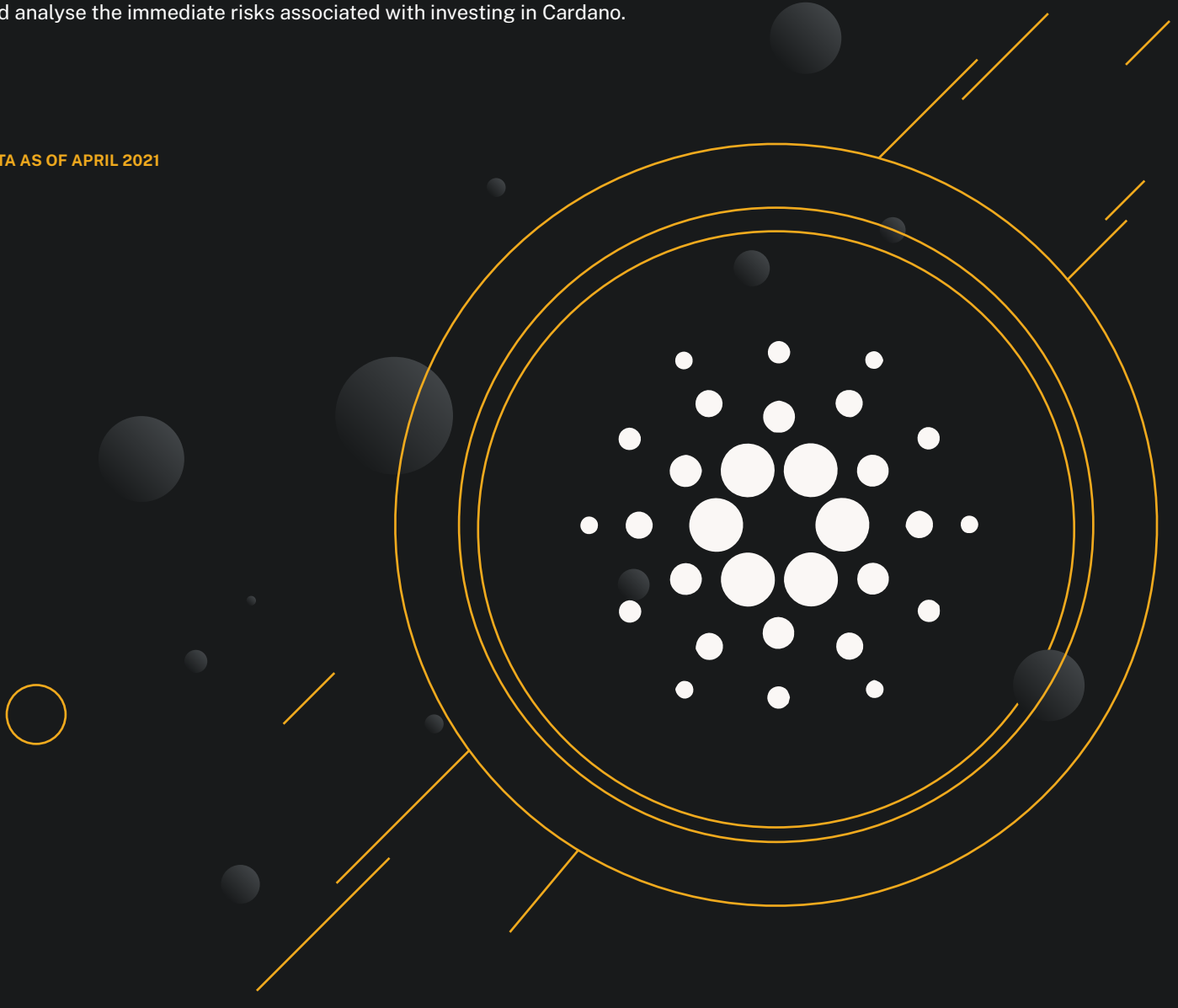
21SHARES

Research Primer
Cardano

This research primer is a guide to understanding the smart contract platform Cardano. This research will explain what Cardano does and what its main use cases are. Also, we will explain the primary methods by which to value Cardano and analyse the immediate risks associated with investing in Cardano.

DATA AS OF APRIL 2021



Cardano Research Primer

Executive Summary

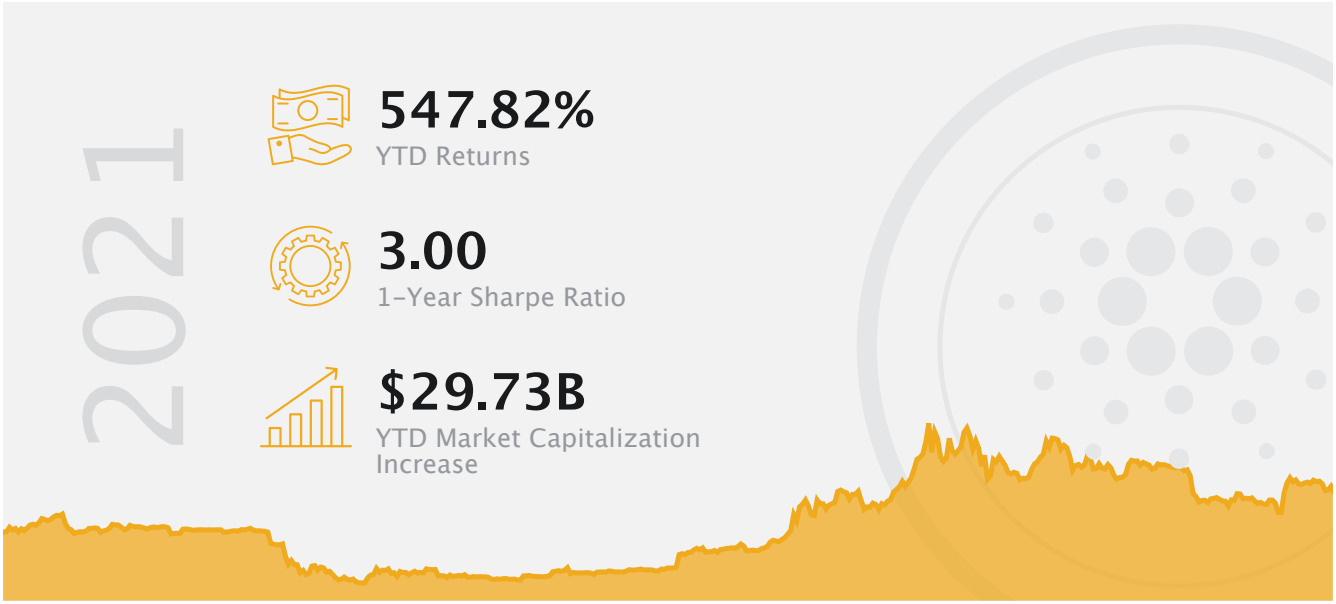
At 21shares, we are excited to have launched the world's first Cardano ETP on the SIX Swiss Exchange on April 26, 2021 (AADA | ISIN: CH1102728750). Cardano is a blockchain-based smart contract platform that aims to allow developers to build decentralized applications. Unlike other leading smart contract platforms like Ethereum, Cardano currently uses a Proof of Stake algorithm called Ouroboros to power its transaction settlement and to produce new blocks in its blockchain. The first version of Cardano was shipped in 2017 and the team behind it is Input-Output (IOHK), a for-profit company founded in 2015 by Ethereum co-founder Charles Hoskinson[1,2].

In this report, we will offer an exhaustive overview of the Cardano network, the ADA cryptoasset, and discuss the various investment risks associated with Cardano — in addition to how an investor can think about the future value of its underlying cryptoasset. Cardano is one of the best-performing large-cap cryptoassets over the last year and this report offers the most exhaustive coverage of Cardano and ADA available on the market.

ADA Key Metrics	As of April 25, 2021
Ticker	ADA
Price (USD)	$1.14
Circulating Supply (ADA)	31,587,810,047 ADA
Market Capitalization (USD)	$35,940,403,656
Annual Inflation (%)	2.12%

Figure 1: ADA Key Metrics (Source: Messari)

Figure 2: ADA Performance 1-Year Performance (Source: Messari)



Cardano Research Primer

How Cardano Works

This section will give a brief overview of exactly how Cardano blockchain works — its consensus mechanism, how blocks are formed on its blockchain, and how it tackles some of the issues apparent on popular smart contract platforms when securing its network. In the Cardano network, those that stake their ADA — essentially locking up their assets — receive a claim on future inflated ADA in proportion to the size of their deposit. Ouroboros works through the concept of "Slot Leaders" who are chosen by those who hold the ADA token on a holder-weighted basis. Slot Leaders work similarly to block producers or miners in the case of Bitcoin or Ethereum, which means that they are the entities that confirm transactions and create new blocks in the Cardano blockchain approximately every 20 seconds. "Input endorsers" are another set of stakeholders which approve blocks and transactions produced by Slot leaders. The network is designed to be scalable as Cardano aims to increase network throughput by increasing the number of "slots" (or blocks) per "epoch" lasting about five days or by allowing the network to run multiple epochs simultaneously[3].

The ADA Token

The Cardano network sets a maximum supply of ADA at 45 billion, with new ADA currently being inflated and paid to Cardano stakers. Once Cardano reaches the "Voltaire" period, ADA holders and stakers will be able to vote for on-chain improvements in the protocol. This governance process will eventually allow token holders to decide whether particular improvements in Cardano get implemented.

Governance and Treasury

The core developer and product team works on the implementation of the Cardano network across three independent entities composed of a foundation and two for-profit organizations to ensure that Cardano stays true to its purpose as the network advances and evolves:

- **The Cardano Foundation**: The foundation with core responsibilities to objectively oversee and supervise the development of Cardano and its ecosystem.
- **Input Ouput**: The technology company founded to design, build, and maintain the Cardano platform.
- **Emurgo**: The enterprise operating to boost the adoption of Cardano through commercial ventures.

A token sale occurred over a two-year pre-launch period between 2015 and 2017 wherein 20% of the ADA supply accounting for over 5 billion or precisely 5,185,414,108 ADA was distributed between these entities:

- **Cardano Foundation**: 648,176,761 ADA
- **IOHK**: 2,463,071,701 ADA
- **Emurgo**: 2,074,165,644 ADA

At the launch in 2017, the total amount of ADA available was equal to 31,112,484,646 ADA; in other words, over 80% of the token was sold to token sale participants[4].

Cardano Research Primer

The State of Cardano

The Cardano development has been organised into five themes defined as network eras that are named after authors, poets and computer scientists: Byron, Shelley, Goguen, Basho, and Voltaire. Each era is characterised by a theme such as Decentralization in the case of Shelley, for example, and represents a set of functionalities that will be delivered across multiple code releases. Currently, the Cardano development sits in the Shelley era.

Phase 0, Byron

Launched in 2017, this is the first phase of Cardano which relies on a federated system as a testing ground to ensure a smooth process before decentralization. In other words, in phase 0, Cardano was more centralized than other blockchains such as Bitcoin and Ethereum. The main feature in this phase was allowing users to buy and sell the cryptoasset ADA, named after revolutionary programmer Ada Lovelace, considered to be amongst the first computer programmers. The Cardano network ran on a federated network of which the rules are based on the Ouroboros consensus protocol. Ouroboros is the first proof-of-stake protocol created based on academic research[5].

Phase 1, Shelley

Launched in July 2020, this upgrade was set to optimize decentralization gradually to transform Cardano from a federated network to a community-led network. The aim of this era is to make Cardano more decentralized than other blockchains as the network should reach equilibrium in incentives with over 1,000 staking pools rather than a dozen large mining pools. Given the required technical knowledge to run staking operations, ADA investors not willing to run a Cardano node full-time can delegate their cryptoassets in a given stake pool to earn rewards for their contributions.

Staking Cardano is designed to prevent the formation of large and influential pools by setting diminishing rewards once a pool has reached a significant size. This phenomenon is called saturation, as the algorithm favors the most popular pools to validate transactions and add a block. In other words, pools with the highest amount of ADA staked.

The rewards vary across pool operators as they set fees and profit margins but for the most popular one, it is about 5% APY. There are more than 2,380 stake pools with over 70% of Cardano's supply staked, which is worth about $27 billion as of writing[6,7].

Cardano Research Primer

The Future of Cardano

The next network upgrades in the development process of Cardano for the foreseeable future are Goguen, Basho, and Voltaire. As previously covered, each era zeroes in on a specific theme. Goguen, Basho, and Voltaire respectively represent various features — smart contracts, scaling, and governance.

Phase 2, Goguen

The Goguen era has been envisioned to unleash the decentralized crypto economy on Cardano through the launch of smart contracts, non-fungible tokens and multi-asset supports akin to ERC20s on Ethereum. Two protocol upgrades already occurred respectively in December 2020 and March 2021 called Allegra and Mary. While the former has brought metadata of Cardano's financial activity, the latter has allowed any developer to create their own Cardano-native tokens[8].

The upcoming upgrade scheduled for late summer this year will bring smart contract functionalities to Cardano in order to let web developers build decentralized applications. The software platform to build these applications is called Plutus and is akin to the Ethereum Virtual Machine (EVM). While Solidity is the predominant programming language on Ethereum, Cardano will launch two programming languages — Haskell and Marlowe.

Haskell is a Turing Complete language requiring a high level of programming skills to deploy smart contracts. Marlowe, on the other hand, is a domain-specific language for financial applications accessible to non programmers. In this vertical, Cardano will therefore compete against Ethereum and other smart contract platforms.

The remaining two eras for Cardano — Basho and Voltaire are currently at the ideation stage. The main themes are scalability and interoperability for Basho, named after famous Japanese poet Matsuo Bashō — and governance for Voltaire, named after the famous 17th century French writer and philosopher. In Basho, the main idea is to introduce side chains to let other blockchains interact with the main Cardano blockchain and to also offload some of the computation from the main chain, akin to sharding in the Ethereum 2.0 roadmap. In Voltaire, the main concept is the sustainability of the network by pooling portions of network fees in a treasury system owned by the community to fund future development and let stakeholders vote with ADA.

Cardano Research Primer

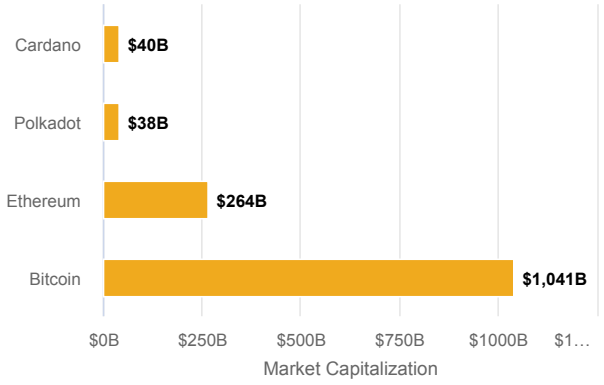
Valuing Cardano

Market Sizing

There are two ways we can think of the potential value of Cardano's native asset, ADA. The first is carrying out a market sizing exercise to compare its value to that of its main competitors as its target market. Secondly, we can compare Cardano's current adoption — through the proxy of fees paid on the network — to that of Ethereum in order to understand if the current value of Cardano can be justified whether there is product-market fit.

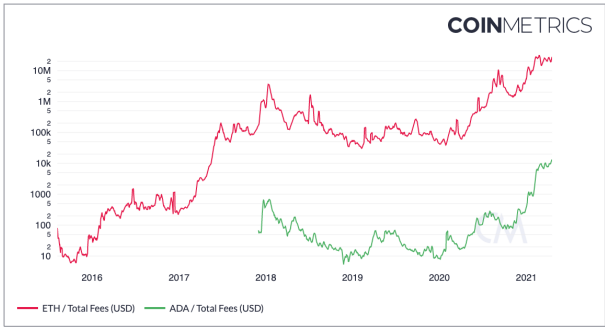
This section compares the current market capitalization of Cardano to Polkadot, Ethereum, and Bitcoin. While Cardano has not fully launched its smart-contract platform, the market for a leading smart contract is exceedingly huge and comparing Cardano's current prominence and usage to that of Ethereum and others is important. Bitcoin represents what the market has judged, as the current best use-case of blockchain technology while the smart contracts use case can be argued to be just as valuable in the long term — based on this logic, the market capitalization of Bitcoin may also offer an indicative comparable. The chart below shows the current market capitalization of Cardano, Polkadot, Ethereum, and Bitcoin.

Figure 3: Smart Contract Platforms Market Capitalization



A further metric we can look at is the total fees that are spent on the Ethereum network compared to the total fees on the Cardano network. Fees are a good signal for the overall demand for a given smart contract platform which is arguably the strongest barometer of fundamental growth. As we can see, the transaction fees on the Cardano network are at levels of magnitudes below that of Ethereum. This is a key metric to track in the coming months to compare Cardano's value to that of Ethereum.

Figure 4: ETH versus ADA — Total Fees



Cardano Research Primer

Risks

Technological Risks

The functionality of Cardano's smart contract platform has a limited operating history and has not been validated over the long run as it is set to launch in late summer this year. In the same vein, the sustainability of the network through governance is still in the ideation stage. Despite a rigorous development process, the crypto network is still developing. Future decisions could affect the design, functionality, and governance, which could adversely influence public perception alongside ADA's performance. Implementing new software upgrades and changes to the protocol could introduce bugs, security risks or adversely affect the crypto network. To mitigate this, for example, IOHK peer reviews their research and has launched a prototyping process to experiment and stress test the real-world economic conditions and the limits of a given upgrade described in the research.

Adoption Risks

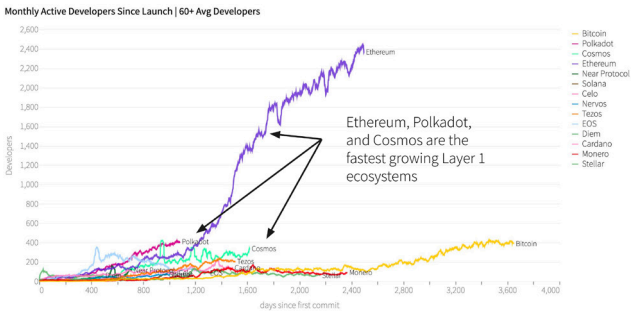
The adoption of Cardano is predicated on developers learning Cardano's programming languages and launching their smart contracts as well as decentralized applications on Plutus and finding product-market fit. Actual adoption is limited at the moment — and will be until the smart contract functionality officially launches. Cardano's smart contracts are currently in their testing phase, while making blockchains interoperable with Cardano is still in the ideation stage. The latter is an important aspect of Cardano's potential developer adoption as there is already material adoption, over $50B invested in Ethereum's smart contracts.

The open question is to what extent applications on Cardano become popular, especially when compared to applications currently popular on Ethereum.

Regulatory risks

The Cardano network was funded initially by a token sale and, as such, is vulnerable to some level of potential regulatory scrutiny due to the suspicion of some jurisdictions, namely the United States, to that particular method of fundraising. As Cardano continues to further decentralize and build working applications, in a similar vein to what Ethereum has done, the likelihood of severe regulatory scrutiny from any governmental body would likely decrease. It can be argued that Ethereum's "safety" in the eyes of US-based regulators, who stated that Ether is not a security, is one key moat that it has over the other smart contract networks such as Cardano.

Figure 5: Monthly Active Developers for Smart Contract Platforms. (Source: Electric Capital[9])



Cardano Research Primer

Contacts

21Shares AG

Dammstrasse 19

6300 Zug, Switzerland

Sales

+41-44-260-8660

sales@21shares.com

Research

research@21shares.com

Newsletter Subscription

https://www.21shares.com/signup

Footnotes

1. https://roadmap.cardano.org/en/byron/
2. https://iohk.io/en/team
3. https://iohk.zendesk.com/hc/en-us/articles/360016060314-Blockchain-storage-consolidation
4. https://cardano.org/genesis/
5. https://roadmap.cardano.org/en/byron/
6. https://adapools.org/
7. https://pooltool.io/
8. https://iohk.io/en/blog/posts/2020/10/29/bringing-new-value-and-utility-to-the-cardano-blockchain/
9. https://medium.com/electric-capital/electric-capital-developer-report-2020-9417165c6444

21SHARES