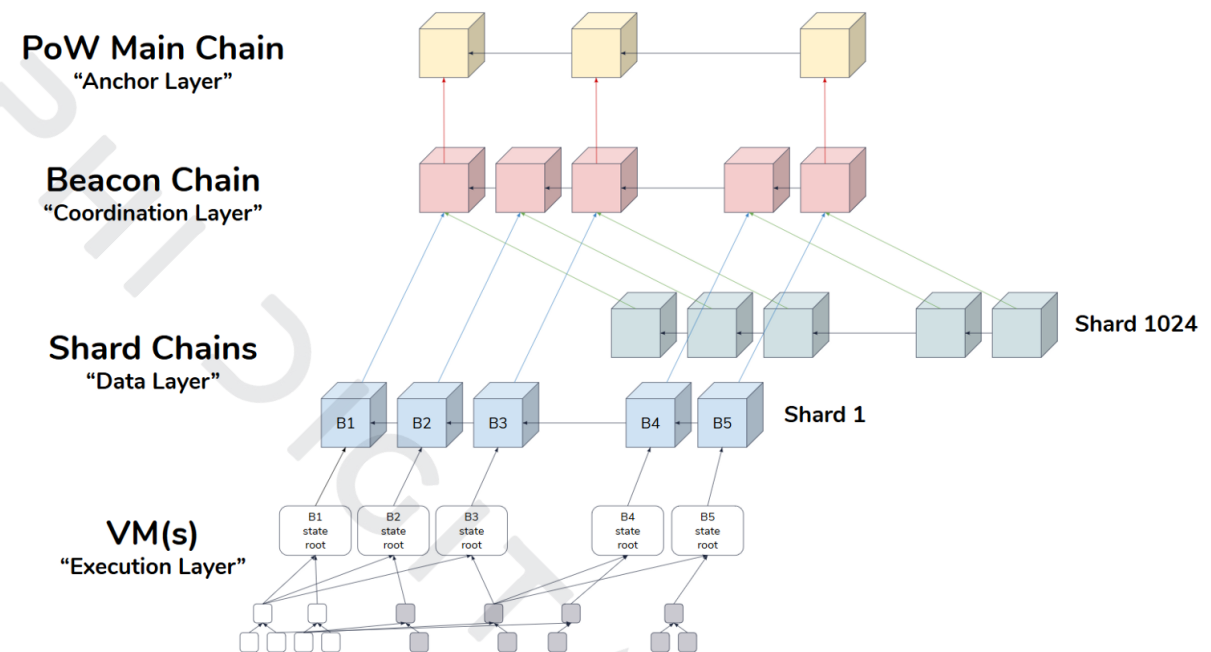
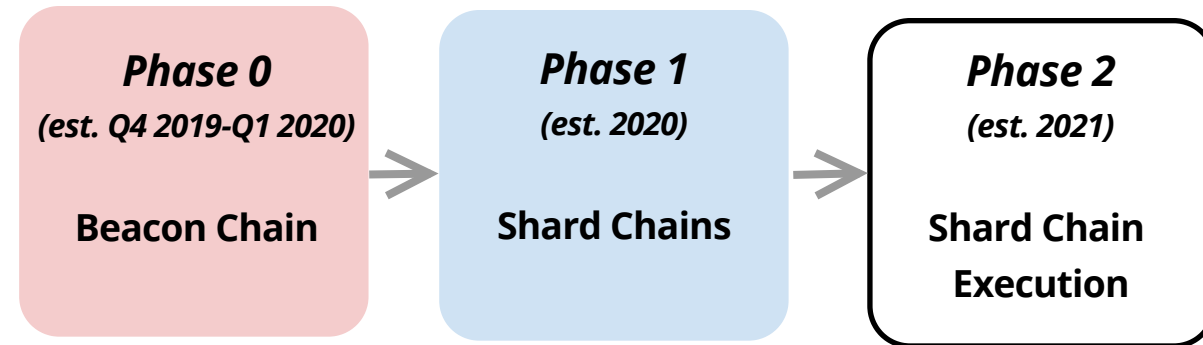
The Transition to Serenity

At the start of Serenity, Phase 0, a new PoS blockchain known as the Beacon Chain will launch. This will be linked to the existing PoW chain and run in parallel. The Beacon Chain plays an important role at the base of the sharding system where it coordinates activity across the network. Its responsibilities include managing validators and their stakes, nominating the block proposer for each shard, organizing validators into committees, applying consensus rules, applying rewards/penalties, and being an anchor point where shards register their states.

To officially launch Phase 0, a minimum of [524,288 ETH](#) need to be staked on the new chain. Users can migrate over by depositing ETH into a contract on the old PoW chain. Afterwards, they will be credited the same amount of ETH (a.k.a BETH) on the new Beacon Chain. The minimum deposit is [1 ETH](#), however, a user will need to deposit at least 32 ETH in order to start acting as a validator.

It's important to note that the deposit process is currently a one-way transaction. This means that once ETH has been deposited, and a user credited with the equivalent amount of ETH on the Beacon Chain, they will [not be able to withdraw](#) their funds back to the old chain, or send to an exchange until Phase 2. This essentially means that participating as an early validator locks up your funds for ~2 years, which could be risky. However, as we touched on earlier in the Long Term Economics section, the less ETH that is staked the higher the base yield becomes for the participating validators. While this could lead to an attractive base yield for some participants, it is effectively capped at ~11% (based on the current spec & assuming no fees) when taking into account the minimum 524,288 ETH that need to be staked for launch. In addition, the ETH earned for staking on the new chain will also not be transferable until Phase 2, which could lead to an interesting dynamic. There is [some discussion](#) around changing the one way deposit structure.

In Phase 1, shard data chains will launch. Based on the current spec there will be [1,024](#) shards. Once Phase 2 occurs, the state of the old PoW chain will be transferred into a shard on the new chain. While the current timeline projects this transition will be completed by 2021, Ethereum has pushed back deadlines in the past. Over the next few years it will be important to track the development progress made and how much of the current spec has changed.



Anatomy of Ethereum 2.0. Diagram by [Hsiao-Wei Wang](#)

Ethereum's Vision



Web 3.0: The Decentralized Internet

To understand Ethereum it's important to understand the problems that currently exist with centralized applications built on the internet. Before we begin it's necessary to note that many of following points are not unique only to Ethereum, but competing protocols as well.

"Web 2.0", or the internet as it exists today, allows users to interact with the web and easily send data around the world. However, it lacks a shared "state" (recorded data layer) tied to user identity. In absence of this shared state, centralized service providers (e.g. Google, Facebook) have accumulated user data and accrued all of the resulting value. This centralization of data has led to negative consequences for users evidenced by various hacks and inappropriate sharing (e.g. Cambridge Analytica). At the core of the internet's next perceived iteration, often referred to as "Web 3.0", is the goal of empowering its users by allowing them to control their data, protect their privacy, and ultimately ensure their freedoms through an open, uncensorable network.

A public blockchain is nothing more than an encrypted database shared across thousands of independent computers rather than held on the server of a single entity. While there is a trade off for efficiency, this decentralization makes it harder to attack and helps ensure no single party has control. As a result, a blockchain, or similar technology, could act as the backbone of a new internet by providing it a trustless shared state. This new web would not only facilitate the transfer of information, but also the transfer of value. The difference is nuanced but its impact is important by eliminating the need for trusted third-parties and rent-seekers. Ethereum is more than just a shared database though. What makes it interesting is what can be built on top of it.



Gavin Wood
April 2014

"Web 3.0, or as might be termed the "post-Snowden" web, is a reimagination of the sorts of things that we already use the Web for, but with a fundamentally different model for the interactions between parties. Information that we assume to be public, we publish. Information that we assume to be agreed, we place on a consensus-ledger. Information that we assume to be private, we keep secret and never reveal. Communication always takes place over encrypted channels and only with pseudonymous identities as endpoints; never with anything traceable (such as IP addresses). In short, we engineer the system to mathematically enforce our prior assumptions, since no government or organisation can reasonably be trusted."



Brian Armstrong
August 2018

"Web 1.0 was about publishing - anyone can write and have global distribution"

Web 2.0 was about interaction - connect with others, collaborate in real time, data

Web 3.0 is about value transfer - money can now be programmed and embedded in any app"

The World Computer

Bitcoin was the first to succeed in establishing a self-sustaining, shared database capable of securely transferring value, but its use case was largely limited to just that (this was done on purpose). This lack of functionality is ultimately what drove the creation of Ethereum, which was intended to be a programmable blockchain with a turing complete virtual machine, the "EVM", capable of running smart contracts and decentralized applications ("DApps"). It's important to highlight that Ethereum's virtual machine will be changed to eWASM in the next 1-2 years (see "Roadmap & Scaling Solutions").

Integrating a native, turing complete virtual machine into the protocol made it possible for applications to run directly on Ethereum, while automatically updating the shared state of the database. While the EVM is not without its faults, this was a game changer and led to an explosion in the development of applications built on top of Ethereum, servicing a variety of different use cases. While no single DApp or use case has gained true widespread adoption yet, with the noted exception of Ethereum as a fundraising platform, we expect this to change as scalability improves and the necessary infrastructure is developed.



"Ethereum offers a highly generalized platform that allows users to make applications for a very wide variety of use cases with much less effort than it would take to create their own blockchain. The platform's vision is that of "the world computer": to create a system which looks and feels to users as much as possible like a computer, while gaining the security, auditability and decentralization benefits of blockchain technology."



-Vitalik Buterin

Tokenized Assets

Ethereum also enables different types of assets, both fungible and non-fungible, to be issued on top of the protocol. These assets are then represented by a token, with Ethereum acting as a peer-to-peer settlement layer for their transfer. This can be done for traditional assets such as equity and debt, in addition to new types of assets that previously did not, or could not exist. Tokenizing assets has the potential to offer improved transparency, liquidity, and market efficiencies. This opens the door for new ways to unlock value. It can also help ensure the law is followed by directly programming in regulatory constraints.

While we can certainly envision a future where all securities are tokenized on top of a protocol, we're hesitant to presume this shift occurs in the near term given the early stage of the technology, and expected difficulty transitioning the legacy financial system. It also remains to be seen whether or not most of these assets will exist on a public blockchain, such as Ethereum, or private networks. However, we are excited and optimistic about the potential new types of tokenized, digital assets can offer.

Traditional Assets



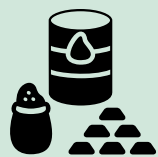
Equity



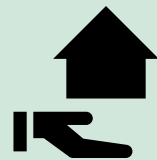
Debt



Collectibles



Commodities

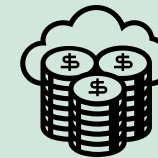


Real Estate

New Assets



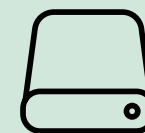
Compute Power



Digital Currencies



TBD



Data Storage



In-game Items

Key Risks & Mitigants



Technical Risks

There are a variety of technical risks affecting Ethereum in the near term, and as it transitions to Serenity. We highlight some of the key risks below, however, this list is not exhaustive.

Infura Centralization

Infura, a ConsenSys spoke, is both an important tool and centralization concern for the Ethereum network. It is Infrastructure-as-a-Service (IaaS) and allows decentralized applications (DApps) to process information on Ethereum without the developers needing to run a full node. It processes more than 10 billion requests per day and serves over 50k developers/DApps. Infura provides an easy way for developers to build on Ethereum without the need to maintain the necessary infrastructure themselves. However, the concern is that Infura is owned and operated by a single company, ConsenSys, while being hosted on AWS. Since many popular Ethereum services/DApps rely on Infura (e.g. MetaMask), it creates a single point of failure for the network. Infura services a disproportionate amount of the network's traffic and accounts for 5%-10% of all nodes. Michael Wuehler, Infura Co-Founder, recently said in an interview "If every single DApp in the world is pointed to Infura, and we decided to turn that off, then we could, and the DApps would stop working. That's the concern and that's a valid concern".

Size of the Blockchain

Ethereum's blockchain continues to grow with the current size of a GETH full node at 188 GB and an archival node at 2.12 TB. For perspective, Bitcoin has existed nearly twice as long as Ethereum and the full size of its blockchain is ~200 GB. This is a problem because the larger the blockchain grows the more difficult it becomes to independently run a node, which hurts decentralization. The developers are aware of this and have a few different approaches to help mitigate this. For Ethereum 1.x, state rent and storage pruning have been proposed. State rent may be contentious to implement but it essentially charges users a fee to store and maintain data on the blockchain. In Ethereum 2.0, sharding the blockchain will help address this further by partitioning network storage.

Cross-Shard Communication

Sharding Ethereum's blockchain (layer-1) is a core component of future scaling plans, but is currently limited by the ability for different shards to communicate with each other. For example, two smart contracts running on different shards (up to 1,024 shards in the current spec) could process functions in parallel, however, having them talk to one another is currently difficult. The Ethereum community has six proposed solutions to improve cross-shard communication, but all are either inefficient from a time, cost, or implementation perspective. Solving this issue is critical for the long-term success of Ethereum.

Code Vulnerabilities

With the drawbacks of Solidity as a programming language, and the added complexity that comes with being Turing-complete, Ethereum has experienced its fair share of code vulnerabilities in the past. This is evident in events that include the DAO hack, parity bug, and most recently the delayed Constantinople upgrade.

Long-Term Value Concerns

ETH, and other cryptocurrencies, represent an entirely new and unique asset class. As a result, determining how these assets can and should accrue value is often theoretical. While there are a few valuation methodologies that can be applied, such as a modified equation of exchange, the assumptions necessary to determine the model's inputs are difficult to estimate and highly speculative. Below we have highlighted a few key concerns that could impact the long-term value of ETH. In the following slides we will explore these topics further.

Key Value Concerns

Competition

- Ethereum faces competition from (1) other public blockchains that are currently live, (2) "next generation" protocols launching in the near term, (3) forked versions of Ethereum, (4) centralized cloud solutions and (5) private blockchains.
- While Ethereum has been able to establish strong network effects relative to other blockchains, will they be enough to maintain their lead? Do new protocols benefit from second-mover advantage, especially considering that Ethereum's scaling solutions will not be fully implemented until at least 2021?

Store of Value Critique

- It's been theorized that in the future, most, if not all, value will accrue to whichever cryptocurrency can become the dominant store of value ("SoV").
- With this in mind, does Ethereum have the necessary characteristics to be a good store of value, and how does it compare to Bitcoin?

Effects of High Velocity

- When using the equation of exchange ($MV=PQ$) to value ETH, a high level of velocity results in a lower price.
- Could Ethereum's success as a network, coupled with the failure of ETH to be considered a SoV, drive velocity to a very high level?

Proof of Stake Security

- With PoS, the security of the network is tied to the value of ETH. Could this lead to a negative feedback loop where a falling price weakens security to a point that it scares away users and developers, only to further help exacerbate the price decline?

Competitive Landscape

Ethereum has been able to establish strong network effects since its launch, that derive from its large community of developers, users, and available infrastructure/tools. In addition, it has succeeded in becoming the psychological standard in terms of brand when people think of smart contract functionality on a blockchain. It has clearly benefited from its first-mover advantage, however, in certain situations, particularly with the development of new technology, those with a second-mover advantage can emerge as the long-term winner. One study determined that first movers were more successful than late movers in just 15 out of 50 product categories (1). This is usually credited to the fact that being the first to innovate consumes a lot of resources while going through the process of trial and error figuring out what works. If Ethereum could re-launch today, it would clearly look much different than its initial design, and in a sense that's exactly what Serenity is trying to accomplish. Ethereum's competitors, particularly the protocols yet to launch, have been able to learn from Ethereum's mistakes and design their technology to avoid the same pitfalls.

Ethereum may have won the short-term race to network effects, but it now has to win the race to scale. While some competitors can already boast better scalability, this is usually at the expense of decentralization and the benefits that come with it. While we recognize the trade off is not so black and white, our team is generally skeptical of this approach. We first and foremost prioritize security, sustainability, and censorship resistance. If efficiency and speed are most important AWS is a good alternative. Our primary concern is that Ethereum's layer 1 scaling plans under Serenity will not be fully implemented until 2021 at the earliest. That is a long time for the platform to be in a state of flux. With the knowledge that significant changes are on the horizon, combined with the fact that the network still does not scale, will developers choose to build on another platform to avoid the headache? That will all depend on how many viable competitors emerge as a direct challenger to Ethereum, how manageable its current mainnet remains leading up to Serenity (see Roadmap & Scaling Solutions), and how long it takes to scale. Below we provide examples of various competitors to Ethereum, however, this list is not exhaustive, and just because a competitor is shown does not infer that our team has a positive outlook on it.

Existing Competition

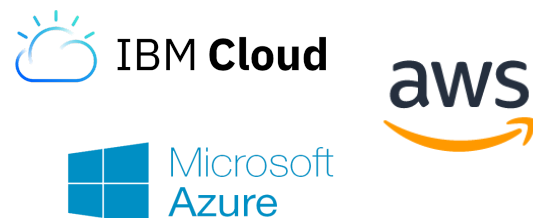
Public Protocols



Ethereum Forks



Centralized Cloud

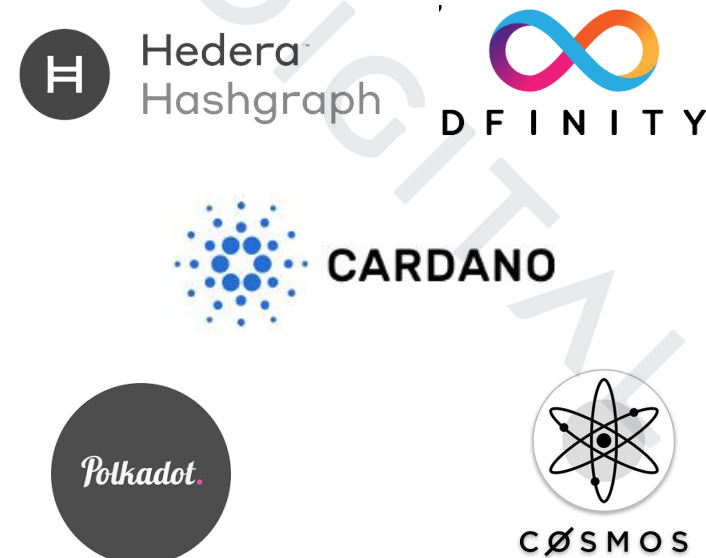


Private Blockchains



Future Competition

Protocols



Layer 2+

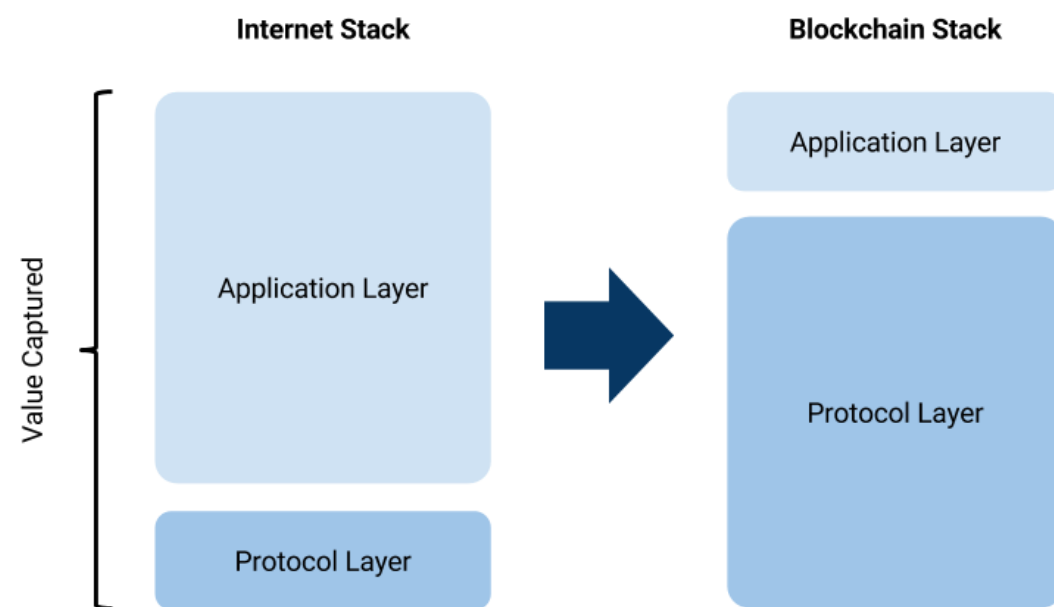


"Fat Protocol" Thesis

Before we move on we first need to address the "Fat Protocol" Thesis. It was first explained by [Joel Monegro](#) from Union Square Ventures in 2016. He stated the following:

"The previous generation of shared protocols (TCP/IP, HTTP, SMTP, etc.) produced immeasurable amounts of value, but most of it got captured and re-aggregated on top at the applications layer, largely in the form of data (think Google, Facebook and so on). The Internet stack, in terms of how value is distributed, is composed of "thin" protocols and "fat" applications. This relationship between protocols and applications is reversed in the blockchain application stack. Value concentrates at the shared protocol layer and only a fraction of that value is distributed along at the applications layer. There are two things about most blockchain-based protocols that cause this to happen: the first is the shared data layer, and the second is the introduction cryptographic "access" token with some speculative value."

- Joel Monegro, USV, 2016



Source: Teemu Paivinen

This idea has its merits, is often cited, and has helped to shape where [prominent hedge funds](#) have looked to deploy capital. As [Jose Macedo](#) pointed out:

"The appeal of the thesis is easy to see: had TCP/IP been investable, it would undoubtedly have been one of the all-time great investments. Moreover, while investing in applications carries with it the 95% startup failure rate, investing in a protocol token theoretically allows one to diversify across all applications built on that protocol since protocols capture the value of everything built on top of them."

If this thesis holds true over the long-term, Ethereum would probably have much to gain, however, it is not without its criticisms. In the next slide we highlight prominent opinions in contrast to the Fat Protocol Thesis.

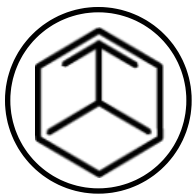
Value Accrual Critiques

Highlighted below are a few key arguments from [John Pfeffer](#) and [Tetras Capital](#). Their respective pieces on the value of cryptoassets, and ETH are excellent reads we highly recommend. Their analysis raises interesting points regarding economic abstraction, value accrual, and the potential need for a protocol token to be seen as a SoV. It's important to note that most of these critiques would hold true for other protocols as well, not just Ethereum.



John Pfeffer
April 2018

"Protocol-land will be frictionless, interoperable, forkable and open-source, so users won't need to tie up capital in stocks of utility protocols, which will push their velocity to very high levels (staking under proof of stake ("PoS") doesn't fix this as very high velocity of non-staked tokens still results in very high average overall velocity). High velocity will mean that the network value of a cryptoasset will be low compared to the economic activity denominated in that cryptoasset. This circumstance means that it will not be possible to secure the blockchain in question without reliance on transaction and/or other kinds of usage fees paid in non-native currencies (could be fiat or a dominant non-sovereign monetary SoV cryptoasset). At that point, there's no reason to have a native currency for that protocol anymore, the native currency collapses and the protocol switches to a transaction/usage fee-only model paid in a non-native currency. In that world, you end up with a multitude of miners / forgers / etc. providing compute services to maintain a multitude of protocols in exchange for transaction/usage fees paid in fiat and/or a dominant non-sovereign monetary SoV cryptoasset. Note that this applies to proof of work as well as PoS consensus algorithms (staking could be in a non-native currency)."



Tetras Capital
May 2018

"The market has argued that there are two different paths towards getting users to do so and towards SoV viability:

- 1. Optimizing first for the necessary and ideal conditions of a SoV (i.e. digital gold), later building more expressive features on top ("bottom-up") or*
- 2. Optimizing first for feature-richness, then implementing and/or enhancing SoV properties down the road ("top-down, utility thesis")*

We believe that the first, "bottom-up" or direct approach is substantially more likely to win and hold the SoV market, and Ethereum is approaching the battle backwards. The "bottom-up" approach Bitcoin is taking is often misinterpreted as being overly conservative or "utility-adverse". This however strawmans the approach and fails to understand the nuance of value accrual. An SoV asset does need a degree of utility such that it has liquidity (or at least future liquidity), but an asset that has no demand for holding will not have any sustainable utility demand. Bitcoin as a "digital gold" does not preclude utility. The Bitcoin ethos is predicated on the notion that people will hold their wealth in the most objectively secure, decentralized, immutable, scarce, and in-demand asset – a combination of characteristics that have never existed for physical assets. From the start, Bitcoin optimized for SoV viability.

It is very likely that all crypto-asset SoV demand will concentrate into a single crypto-asset. In our opinion this will likely be Bitcoin or a digital asset (future or existing) that is very similar to Bitcoin – prioritizing SoV properties from the onset. There are strong positive feedback loops between liquidity, acceptance, and value. SoV convergence will be accelerated for crypto-assets because of the role the asset value plays in securing the network. As the value of a crypto-asset falls, its network becomes increasingly vulnerable to attacks or failures. As the market reacts, savvy investors will recognize the emerging winner and switch to it not only because of its relative, increasing social scalability, liquidity and value but also because the more valuable network will provide stronger security guarantees. This feeds back into the falling assets' demise."

ETH as a Store of Value

John Pfeffer and Tetras Capital believe that value will ultimately accrue to the sole, dominant SoV cryptocurrency. Before we discuss the merits of whether all, or most, value will accrue to the dominant SoV, let's begin by analyzing if Ethereum has the necessary characteristics to be seen as a viable SoV. The analysis below is focused on ETH's issuance policy relative to Bitcoin, which is largely perceived as the strongest SoV cryptocurrency. Our team has written extensively about Bitcoin [here](#). It's important to note that there are many other factors that can affect ETH's SoV viability including the length of its track record, security, and immutability. To summarize those points, Bitcoin is older, more secure and lacks the same immutability questions that Ethereum has as a result of events such as the DAO Hack. ,

Issuance Policy



- Bitcoin has a finite maximum supply of 21 million BTC, of which ~17.5 million has already been issued. However, in the future the actual floating supply will probably be much lower than 21 million given the amount of BTC lost in the early days, which is estimated to range from 2-3 million.
- Its monetary policy is pre-determined and has not been subject to change. It is dis-inflationary with the block reward halving roughly every 4 years.
- Its current annualized issuance rate is ~3.8%, which will gradually trend towards 0 until the year 2140. The next major inflation event should occur in May 2020 and will bring the rate down to ~1.8%.
- While Bitcoin exhibits a strong monetary policy there is some concern about network sustainability once inflation goes away. If a fee market does not develop by that point there will be decreased economic incentive to run the network as a miner. It's possible that this could lead to a change in issuance policy, however, this change would be highly unpalatable strongly opposed. We do not view this as likely.



- Ethereum has no maximum supply, and ~105 million have already been created.
- It does not have a pre-determined monetary policy, with ETH issuance set to change in the Constantinople Hard Fork and future implementation of Serenity.
- Its annualized issuance rate after Constantinople is 4.8%. The current spec for Serenity has the issuance rate dropping to 0.22% by ~2021, assuming 10 million ETH are staked. It's reasonable to assume that this sharp decrease in inflation is at least partially driven by a desire to improve ETH as a SoV.
- Assuming ETH's issuance stays around this level, it will have a lower inflation rate than Bitcoin until ~2032 when BTC's issuance rate drops to 0.20%. As we discussed in the Long-Term Economics section, we believe it makes more sense for Ethereum to raise its issuance rate in the early years of Serenity until a substantial fee network develops. Having a perpetually low issuance rate makes sense for Ethereum as the block rewards will help sustain the network in the absence of a fee market. However, that is not to say it's an advantage over Bitcoin, which is focused on being sound money and views its finite supply as critical. The main problem many BTC supporters have with Ethereum is not that the inflation is currently too high, but that its issuance policy is subject to change in the first place.

Effects of Rising Velocity

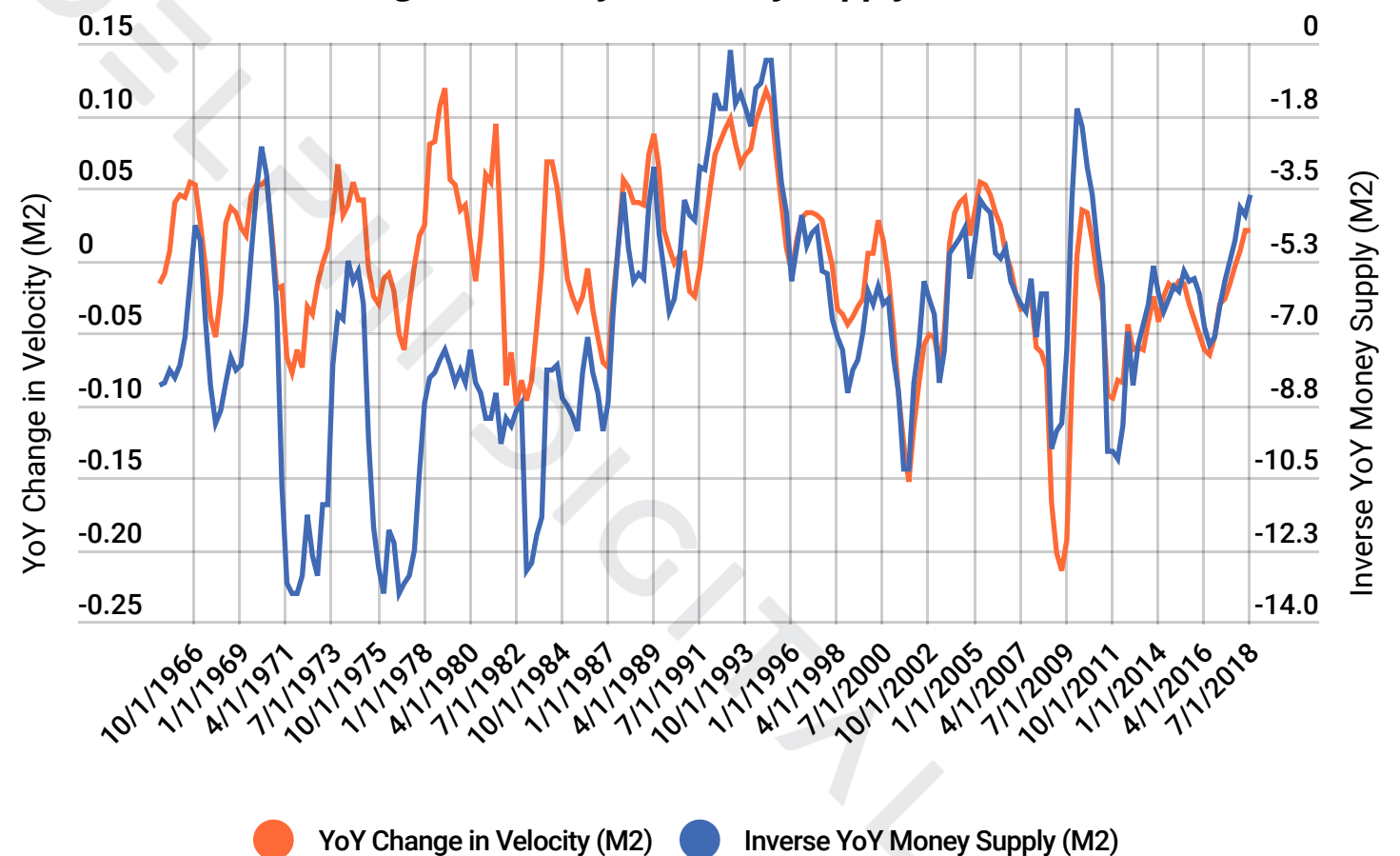
An exponential rise in the velocity of ETH is also a commonly cited criticism of its long-term value proposition. Assuming the scaling solutions being developed for Ethereum are successful, the velocity of ETH is highly likely to rise all else held equal. In the traditional equation of exchange ($MV=PQ$), a rise in velocity can put downward pressure on price as ETH changes hands more frequently. While velocity is certainly an important factor to be aware of, it is often calculated as an output from the equation of exchange ($MV=PQ$) rather than an input. The Federal Reserve Bank of St. Louis, for example, calculates money velocity as the ratio of nominal GDP to a measure of the money supply. The exhibit below shows the inverse relationship between the change in velocity and the change in money supply (M2).

Over time, velocity of money can fall if the M1 money stock expands faster than the rate of economic growth. But velocity also depends on the demand for money, which is driven by the opportunity cost of holding money. When interest rates are high, velocity tends to rise as the demand for holding money declines, and vice versa.

However, a rise in ETH velocity is a double-edged sword. The more ETH changes hands, the more transaction fees are generated for validators. Transaction fees on top of consistent block rewards will encourage more people to run validators, assuming some degree of market efficiency, with competition eating away higher profit margins for existing validators. This may boost the demand for ETH as prospective validators acquire positions large enough to meet the staking requirements.

The more ETH that gets staked, the higher the issuance rate though, so price fluctuations may depend on how fast the demand grows relative to the supply increase.

Change in Velocity vs. Money Supply (M2; USD)



Effects of Rising Velocity

Even if a small minority of ETH ends up being staked by validators, the network could still boast a higher value if the amount of on-chain transaction value continues to grow at a rapid clip. However, before we can calculate a range of possible values, we first need to lay out a few assumptions.

Using the average daily on-chain transaction value so far in 2019 (\$320MM) we can project the possible future on-chain volume ten years from now. Assuming a 30% compound annual growth rate (CAGR) the value of on-chain transactions would grow to \$1.6 trillion annually a decade from now. For simplicity sake, we assume the supply of ETH grows at 3% per year and 10 million of it is locked up for staking purposes. Under these conditions, the implied network value of Ethereum would be roughly \$8 billion if its velocity increased 25x compared to its current level. This hypothetical velocity for ETH would be roughly 35x greater than the velocity of M1 money stock and over 100x greater than the velocity of M2 money stock in the U.S. today.

| Key Assumptions | |
|---------------------------------------|---------------------|
| Current Velocity (2019 Avg) | 7.96 |
| Velocity 25x | 199.10 |
| ETH Issuance Rate CAGR (10yr) | 3% |
| ETH Total Supply in 10yr | 141,122,763 |
| ETH Locked Up (Staking, etc.) | 10,000,000 |
| Annual On-Chain Txn CAGR (10yr) | 30% |
| Daily USD Txn Value (2019 Avg) | \$318,517,670 |
| Annual USD Txn Value (2019 Daily Avg) | \$116,258,949,426 |
| Annual USD Txn Value in 10yr | \$1,602,728,343,188 |
| Implied Network Value | \$8,049,995,232 |
| Implied ETH Price | \$61.39 |

| Implied ETH Price (USD) | | | | | | | | | | | | | |
|----------------------------|---------------------|----------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| | | Total Number of ETH Staked | | | | | | | | | | | |
| Txn Value in 10yr (MM USD) | Txn Value 10yr CAGR | 5,000,000 | 10,000,000 | 15,000,000 | 20,000,000 | 25,000,000 | 30,000,000 | 35,000,000 | 40,000,000 | 45,000,000 | 50,000,000 | 55,000,000 | 60,000,000 |
| \$116,259 | 0% | \$ 4.29 | \$ 4.45 | \$ 4.63 | \$ 4.82 | \$ 5.03 | \$ 5.25 | \$ 5.50 | \$ 5.77 | \$ 6.07 | \$ 6.41 | \$ 6.78 | \$ 7.20 |
| \$189,374 | 5% | \$ 6.99 | \$ 7.25 | \$ 7.54 | \$ 7.85 | \$ 8.19 | \$ 8.56 | \$ 8.96 | \$ 9.41 | \$ 9.90 | \$ 10.44 | \$ 11.04 | \$ 11.72 |
| \$301,546 | 10% | \$ 11.13 | \$ 11.55 | \$ 12.01 | \$ 12.50 | \$ 13.04 | \$ 13.63 | \$ 14.27 | \$ 14.98 | \$ 15.76 | \$ 16.62 | \$ 17.59 | \$ 18.67 |
| \$470,332 | 15% | \$ 17.35 | \$ 18.02 | \$ 18.73 | \$ 19.50 | \$ 20.34 | \$ 21.26 | \$ 22.26 | \$ 23.36 | \$ 24.58 | \$ 25.92 | \$ 27.43 | \$ 29.12 |
| \$719,845 | 20% | \$ 26.56 | \$ 27.57 | \$ 28.67 | \$ 29.85 | \$ 31.14 | \$ 32.54 | \$ 34.07 | \$ 35.75 | \$ 37.61 | \$ 39.68 | \$ 41.98 | \$ 44.57 |
| \$1,082,746 | 25% | \$ 39.95 | \$ 41.47 | \$ 43.12 | \$ 44.90 | \$ 46.83 | \$ 48.94 | \$ 51.25 | \$ 53.78 | \$ 56.58 | \$ 59.68 | \$ 63.15 | \$ 67.04 |
| \$1,602,728 | 30% | \$ 59.14 | \$ 61.39 | \$ 63.83 | \$ 66.46 | \$ 69.32 | \$ 72.44 | \$ 75.86 | \$ 79.61 | \$ 83.75 | \$ 88.34 | \$ 93.47 | \$ 99.23 |
| \$2,337,567 | 35% | \$ 86.25 | \$ 89.54 | \$ 93.09 | \$ 96.93 | \$ 101.11 | \$ 105.66 | \$ 110.63 | \$ 116.10 | \$ 122.14 | \$ 128.85 | \$ 136.33 | \$ 144.73 |
| \$3,362,844 | 40% | \$ 124.08 | \$ 128.81 | \$ 133.92 | \$ 139.45 | \$ 145.45 | \$ 152.00 | \$ 159.16 | \$ 167.03 | \$ 175.72 | \$ 185.36 | \$ 196.12 | \$ 208.21 |
| \$4,776,463 | 45% | \$ 176.24 | \$ 182.96 | \$ 190.22 | \$ 198.07 | \$ 206.60 | \$ 215.89 | \$ 226.07 | \$ 237.24 | \$ 249.58 | \$ 263.28 | \$ 278.56 | \$ 295.73 |
| \$6,704,077 | 50% | \$ 247.37 | \$ 256.80 | \$ 266.98 | \$ 278.00 | \$ 289.97 | \$ 303.02 | \$ 317.30 | \$ 332.99 | \$ 350.31 | \$ 369.53 | \$ 390.98 | \$ 415.08 |
| \$9,305,578 | 55% | \$ 343.36 | \$ 356.45 | \$ 370.58 | \$ 385.88 | \$ 402.50 | \$ 420.61 | \$ 440.42 | \$ 462.20 | \$ 486.24 | \$ 512.92 | \$ 542.70 | \$ 576.15 |
| \$12,782,807 | 60% | \$ 471.66 | \$ 489.65 | \$ 509.06 | \$ 530.07 | \$ 552.90 | \$ 577.78 | \$ 605.00 | \$ 634.91 | \$ 667.94 | \$ 704.59 | \$ 745.49 | \$ 791.44 |
| \$17,388,649 | 65% | \$ 641.61 | \$ 666.08 | \$ 692.48 | \$ 721.07 | \$ 752.11 | \$ 785.96 | \$ 822.99 | \$ 863.68 | \$ 908.61 | \$ 958.46 | \$ 1,014.11 | \$ 1,076.61 |
| \$23,437,733 | 70% | \$ 864.81 | \$ 897.79 | \$ 933.38 | \$ 971.91 | \$ 1,013.76 | \$ 1,059.37 | \$ 1,109.28 | \$ 1,164.13 | \$ 1,224.69 | \$ 1,291.89 | \$ 1,366.89 | \$ 1,451.14 |
| | ETH in Circulation | 136,122,763 | 131,122,763 | 126,122,763 | 121,122,763 | 116,122,763 | 111,122,763 | 106,122,763 | 101,122,763 | 96,122,763 | 91,122,763 | 86,122,763 | 81,122,763 |

Data as of March 4th, 2019

Sources: [Coinmetrics](#), [Etherscan](#)

$$\text{Implied ETH Price} = \frac{\{(\text{Current Annualized Txn Value} * (1+g)^{10}) / \text{Velocity}\}}{\text{ETH Circulating Supply}}$$

Effects of Rising Velocity

Let's take a look at another scenario using the same assumptions but a 50x multiplier on current ETH velocity. Under these conditions, the implied network value of Ethereum would be \$4 billion, resulting in price of \$31 per ETH if the 10 million ETH staked are removed from the total circulating supply. Using the fully diluted ETH supply (~140 million assuming 3% growth rate per year) the implied price falls to \$28.

There are certainly a few caveats to these assumptions. We expect the velocity of ETH not being staked or locked up in other applications (DeFi dapps, etc.) to be high as network usage grows because of a low, stable issuance rate. However, we do not believe transacting on Ethereum will be frictionless and all money will be held in BTC as the sole store of value. Even if fees are negligible there is likely still going to be some effort required in the process. The convenience of holding some ETH for immediate use in an application built on Ethereum can also suppress velocity, especially if the volatility of ETH continues to fall over time. While we recognize the comparison is not entirely apples-to-apples, people hold local currencies instead of U.S. dollars because local economies are priced in local currency terms. There are substantially higher friction costs trying to convert from Mexican Pesos to USD than we anticipate to switch between cryptocurrencies, but assuming every individual will immediately transfer ETH to BTC as soon as they receive it, is a bit naive in our view.

| Implied ETH Price (USD) | | | | | | | | | | | | | |
|-----------------------------------|----------------------------|-----------------------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|-------------------|-------------------|-------------------|-------------------|
| | | Total Number of ETH Staked | | | | | | | | | | | |
| Txn Value in 10yr (MM USD) | Txn Value 10yr CAGR | 5,000,000 | 10,000,000 | 15,000,000 | 20,000,000 | 25,000,000 | 30,000,000 | 35,000,000 | 40,000,000 | 45,000,000 | 50,000,000 | 55,000,000 | 60,000,000 |
| \$116,259 | 0% | \$ 2.14 | \$ 2.23 | \$ 2.31 | \$ 2.41 | \$ 2.51 | \$ 2.63 | \$ 2.75 | \$ 2.89 | \$ 3.04 | \$ 3.20 | \$ 3.39 | \$ 3.60 |
| \$189,374 | 5% | \$ 3.49 | \$ 3.63 | \$ 3.77 | \$ 3.93 | \$ 4.10 | \$ 4.28 | \$ 4.48 | \$ 4.70 | \$ 4.95 | \$ 5.22 | \$ 5.52 | \$ 5.86 |
| \$301,546 | 10% | \$ 5.56 | \$ 5.78 | \$ 6.00 | \$ 6.25 | \$ 6.52 | \$ 6.81 | \$ 7.14 | \$ 7.49 | \$ 7.88 | \$ 8.31 | \$ 8.79 | \$ 9.34 |
| \$470,332 | 15% | \$ 8.68 | \$ 9.01 | \$ 9.37 | \$ 9.75 | \$ 10.17 | \$ 10.63 | \$ 11.13 | \$ 11.68 | \$ 12.29 | \$ 12.96 | \$ 13.71 | \$ 14.56 |
| \$719,845 | 20% | \$ 13.28 | \$ 13.79 | \$ 14.33 | \$ 14.93 | \$ 15.57 | \$ 16.27 | \$ 17.03 | \$ 17.88 | \$ 18.81 | \$ 19.84 | \$ 20.99 | \$ 22.28 |
| \$1,082,746 | 25% | \$ 19.98 | \$ 20.74 | \$ 21.56 | \$ 22.45 | \$ 23.42 | \$ 24.47 | \$ 25.62 | \$ 26.89 | \$ 28.29 | \$ 29.84 | \$ 31.57 | \$ 33.52 |
| \$1,602,728 | 30% | \$ 29.57 | \$ 30.70 | \$ 31.91 | \$ 33.23 | \$ 34.66 | \$ 36.22 | \$ 37.93 | \$ 39.80 | \$ 41.87 | \$ 44.17 | \$ 46.74 | \$ 49.62 |
| \$2,337,567 | 35% | \$ 43.13 | \$ 44.77 | \$ 46.55 | \$ 48.47 | \$ 50.55 | \$ 52.83 | \$ 55.32 | \$ 58.05 | \$ 61.07 | \$ 64.42 | \$ 68.16 | \$ 72.36 |
| \$3,362,844 | 40% | \$ 62.04 | \$ 64.41 | \$ 66.96 | \$ 69.72 | \$ 72.73 | \$ 76.00 | \$ 79.58 | \$ 83.51 | \$ 87.86 | \$ 92.68 | \$ 98.06 | \$ 104.10 |
| \$4,776,463 | 45% | \$ 88.12 | \$ 91.48 | \$ 95.11 | \$ 99.03 | \$ 103.30 | \$ 107.95 | \$ 113.03 | \$ 118.62 | \$ 124.79 | \$ 131.64 | \$ 139.28 | \$ 147.87 |
| \$6,704,077 | 50% | \$ 123.68 | \$ 128.40 | \$ 133.49 | \$ 139.00 | \$ 144.99 | \$ 151.51 | \$ 158.65 | \$ 166.49 | \$ 175.15 | \$ 184.76 | \$ 195.49 | \$ 207.54 |
| \$9,305,578 | 55% | \$ 171.68 | \$ 178.23 | \$ 185.29 | \$ 192.94 | \$ 201.25 | \$ 210.30 | \$ 220.21 | \$ 231.10 | \$ 243.12 | \$ 256.46 | \$ 271.35 | \$ 288.08 |
| \$12,782,807 | 60% | \$ 235.83 | \$ 244.82 | \$ 254.53 | \$ 265.04 | \$ 276.45 | \$ 288.89 | \$ 302.50 | \$ 317.46 | \$ 333.97 | \$ 352.29 | \$ 372.75 | \$ 395.72 |
| \$17,388,649 | 65% | \$ 320.80 | \$ 333.04 | \$ 346.24 | \$ 360.53 | \$ 376.06 | \$ 392.98 | \$ 411.49 | \$ 431.84 | \$ 454.30 | \$ 479.23 | \$ 507.05 | \$ 538.31 |
| \$23,437,733 | 70% | \$ 432.40 | \$ 448.89 | \$ 466.69 | \$ 485.95 | \$ 506.88 | \$ 529.69 | \$ 554.64 | \$ 582.07 | \$ 612.34 | \$ 645.94 | \$ 683.44 | \$ 725.57 |
| | ETH in Circulation | 136,122,763 | 131,122,763 | 126,122,763 | 121,122,763 | 116,122,763 | 111,122,763 | 106,122,763 | 101,122,763 | 96,122,763 | 91,122,763 | 86,122,763 | 81,122,763 |

**Assuming velocity of ETH is 50x its current level*

Data as of March 4th, 2019

Sources: [Coinmetrics](#), [Etherscan](#)

Proof of Stake Security



Ethereum's GitHub

Proof of Stake (PoS) is a category of consensus algorithms for public blockchains that depend on a validator's economic stake in the network. In proof of work (PoW) based public blockchains (e.g. Bitcoin and the current implementation of Ethereum), the algorithm rewards participants who solve cryptographic puzzles in order to validate transactions and create new blocks (i.e. mining). In PoS-based public blockchains (e.g. Ethereum's upcoming Casper implementation), a set of validators take turns proposing and voting on the next block, and the weight of each validator's vote depends on the size of its deposit (i.e. stake).

As the above description implies, with a PoS based consensus model network security is closely tied to price. While there are clear benefits to be gained by implementing PoS (as highlighted below), if the intrinsic value that accrues to the network is lower than expected it could weaken security. In a worst case scenario you could have a negative feedback loop start to develop where as the price trends lower, security falls with it, and Ethereum's use declines given the concerns over security further exacerbating a price decline. We are not arguing this is a likely scenario and it remains to be seen what value Ethereum has to trade at for this to actually become an issue.

Benefits

- Much more energy efficient than PoW mining
- No need for specialized ASIC hardware in order to participate in running the network
- Penalties for not following the protocol can be established where bad actors have their stake slashed
- Should improve network decentralization
- ETH locked up for staking should reduce velocity to a degree
- Enables ETH to be a yield producing asset if staked

Concerns

- Unproven/limited track record relative to PoW
- Network security driven by the value of ETH where a price trending lower could spark a negative feedback loop
- Risk in the transition from PoW to PoS; Ethereum needs to upgrade to an entirely new consensus algorithm
- "Unfair" economic model; allocate new funds in proportion to existing holdings
- Discouragement attacks

Competition

First-mover advantage is not necessarily a benefit, as second-movers have been able to learn from Ethereum's mistakes. However, Ethereum has been able to develop the strongest network effects to date as a Turing-complete protocol. The code is open-source, meaning that features successfully implemented on one protocol can be adopted by another. Whether this is a benefit or concern for Ethereum in that sense remains to be seen, but we do believe it is important to establish network effects quickly. A key concern is that Ethereum's scaling plans (Serenity) will not be fully implemented until at least 2021. Newer, potentially better, protocols will launch before then.

Store of Value Critique

A good SoV should have a conservative, difficult to change monetary policy while also being immutable, censorship resistant, and secure. Bitcoin's issuance rate will trend to 0 over time until 2140 given its pre-determined maximum supply of 21 million BTC, while Ethereum will likely have a small issuance rate ($\leq 1\%$) in perpetuity. Bitcoin's finite supply is critical to its perception as a SoV, however, it could lead to sustainability issues down the road if a large enough fee market does not develop. Ethereum does not have a finite supply, but its low perpetual inflation makes a lot of sense in the context of what it's trying to achieve. A primary difference between the two is that Bitcoin's monetary policy has not been subject to change, while Ethereum's is still being figured out. Over the long run, we believe that if Ethereum is able to achieve scale, mass adoption, and set a definitive monetary policy, it can become a SoV to some degree. We think it's overly aggressive to assume that only one chain succeeds at being viewed as a SoV, however, we can imagine a scenario where one chain accrues most of the value. We could see a few dominant chains in the future, with each differentiating themselves in unique ways. Not every participant will act rationally, and rational investors could allocate across different cryptocurrencies for diversification and hedging purposes. Ultimately, we agree that Bitcoin has stronger characteristics for being perceived as a SoV in the long run, however, we believe Ethereum can make some changes to better position itself as one.

High Velocity Dampening Price

While the equation of exchange ($MV=PQ$) can be used to try and value Ethereum, it is an imperfect application given its unique characteristics, particularly as a yield producing asset under Serenity. At the moment, the math for producing an Ethereum valuation under Serenity is somewhat circular and/or highly speculative, but we expect this to become clearer as the asset class matures. We do not agree that only one cryptocurrency will succeed at becoming the sole SoV, and thus accrue all of the resulting value. Since we also believe Ethereum can be perceived as a SoV in the long run, under certain conditions, this negates the point that the lack of SoV status will drive velocity to very high levels. It's far too early to try and predict ETH's future velocity, but a low level would help support price.

Proof of Stake Security

There is risk in the transition from PoW to PoS, and PoS has a shorter history to evaluate. However, we believe the change could be a net benefit for Ethereum. Since we have refuted the previous arguments why ETH can not accrue value, this is a benefit for the network's security under PoS.

Appendix



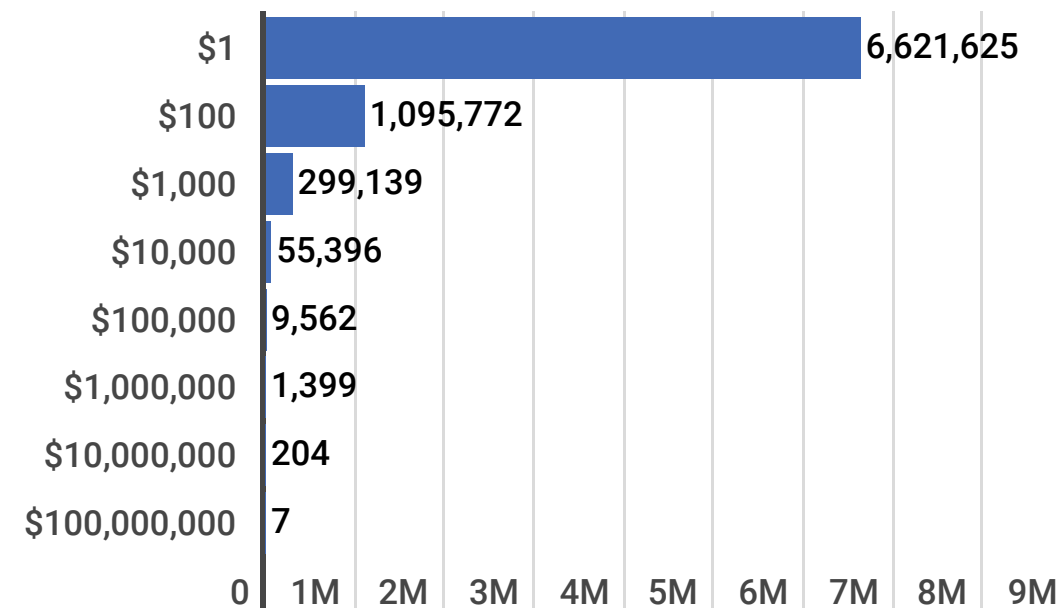
ETH Distribution

Thanks to our friends at [Glassnode](#), we were able to obtain data so we could analyze the current state of ETH Distribution. While we've attached the relevant charts on this page, a few takeaways can be seen below:

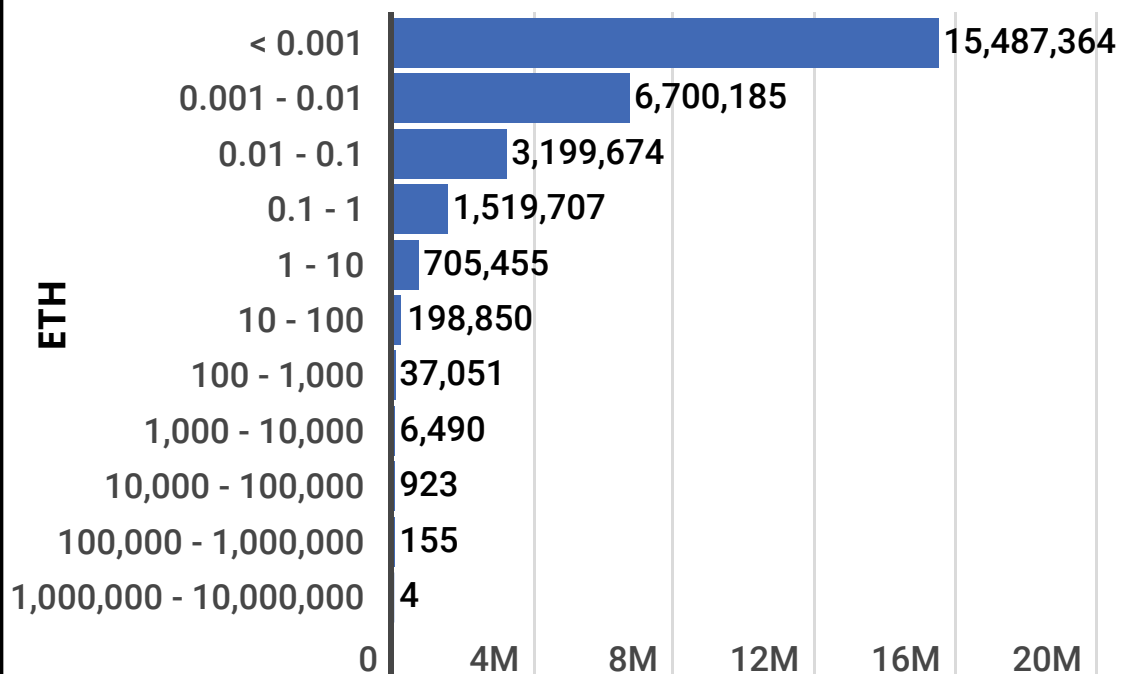
- Over 50% of addresses have less than 0.001 ETH (~\$0.13)
- Only around ~25% of addresses have over \$1
- Over 80% of the total coins are held by addresses which have a balance of over 1,000 ETH (~\$137,000 ATM)
- There are 159 addresses with over 100,000 ETH

*It's important to note that there are around ~33 million *non-zero* addresses in the network while there's actually a total of ~75 million total addresses (so ~55% have a balance of zero). Also this analysis only includes *external addresses*, which means contracts are excluded in this set.*

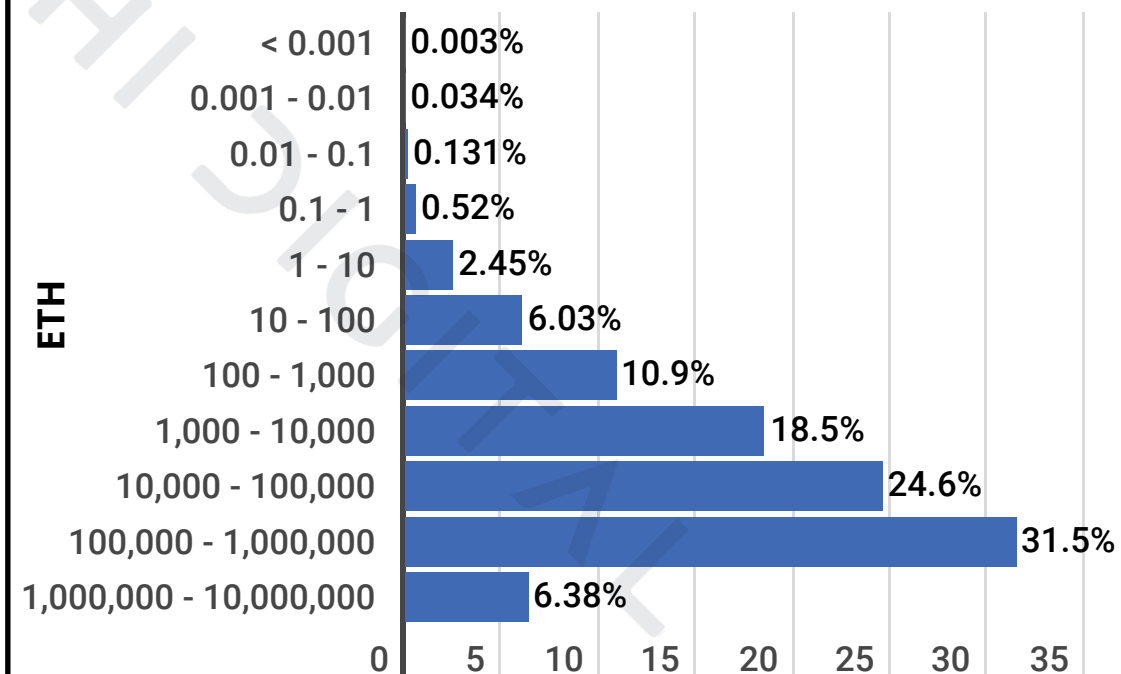
Addresses Richer Than



Balance vs Number of Addresses



Balance vs % Total Coins Held



Uncorrelated Asset

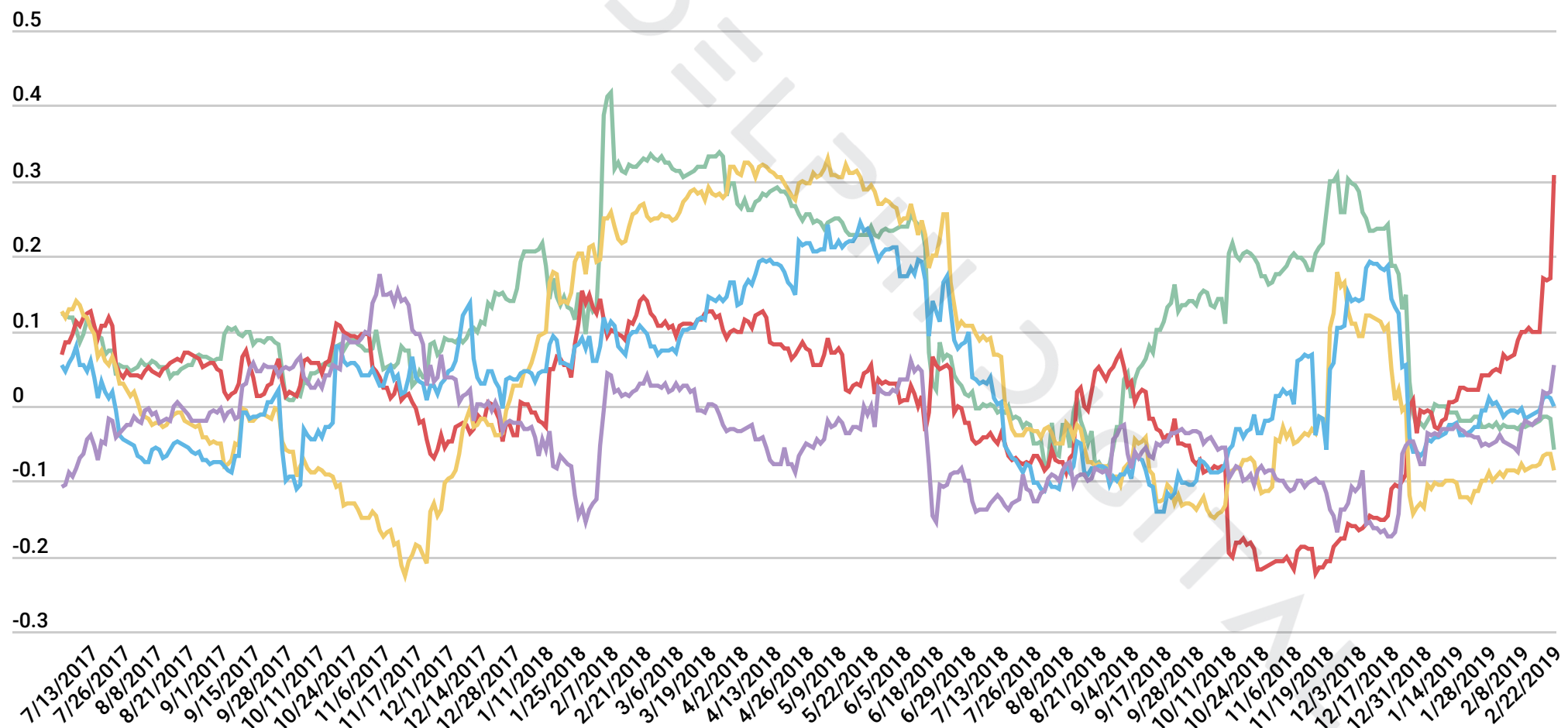
Similar to BTC, ETH is generally uncorrelated to other traditional asset classes like stocks, bonds, and commodities. This potentially makes ETH an attractive asset for portfolio diversification depending on a person or institution's risk tolerance and return objectives.

ETH Correlations with Other Asset Classes

| | SPY | GLD | Crude Oil | BCOM | TLT |
|--------------|--------|-------|-----------|-------|--------|
| 2017-Present | 0.085 | 0.052 | 0.014 | 0.037 | -0.011 |
| 2018-Present | 0.103 | 0.070 | 0.029 | 0.045 | -0.020 |
| 6 Months | 0.014 | 0.072 | -0.068 | 0.013 | 0.009 |
| 3 Months | -0.138 | 0.407 | -0.101 | 0.090 | 0.047 |

SPY is SPDR S&P 500 ETF; GLD is SPDR Gold Shares ETF; BCOM is Bloomberg Commodity Index; TLT is iShares 20+ Year Treasury Bond ETF

ETH Correlations with Other Asset Classes (90-Day)



Data as of March 4th, 2019

Sources: [Binance](#), [Bloomberg](#), [Blackrock](#), [SPDR](#)

● SPY ● GLD ● Crude ● BCOM ● TLT

Price Momentum

We recognize the power of price momentum, especially in a nascent market driven largely by sentiment. ETH jumped over 50% in just two weeks in mid-February, pushing short-term momentum indicators, specifically the 14-day relative strength index (RSI), into overbought territory for the first time since May 2018. The last time its RSI reached these levels, ETH proceeded to fall almost 30% over the following 30 days.

Overbought conditions are often viewed as a near-term warning signal price momentum is a bit overheated. However, more often than not ETH's price continues to trend higher in the immediate time period following such an occurrence. Over the last three years, ETH has a median return of 12% in the two weeks following an overbought reading, posting gains ~60% of the time.

Similar to BTC, ETH broke above its 100-day moving average in mid-February for the first time since May 2018. While many view this as a bullish indicator, we may be in for disappointing returns in the short run if history is any guide. ETH's price drawdown from its all time high has been worse than BTC's, and as a result it has failed to test its 100-day moving average as often as BTC since the start of 2018.

ETH Price vs. 14-Day RSI



ETH Price vs. Moving Averages



Ethereum's Founders



Vitalik Buterin is a Russian-Canadian writer and programmer who was heavily involved in the Bitcoin community since 2011, co-founding and writing articles for Bitcoin Magazine. After taking a trip to California in May of 2013 for a Bitcoin conference, Buterin saw first hand the community starting to develop around cryptocurrency. This led to him creating Ethereum which started with a whitepaper he drafted in late 2013. He remains one of the lead people behind the direction of the project and frequently participates in discussions revolving around Ethereum.



Anthony Diiorio is the founder of the Bitcoin Alliance of Canada and co-founder of Ethereum. Currently he is the CEO and Founder of Decentral and Jaxx.



Charles Hoskinson is a co-founder of Ethereum who went on to become the founder of Cardano, another popular public blockchain platform. He is also the CEO of IOHK.



Amir Chetrit is a co-founder of Ethereum. There is limited public information available on Amir, but we believe he focused on business and operations early on in the project's life.



Mihai Alisie is a co-founder of Ethereum and Bitcoin Magazine. Currently he is focused on building the Akasha project.

Co-Founders That Joined Later On



Dr Gavin Wood is a co-founder credited with creating the solidity contract language and writing Ethereum's yellow paper (formal specification of the protocol). He went on to found Parity Technologies which is also building Polkadot.



Joseph Lubin is a co-founder of Ethereum who went on to found ConsenSys, a Brooklyn based software production studio that has over 50 spokes building on-top of the Ethereum blockchain. Mr. Lubin's work has significantly grown out the Ethereum ecosystem.



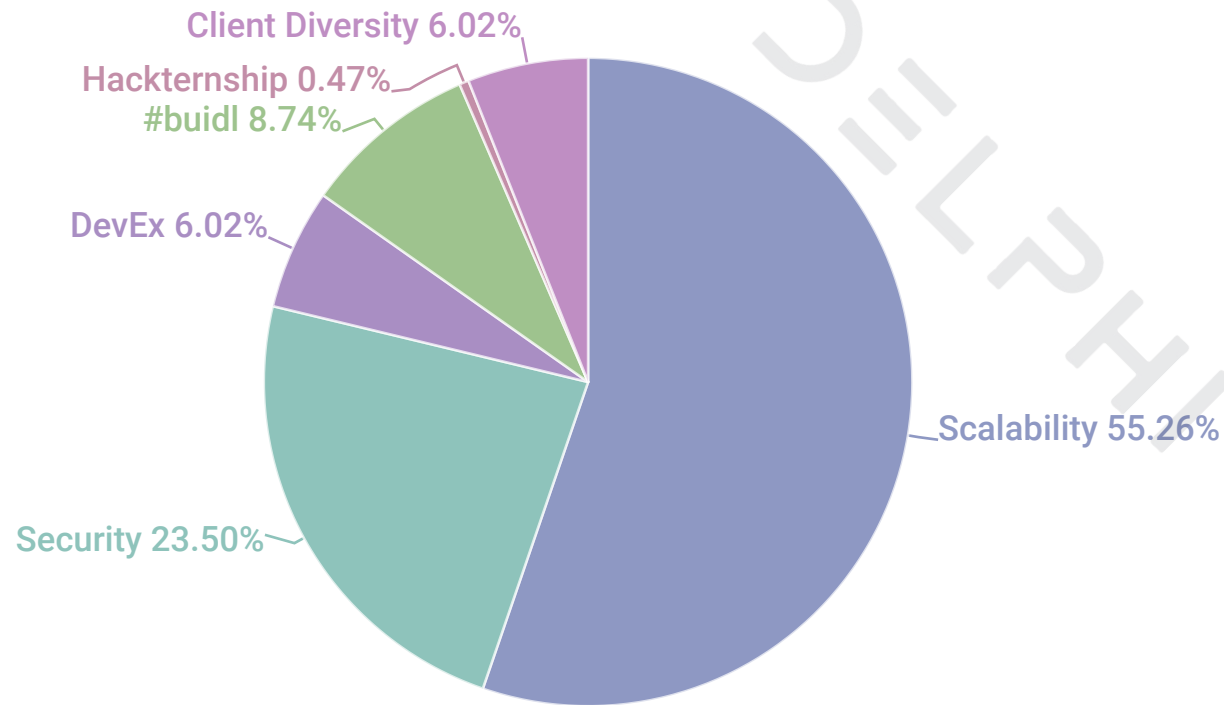
Jeffrey Wilke is a co-founder of Ethereum and is credited with running the first implementation of Ethereum using the Go programming language in 2013. He continues to be active in Ethereum's development.

The Ethereum Foundation



Vitalik Buterin decided to make Ethereum a non-profit, and the Ethereum Foundation was set up on July 14th, 2014. Based out of Switzerland, the Foundation was tasked with overseeing the development of Ethereum's open source software. Since the beginning of 2018, the Ethereum Foundation provided close to \$18 million in support to 70 projects through three waves of grants (Waves I, Waves II, and Waves III). Below, we've broken out the grant funds by category as well as displaying the top 15 grants during this time.

Grant Funds by Category



| Project | Amount Given |
|----------------------|--------------|
| Parity Technologies | \$5,000,000 |
| StarkWare | \$4,000,000 |
| L4 Research | \$1,500,000 |
| ENS Foundation | \$1,000,000 |
| Prysmatic Labs | \$500,000 |
| Runtime Verification | \$500,000 |
| Status | \$500,000 |
| Zeppelin | \$430,000 |
| N-C Payment Channel | \$420,000 |
| Kestrel Institute | \$400,000 |
| Prototypal | \$375,000 |
| FMG Framework | \$300,000 |
| DappNode | \$250,000 |
| Finality Labs | \$250,000 |
| Perun | \$250,000 |
| PISA | \$250,000 |

| | |
|--------------------------|--|
| ETH Dev's Wallet Address | 0xde0B295669a9FD93d5F28D9Ec85E40f4cb697BAe |
| USD Balance | \$89,525,781.82 |
| ETH Balance | 645,829.57 ETH |

Data as of March 6th, 2019

Sources: [EthDocs.org](#), [Ethereum Foundation](#)

The Role of ConsenSys



ConsenSys is an Ethereum production studio founded in October of 2014 by Joseph Lubin and is based out of Brooklyn, New York. They are focused on building and scaling tools and enterprise software products powered by Ethereum. While the price decline of ETH over the past year has forced the company to downsize recently, Consensus has shifted focus to a few core products which they hope will make it easier for dApps to build on Ethereum. We've highlighted a few of these below:



- **Infura** provides a way for developers to connect to Ethereum without having to run a full node. The issue is that Infura is operated solely by ConsenSys and relies on cloud servers hosted by Amazon.



- **MetaMask** is the popular browser extension that lets you run dApps without being part of the Ethereum network as an Ethereum node. MetaMask is actually powered by Infura.



- **Kaleido** aims to generate more integration of blockchain into businesses. They recently announced a platform via a collaboration with AWS.



- **Nethereum** is the .Net integration library for Ethereum, simplifying the access and smart contract interaction with Ethereum nodes. Both, public and permissioned like Geth, Parity, or Quorum.



- **Truffle** is a development environment, testing framework and asset pipeline for blockchains using the EVM, aiming to make life as a developer easier.



- **PegaSys**' mission is to build blockchain solutions ready for production in business environments. They focus around privacy, scalability, and permissioning.

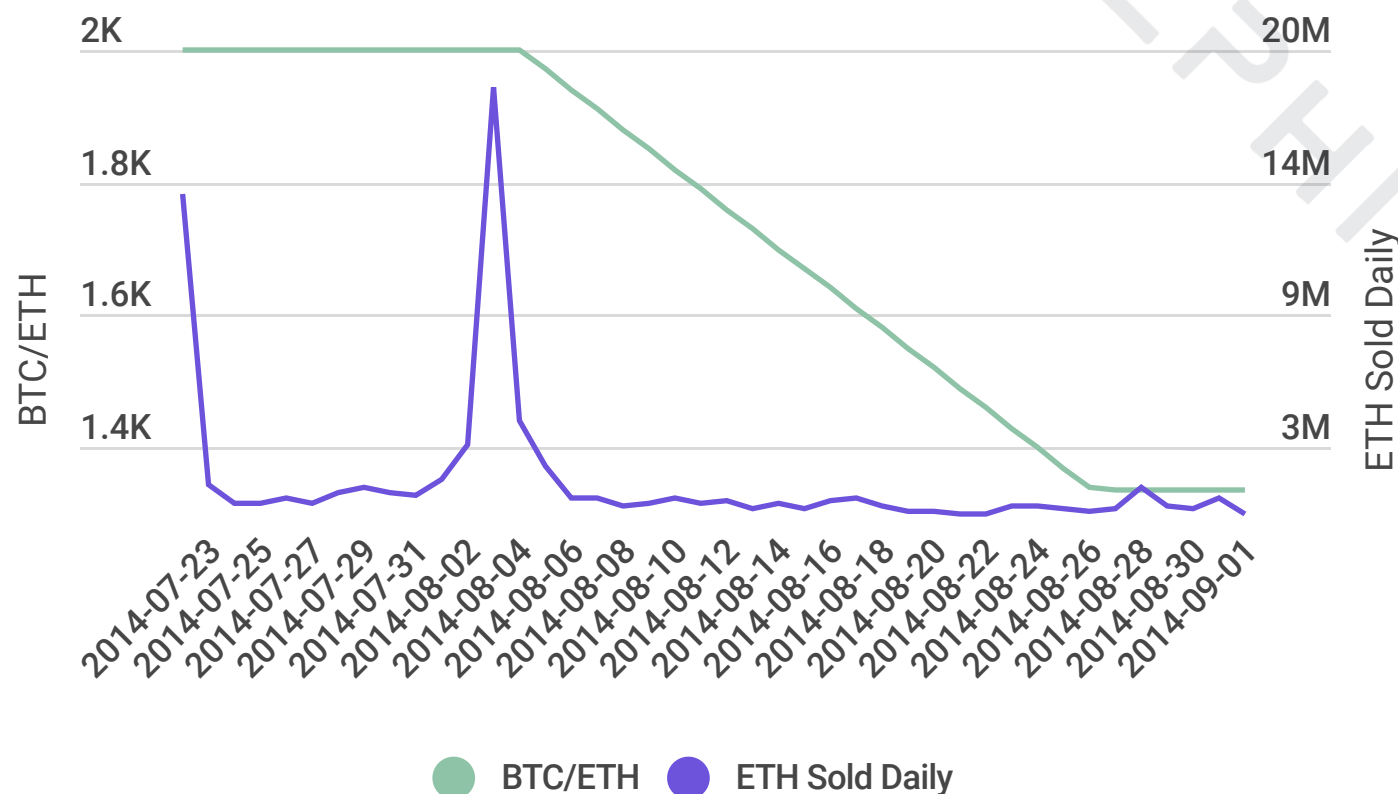
Token Sale Overview



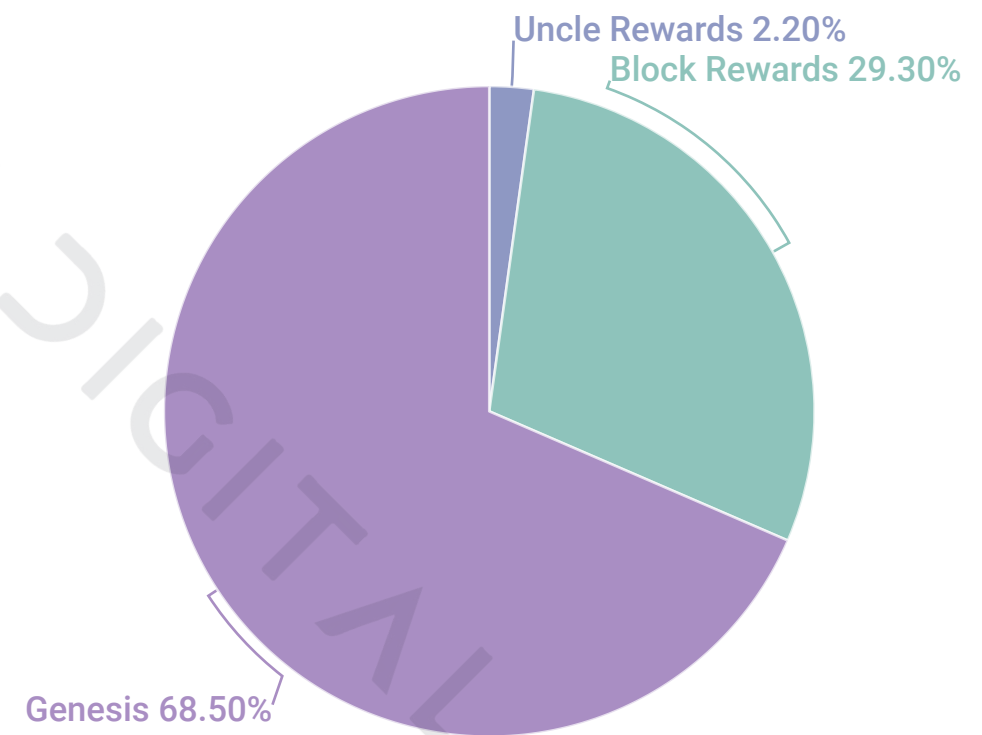
Vitalik Buterin first sent the Ethereum whitepaper to a group of friends in November of 2013. In January 2014, Ethereum was formally announced by Vitalik at the North American Bitcoin Conference in Miami, Florida.

The token sale was launched on July 22nd, 2014 and ended on September 2nd, 2014. There was no cap on the sale, which was open to the general public. During the 42-day crowdsale, \$18 million in bitcoin was raised with ~60 million ETH being exchanged for ~31,000 BTC. More than 40% of the ETH sold went to the top 100 purchasers. The Ethereum platform went live on July 30th, 2015 and traded around \$1 for most of 2015.

ETH Token Sale



Current ETH Supply by Source



Prominent ETH 2.0 Developers



As expected, **Vitalik Buterin** is very involved in the development of ETH 2.0. That being said, he's been able to leverage the help of an experienced team as well as the strong community Ethereum has been able to garner. Below, we identify a few of the key developers working on ETH 2.0. It's important to note that this does not include every developer contributing to the next iteration of the network.



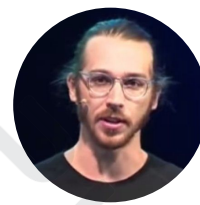
Vlad Zamfir is one of Ethereum's lead researchers and while he has spent some time working on other projects over the past few years, he has stated that Ethereum is still his primary focus.



Justin Drake studied mathematics and founded the Cambridge Bitcoin Meetup group in 2013. In 2014, he left his job as a programmer to learn more about blockchain. Now, he researches sharding for Ethereum.



Karl Floersch started contributing to Ethereum after graduating from Stony Brook University with a degree in CS. His current focus is working on Ethereum's proof of stake protocol Casper.



Danny Ryan has been a firm believer in open source for many years. Although not contributing to Ethereum until 2017, he was the developer behind Casper FFG and is one of the core developers working on ETH 2.0.

While there are hundreds of people working directly to help improve Ethereum, we wanted to take some time to highlight the key developers currently working on ETH 2.0. We've highlighted the top five contributors from ethereum / eth2.0-specs below:

| Developer | Total ETH 2.0 Commits in 2018 | Github | Twitter |
|-----------------|-------------------------------|------------------------------|---------------------------------|
| Danny Ryan | 335 | @djrtwo | @dannyryan |
| Vitalik Buterin | 280 | @vbuterin | @VitalikButerin |
| Hsiao-Wei Wang | 177 | @hwwhww | @icebearhww |
| Justin Drake | 172 | @JustinDrake | @drakejustin |
| Terence Tsao | 54 | @terenc3t | @terenc3t |

Data as of March 6th, 2019

Sources: [Github](#)

Ethereum 2.0 Clients Under Development

Despite the many delays, Ethereum 2.0 finally had some specification created in 2018 which gave developers the ability to start building client software. Clients are software implementations usually written in differing programming languages that users deploy to connect to and participate in the Ethereum network. Each programming language has its own community of developers, so developing clients within different frameworks is important. The Ethereum Foundation is involved in one way or another with a majority of these developer teams, whether through their grant program or sharing research.

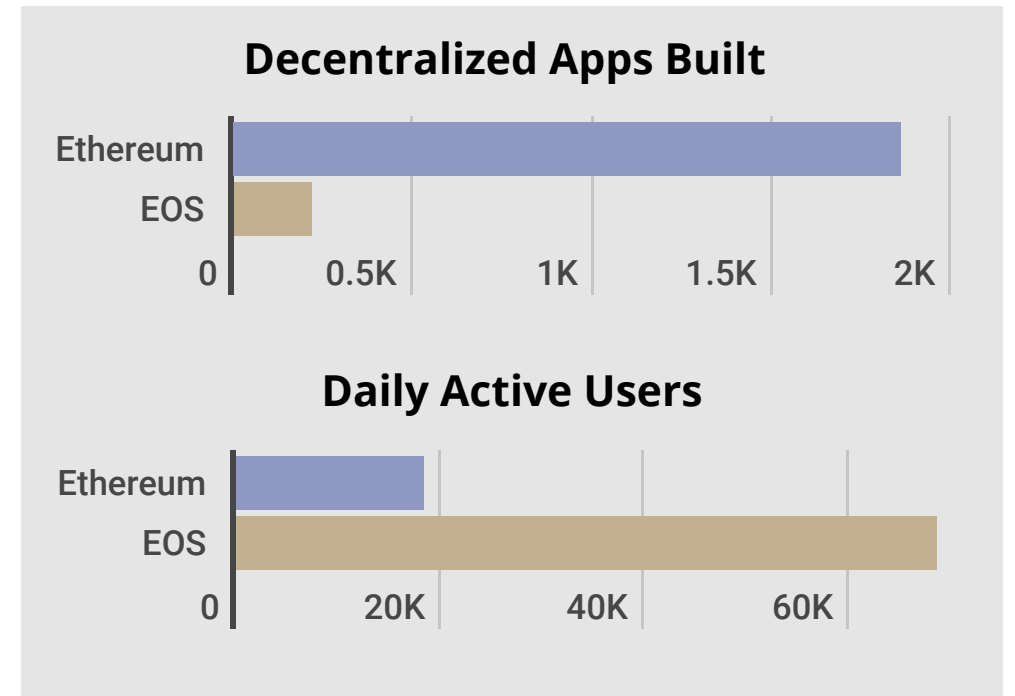
Below, we've laid out some teams currently working towards developing these clients for **Ethereum 2.0**.

| Clients | Language/Framework | Developer | Github |
|-------------------|-------------------------|---------------------|---|
| Prysm | Go | Prysmatic Labs | https://github.com/prysmaticlabs/prysm/tree/master/beacon-chain |
| Lighthouse | Rust | Sigma Prime | https://github.com/sigp/lighthouse |
| Nimbus | Nim | Status | https://github.com/status-im/nim-beacon-chain |
| Lodestar | JavaScript / TypeScript | Chain Safe Systems | https://github.com/ChainSafeSystems/lodestar |
| Harmony | Java | Harmony | https://github.com/ether-camp/ethereum-harmony |
| Artemis | Java | PegaSys (Consensys) | https://github.com/PegaSysEng/artemis |
| Yeeth | Swift | Yeeth | https://github.com/yeeth |
| Trinity | Python | Ethereum Foundation | https://github.com/ethereum/py-evm |
| Substrate Shasper | Rust | Parity Tech | https://github.com/paritytech/shasper |

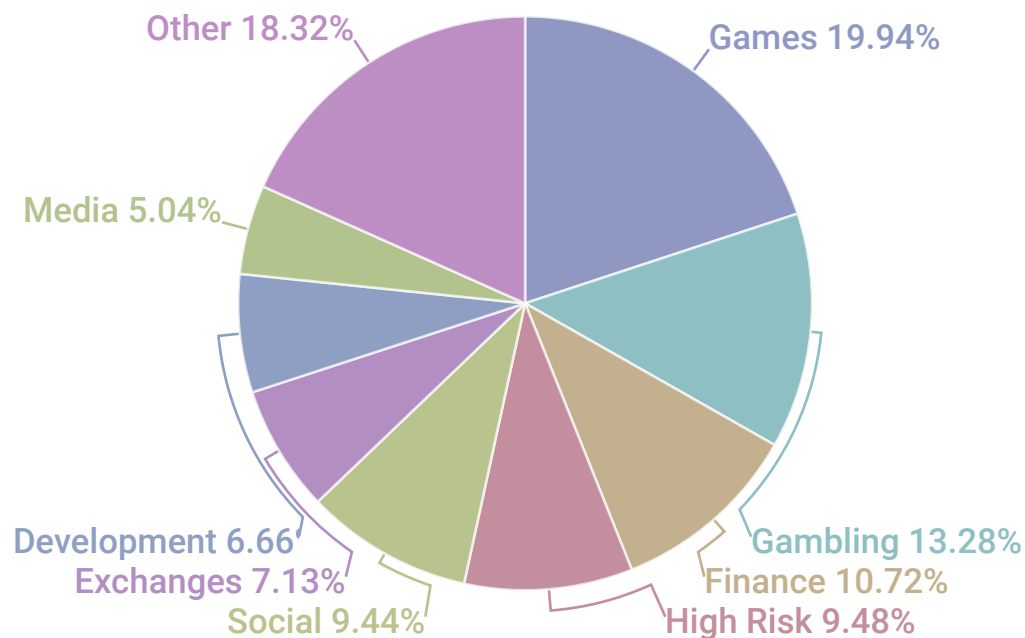
DApps Overview

As the market stands today, a majority of the underlying development for decentralized applications have been on Ethereum and EOS. To the right, we take a look at the amount of dApps built on both as well as the traction they've been able to gain.

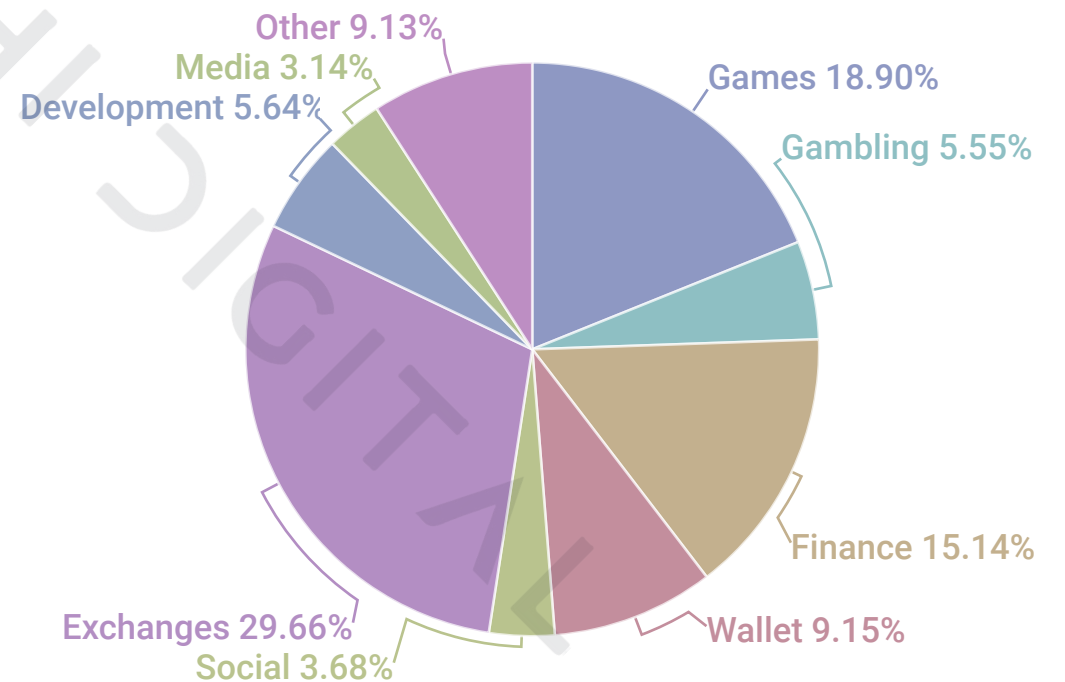
As you can see, there are over **2,000 dapps built on Ethereum and EOS** with around 87,000 daily active users. This is a small number of DAU, however when you take into consideration how difficult it is to currently use over 99% of these dApps right now it's impressive that there is still some interest. We believe a decentralized app that actually provides an interesting use case as well as a pleasant UI and UX could play a large role in boosting the traction these dApp protocols see.



Ethereum DApps by Category



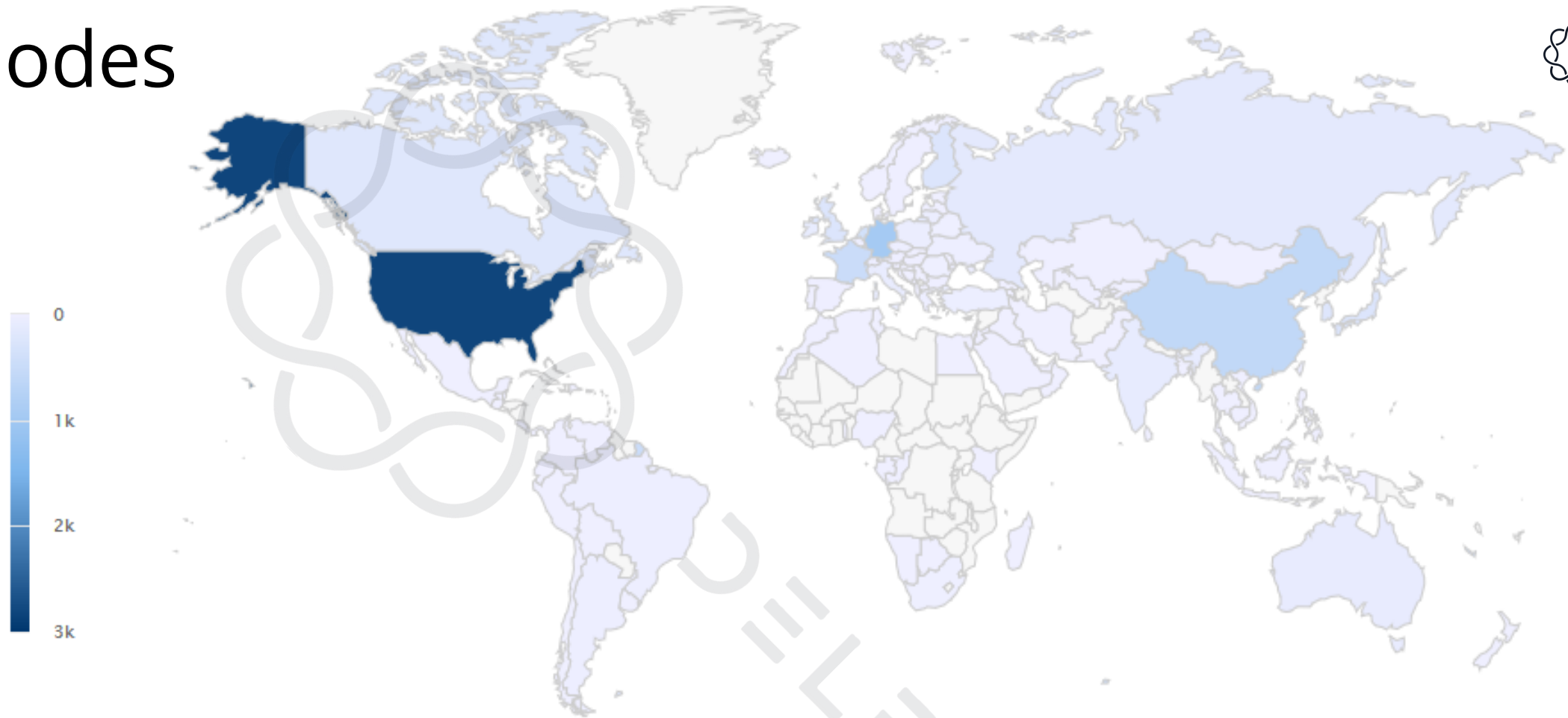
Ethereum DApp Categories by MAU



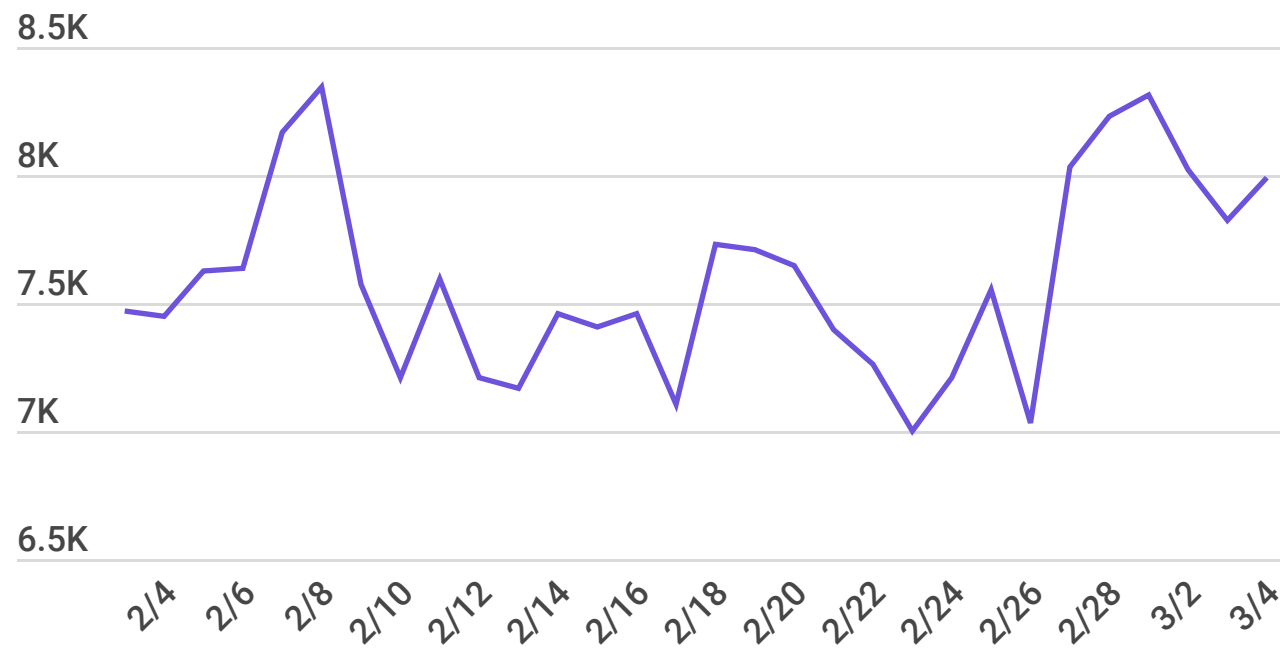
Data as of March 4th, 2019

Sources: [State of the Dapps](#)

Nodes



Total Nodes (Last 30D)



Data as of March 4th, 2019

Sources: [Etherscan](#)

Top 10 Countries by Nodes

| Country | Total Nodes | % of Total | Delta Last 7 Days |
|----------------|-------------|------------|-------------------|
| United States | 2,819 | 34.73% | +9.6% |
| Germany | 960 | 11.83% | +13.3% |
| China | 603 | 7.43% | +11.9% |
| France | 480 | 5.91% | +17.2% |
| Singapore | 395 | 4.87% | -14.4% |
| Netherlands | 372 | 4.58% | -5.2% |
| United Kingdom | 254 | 3.13% | -1.1% |
| Japan | 250 | 3.08% | -5.1% |
| Finland | 247 | 3.04% | +17.5% |
| South Korea | 225 | 2.77% | +12.5% |

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