Cardano (ADA)

Digital Assets Research

Sean Farrell[AC]
sean.farrell@fundstrat.com
@SeanMFarrell

Walter Teng
walter.teng@fundstrat.com
@walterteng_

JB DeGroft
jb.degroft@fundstrat.com

Key Statistics	
Token Price	$0.50
Range (52W)	$0.40 / $3.10
Market Cap	$16.8B
Circulating Supply	33.8B
Volume (24H)	$518.2M

Source: Coingecko (8/4/2022)

Cardano: Building Towards Sustainable DeFi

- **Cardano (ADA)** is an open-source blockchain founded in 2015 that leverages a Proof-of-Stake (PoS) consensus mechanism through a protocol known as Ouroboros. It supports the development of decentralized applications (dApps) through a multi-asset ledger and smart contract functionality. ADA is the native token on Cardano and is used to transact, pay network fees, and provide security via staking.
- **Peer-Reviewed Research** – IO Global (IOG) is a technology consulting company and the primary developer of Cardano. In contrast to other blockchains, Cardano developers have favored a measured approach in bringing smart contract functionality to market, relying on peer-reviewed research and formal methods to build the platform. IOG believes that this strategy will result in a robust and scalable network with more sustainable incentive structures compared to other smart contract platforms. Smart contracts were enabled in September 2021 with the completion of the Alonzo upgrade.
- **Unique Architecture** – Cardano employs an Extended Unspent Transaction Output (EUTXO) accounting model (as opposed to an account-based model like Ethereum) for its ledger, which combines the structural simplicity of the UTXO model with the ability to execute smart contracts. The proposed advantages of the EUTXO model are greater cost predictability and the capability of processing multiple transactions in parallel. Cardano is written in Haskell, a functional programming language, which enables increased precision and traceability compared to object-oriented languages like Solidity or Rust.
- **Modular Scaling** – Cardano's Layer 2 scaling solution, Hydra, adds the capacity to perform off-chain transactions and makes regular payment transactions magnitudes cheaper and faster. Hydra prevents peer-to-peer microtransactions from overloading the mainchain by allowing users to perform a series of actions off-chain and move only the final state back on-chain.
- **Digital Identity and Sustainable DeFi** – The north star for IOG is bringing sustainability to DeFi via digital identification metadata, which might allow community-defined best practices to emerge and reduce the attack surface for corrupt players in DeFi. The initiatives IOG is undertaking today are done with the goal of ultimately reducing scams, hacks, and exploits and eliminating corruption via trustless identity solutions.
- **Risks** – Risks to consider when investing in Cardano: technology, valuation, regulatory, and execution.
- **Bottom line** – Cardano's low time preference has resulted in a relative lack of observable traction in terms of dApps and fees paid to the network. However, IOG has defined initiatives that include mainchain bridging, native stablecoins, and the improvement of developer resources, which could lead to an influx in capital and help Cardano to grow into its valuation. The next major milestone to monitor is the Vasil hard fork later this month.

Introduction

Technology Design

Ecosystem

Highlighted Applications

Quantitative Analysis

Appendix

Project Overview

CARDANO

Founded:	**2015**
Partners:	INPUT | OUTPUT; Cardano Foundation; EMURGO

Summary

- **Cardano** is an open-source blockchain that leverages a Proof-of-Stake (PoS) consensus mechanism. It supports the development of decentralized applications (dApps) through a multi-asset ledger and smart contract functionality.
- Cardano was first conceptualized by Charles Hoskinson and continues to be developed by **Input Output Global (IOG)** today. Hoskinson is a veteran in the digital asset space, having previously co-founded Ethereum.

IOG's Vision

- Democratize access and bring transparency to finance using scalable, interoperable, and sustainable technologies.
- Create a global society that offers a more direct way for individuals and businesses to interact and create.
- Realize a vision of a world without intermediaries, where "power is not controlled by few, but by the empowered many."

Differentiation

- Leadership favors a measured approach to network upgrades relative to other L1 networks.
- Built with a UTXO model using Haskell programming language, which might allow for increased security and precision.
- Cardano's protocols aim to provide more viable long-term rewards for staking in trustless environments.
- IOG's north star centers around building identity solutions that could lead to sustainable DeFi applications.

Financing

- The project garnered significant early interest, having raised $79 million for 25.9 billion ADA tokens through a 2017 ICO, executed over 4 tranches.
- Three entities (Input Output Global, Emurgo, Cardano Foundation) supporting Cardano's development received 5.2 billion ADA tokens, unlocked over three tranches with the final date being June 1st of 2019 ($442m at time of unlocking).

Source: Fundstrat, IOG

Input Output Global
Blockchain research committed to the principles of academic rigor

Figure: Input Output Global Management Team

INPUT | OUTPUT




Charles Hoskinson	Tamara Haasen	Romain Pellerin	Jeff Pollack
CEO / Founder	**President & Chief of Staff**	**Chief Technology Officer**	**Chief Financial Officer**
• Previously founded Invictus Innovations and co-founded Ethereum • Analytic Number Theory at University of Colorado Boulder	• Previously held leadership position at a non-profit • Law degree from Bond University	• Previously founded three start-ups as CEO and CTO positions • PhD in Distributed Computing from Conservatoire National des Arts et Métiers and Télécom SudParis	• Previously COO of Mizuho Securities and CFO of Blocbyte Holdings • BA Economics and Accounting at Rutgers University

Input Output Global (IOG) is a for-profit organization responsible for the technological research and development of the Cardano blockchain and its ecosystem. The vision is currently executed by over 400 employees in 50 countries.

Source: Fundstrat, IOG

Input Output Global (Cont.)
Blockchain research committed to the principles of academic rigor

Figure: Input Output Global Management Team

INPUT | OUTPUT




Jerry Fragiskatos	Gerard Moroney	Robert L. Adams	Prof Aggelos Kiayias
Chief Commercial Officer	**Chief Operating Officer**	**Executive VP of Strategy**	**Chief Scientist**
• Previously led digital transformations that resulted in $3B revenue • Masters of Engineering from McGill University and MBA from Collège des Ingénieurs	• Previously held leadership positions at Accenture and Upraxis • PhD from University of Liverpool	• Previously held leadership positions at Cisco and Dell • Computer Science degree from Penn State University	• Previously held leadership positions at Hua Nan Bank and CTBC Bank • PhD from City University of New York

IOG-Developed Technology

CARDANO · IO.ATALA PRISM · DAEDALUS · MANTIS

Source: Fundstrat, IOG

Cardano Foundation & Emurgo

Ancillary organizations supporting ecosystem adoption and growth

Figure: Cardano Foundation & Emurgo

Cardano Foundation

Frederik Gregaard

Chief Executive Officer

- Previously Head of Digital Financial Services at PwC Switzerland
- Master of Science from Copenhagen Business School

Cardano Foundation is a non-profit overseeing the development of Cardano and its ecosystem.

Partnerships

veritree

UBX

RIVAL

EMURGO

Ken Kodama

Chief Executive Officer

- Founder and Chairman of Sife Capital
- Bachelors in Business Administration from University of St. Andrews

Ellappan Venkatesan

CEO, Emurgo Academy

- Previously CEO of talent sourcing company
- Bachelors in Computer Science from Bharathidasan University

Emurgo is a for-profit operating enterprise tasked with boosting adoption of Cardano by investing in ecosystem startups and providing blockchain education.

Partnerships

adanian LABS

OCCAMFI

Source: Fundstrat, IOG

Introduction

Technology Design

Ecosystem

Highlighted Applications

Quantitative Analysis

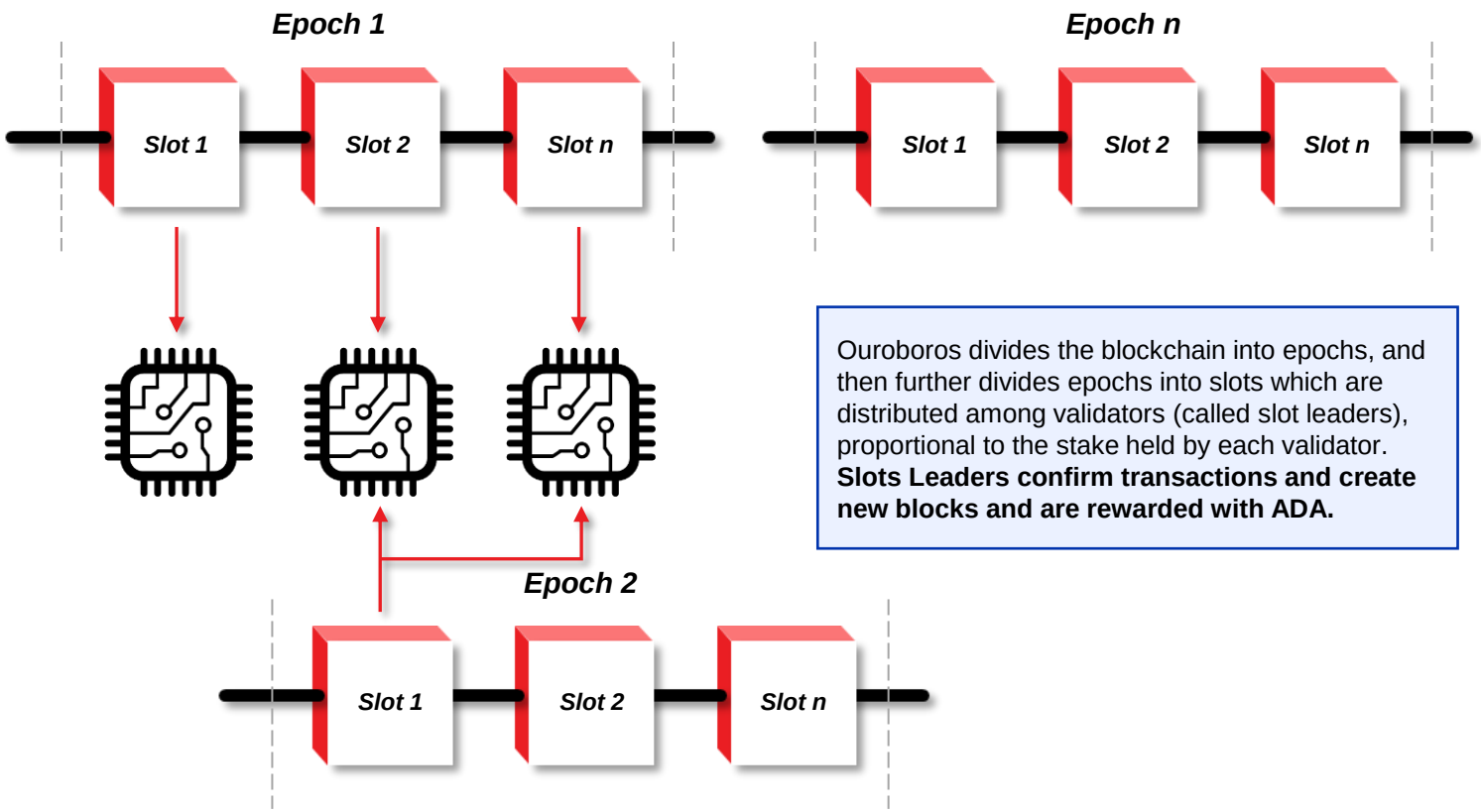
Appendix

Cardano Employs Ouroboros Consensus

A PoS Protocol Based on Peer-Reviewed Research

- **Ouroboros organizes blocks into time slots, which are distributed randomly such that each node validates a number of blocks proportional to the ADA staked. All nodes validate every block.**
- **Cardano does not require computationally-intense block mining like in proof-of work systems, nor does it require slashing. Instead, the protocol's reliability is achieved through random leader selection and according to IOG, has been deemed provably secure via peer-reviewed research.**

Figure: Introduction to Ouroboros



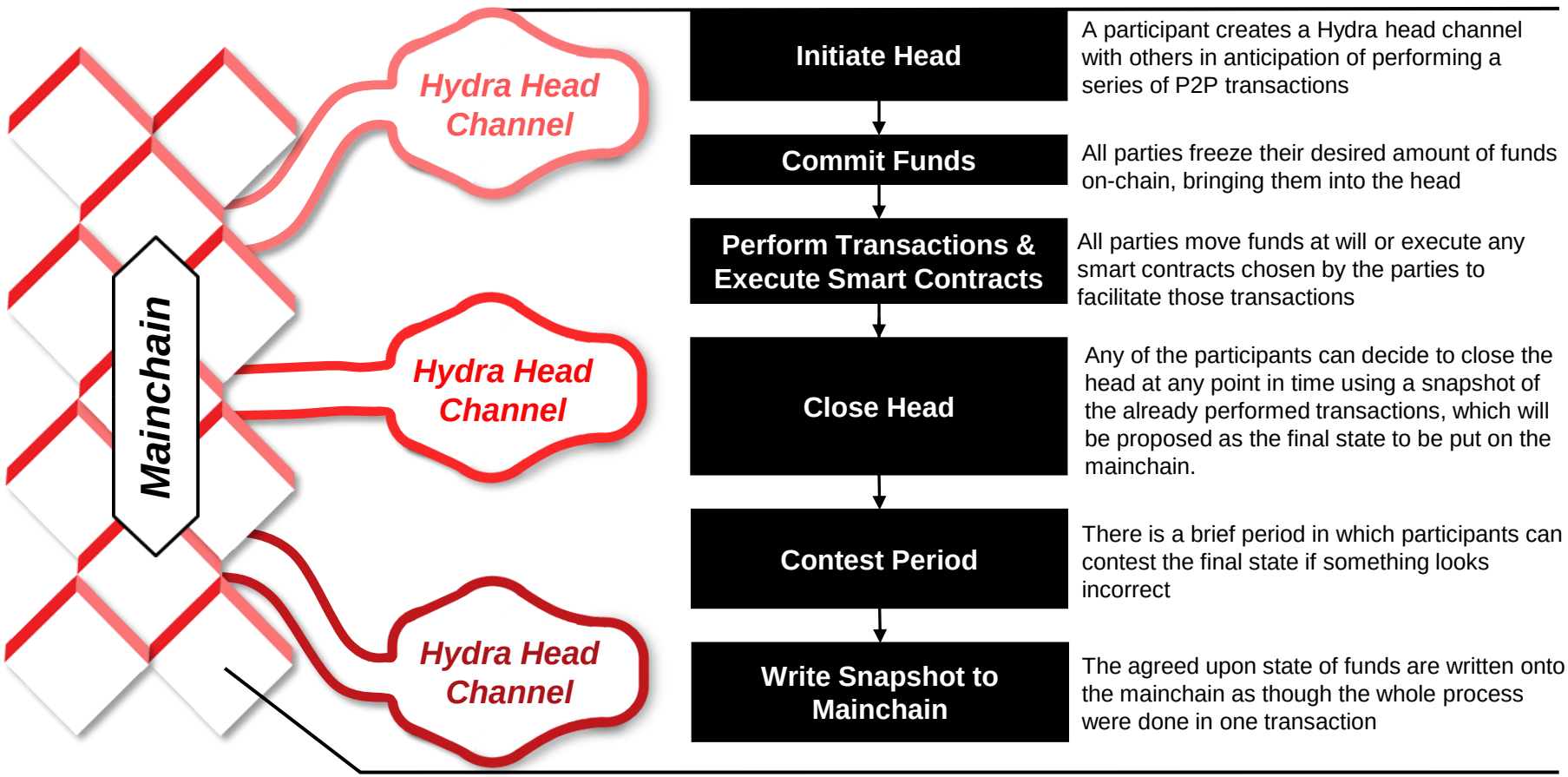
Source: Fundstrat, IOG

Hydra Adds The Capability To Perform Off-Chain Transactions

Regular payment transactions are magnitudes faster and cheaper

- **Hydra is a layer 2 scaling solution that enables peer-to-peer microtransaction throughput by allowing users to perform a series of actions off-chain and move only the final state of those actions back on-chain.**
- **Hydra uses isomorphic state channels, meaning every head channel takes on the same exact properties of the mainchain. This allows for on-chain security in off-chain transactions, seamless closing of head channels, and smart contracts written on the mainchain to be applied within Hydra heads.**

Figure: Compressing transactions with Hydra



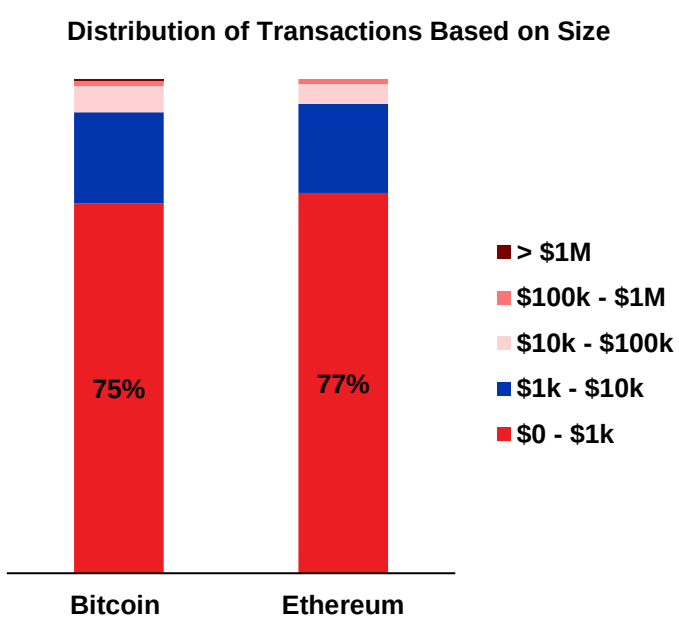
Source: Fundstrat, IOG

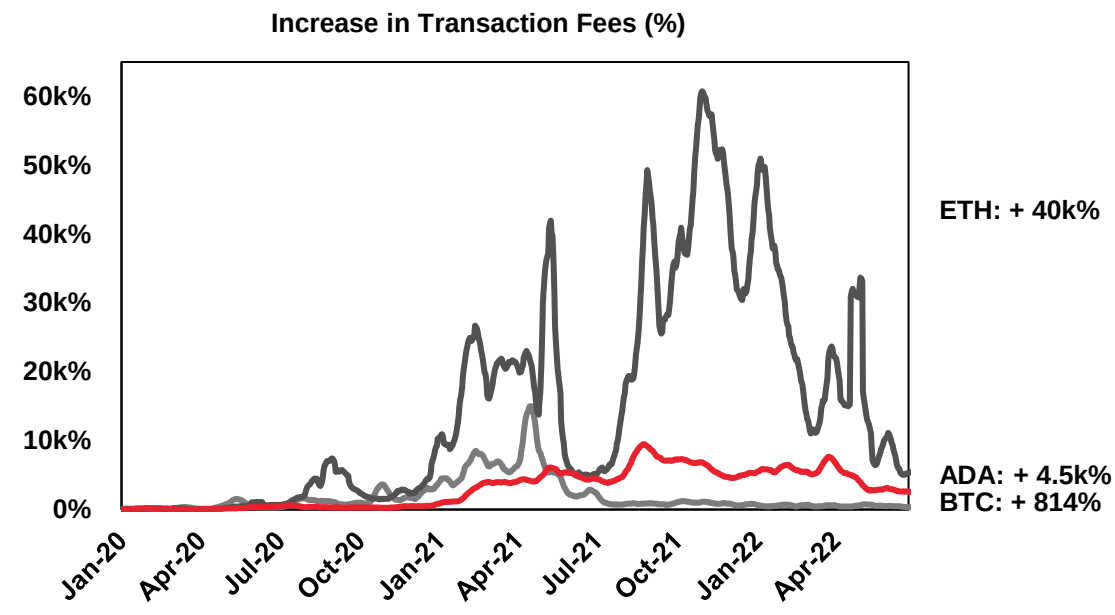
Hydra Alleviates Network Congestion

Regular payment transactions are magnitudes faster and cheaper

- **Moving peer-to-peer payments off-chain will likely free up a sizeable portion of available computing resources.**
- **Hydra will allow dApp developers to choose the level of data availability and storage required for their application. Applications that prioritize low transaction fees and minimal latency will run through Hydra, while dApps that require a more granular level of verification and security can stay on the mainchain.**

Figure: Estimated distribution of transfers bucketed by amount transferred





Using network activity on Ethereum and Bitcoin as a proxy for the distribution of txn sizes on Cardano, we can estimate that approximately 75% of transfers occurring on Cardano are likely small (<$1k) peer-to-peer payments.

Demand for Ethereum's smart contract capabilities and proven security model has pushed gas fees to non-negligible amounts.

Cardano is not yet seeing the same pressure on the network's computation power due to the nascency of smart contracts on Cardano, but Hydra is expected to prevent that pressure from occurring.

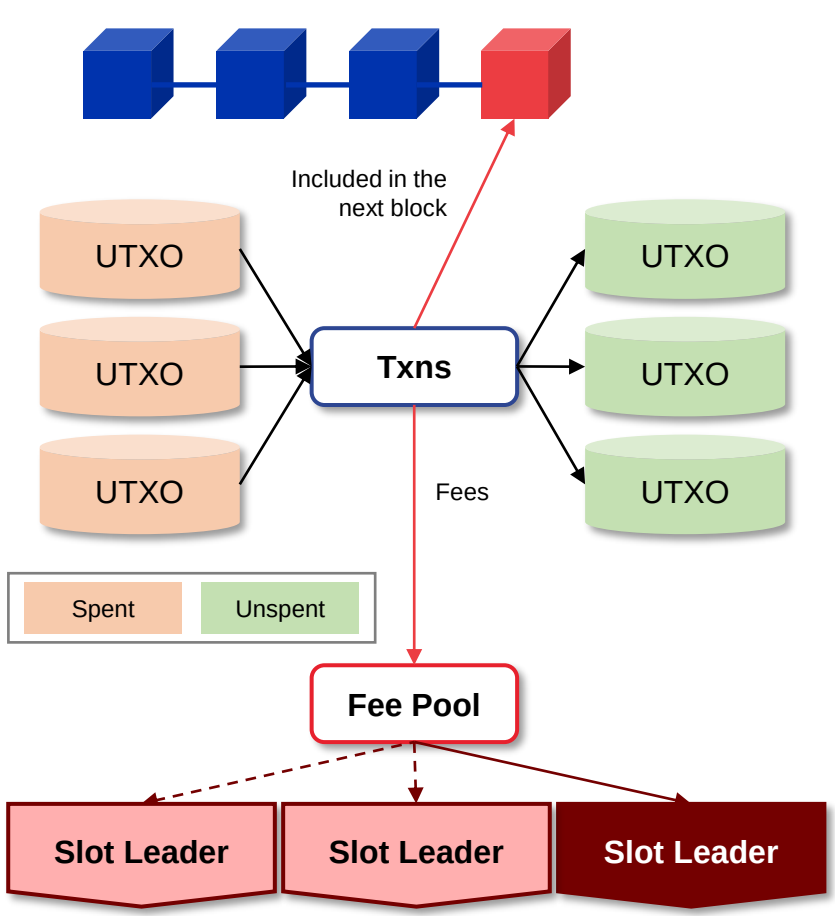
Source: Fundstrat, IOG, Glassnode, Data as of 7/6/2022.

Cardano Transaction Fee Design in EUTXO Model

Combination of fixed and variable fee yields optimum results

- **Cardano employs an Extended Unspent Transaction Output (EUTXO) accounting model (as opposed to an account-based model like Ethereum) for its ledger, which combines the structural simplicity of the UTXO model with the ability to execute smart contracts.**
- **Upper bounds on stake reward proportionality favors fair distribution and decentralization ethos.**

Figure: Cardano's Transaction Fee Design



1 **Fee in ADA / Byte**

This covers the computing and storage cost

2 **DDoS Protection**

Dummy transactions cost attackers a significant amount of money.

$$Fee_{Tx} = 0.000044 * (n_{Bytes}) + 0.155381$$

- To incentivize decentralized staking, stake pools have a maximum limit before they no longer receive greater rewards. That limit is at 1/k, where k = 500 as of writing.
- Fees are held in a pool until the end of every epoch and then distributed amongst the nodes that were elected as slot leaders at a proportion equal to the portion of blocks created by each node

Source: Fundstrat, IOG

Cardano Transaction Fee Design in EUTXO Model (Cont.)

Script execution costs vary based on script size & complexity

- **Advantages of the EUTXO model are greater cost predictability and the capability of processing multiple transactions in parallel. Cardano is written in Haskell, a functional programming language, which enables increased precision and traceability compared to object-oriented languages like Solidity or Rust.**
- **At the base layer, script execution cost is comprised of the current cost of each CPU & memory unit, as well as the transaction size. Additional scripts within transactions will add additional execution costs.**

Figures: Cardano's Script Transaction Fee Design & Example Script Execution Costs

Key Script Txn Fee Inputs & Examples

1 On-chain Transaction Size (*Bytes*)
The size of a transaction varies - around 300 bytes for a simple transaction and scripts ranging from ~4000-8000 bytes

2 Number of Computational Steps (*CPU*)
1 step is equivalent to 1 picosecond of execution time. Most scripts consume less than 1,000,000,000 steps

3 Number of Memory Units (*Bytes*)
Memory units represent the number of bytes that the script allocates. Most scripts should use less than 1,000,000 bytes (1 MB)

Example Transactions	Txn Size (*Bytes*)	CPU	Memory (*Bytes*)	Estimated Fee (*ADA*)
Simple Transaction (sending ADA only)	300	0	0	0.17
Plutus AlwaysSucceeds Script	340	1,624,000	160	0.17
Plutus Minting Script	3,400	500,000,000	1,400,000	0.42
Complex Plutus Script	8,192	2,000,000,000	1,000,000	0.72
Maximum Script Cost	16,384	10,000,000,000	10,000,000	2.17

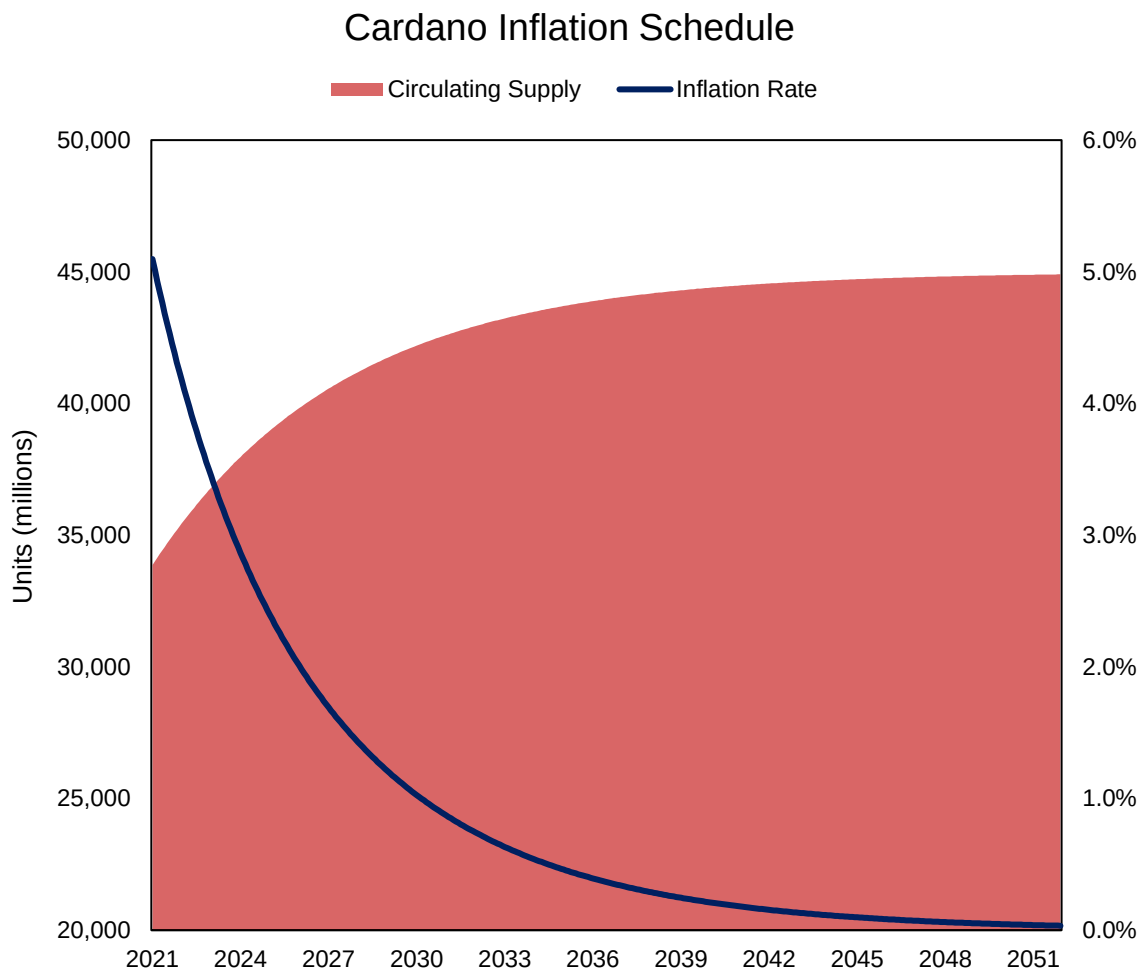
Source: Fundstrat, IOG

Cardano Distribution Schedule

Token distribution reflects design principles of other successful projects

- **Monetary expansion will be the main source of rewards for operators and delegators early on, but this will gradually be replaced by transaction fees detailed in the previous slide as inflation converges to null.**

Figure: Cardano Inflation Schedule



- Cardano's inflation rate is the function of the reserve balance and participation in staking.
- Given the formula above, the reserve will never be completely empty. Instead, the rate of inflation asymptotically approaches zero.
- This makes ADA disinflationary, similar to the inflation rate of Bitcoin, which halves every four years.

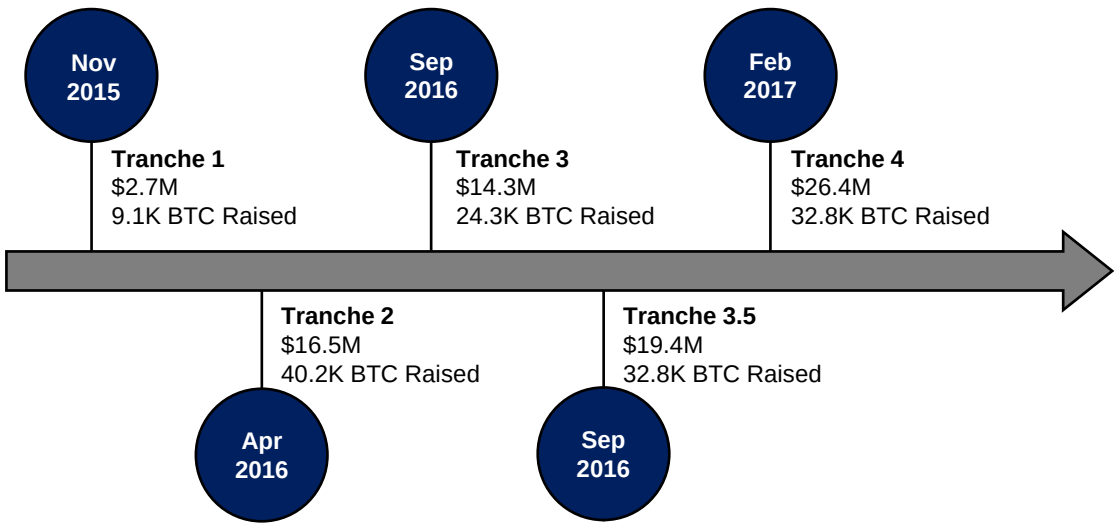
Source: Fundstrat, IOG, Messari, CoinMarketCap

Funding Rounds

Fair launch mechanism differentiates Cardano from competition

- **Cardano has only raised external funding from a series of ICO rounds, separating it from well-funded competing Layer-1s that have risen to popularity in 2021 such as Solana and Avalanche.**

Figure: Cardano Public Funding Rounds



- Cardano raised $76.4M for over 5 public funding rounds from 2015 – 2017.
- Cardano distributed vouchers for 25.9B ADA in a series of public token sales from September 2015 to January 2017. Through Cardano's native Daedalus wallet, participants could redeem vouchers for actual ADA tokens.
- Three entities supporting Cardano's development received 5.2B ADA in total, with the most significant recipient being IOG (48%).

Figure: Cardano Distribution to Date

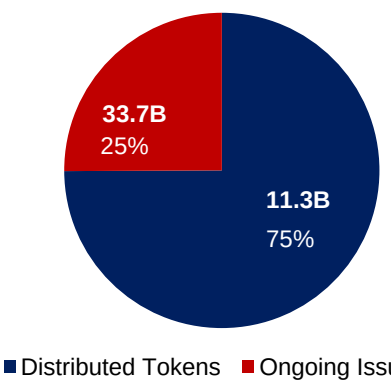


Figure: Initial Token Distribution

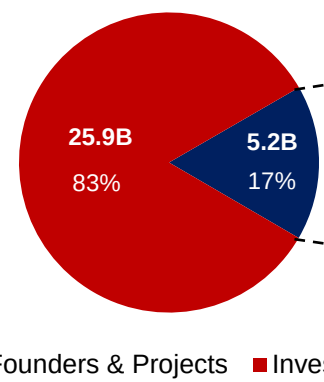
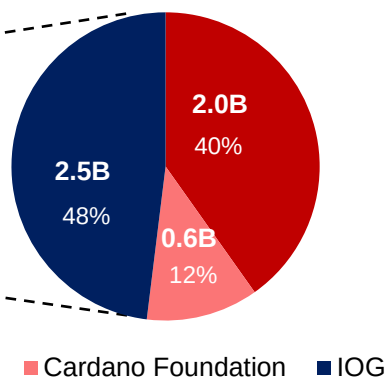


Figure: Founders & Project Breakdown



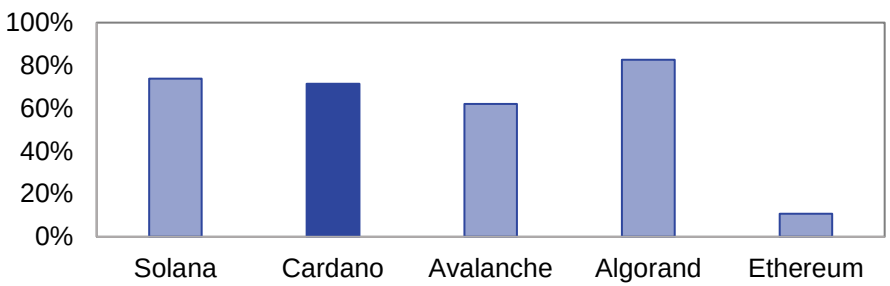
Source: Fundstrat, IOG, Messari, Data as of May 2022

Staking Overview
High participation rates and competitive yields

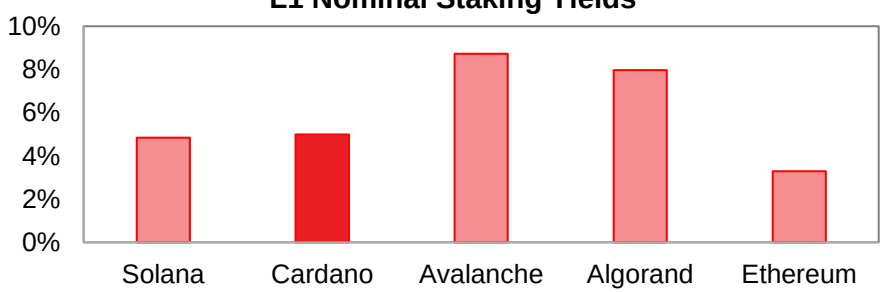
- **Cardano's PoS consensus mechanism, Ouroboros, allows users to participate in block production by operating stake pools on their own or delegating to existing stake pools in exchange for staking rewards.**
- **Cardano currently boasts one of the highest staking participation rates amongst L1s with over 70% of the 33.8 billion circulating token supply committed to a staking pool.**
- **After inflation, the current real yield for delegators is 1-3% depending on fees charged by the pool operator.**

Figures: Key Staking Metrics, ADA Staking Pool Distribution, L1 Staking Yields and Participation Rates

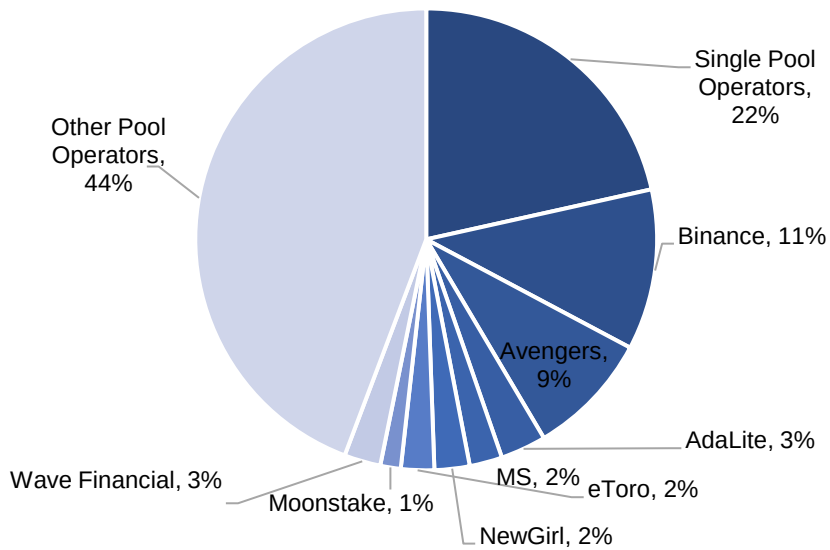
L1 Staking Participation Rates



L1 Nominal Staking Yields



ADA Staking Pool Distribution



~3,000
Total Pools

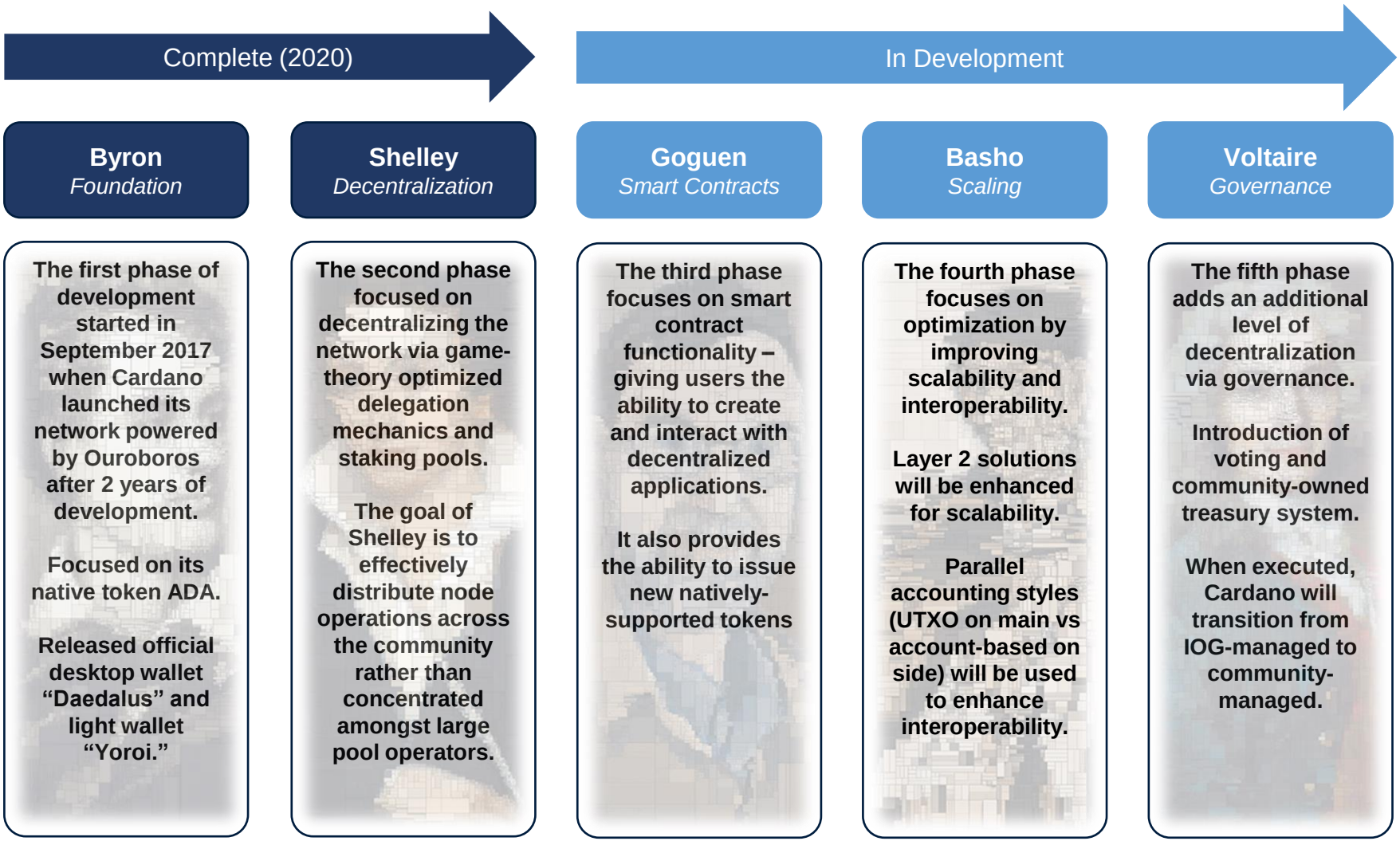
~1 Million
Staking Addresses

The largest individual staking pools are operated by entities with significant ADA holdings like exchanges, wallets, and investment firms that generate income-type yield on client assets.

Source: Fundstrat, Staking Rewards, Adapools.org, PoolTool.io, Data as of June 2022

Development Roadmap
Five “Eras” from building blocks to governance

Figure: Cardano Development Roadmap



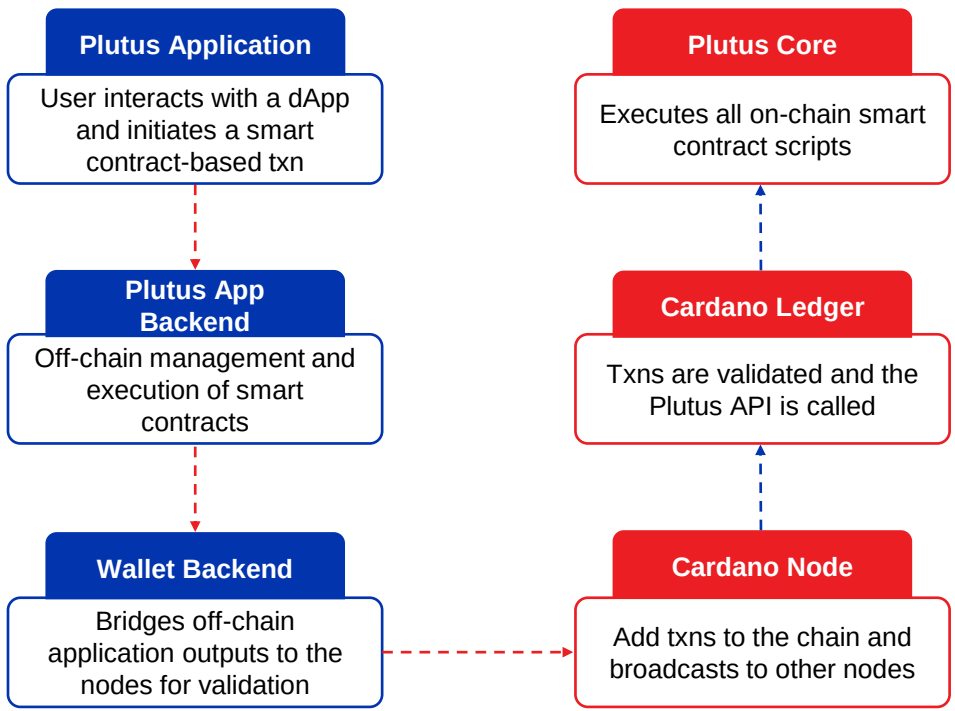
Source: Fundstrat, IO Global

Plutus Launched with Varying Degrees of Success

Smart contracts offer more utility but are more data-intensive

- **Cardano implemented smart contract capability in Sep 2021 with the Alonzo hard fork, thus enabling the development of a DeFi ecosystem on the L1 beyond simple data transfers between users. The smart contract language on Cardano is known as Plutus.**
- **Smart contracts require more data per transaction than simple value transfers. Consequently, Cardano has encountered instances in which mainnet launches of DeFi applications resulted in high latency and low throughput. IOG has attributed these early challenges to a lack of developer education, adaptation, and optimizations that needed to be in place. IOG is confident these issues will be resolved via the upcoming Vasil upgrade.**

Figure: Plutus smart contract backend and launch issues



Uncertified dApps in Early Deployment

Highly-anticipated application launches on the Cardano mainnet brought an overwhelming amount of network activity and Cardano enhancements were required as a result.

Minswap

The first Cardano mainnet dApp; the network did not process multiple txns concurrently, causing repeatedly-failed txns

Sundaeswap

The first Cardano decentralized exchange; the network was overloaded with too much network activity on launch. Users' txns would take hours to go through

The IOG team has developed and is currently testing updates to better handle activity bursts

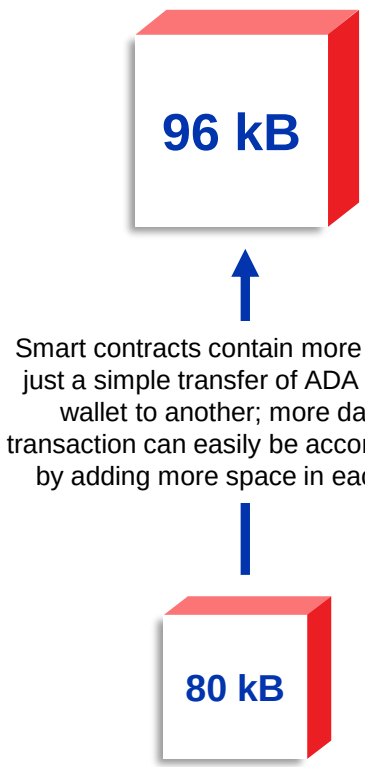
Source: Fundstrat, IO Global

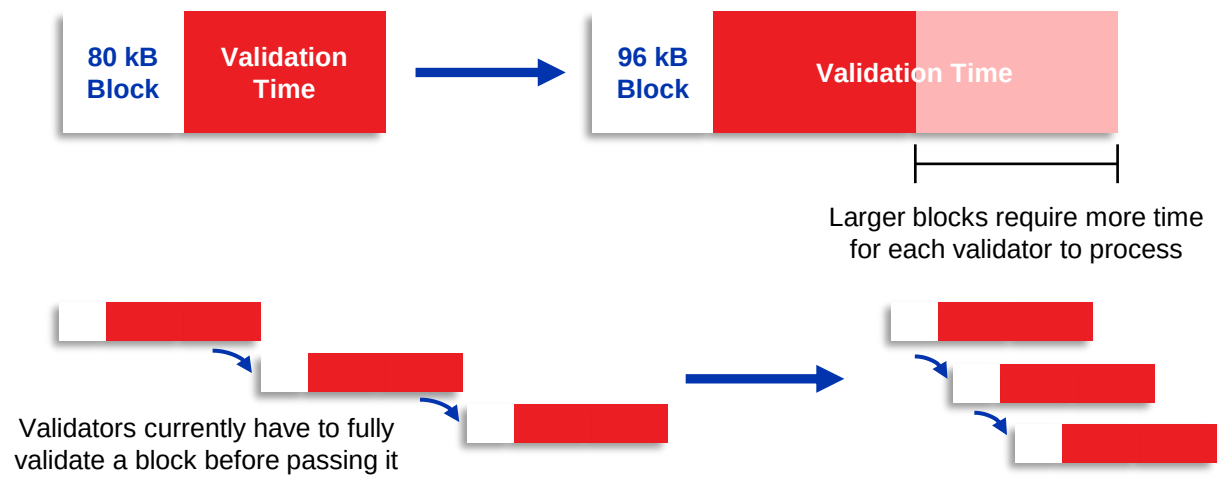
Implementing Upgrades

The current updates include a larger block size and diffusion pipelining

- **Increasing block size allows more to be added to the blockchain every epoch, increasing transaction throughput. A larger block size will allow the network to handle more data-intensive transactions like DEX swaps and NFT mints.**
- **Diffusion pipelining allows blocks to be propagated to other nodes while they are still being validated, enabling multiple nodes to validate blocks concurrently. This prevents larger blocks from slowing the consensus process.**
- **Developers believe these solutions will result in an immediate scalability increase and should help mitigate congestion during the ongoing rollout of smart contract-enabled dApps.**

Figure: Updates that IOG is implementing to increase transaction throughput in the near-term





Transaction Size	0.5 kB	1 kB	2 kB
Current Consensus	8	4	2
Maximum Block Size	48	24	12
Diffusion Pipelining	110	55	27

Diffusion pipelining allows validators to pass on the block much earlier in the validation process before fully verifying all of the transactions, greatly shortening the time to achieve consensus

Source: Fundstrat, IO Global

Introduction

Technology Design

Ecosystem

Highlighted Applications

Quantitative Analysis

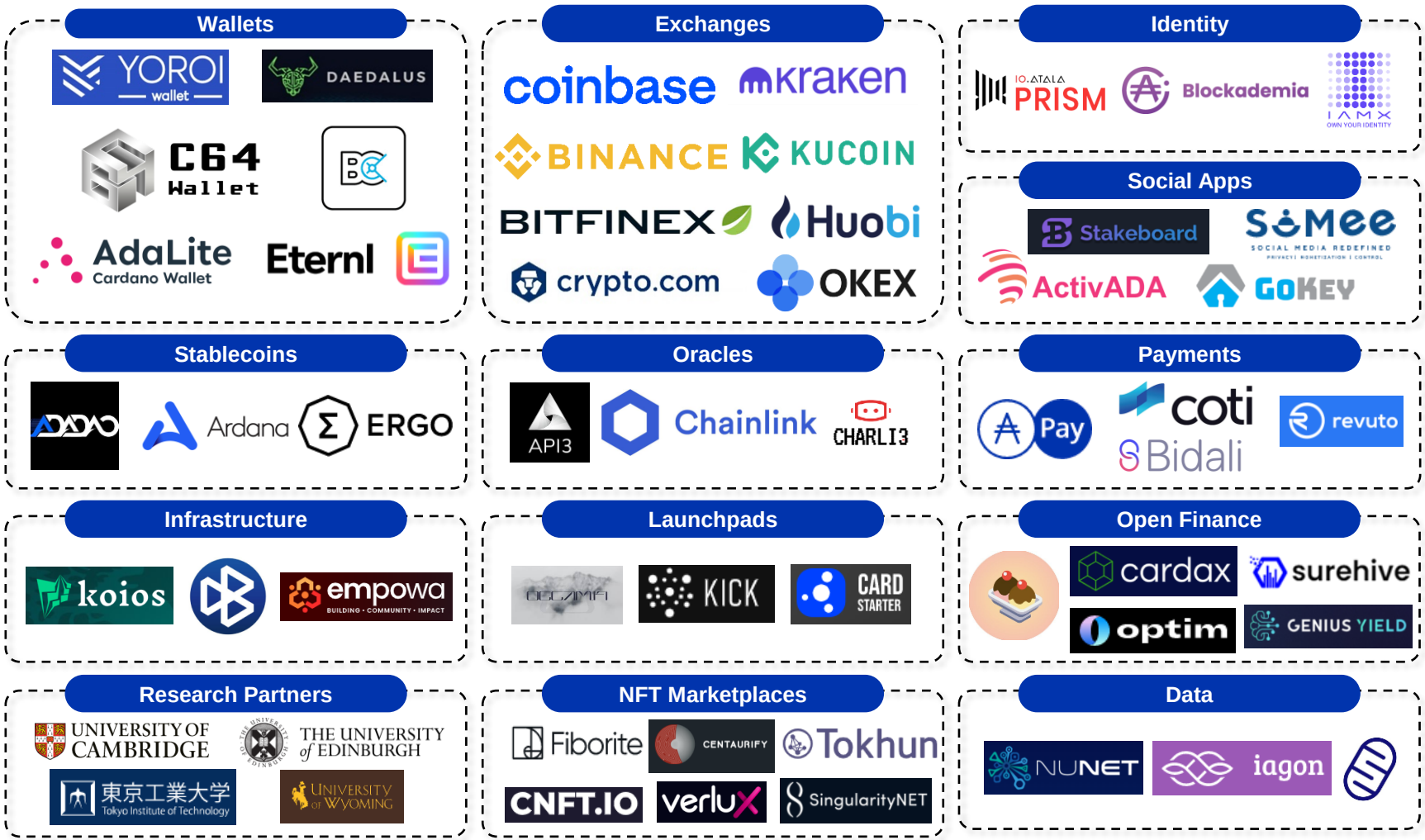
Appendix

Early Ecosystem Growth

New ecosystem fund and partnerships support early adoption

- **Including NFT collections, there have been 92 projects launched on Cardano to date.**

Figure: Cardano Ecosystem (As of July 22, 2022)



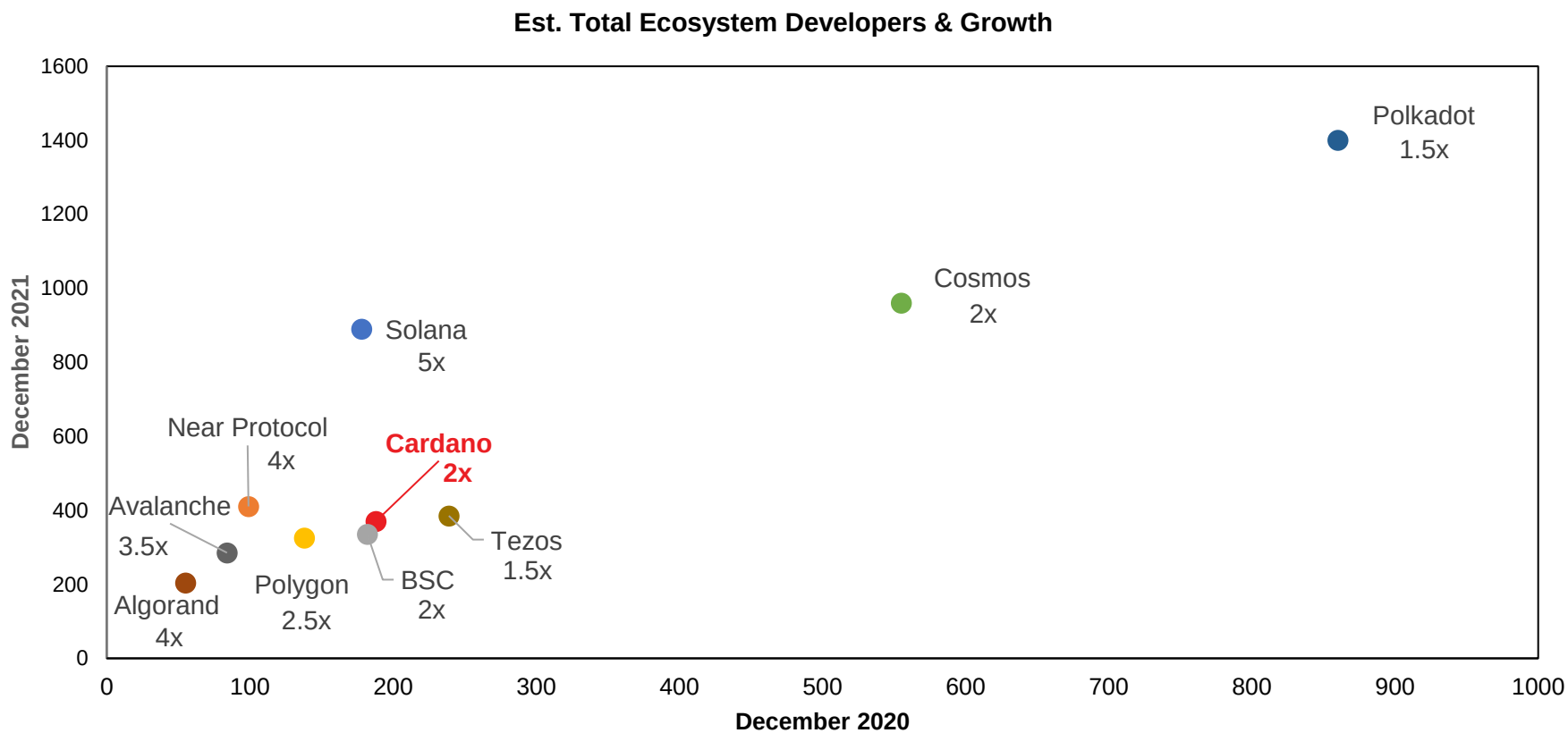
Source: Fundstrat, IOG, dApp Orbit Tracker

Ecosystem Developer Growth Alongside Peers

Developers are critical participants contributing to long-term growth

- **Cardano ecosystem developers (excluding IO Global) grew 90% in 2021 to over 350 monthly developers in total. This includes both full-time and part-time developers contributing to the greater Cardano ecosystem.**
- **By comparison, this outpaces some competing smart contract platforms with greater than 300 developers like Binance Smart Chain (+80%) and Cosmos (+70%) – while others like Solana, Near, and Polygon have outperformed – putting Cardano in the middle of the pack.**

Figures: Estimated Total Ecosystem Developers



Source: Fundstrat, Electric Capital 2021 Developer Report (latest available)

IOG's Road to Sustainable DeFi

The goal is for regulated DeFi that solves real-world problems

- **In IOG's broadcast of 2022 plans, Charles Hoskinson committed to building a financial operating system by Q3 2022 that will give financial services to the 350 million unbanked demographic in Africa.**

Figure: Open Finance vs Decentralized Finance

Regulated Decentralized Finance	Existing Decentralized Finance
Emphasis on providing banking services to the unbanked population	Focus on disintermediating financial services offered to banked demographic
Collaborative approach with regulators and local government to boost adoption	Speed of innovation often require protocols to tread on legal gray areas
Unbundling financial services with clear use-cases amongst non-crypto natives	Hypothecation of financial instruments with no clear product-market fit beyond crypto
The purpose of decentralization is to alleviate corruption	Most successful protocols have uncompromising ethos of decentralization

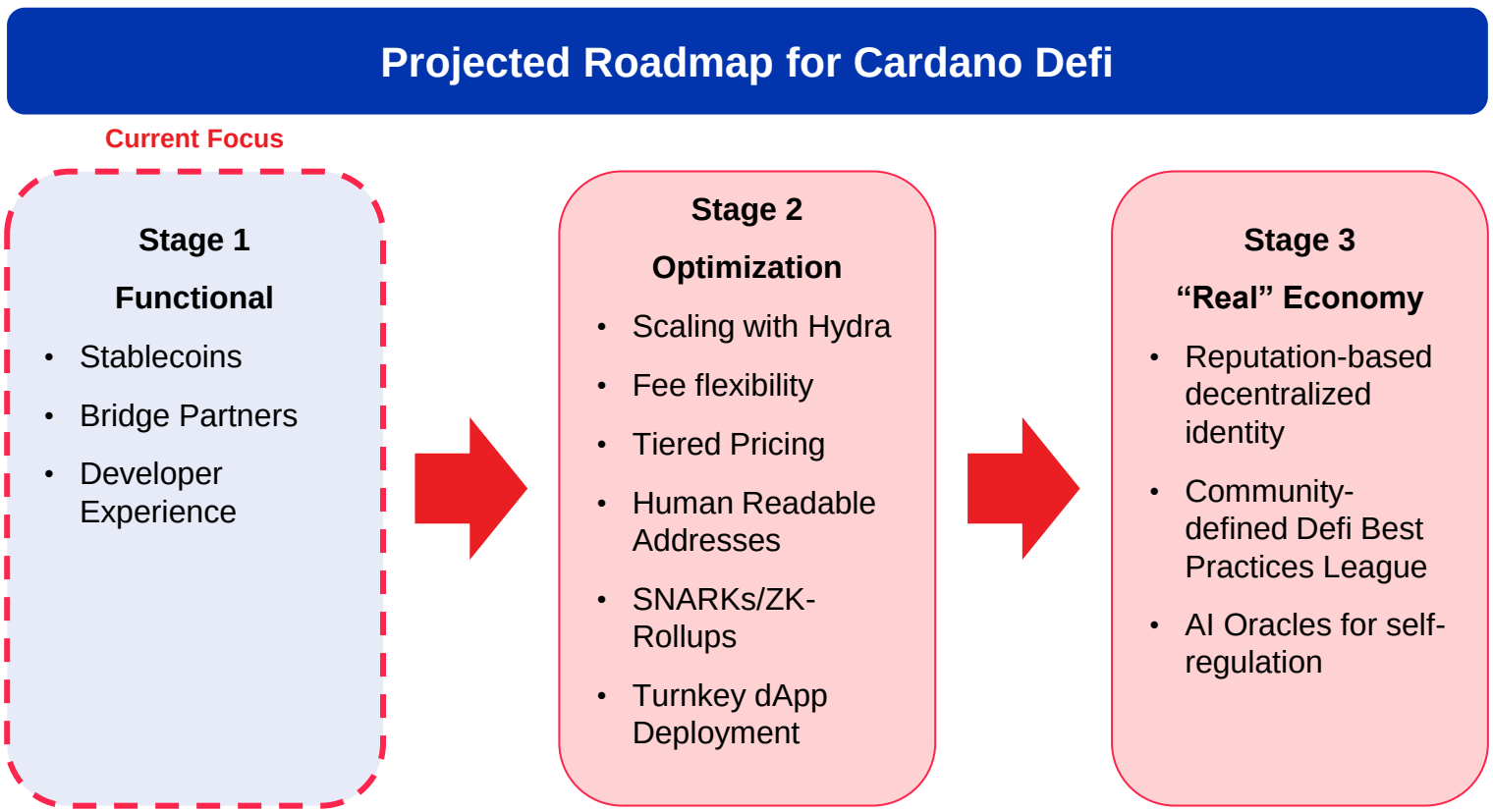
Source: Fundstrat, IOG

DeFi Roadmap Starts with Functional Elements

IOG's initial focus is on bridges, stablecoins, and developer tooling

- **While the ultimate goal for IOG and many within the Cardano development ecosystem is to create a decentralized economy that wholly integrates real-world assets, it has become apparent that supporting a DeFi ecosystem is an essential first step.**
- **Bridges, stablecoins, and developer tooling are key strategic initiatives the developer community will be focused on in the immediate term.**

Figure: IOG's Core DeFi Initiatives

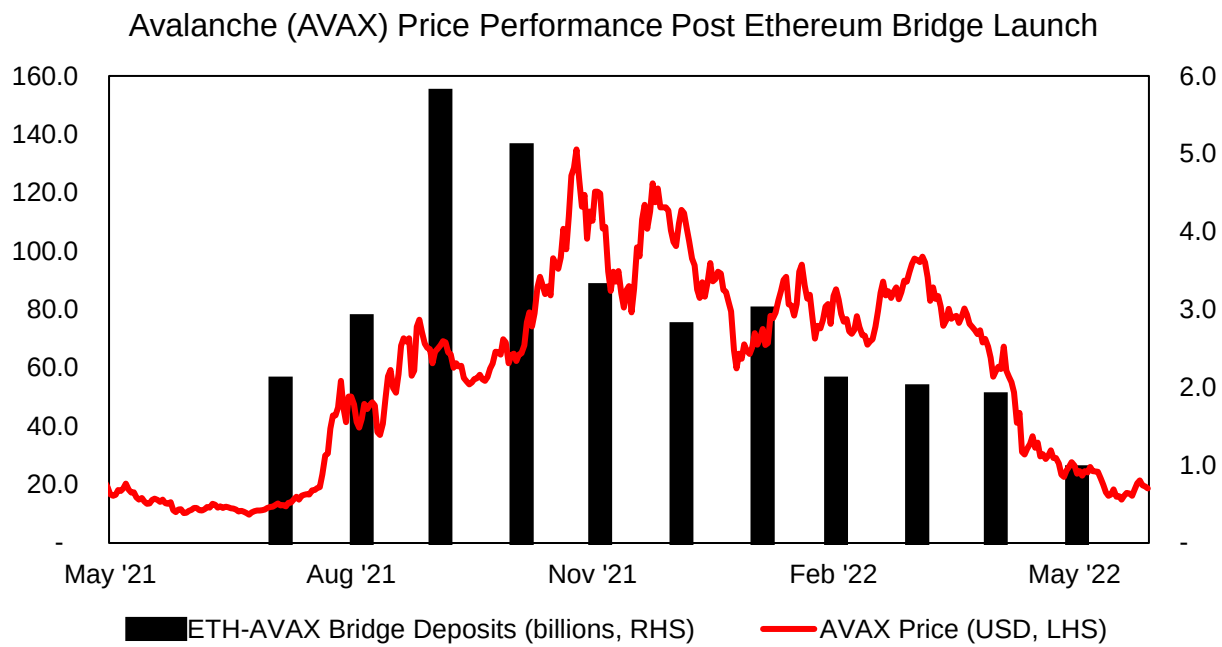


Source: Fundstrat, IOG

Bridges
Allowing liquidity to flow from other ecosystems

- **Bridges are protocols that connect two fundamentally different networks. Mechanically, they require a "deposit" on one end of the bridge and are provided a derivative ("wrapped") asset on the destination side of the bridge (ex: ETH to WETH).**
- **In many ways, if we consider the functional similarities between smart contract platforms and decentralized economies, bridges are akin to opening up the capital account in an emerging market country, which, if executed well, could lead to considerable capital flows between economies.**
- **Presently, Cardano's bridge partners are in early stages of deployment. IOG and other Cardano developers wish to bring a robust mainchain bridge to market to shepherd liquidity from other networks to Cardano.**
- **Historically, we have seen the introduction of Ethereum (where most of the liquidity in DeFi resides) bridges as a conduit for increased development and dApp usage.**

Figure: Bridges Overview



Avalanche (AVAX) is an example of a competing Layer 1 network that empirically benefitted from bridging to a high TVL chain, thus allowing users to migrate their liquidity to Avalanche.

Multichain

RenBridge

IOG has identified Multichain and RenBridge as potential partners for the Cardano network.

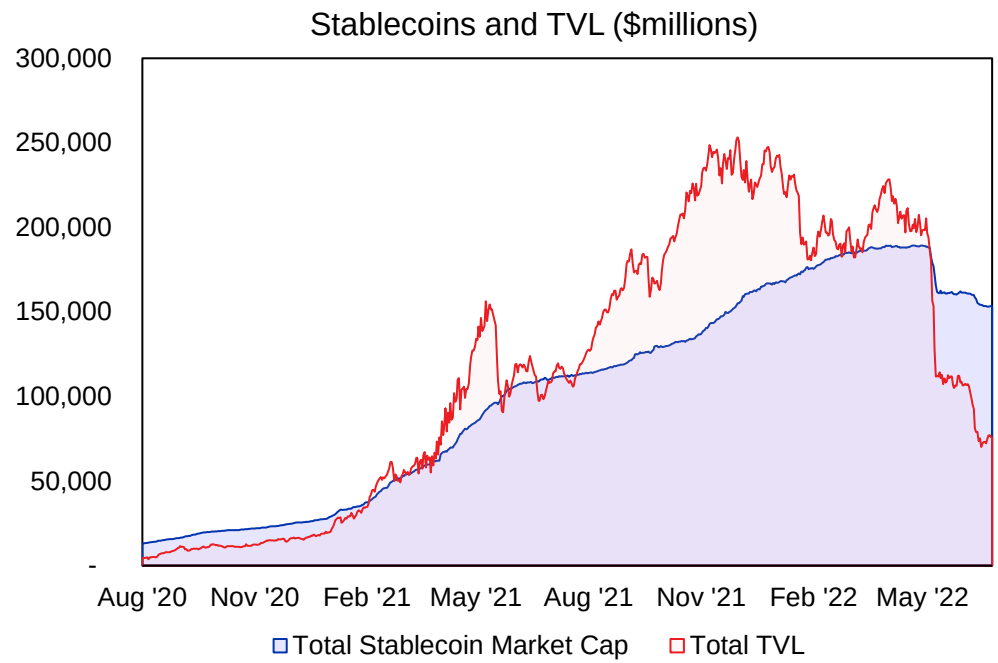
Source: Fundstrat, IOG, TradingView, Etherscan

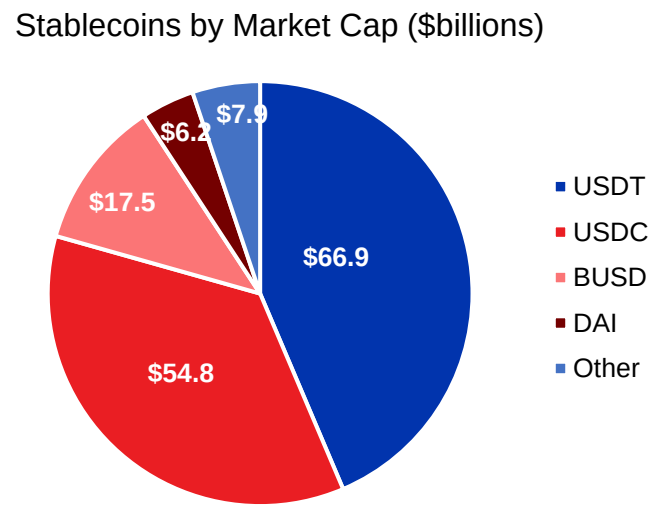
Stablecoins

Integral part of DeFi that provides users with a familiar unit of account

- **Stablecoins are digital assets designed to remain pegged to the value of a designated asset, through collateralization or algorithmic supply adjustments. The most common stablecoins are USD-pegged (USDT, USDC).**
- **Stablecoins offer a relatable store of value within a blockchain ecosystem, allowing users to transact and participate in digital economies without the need to convert back to fiat currency in the non-digital financial system. Many refer to stablecoins as a key "on-ramp/off-ramp" tool from the fiat economy to the crypto economy.**
- **The correlative relationship between stablecoin market cap growth and the total value locked across all crypto networks speaks to their integral role in providing liquidity in web3 applications. While there are currently bridged (wrapped) stablecoins available via select sidechains on Cardano, a native, fiat-backed stablecoin would provide potential users a more secure and liquid resource to transact with on the network.**

Figure: Stablecoins Overview





USD Coin

IOG has identified USDC as a preliminary stablecoin partner for the Cardano network due to its 1:1 fiat-backing and sound reputation in the industry.

Source: Fundstrat, IOG, DefiLlama

Developer Resources

Onboarding builders into the Cardano ecosystem

- **Cardano uses a functional programming language in Haskell, which no other major blockchains have adopted as their smart contract language. This means there are fewer experienced developers ready to deploy Haskell-based dApps on Cardano. Also, as mentioned previously, Cardano uses a UTXO-based model, which requires another element of education for smart contract developers.**
- **As previously noted, IOG has expressed that the complexity of Cardano requires greater developer education. Fortunately, there is ample precedent found on other chains that provides guidance on how to improve the developer experience and potentially attract greater developer mindshare.**

Figure: Qualitative Assessment of Haskell programming Language and potential path forward for Cardano

Likely due to the complexity of the Haskell programming language, there is an observably smaller developer pool. The benefit of this is that the developer community can listen to and iterate on feedback at a faster pace.

Blockchain	Language	"Most-Loved" Ranking[1]	Github Stars
Ethereum	Solidity	10	17.3k
Solana	Rust	1	68.2k
Near	Rust	1	68.2k
Polkadot	Rust	1	68.2k
Cardano	**Haskell**	**22**	**3.7k**

Steps that IOG has outlined to improve the developer experience:

- Provide resources to expedite tooling & education initiatives with an emphasis on production-ready practices.
- Provide end-to-end developer education.
- Further collaborate with existing developers in the Cardano ecosystem around upcoming changes to ensure that tooling is consistent and enduring.
- Through Cardano Improvement Proposals, create a roadmap to improved protocol interoperability.

Source: Fundstrat, IOG, Pontem.Network, Github, (1) Most-loved ranking is derived from a StackOverflow survey that asked developers what their most loved programming languages are. Due to their similarities, JavaScript was used as a proxy for Solidity

Capital Ready to be Deployed Via the cFund

Venture capital fund investing in the Cardano ecosystem

- **cFund is an early-stage, sector agnostic venture fund that invests in companies that accelerate Cardano and its ecosystem. The Fund is a collaboration between Wave Financial[1] and IO Global.**

Figure: Fund Overview, IOG, and Select Current Investments

Fund Strategy

- Equity of token investments less than $20 million pre-money
- 5% - 20% of the funds held in dry powder (fiat currency and liquid tokens)
- Facilitates equity investments and strategic risk management
- Liquid positions managed via lending, staking, and derivatives strategies to maximize yield

In Partnership with IOG

- **Founder:** Charles Hoskinson
- Driving development of Cardano and its ecosystem
- Goal of building high-assurance blockchain infrastructure solutions for public and private sector clients

Current Investments

coti
A decentralized and scalable payments network for the global e-commerce market

BlockSwap Network
An automated liquidity protocol for the PoS chains that allows users to restake staked assets

Occam.Fi
Suite of DeFi solutions tailored for the Cardano blockchain. DeFi applications will be able to raise capital using the launchpad.

1. Wave Financial is a multi-product asset manager in the digital asset space.
Source: Fundstrat, Wave Financial

Introduction

Technology Design

Ecosystem

Highlighted Applications

Quantitative Analysis

Appendix

Empowa: Addressing Africa's Housing Problem

Tokenizing property on Cardano for real world impact

Figure: Empowa Overview

Africa's Housing Problem

The African housing market is severely undersupplied due to several factors including the continent's high population growth. Additionally, Africans that do have access to housing generally pay anywhere between 25-45% interest on mortgages – a result of the significant housing supply/demand mismatch and lack of funding.

Housing Shortage

50 million home shortage across Africa

High Interest Rates

25-45% rates for mortgages

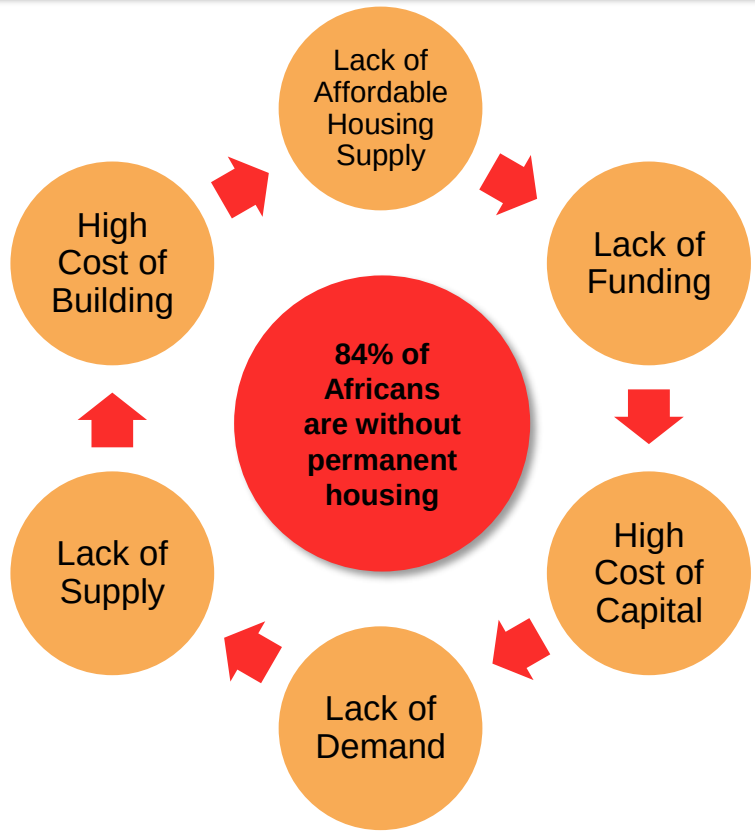
Low Mortgage Origination

Mozambique has 30M people but only 600 mortgages

Lack of Property Rights

80% of population owns land and assets without legal record

Reinforcing Cycle



empowa
BUILDING • COMMUNITY • IMPACT

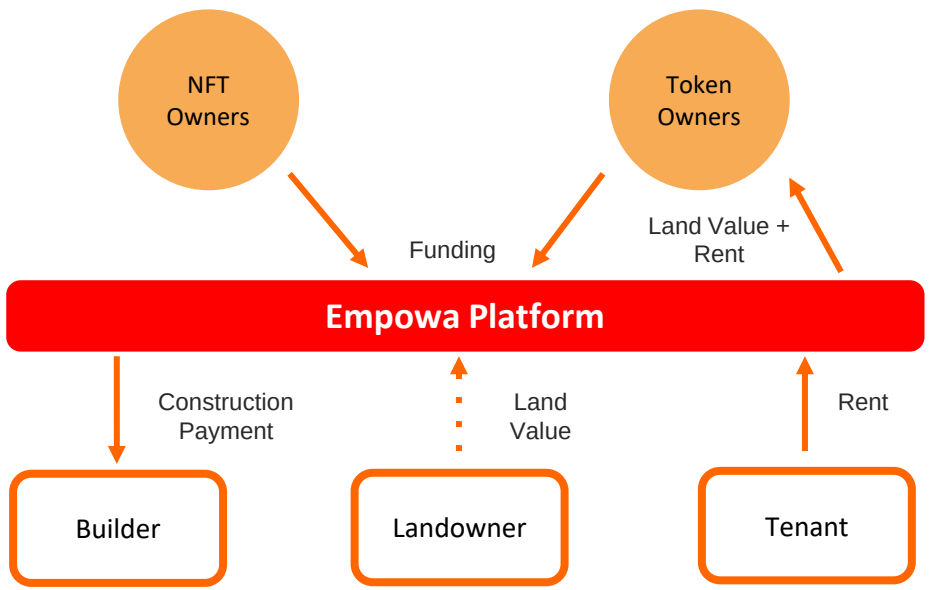
Source: Fundstrat, Empowa, World Bank Group

Empowa: Addressing Africa's Housing Problem
Tokenizing property on Cardano for real world impact

Figure: Empowa Overview

The Solution

Through decentralized financing options, Empowa aims to increase the capital available to African home builders. They are taking a broad approach starting first with NFT sales followed by the EMP token sale. EMP token holders will receive a portion of future rental income from the properties.



*Simplified Platform Structure**

Project Overview

empowa
BUILDING • COMMUNITY • IMPACT

Project:	Empowa
Website:	Empowa.io
Token:	EMP
Primary Purpose:	Native Currency, Funding Mechanism
Token Sale Terms	$0.25 (50M allocation)
Supply:	200,000,000 EMP
Fully Diluted MC:	$50.0M
Industry Segment:	RealFi, Tokenization

Source: Fundstrat, Empowa

Atala PRISM: Decentralized Identity & Record Keeping Solution

Rolling out to over 5 million students and teachers on Cardano

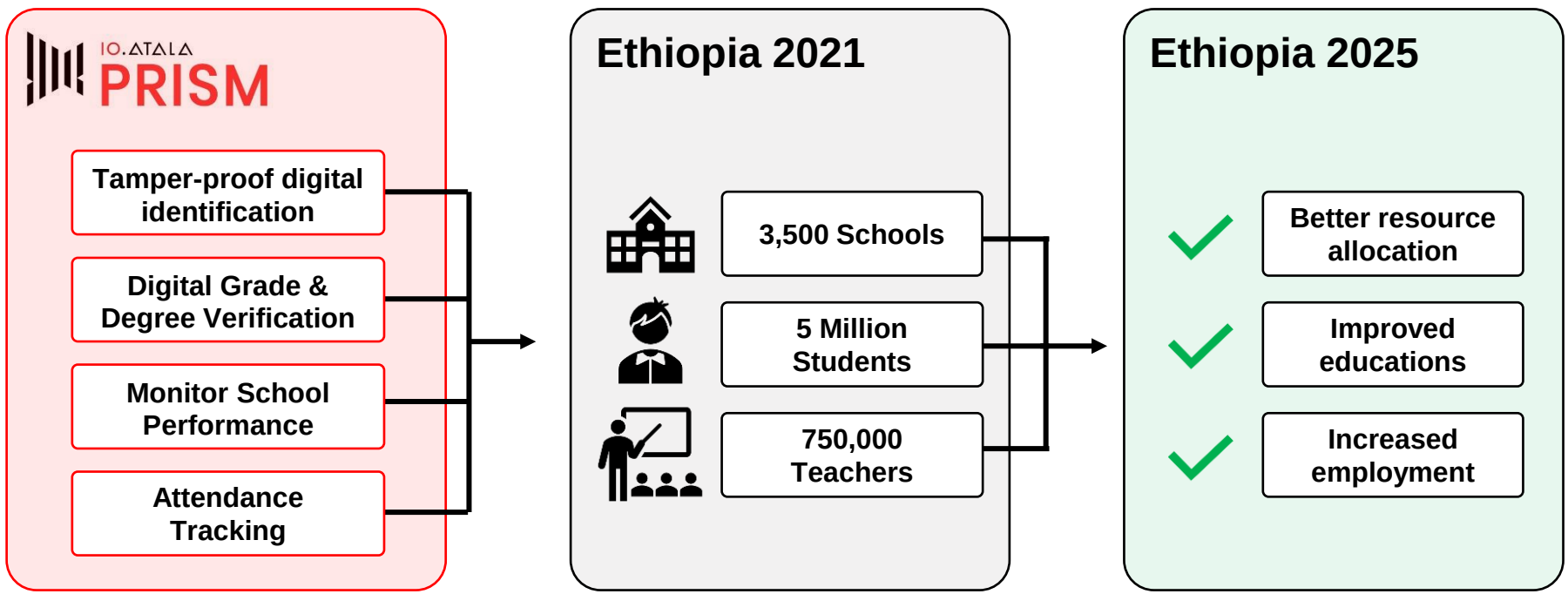
Figure: Atala PRISM Overview

Overview

- Atala PRISM is a decentralized identity & record keeping solution with the goal of digitizing services in developing geographies.
- By building on Cardano, the platform is highly customizable depending on use case and user base, as well as highly secure and scalable.

Major Use Case (below)

- Atala PRISM is a key component of Ethiopia's Digital Transformation strategy. The platform is first being implemented in the country's education system of 5 million students and is expected to provide a host of benefits.
- For Cardano, this also introduces over 5 million new users to its platform.



Source: Fundstrat, IOG, Atala Prism

SundaeSwap
One of the first native decentralized exchanges on Cardano

Figure: SundaeSwap Overview

Project Overview

SundaeSwap

Project:	SundaeSwap
Website:	Sundaeswap.finance
Token:	SUNDAE
TVL:	$34.1M
Backers & Partners	cFund, Alameda Research, Double Peak Group, runtime verification, Mlabs
Mainnet Launch:	Jan 20, 2022
Industry Segment:	Decentralized Exchange
Project Description:	SundaeSwap is one of the first functional decentralized exchanges on Cardano. It allows users to deposit tokens as liquidity, enabling others to swap in and out of tokens. In exchange, swappers pay a fee for utilizing the platform which accrues to the liquidity providers.

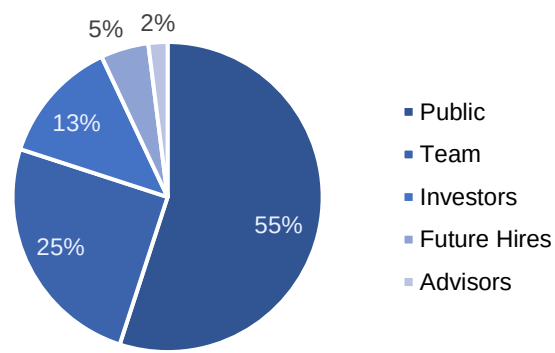
Tokenomics

Distribution
2 billion tokens were minted at inception and are to be distributed as the protocol matures. Currently, the white paper only includes a high-level token distribution breakdown (below). Importantly, 5% of the supply has been distributed via the ISO and the lion-share of tokens has been allocated to liquidity rewards.

Team / Investor / Advisor Vesting
Tokens allocated to early team members will be released according to a 4-year schedule while investors and advisor tokens vest over a 2-year period. Tokens are released on a monthly basis.

Profit-Sharing
The white paper notes the intent to implement a profit or fee-sharing mechanism whereby swapping fees accrue to token holders similar to SushiSwap.

SUNDAE Token Distribution



Source: Fundstrat, IOG, SundaeSwap, DeFi Llama

Introduction

Technology Design

Ecosystem

Highlighted Applications

Quantitative Analysis

Appendix

Key Network Adoption Metrics

Strong Growth in 2021 followed by pullback across most metrics

- **TVL increasing in Q2 irrespective of price declines is a positive sign that suggests the ecosystem is attracting new entrants.**

Figure: Key Metrics

Quarter End	Q3 2020	Q4 2020	Q1 2021	Q2 2021	Q3 2021	Q4 2021	Q1 2022	Q2 2022
ADA Price ($)	**$0.10**	**$0.18**	**$1.19**	**$1.38**	**$2.11**	**$1.31**	**$1.14**	**$0.45**
% Change	*21%*	*80%*	*556%*	*16%*	*53%*	*-38%*	*-13%*	*-61%*
Circulating Supply (MM)	**31,635**	**31,812**	**32,010**	**32,188**	**32,397**	**32,910**	**33,123**	**33,469**
% Change	*2%*	*1%*	*1%*	*1%*	*1%*	*2%*	*1%*	*1%*
Market Cap ($MM)	**$3,199**	**$5,780**	**$38,180**	**$44,454**	**$68,391**	**$43,169**	**$37,915**	**$15,120**
% Change	*24%*	*81%*	*561%*	*16%*	*54%*	*-37%*	*-12%*	*-60%*
FD Supply (MM)	**45,000**	**45,000**	**45,000**	**45,000**	**45,000**	**45,000**	**45,000**	**45,000**
% Change	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*
FD Market Cap ($MM)	**$4,550**	**$8,176**	**$53,673**	**$62,147**	**$94,997**	**$59,028**	**$51,510**	**$20,330**
% Change	*21%*	*80%*	*556%*	*16%*	*53%*	*-38%*	*-13%*	*-61%*
Avg Daily Active Addresses	**13,917**	**13,121**	**64,679**	**88,983**	**104,322**	**169,506**	**157,248**	**88,722**
% Change	*62%*	*-6%*	*393%*	*38%*	*17%*	*62%*	*-7%*	*-44%*
Avg Daily Txn Count	**5,666**	**5,885**	**25,480**	**40,542**	**56,489**	**113,682**	**125,674**	**94,082**
% Change	*60%*	*4%*	*333%*	*59%*	*39%*	*101%*	*11%*	*-25%*
Total Fees ($MM)	**$0.0**	**$0.0**	**$0.5**	**$1.2**	**$2.4**	**$3.9**	**$4.3**	**$2.3**
% Change	*151%*	*8%*	*2598%*	*159%*	*104%*	*61%*	*9%*	*-47%*
Total Value Transferred ($MM)	**$0.10**	**$0.10**	**$0.70**	**$0.60**	**$1.20**	**$0.90**	**$2.00**	**$1.90**
% Change	*248%*	*-56%*	*1033%*	*-5%*	*88%*	*-27%*	*136%*	*-4%*
Average TVL ($MM)	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**$165**	**$215**
% Change	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*30%*

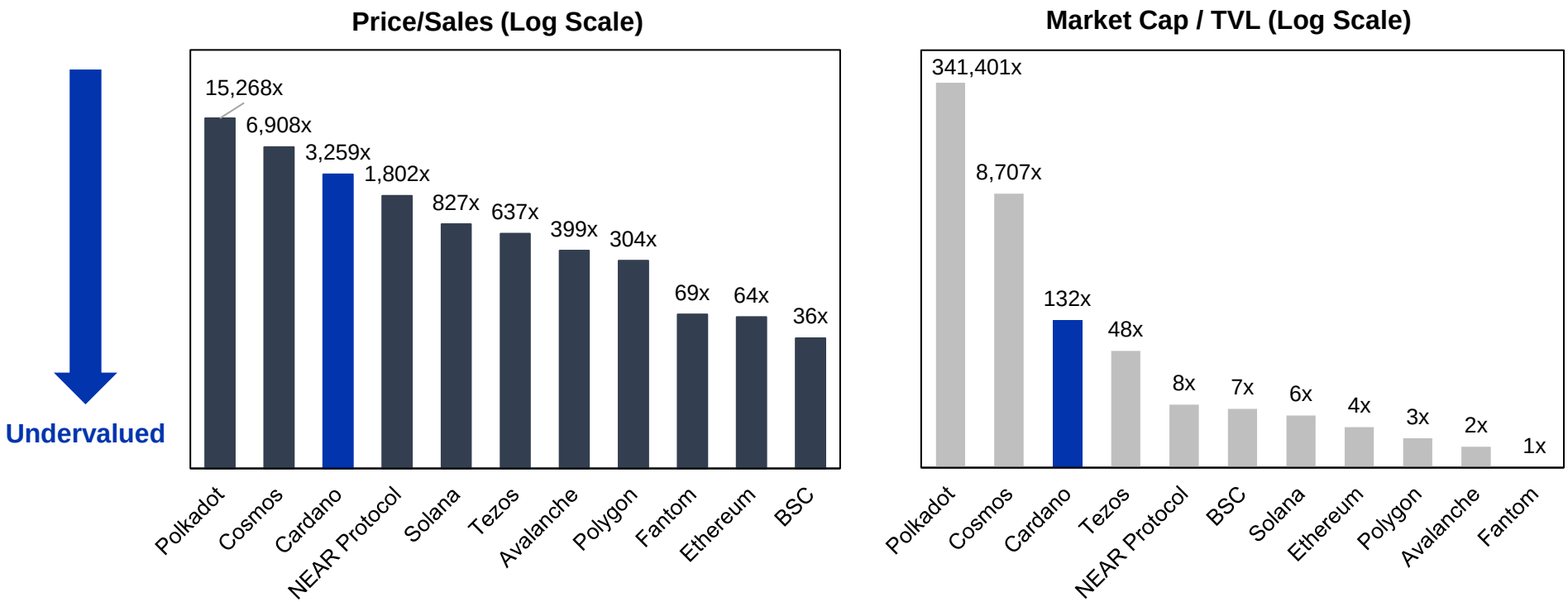
Source: Fundstrat, CoinMetrics, DefiLlama

Valuation Metrics

Using traditional valuation multiples for L1 blockchains

- **Below, we calculated multiples of price/sales and market cap/total value locked (TVL) among competing L1 blockchains. P/S is calculated using the non-fully-diluted market cap divided by the annualized daily fees over the previous 30 days.**
- **While we acknowledge the limitations of TVL as a reliable valuation metric, we feel it does provide directional insight on how frothy a token's price is relative to the economic value stored in each ecosystem.**
- **Based on the latest data, Cardano ranks toward the higher end of both multiple ranges.**

Figure: Comparative Valuation Metrics (As of June 2022)

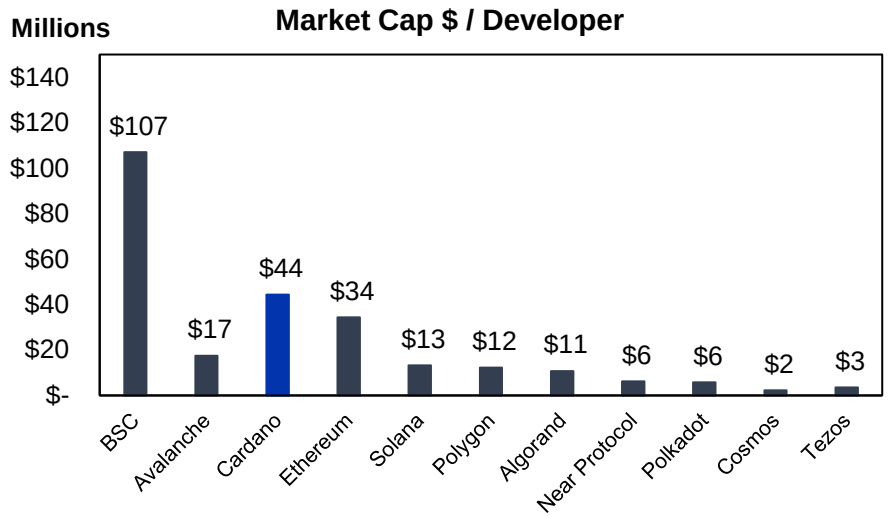


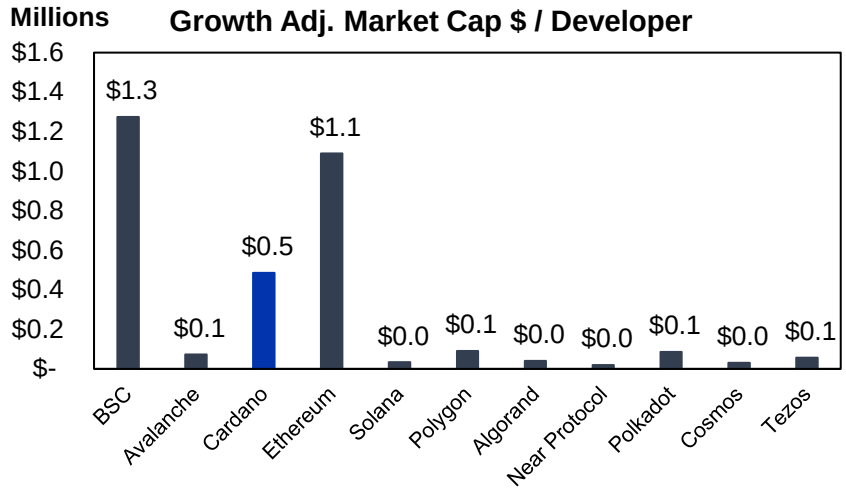
Source: Fundstrat, Messari, Token Terminal, Stats.Avax.Network, Coingecko, DefiLlama

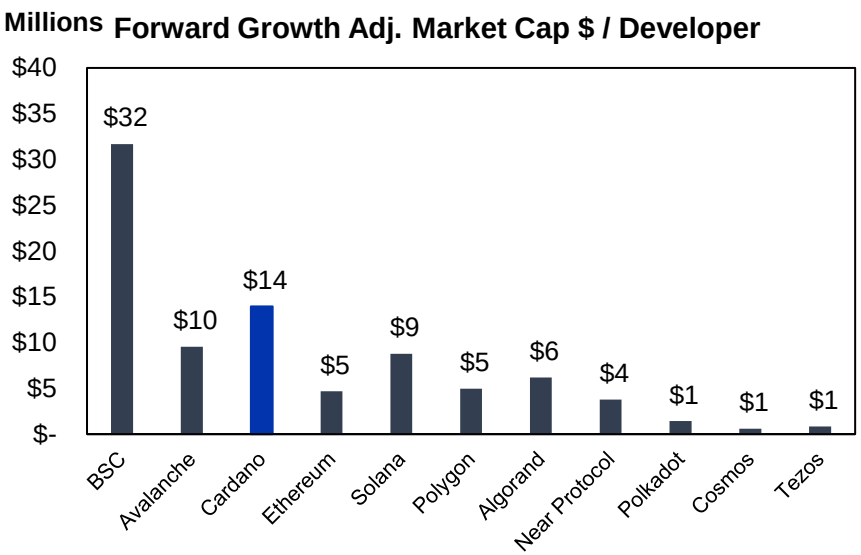
Ecosystem Developer Metrics

Developer activity is a key value driver for L1s

Figure: Comparative Developer Valuation Metrics (As of 7/5/22)







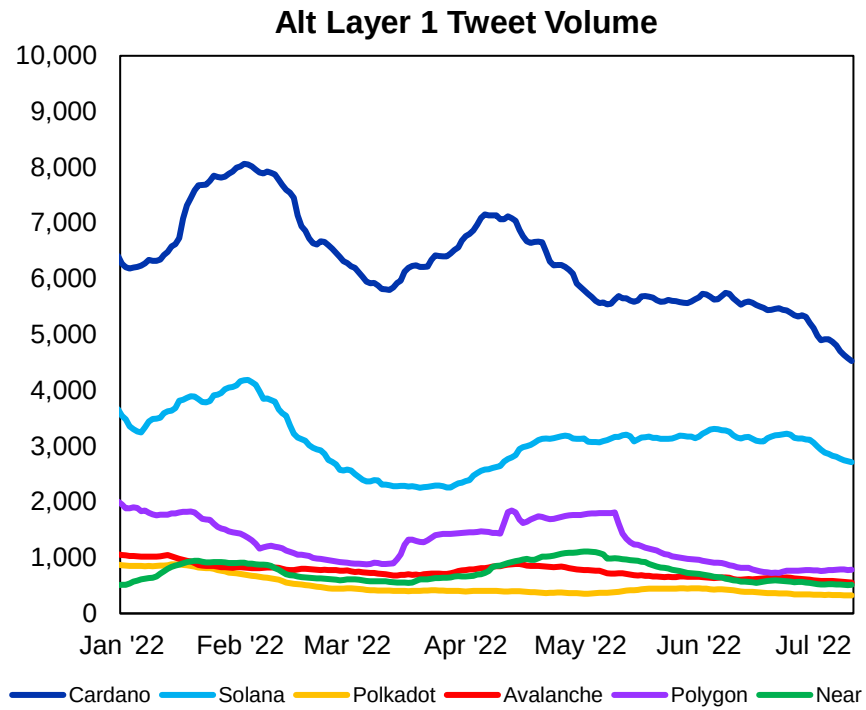
- We view ecosystem developer activity as a leading indicator for L1 growth. More developers are generally associated with higher levels of dApp development which in turn provides users with more use cases for the L1.
- We can observe this relationship by simply comparing the fully diluted market cap and the total number of ecosystem developers (top left). From this metric, Cardano is currently valued at $44M per developer. Taking this one step further, we adjust this metric for developer growth from December 2020 to December 2021 (top right).
- Lastly, we project this metric out one year at an annual developer growth rate half that of 2021, resulting in a forward value of $14M per developer. Please note that the latest developer count available is from December 2021.

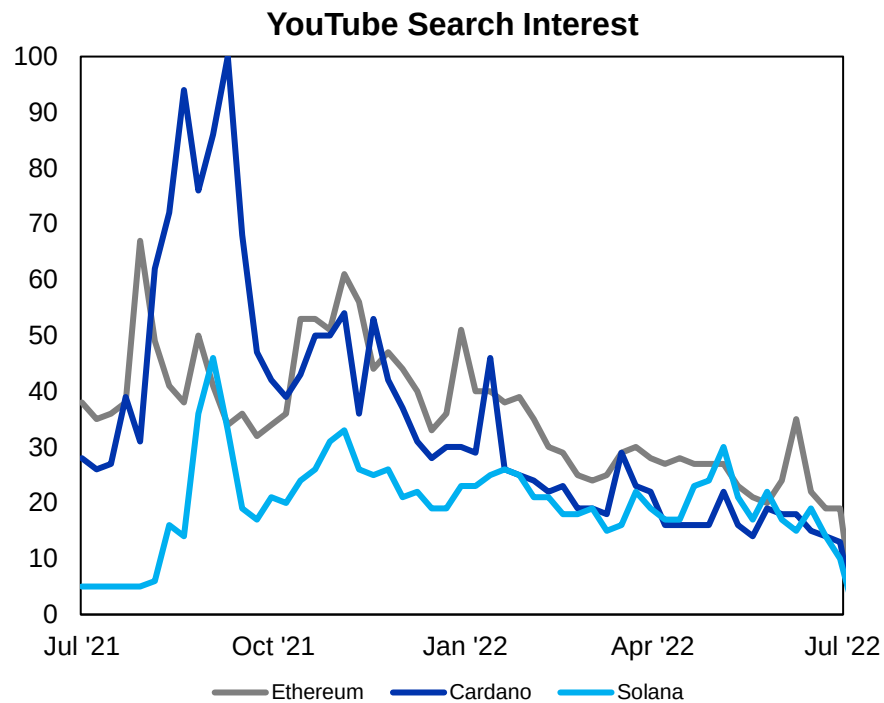
Source: Fundstrat, Messari, Token Terminal, Stats.Avax.Network, Electric Capital, Coingecko

A Dedicated Community

Cardano has one of the strongest and largest communities of L1s

Figure: Comparative Community Engagement Metrics (As of 7/12/22)





- Cardano's community engagement is among the highest of the alternative L1 protocols. Cardano's tweet volume[1] remained resilient throughout a broader market downturn. Cardano averaged ~6,300 tweets a day in 2022, compared with ~3,000 for Solana, ~1,300 for Polygon, ~760 for Avalanche, ~750 for Near, and ~390 for Polkadot. Ethereum had the most tweets out of any Layer 1 at ~50,600 (not pictured).
- Relative YouTube search interest also suggests strong engagement from the community. Cardano has periodically led Ethereum in YouTube search interest. Cardano had higher relative search interest compared to both Ethereum and Solana in early Q4 of 2021, and now only lags slightly behind Ethereum.
- ***We think that the strong Cardano community is one of the stronger tailwinds for Cardano. As a more robust dApp ecosystem emerges on Cardano, it will be met with a fervent base of retail investors eager to participate in the Cardano economy.***

Source: The Tie, Google Trends, (1) TheTie.io defines Tweet Volume as the total number of tweets about a particular asset over the last 24 hours.

Summary of Key Near-term Milestones
Network improvements, bridges, stablecoins

Figure: Key upgrades and milestones that we will be monitoring

The following are key milestones that we will be looking for developers to reach over the coming 12 months.

1. **Vasil Hardfork –** The Vasil hardfork, which was originally set to go live on June 29th, was delayed for a month to iron out a few bugs prior to launch. We are not necessarily concerned about the bugs, since this happens quite often in software development. This network upgrade is set to address many of the scalability concerns that plagued the first generation of dApps.

2. **Bridge Launch** – The launch of an audited, reputable multichain bridge to the Cardano mainchain will be a critical step toward opening the ecosystem up to existing crypto-native liquidity, and in turn, may incentivize the migration of developers to Cardano.

3. **Stablecoin Launch** – Stablecoins provide a familiar unit of account, in the same way that investors in foreign emerging markets often price wealth in USD, transacting in the leading global reserve currency generally allows for more frictionless transacting in DeFi and Web3 applications. The adoption of native USDC would be a major achievement for the platform.

Source: Fundstrat, IOG

Risks to Consider

Risks to consider as Cardano grows into its valuation

Figure: Risks to consider while evaluating the Cardano ecosystem

Technological Risk

The functionality of Cardano's smart contracts following the Alonzo upgrade in September has yet to prove competitive to comparable L1 platforms. While some dApps have been deployed on-chain, there were challenges faced by some of the earliest dApps. IOG is addressing these concerns, but the technological risk will remain high until Cardano is tested in a decentralized, public setting for an extended period.

Valuation Risk

At the time of writing, Cardano is trading at a $17.3bn market cap, making it the third-largest smart contract platform behind Ethereum and Binance Smart Chain. Despite this valuation, we have yet to see any significant revenue-generating dApps built atop the platform. Cardano ranks high on both price-to-sales and price-to-TVL metrics, indicating that the market ascribes it a valuation premium relative to its peers. As described in technological risks, whether this premium is justified remains to be seen.

Legal & Regulatory Risk

Similar to other digital assets apart from Bitcoin, Cardano could be ruled as a security and face significant scrutiny from regulators in the coming years. This is due to the fact that Cardano launched in 2017 through an initial coin offering. This risk, however, is not exclusive to Cardano, dampening the possibility of Cardano being singled out. As Cardano moves towards a level of decentralization on par with Ethereum, the likelihood of severe regulatory scrutiny also diminishes.

Execution Risk

Cardano's lack of traction is partly due to IOG's peer-reviewed approach to designing the network. While this approach could pay off in the long-term, at some point, the network will need to attract a larger mass of developers that build credible and lasting applications atop the network. The IOG team (among others) is currently adopting a more product-focused approach to building that centers on users and developers instead of mathematicians. While we think IOG and other Cardano developers are making the right strides, changing a team's culture is often challenging.

Source: Fundstrat

Introduction

Technology Design

Ecosystem

Highlighted Applications

Quantitative Analysis

Appendix

Disclosures

This research is for the clients of Fundstrat Global Advisors only. For important disclosures and rating histories regarding sectors or companies that are the subject of this report, please contact your sales representative or Fundstrat Global Advisors at 150 East 52nd Street, New York, NY, 10022 USA.

Analyst Certification (Reg AC)

Sean Farrell, the research analyst denoted by an "AC" on the cover of this report, hereby certifies that all of the views expressed in this report accurately reflect my personal views, which have not been influenced by considerations of the firm's business or client relationships.

Neither I (Sean Farrell), nor a member of my household is an officer, director, or advisory board member of the issuer(s) or has another significant affiliation with the issuer(s) that is/are the subject of this research report. There is a possibility that we will from time to time have long or short positions in, and buy or sell, the securities or derivatives, if any, referred to in this research

Conflicts of Interest

This research contains the views, opinions and recommendations of Fundstrat. Input Output Global, Inc. is a client of Fundstrat and receives Fundstrat's published research reports. Input Output Global, Inc. has commissioned/paid for this specific research project and has permission to distribute. This report is intended for research and educational purposes.

Analyst Industry/Sector Views

Positive (+): The analyst expects the performance of his industry/sector coverage universe over the next 6-18 months to be attractive vs. the relevant broad market benchmark, being the S&P 500 for North America.

Neutral (N): The analyst expects the performance of his or her industry/sector coverage universe over the next 6-18 months to be in line with the relevant broad market benchmark, being the S&P 500 for North America.

Negative (-): The analyst expects his or her industry coverage universe over the next 6-18 months to underperform vs. the relevant broad market benchmark, being the S&P 500 for North America.

General Disclosures

Fundstrat Global Advisors is an independent research company and is not a registered investment advisor and is not acting as a broker dealer under any federal or state securities laws. Fundstrat Global Advisors is a member of IRC Securities' Research Prime Services Platform. IRC Securities is a FINRA registered broker-dealer that is focused on supporting the independent research industry. Certain personnel of Fundstrat (i.e. Research Analysts) are registered representatives of IRC Securities, a FINRA member firm registered as a broker-dealer with the Securities and Exchange Commission and certain state securities regulators. As registered representatives and independent contractors of IRC Securities, such personnel receive commissions paid to or shared with IRC Securities for transactions placed by Fundstrat clients directly with IRC Securities or with securities firms that share commissions with IRC Securities in accordance with applicable SEC and FINRA requirements. IRC Securities does not distribute the research of Fundstrat, which is available to select institutional clients that have engaged Fundstrat.

As registered representatives of IRC Securities our analysts must follow IRC Securities' Written Supervisory Procedures. Notable compliance policies include (1) prohibition of insider trading or the facilitation thereof, (2) maintaining client confidentiality, (3) archival of electronic communications, and (4) appropriate use of electronic communications, amongst other compliance related policies.

Fundstrat does not have the same conflicts that traditional sell-side research organizations have because Fundstrat (1) does not conduct any investment banking activities, (2) does not manage any investment funds, and (3) our clients are only institutional investors.

This research is for the clients of Fundstrat Global Advisors only. Additional information is available upon request. Information has been obtained from sources believed to be reliable but Fundstrat Global Advisors does not warrant its completeness or accuracy except with respect to any disclosures relative to Fundstrat and the analyst's involvement (if any) with any of the subject companies of the research. All pricing is as of the market close for the securities discussed, unless otherwise stated. Opinions and estimates constitute our judgment as of the date of this material and are subject to change without notice. Past performance is not indicative of future results. This material is not intended as an offer or solicitation for the purchase or sale of any financial instrument. The opinions and recommendations herein do not take into account individual client circumstances, risk tolerance, objectives, or needs and are not intended as recommendations of particular securities, financial instruments or strategies. The recipient of this report must make its own independent decision regarding any securities or financial instruments mentioned herein. Except in circumstances where Fundstrat expressly agrees otherwise in writing, Fundstrat is not acting as a municipal advisor and the opinions or views contained herein are not intended to be, and do not constitute, advice, including within the meaning of Section 15B of the Securities Exchange Act of 1934. All research reports are disseminated and available to all clients simultaneously through electronic publication to our internal client website, fundstrat.com. Not all research content is redistributed to our clients or made available to third-party aggregators or the media. Please contact your sales representative if you would like to receive any of our research publications.