

The road to Ethereum 2.0

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Research Note from ListedReserve

The risks to Ethereum are poorly understood and likely mis-priced

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Executive summary

- Ethereum has outperformed bitcoin for the last 12 months rising x% to bitcoin's y%.
- Enormous support for Ethereum in the VC community in particular.
- Benefitted from the explosion in issuance of USD Tether as well as the growth in NFT's.
- Very high fees have curtailed growth on the platform since Q1.
- The roadmap for Ethereum is complex and delayed.
- Perhaps most importantly, we believe the technical risk associated with Ethereum is mispriced.
 - The “distributed ledger” is not distributed at all. In fact, nodes are highly centralised and running a full node is extremely difficult, to the point where very few people do. This makes the protocol fragile.
 - The move to proof-of-stake is risky and potentially a race to the bottom in fees and damaging for the security model.
 - Vulnerable to superior protocols where there is no genuinely distributed ledger effect protecting it or proof-of-work protocol.

1. Ethereum

Ethereum, launched in July 2015, is an open-source platform and operating system with its own cryptocurrency, Ether. It is the second highest valued cryptocurrency May 2021 with a market cap roughly 45% that of bitcoin. It is the clear leader in terms of meaningful transaction count particularly through its association with the leading stable coin, Tether.

2. Smart contracts

The major benefit Ethereum had over Bitcoin when it first launched was the inclusion of smart contracts as a part of the protocol thanks to Ethereum's support for scripting languages. These smart contracts are a transactional protocol that will automatically execute when certain conditions that have been agreed upon have been met. The smart contract acts automatically, removing the need for third party involvement and cutting out the additional costs of intermediaries, arbitrators and enforcements.

Smart contracts are defined by the individual ahead of the conditions being met. All smart contracts are also immutable, which means that they cannot be altered or changed after being applied.

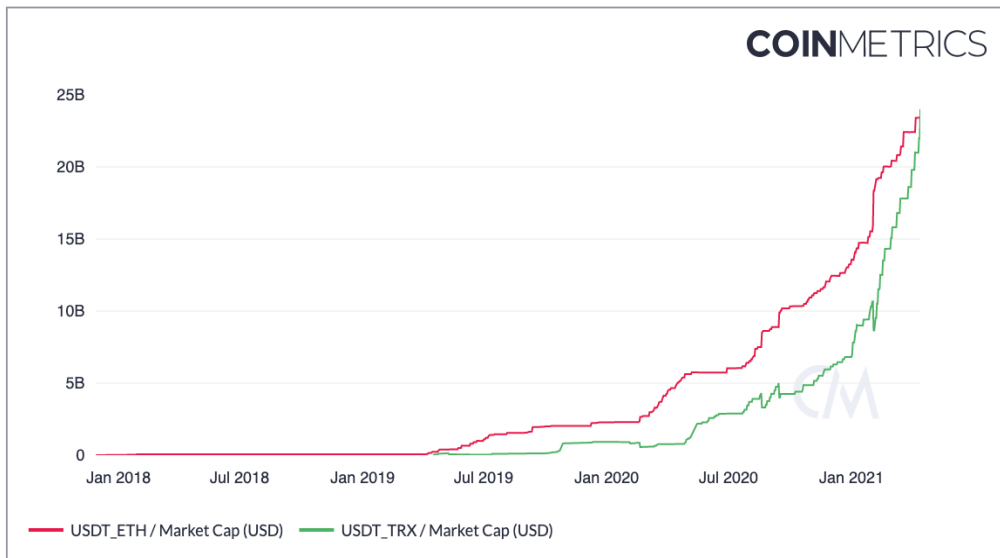
A smart contract does not constitute a valid binding agreement in law. It is more like an automated obligation than a legally binding agreement but that does not matter, since it is binding in reality and will execute as written. A vending machine is often referred to as the first smart contract machine, where when conditions are met the machine will dispense with the correlated item. If you press the wrong button (i.e. code wrongly) tough, you get the wrong outcome and you cannot change it.

3. Gas

Ethereum operates using what is known as a Gas fee. The fee is paid to undertake a transaction on the network. The fee fluctuates depending on the network congestion, being higher when more Ether is being transferred on the network and lower when less transactions are going through. Users can also pay a higher fee to prioritize their transaction on the network, pushing it to the front of the line and being processed much faster.

In the early days of Ethereum it was significantly cheaper to transact than on bitcoin and this was a source of success. However, when Tether (the USD stable coin) was issued on the network that started to change and fees on Ethereum began to increase. In April and May this year Ethereum fees exceeded bitcoin fees for most of that period.

The steep rise in issuance of Tether began in late 2020 and continued this year. This put pressure on fees and consequently users looked for alternatives. The most used of those is the Tron network which now exceeds Ethereum in terms of Tether issued on its network.



The chart shows us two things. Firstly, the absolute explosion in the use of stable coin USD Tether (subject of another article). The chart is less than compelling for Ethereum though, because as soon as it encountered fee issues, it was trivial for users to switch platforms and use USD issued on Tron. Most people outside of the industry would not have heard of Tron but over \$30 billion in Tether issued on that platform now. Its transaction count on Tether exceeds Ethereum and that switch happened in less than a year.

4. Roadmap

Ethereum was developed and released by the Ethereum Foundation in 2015. That makes its governance rather different from Bitcoin because the founders are still around, the most prominent perhaps is Vitalik Buterin. He has an opinion and is still involved.

The Foundation was absolutely aware of the risk that Gas fees posed to the network and they proposed an upgrade to the protocol as long ago as 2015, just after launch. They correctly predicted that Ethereum would not scale as it stood.

The proposed upgrade moves Ethereum from a Proof-of-Work protocol to a Proof-of-Stake protocol. Proof-of-Work (POW) uses cryptography to demonstrate that a particular miner has expended energy in resolving a block of transactions. Some people consider this method to be a waste of energy since there are other methods that can be used. The great advantage of POW is that it is not possible to cheat and not easy to replicate at scale. It has also been road tested now for a long period of time with great success. Still, it is a trade-off because it requires time to solve the problems (the work) which slows down the blockchain and restricts the number of transactions. It is this bottle-neck that forces fees upward, since as transactions join the queue if you wish to be in the next block you need to pay more.

Proof-of-Stake is different. Simply the protocol will allow the miner who stakes the most coins of the underlying protocol (ETH) in this case to have the greatest chance of resolving a given block. This allows for configurable block times and to some extent more configurable fees. It will absolutely lower the fee issues that Ethereum has faced this year.

The upgrade path to Ethereum essentially has three phases:

<p>The Beacon Chain</p> <p>The first Eth2 addition to the ecosystem. The Beacon Chain brings staking to Ethereum, lays the groundwork for future upgrades, and will eventually coordinate the new system.</p> <p>THE BEACON CHAIN IS LIVE</p>	<p>The merge</p> <p>Mainnet Ethereum will need to "merge" with the Beacon Chain at some point. This will enable staking for the entire network and signal the end of energy-intensive mining.</p> <p>ESTIMATE: 2021</p>	<p>Shard chains</p> <p>Shard chains will expand Ethereum's capacity to process transactions and store data. The shards themselves will gain more features over time, rolled out in multiple phases.</p> <p>ESTIMATE: 2022</p>

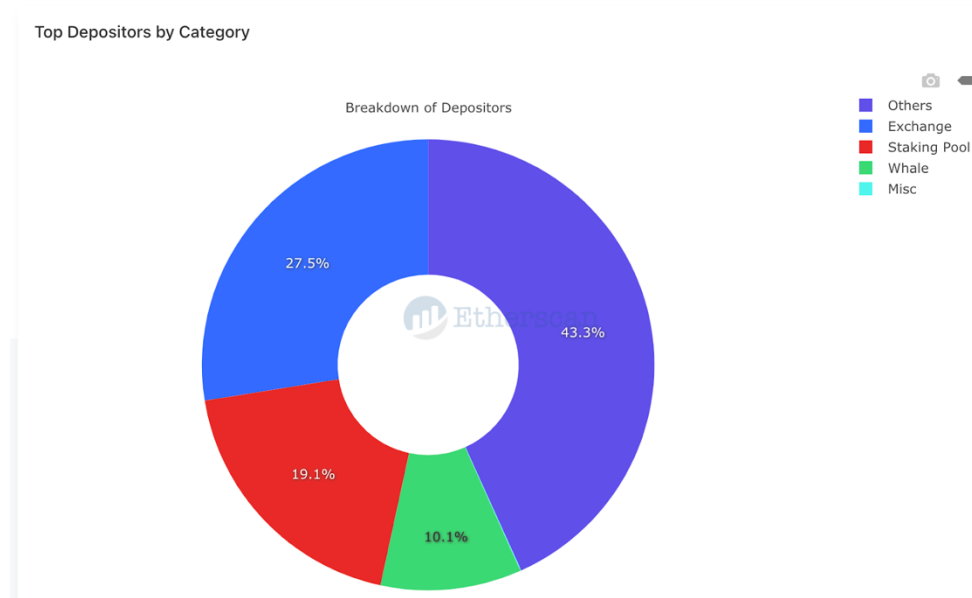
The Beacon Chain

This Beacon Chain is now live and is the first step on the road-map. Essentially the Beacon Chain will be the coordination point for Ethereum. Its launch didn't really change anything about the way the blockchain works. In the future though it will become incredibly important.

It is already possible to stake ETH on the Beacon Chain, \$13.6bn of ETH has been staked at the end of May. All stakers will earn a return from doing it. The return is a function of current transaction fees; these amounts won't be paid out until "The Merge". Essentially this is a practice run for a full staking model.

Staking is reasonably equal with exchanges and mining pools representing half and individual holders the balance. This is actually a very healthy spread since all user groups are well represented and implies some degree of consensus and belief across all stakeholders.

Eth Staking by user group



The dominant group in the exchange category is Kraken followed by Binance. The fact that no individual group is significant though is encouraging.

The Merge

This is perhaps the riskiest step in the whole operation. The Beacon Chain will merge with the Ethereum Mainnet. At that point the rewards earned from staking to that point will be paid out and going forward Ethereum will become a fully-fledged Proof-of-Stake system with future rewards paid out on a POS basis.

How this merge will technically happen is still unclear (at least to us) but it represents a massive technical risk mostly because this has never been done before.

There is an assumption from investors that developers in this sector are “technical wizards”. It is certainly true that some of the very best developers do indeed work on these projects. Most of the developers though are just skilled people doing their best. This upgrade is no different from your business moving from one platform to another. It takes planning, it takes work, things get forgotten then when it goes live, it breaks. There is no difference here, something will break and so we are cautious about the change. We are further cautious about staking ETH into an unknown technical environment.

Shard Chains

The final phase of the upgrade is Shard Chains. Ethereum currently has a scaling problem. A full copy of an Ethereum Archive Node is now many [10TB] terabytes in size and is beyond the reach of a normal laptop.

The reason is that all smart contracts and protocols that run on Ethereum are actually stored on the chain and so the more popular Ethereum gets, the larger it gets, and the fewer people can run a full node. That creates centralisation risk.

The answer proposed is Shard Chains. There will be 64 chains in total which will share the Ethereum load and potentially make it easier for people to run a node. Users will only need to run the shard on which they operate. The Beacon Chain will keep the shards honest and synchronised, and the user will in theory be able to rely on what their shard tells them.

Again, this is new. Sharding is common in database management, but it has never been used in decentralised technology before and arguably runs contrary the concept.

A More Detailed Map

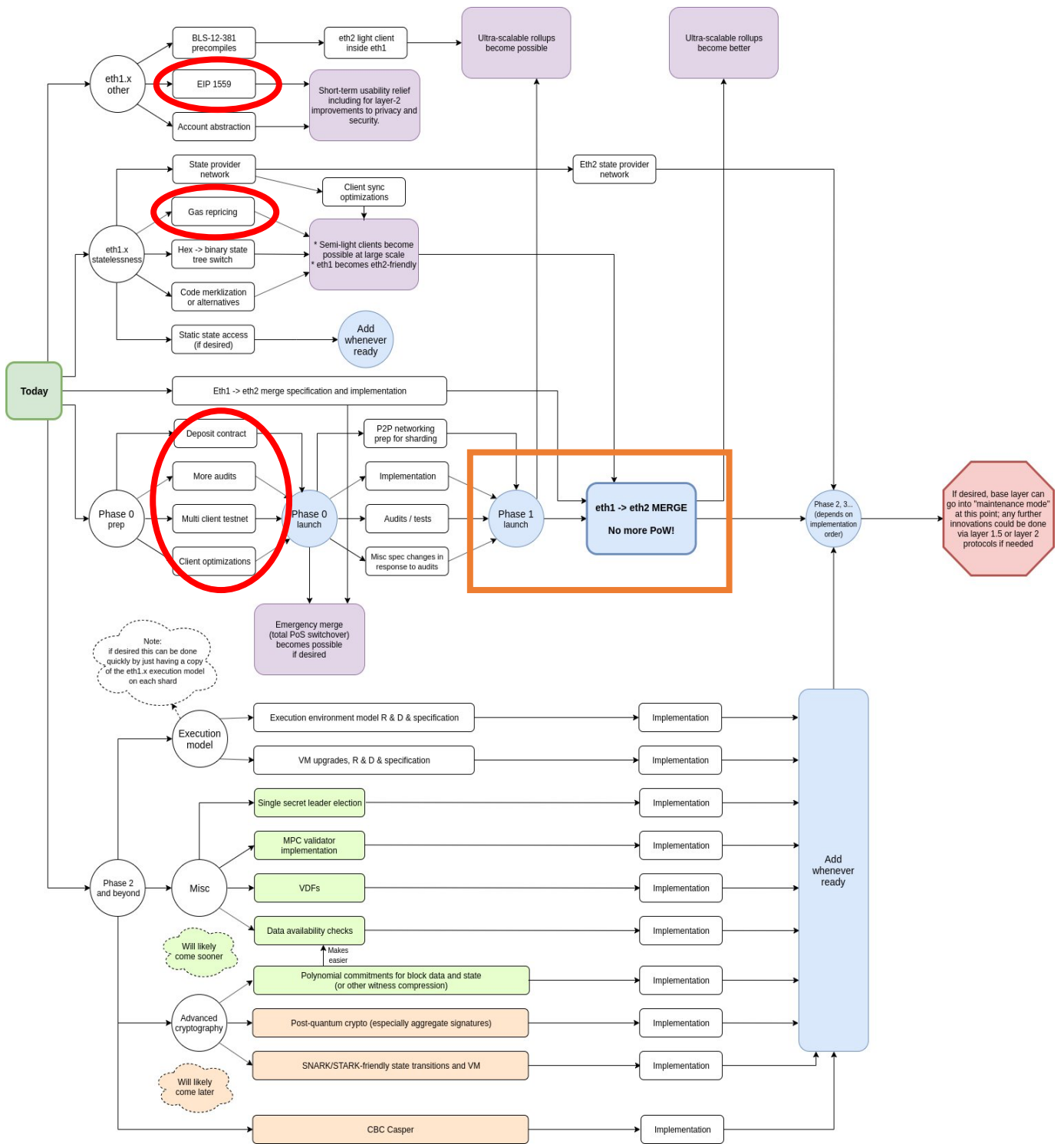
To the more detailed map of the upgrade path. Vitalik Buterin provided a vision on what Ethereum 2.0 might look like over the next five. (see next page). First issued in 2015, it is complex and clearly has been more time consuming than first envisaged.

At present we are approaching BIP1559 – circled in red in the diagram below, more on that particular change later. All told though the path is complicated, each series relying on its predecessors and there being very little detail provided on what is required to get from one to the other.

We have highlighted the riskiest parts of the whole process in orange. How do you “Merge”? No doubt this is doable but as anyone who has ever tried to merge anything will tell you, it is not easy. When faced with a decentralised piece of technology with developers from every corner of the world (most of whom don’t get paid), it’s even less easy.

It could be summarised as risk layered on risk, with billions of dollars of smart contract protocol and token issuance sat on top of it.

Vitalik's vision



5. Delays

But I am completely confident of this: 2020 is Ethereum 2.0's year of delivery. The signal event will be the genesis of the beacon chain in the early part of the year. With three or four production-ready clients and 500,000 ether staked, this new Proof-of-Stake chain will start completing the first and most challenging phase of Eth2's delivery.

This was a quote from one of the lead Ethereum developers in 2019. A maths graduate from Cambridge University and a highly talented developer. It serves to show just how difficult the task is to *safely* execute what is proposed. We know too, that the longer delays continue, the more likely they will continue.

- Proof-of-Stake roadmap first proposed 2015
- Byzantium hard fork 2017 - delayed by 1 year
- Constantinople hard fork 2019 - delayed by 1 year+
- Istanbul hard fork; took place 2019 and late by virtue of its predecessors
- Berlin hard fork: April 2021 (timetable in the bin because everything is very late)
- London hard fork: Scheduled July 2021 (see below)

The fact is, that despite the confidence expressed by developers, each hard fork is a material and meaningful change to the code. The changes *compound*, they introduce new risk and subsequent changes can be impacted by their predecessors. These risks subside only with time as the system is road tested but we cannot know their impact until the changes stop and there is no sign that the changes will stop soon.

In June 2021, Vitalik Buterin was interviewed and offered early 2022 as a likely moment when Ethereum would move to Proof-of-Stake (the merge). A short clip of the relevant moment is [here](#); safe to say Vitalik does not exude confidence in answering. History indicates then that this is all likely to be delayed, but that will be 7 years since it was first proposed so landing on a final date is going to be anyone's guess.

This is not to criticise the genuine efforts of Ethereum developers to build something meaningful and lasting. Perhaps though, simple is best when it comes to decentralised systems. We shall see.

6. Competitors

The issue for Ethereum is their promise was speed and efficiency. They delivered it initially but as they became victims of their own success it is not difficult for other blockchains to deliver "fast and cheap". Fast and cheap is an awful contest to be in because it is definitionally a race to the bottom.

Historically the major criticism for Bitcoin was that a superior protocol would emerge with faster and more efficient transactions. In 2017, this was put to the test and thousands of competing protocols and Bitcoin forks emerged promising better and faster. However, none of them were successful in toppling Bitcoin for the following reasons:

- Network effect.
 - There are 10,000+ public nodes running the Bitcoin code and many, many more private nodes doing so. This protects the protocol, since by design all these nodes monitor each other

- o Proof-of-work. Bitcoin's POW mining protocol network is hard to replicate. This is now an enormously powerful machine that carries out more calculations per second than any other network in history. Supplanting it, particularly in the way it was done with Bitcoin which was entirely natural, no fund raising or VC money; just natural accretion.

The issue for Ethereum is that as it moves away from Proof-of-Work and continues to host all transactions on-chain it loses its network effect. Very few people run full Ethereum nodes, so replicating a situation of few nodes, is not hard. Running a mining protocol that only relies on an internal measure of "how many tokens you have" and has no grounding in any external reality, is also not hard. Consequently, replicating that situation is less difficult than if you require, say, an enormous amount of computing power.

As a result, we consider that the changes proposed by Ethereum make it more vulnerable to competition, not less and the experience with Tron and Tether is a very good example. Indeed, the very criticisms that were first proposed for Bitcoin apply more to the newer protocols than to Bitcoin itself.

7. Other risks

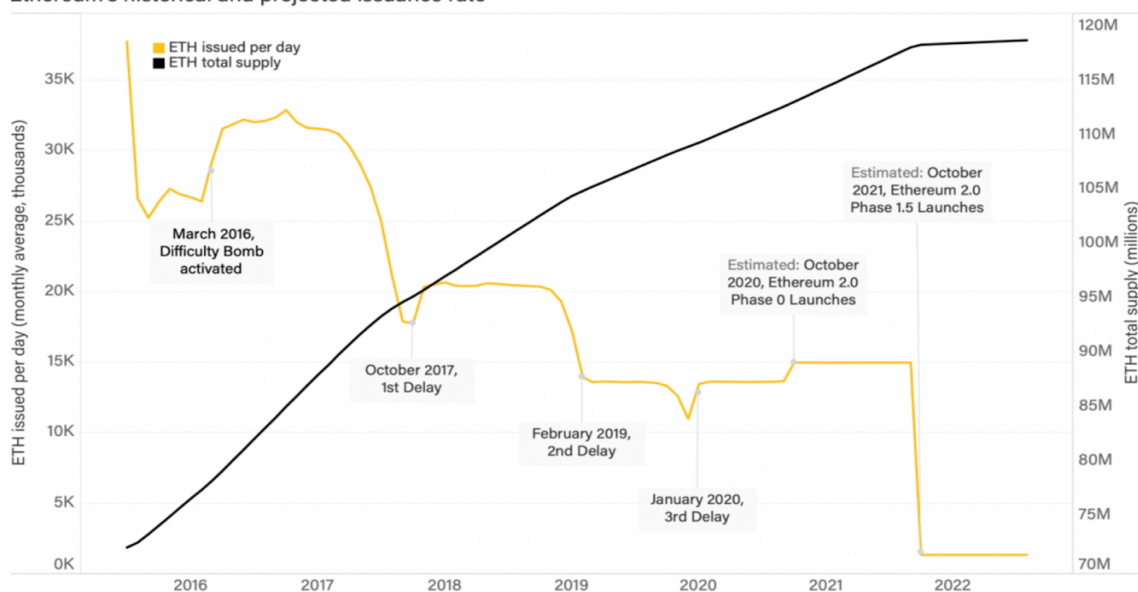
The original plan was that Sharding would be launched prior to the Merge. However, the pressure on fees meant that Merging now precedes Sharding. This is fine but emphasises that nothing is certain with Ethereum, not the code, not the roadmap and not (as we shall see) the money supply.

Uncertain supply

By virtue of its regular code changes, Ethereum has always had an uncertain supply curve. The contrast is frequently drawn with Bitcoin and its hard cap of 21,000,000 coins. Supply of ETH changes, there is no ultimate limit but later this year the inflation rate of ETH will drop substantially.

To date, the changes to bring Ethereum to POS and address its scaling issues have had profound effects on supply and ultimate supply. If anything is good here it is that net issuance is falling, the concern is the ease and frequency with which these changes are made.

Ethereum's historical and projected issuance rate



Perhaps the best thing that can happen post the merge is that there is consistent operation of the code base for an extended period, with a known issuance curve. If done properly this could greatly benefit the valuation for Ethereum. At present it is rather hard to make an assessment against a moving, or potentially moving target.

8. Next up, London

The London fork (EIP-1559) will be the next major update in the Ethereum protocol, scheduled for July 2021. This change, amongst other things, alters the fee mechanism. Fees will be allocated to the network (rather than direct to miners) and a 'fair' base fee for all transactions will be set. The base fee will be charged based on network congestion; this pricing structure will be predictable, allowing wallets to automatically detect which tier the base fee is currently at - meaning this should be the end to any user having to adjust their own gas settings (which has been painful and time-consuming guess work).

The London change will bring more certainty to fees but, importantly, Ethereum miners do not support the change (mostly because it will cost them a lot of money).

Again, from a risk perspective making significant changes to miner economics is a large and untested change. It may be that there is a beneficial impact for Ethereum in the short term as transactions costs fall but the longer-term impact is less favourable. Will miner-economics change again? Who would invest in mining Ethereum when the protocol can so easily pivot to your disadvantage?

The main benefit of coded protocols is that market participants know exactly how the protocol will behave. That only works if the code itself doesn't change and that simply is not true with Ethereum and it has never been. That flexibility is viewed by many as an advantage. However, like any investment, you want to know the rules before you put your money in and the only consistent rule with Ethereum is; "the rules might change" and the London hard fork proves it.

9. Tethered?

It would be wrong to write about Ethereum and not mention Tether. Tether is a digital claim on a USD. The Issuer simply issues one digital tether token on Ethereum from each \$1 received. Total issuance of Tether now exceeds US\$50billion. The tokens are accepted across the industry at face value (or very close) and are simply a lot more useful than a USD because they can be sent around from a mobile phone without going via banks. In fact, as a test case for a Central Bank Digital Currency, Tether is a very good one.

The issue is that in China, where Tether is very popular, there is a continual risk of crackdown from the authorities. On the formal release of the Chinese Digital Yuan, which will likely happen in the next three years (and likely less), there will probably be a simultaneous crackdown on Tether.

Tether has been the number one application for Ethereum for a long time you might think of it as the number one customer of the Ethereum network and a hard crack down would have a significant impact on the value of Ethereum. This risk applies equally to Bitcoin except that any exodus from Tether would likely flood into Bitcoin and other cryptocurrencies and not into related protocols like Ethereum and Tron.

In short, Tether comes with enormous regulatory risk and as a major transmitter of that protocol, Ethereum must assume its share of the risk in any analysis.

10. Conclusion

Ethereum represents a different path in the evolution of digital currencies from Bitcoin. The latter having an ossified code base, a decentralised mining base, decentralised nodes. It is reliable but slow.

Ethereum is aiming for something far more ambitious, but there will be compromises along the way. Ultimately the protocol is not decentralised, its code changes a lot, and nobody is quite sure on the direction of travel or the timeline for the destination.

Each hard fork introduces new risk, each change to the protocol and the mining economics confuses the message. Even in research this note it was very hard to get to the bottom of what is actually going on. In writing research notes, that would be common when analysing a private company, but perhaps it should not be that way when analysing something that is meant to be an open-source protocol.

All told though, Ethereum has thousands of committed developers, it has no lack of funding and most likely it will be around for a long time yet, but it is risky. The risks are everywhere we look plus all the places we cannot see and we invest accordingly.