



# Strategic perspectives: Disruption

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## **Chair:**

- *Justine O'Connell, Head of Debt, Alternatives and Innovation Research, Frontier Advisors*

## **Presenter:**

- *Catherine Wood, CEO, Ark Invest*



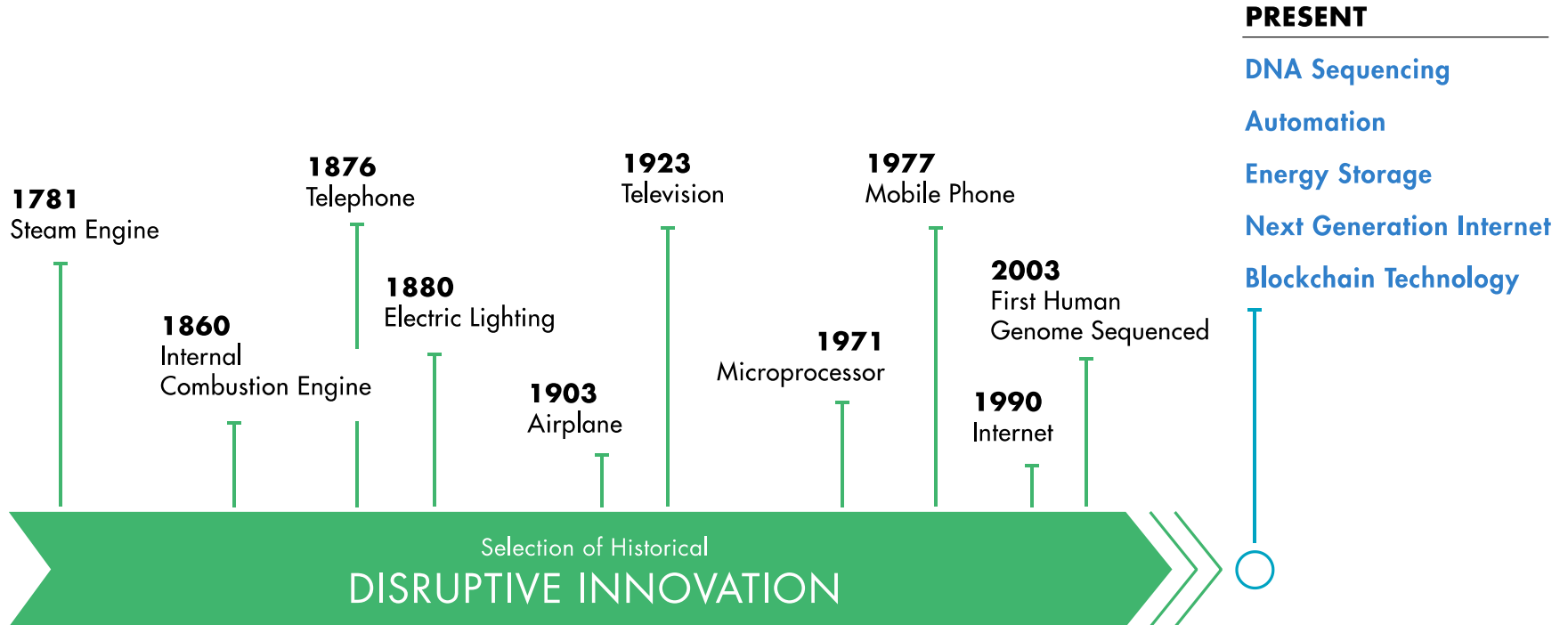
# *Innovation Is Key to Growth*

June 2018

For Institutional Investors Only

# THE WORLD IS CHANGING RAPIDLY

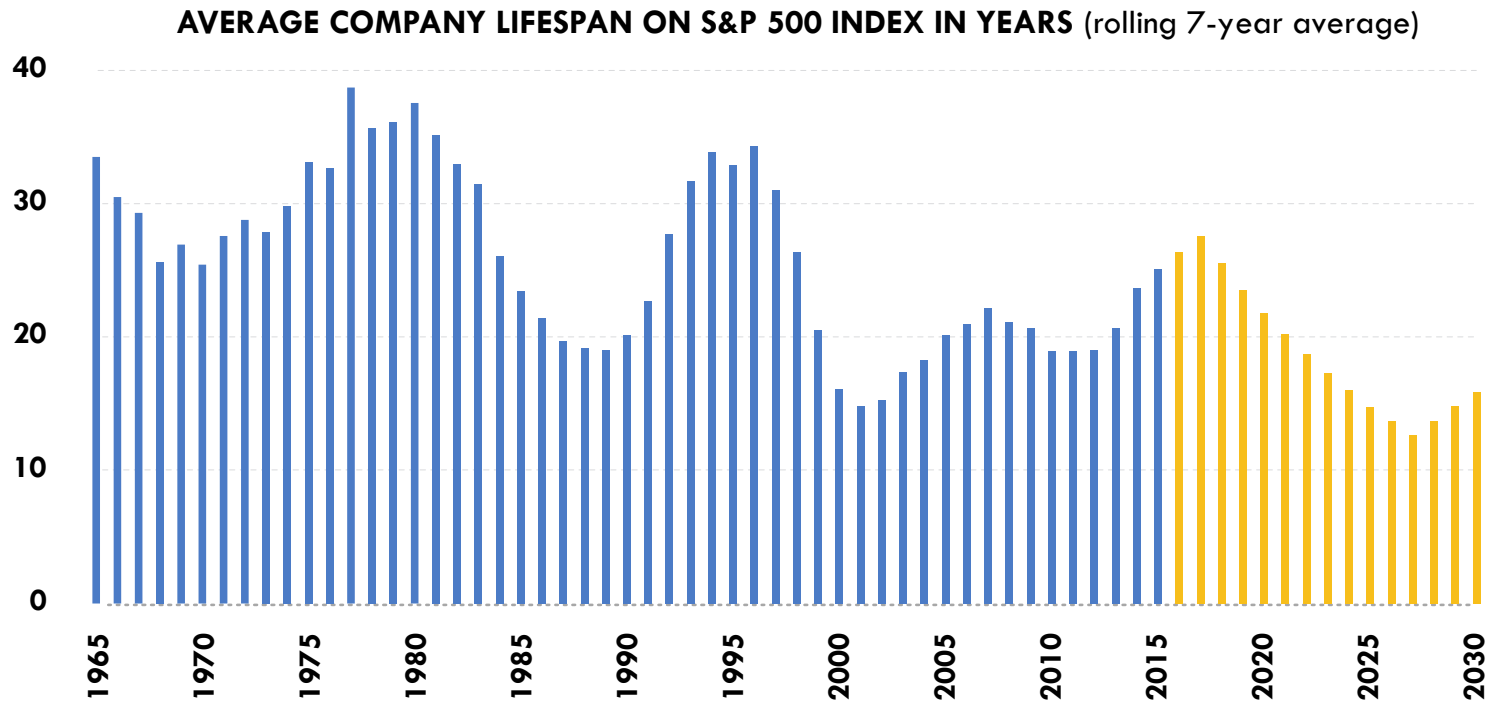
- Today, more innovation platforms exist than ever before
- ARK seeks to capitalize on powerful opportunities for growth associated with secular shifts and long-term trends
- While benchmarks reflect past successes, ARK's investment approach focuses on innovation to capture future growth



# INVESTING AT THE PACE OF INNOVATION MATTERS

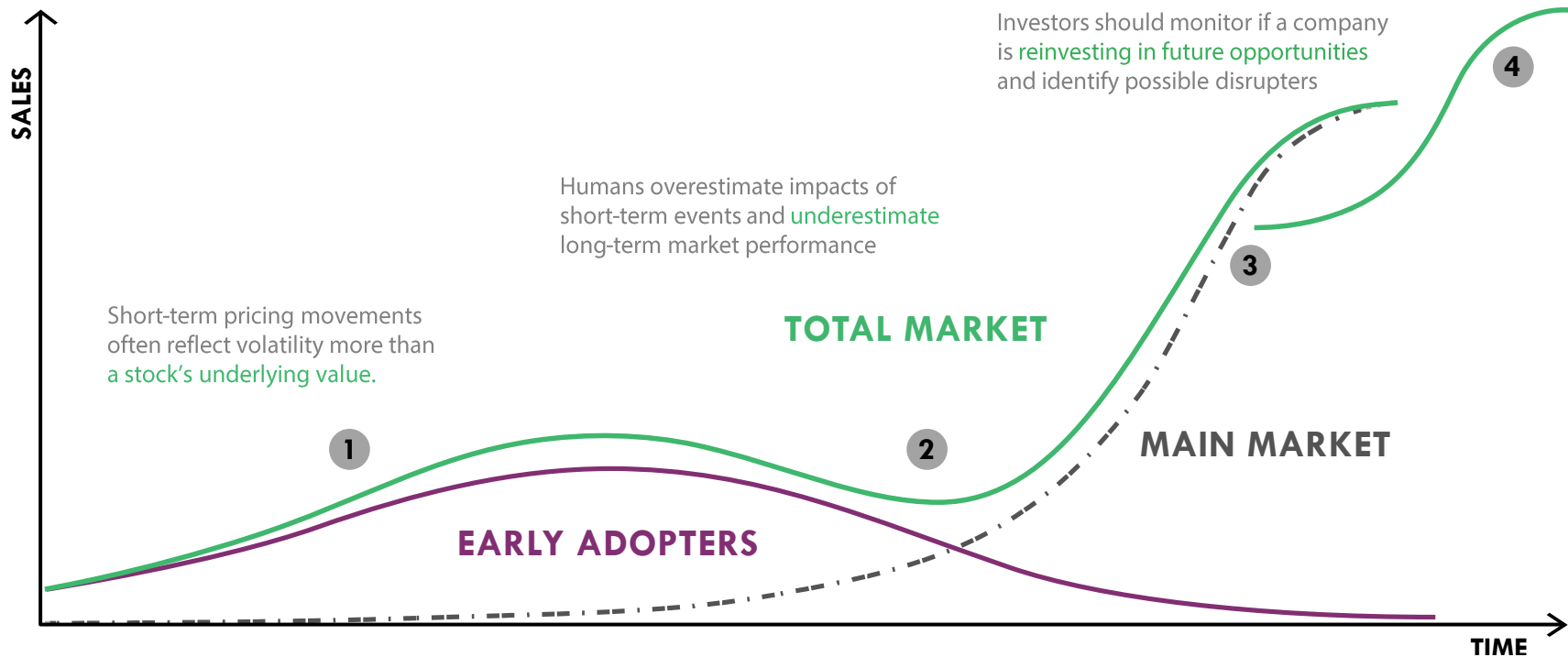
Disruptive innovation creates both opportunities and value traps

- The average lifespan of S&P 500 companies reflects the accelerating pace of change
- The average lifespan of an S&P 500 company has dropped from 33 years in the 1965 to 20 years in 1990, and is forecast to shrink to 14 years by 2026. At the current and forecast turnover rate, roughly 50% of the current S&P 500 will be replaced within the next ten years <sup>1</sup>



# RECOGNIZING THE UNIQUE S-CURVES OF INNOVATION

Indices are ill-equipped to capture adoption curves of innovation



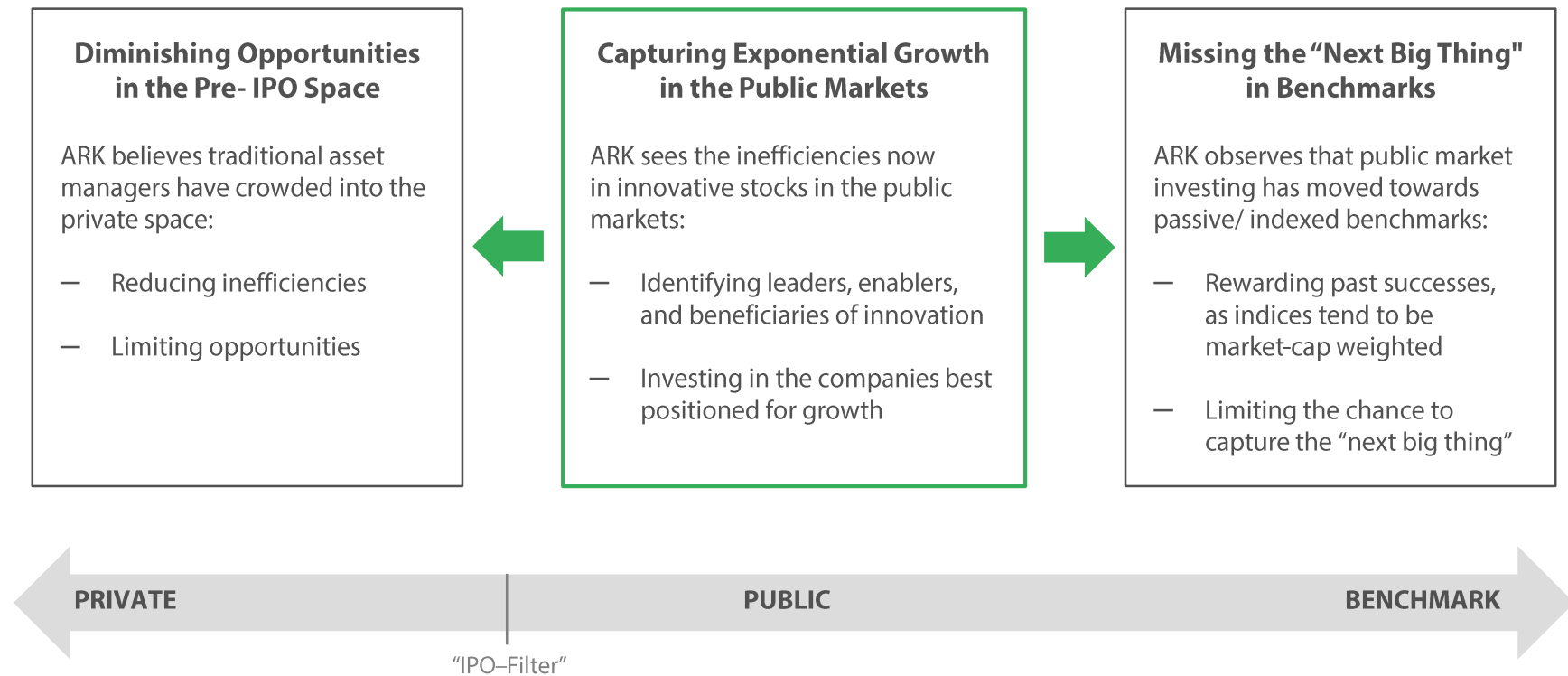
1. Innovations often have long flat adoption curves as inertia, network effects, and lack of understanding delay their embrace
2. Performance declines during the gap between the early adopters and mass market acceptance

3. Many truly innovative products and services are platforms in "winner takes most" markets
4. As companies realize the commercial successes of their innovations, they must continue to evolve and differentiate

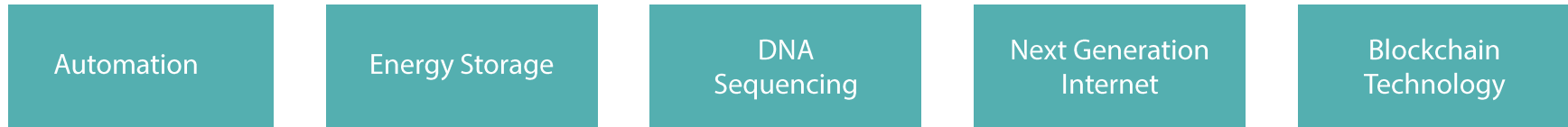
# WHY INVEST IN THE PUBLIC MARKETS?

## Diversification to benchmarks by offering exposure to exponential growth

- ARK provides access to disruptive innovation, aiming for exponential growth in the public market, without the costs, high carry, and illiquidity of venture capital funds



## ARK Identifies Five Innovation Platforms...



...That Enable Long-Term Investment Opportunities



### Industrial Innovation

Elements
Autonomous Vehicles
3D Printing
Robotics
Battery Technology
Space Exploration
Mobility-as-a-Service
Innovative Materials
...

### Genomics Innovation

Elements
Gene Therapy/ Stem Cells
DNA
Cancer Treatments
Diagnostics
Bioinformatics
Therapeutics
Agricultural Biology
...

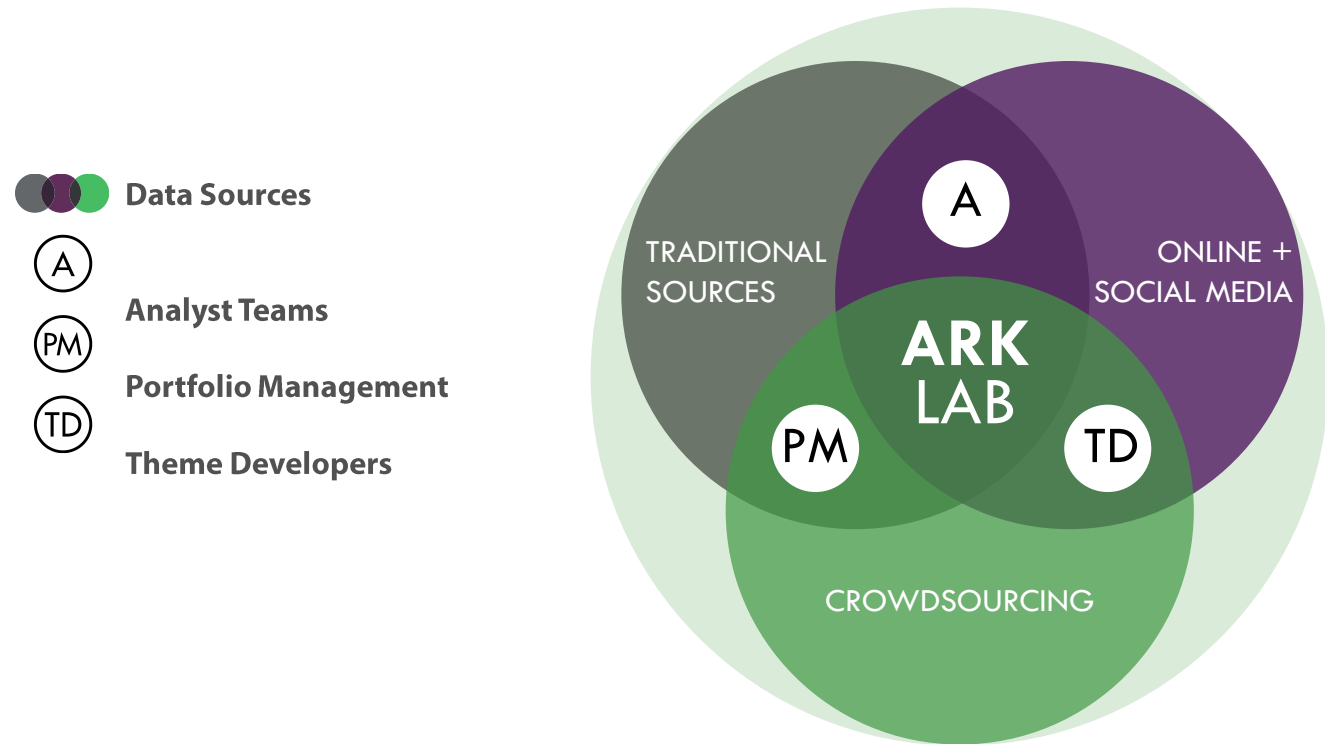
### Internet Innovation

Elements
Cloud Computing
Big Data
Artificial Intelligence
Mobile/ IoT
Digital Media
Bitcoin/ Cryptocurrencies
Fintech
...



**ARK's Open Research Ecosystem leverages multiple data sources, both internal and external, to produce timely, original analysis**

- The center of a patent-pending research process, ARK's virtual collaboration platform allows for an organized exchange of insights and ideas among ARK Team members and external thought leaders



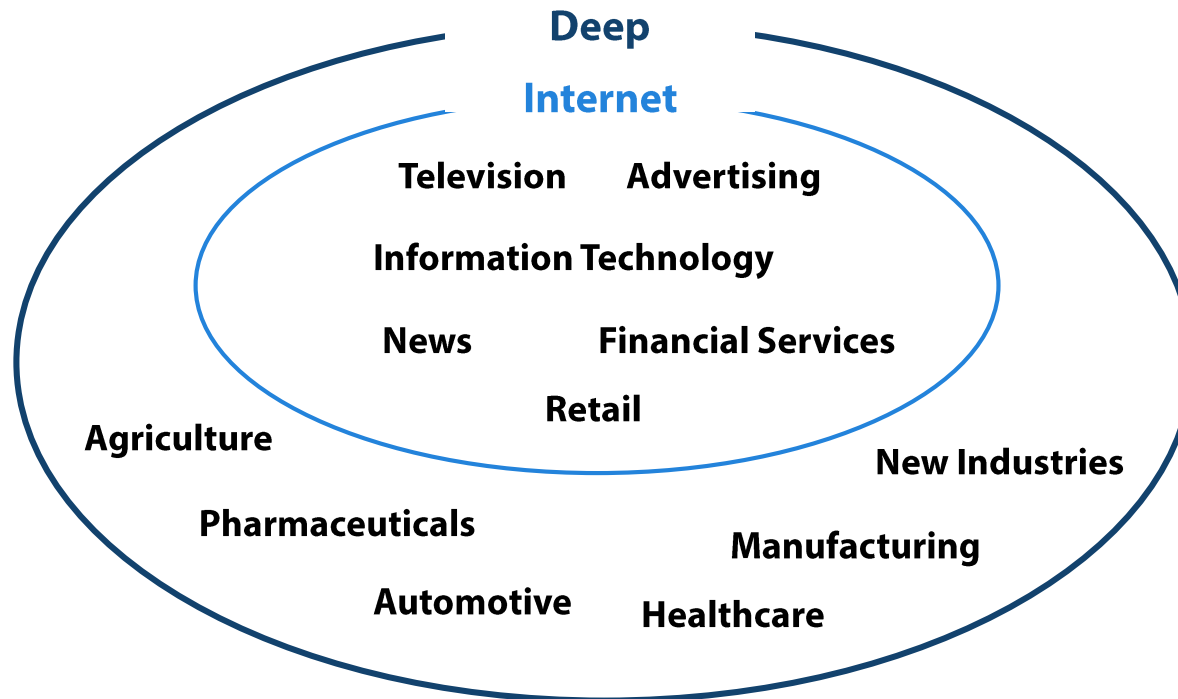
**Data Sources** include social media, traditional sources, and crowdsourcing  
**Analyst Teams** are organized by cross-sector disruptive innovation themes  
**Portfolio Management** evaluates research, fundamentals, and bottom-up characteristics, and market movements  
**Theme Developers** are external thought leaders across innovations, including academia, think tanks, and venture capital



Research by James Wang

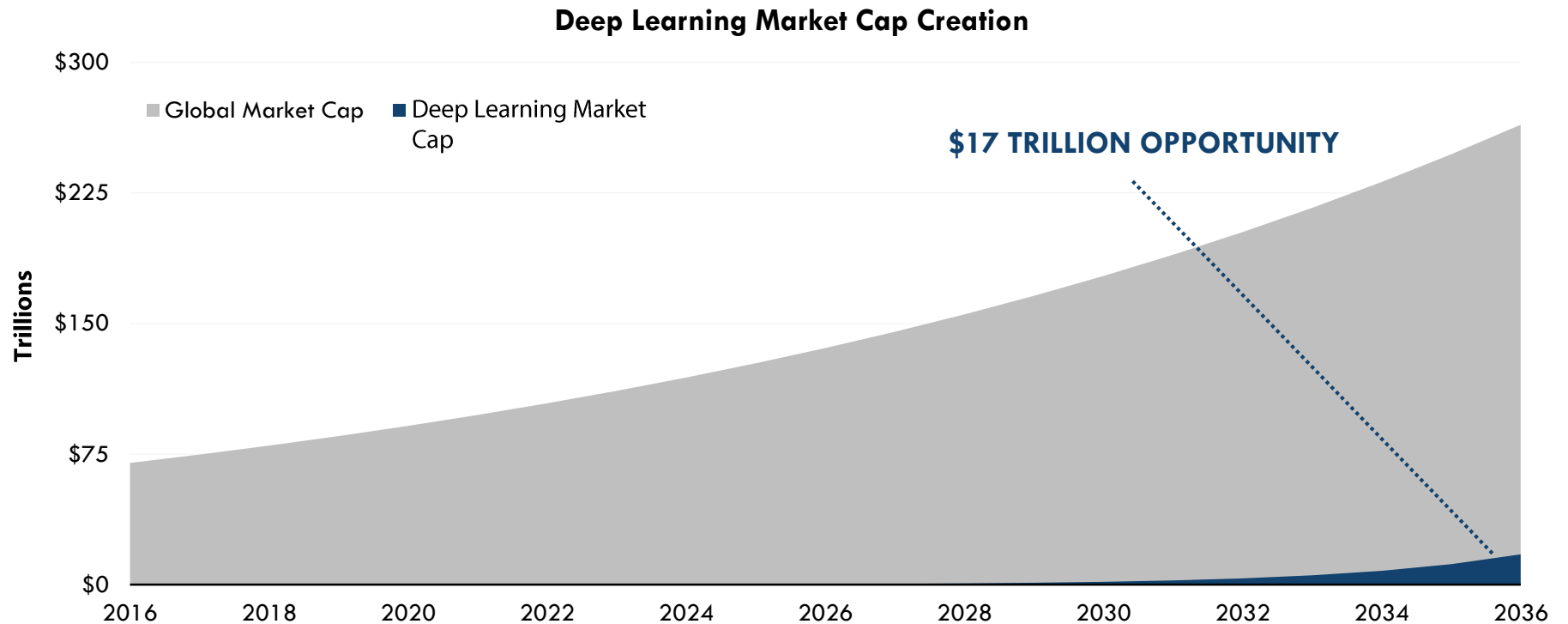
Deep learning is a continuation of “software eating the world”

- Relative to the Internet, Deep Learning could impact more sectors, causing more profound disruptive innovation across different industries.



Based on ARK's research...

- Deep Learning could approach a global market cap of \$17 trillion in 20 years.



Forecasts are inherently limited and cannot be relied upon.

Source: ARK Investment Management LLC, 2017; Deep Learning penetration adjusted for global market cap, assuming 6.9% historical growth rate of global equities, 6.6% deep learning share in 20 years.

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Research by Bhavana Yarasuri and Julia Hemmendinger

**In the 1980s**, communicating across the world was expensive.

### Voice over IP (VoIP)

➡ Instant communication everywhere without relying on expensive telecom providers

*The Internet enabled "free voice"*

**Today**, transferring funds across the world is expensive.

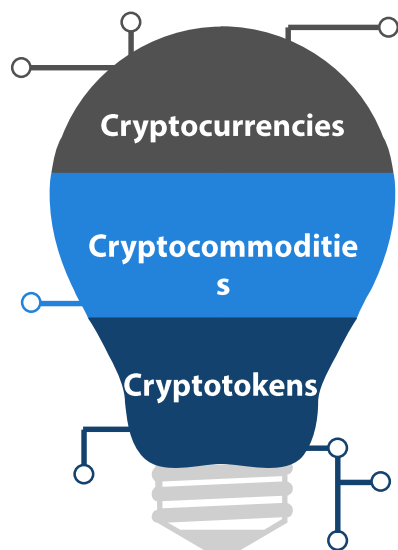
### Money over IP (MoIP)

➡ Instant value transfer of any amount to any person anywhere at almost no cost

*ARK believes blockchain technology will enable fee-less transfers*

## Blockchain technology has the potential to create a new asset class

- ARK believes that bitcoin and other cryptocurrencies are not just “currencies”, but could be considered part of a new asset class: **Cryptoassets**. The definition of an asset class was addressed by Robert Greer<sup>1</sup> in 1997. Greer differentiates asset classes in three ways: politico-economic features, correlation of price movements, and risk-reward profiles. ARK believes the same differentiation can be applied to cryptoassets when comparing them to other asset classes such as equities, bonds, or currencies.



### Verticals ARK defines within cryptoassets:

<b>Cryptocurrencies</b>	<b>Uses:</b> means of exchange, store of value, unit of account <b>Examples:</b> bitcoin, litecoin, monero, zcash
<b>Cryptocommodities</b>	<b>Uses:</b> cloud storage, compute cycles, bandwidth <b>Examples:</b> ether, golem, filecoin
<b>Cryptotokens</b>	<b>Uses:</b> consumer facing distributed applications <b>Examples:</b> augur, gnosis, aragon, steemit

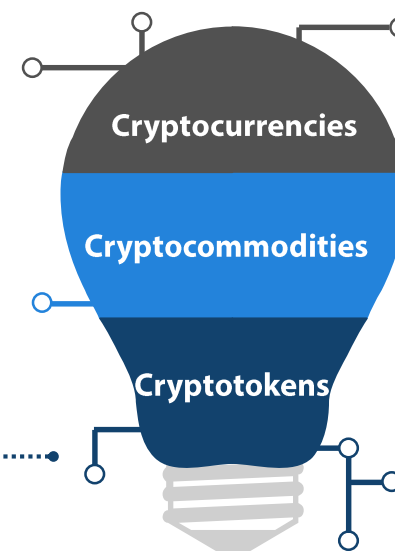
## What we expect in the future for cryptoassets

- As the cryptoasset market evolves, each category will have a unique utility and value proposition.

- 01** A store of value, particularly in emerging markets.
- 02** A means of payment, particularly in emerging markets.
- 03** A reserve currency for all other crypto-assets.

**04** Computing power, storage, bandwidth, and other digital commodities will become securitized products that trade on financial exchanges.

**05** Just as bonds are claims on fixed assets and equities are claims on excess cash flows, tokens will be claims on the utilization of assets and could become a part of corporate capital structures.





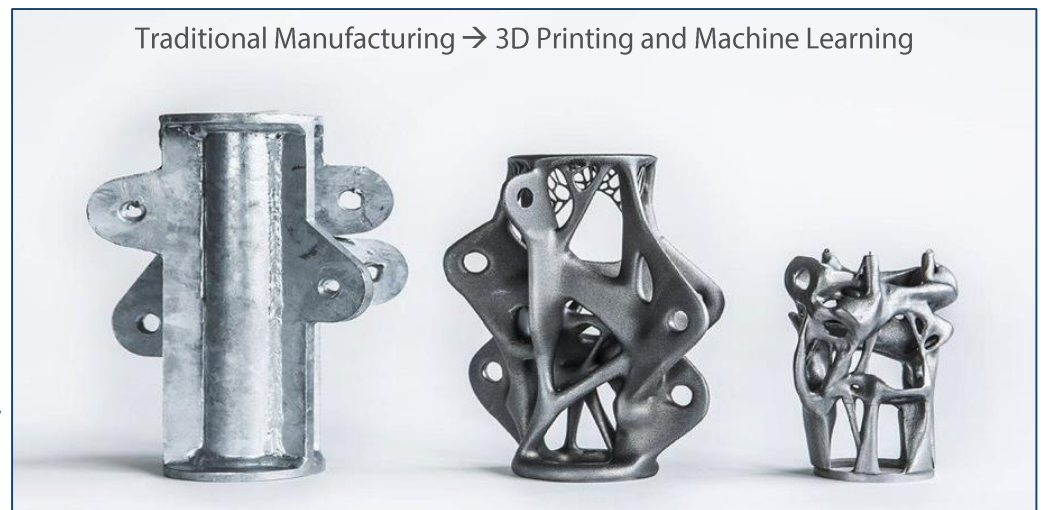


Research by Tasha Keeney

## 3D printing should revolutionize traditional manufacturing

- By building objects layer-by-layer, instead of removing material from a larger block or using a mold, 3D printing offers a range of benefits:

- **Shortens design-to-production time**
- **Shifts power to the designers**
- **Creates products with less waste**
- **Enables radically new architectures**
- **Reduces the cost of manufacturing significantly**

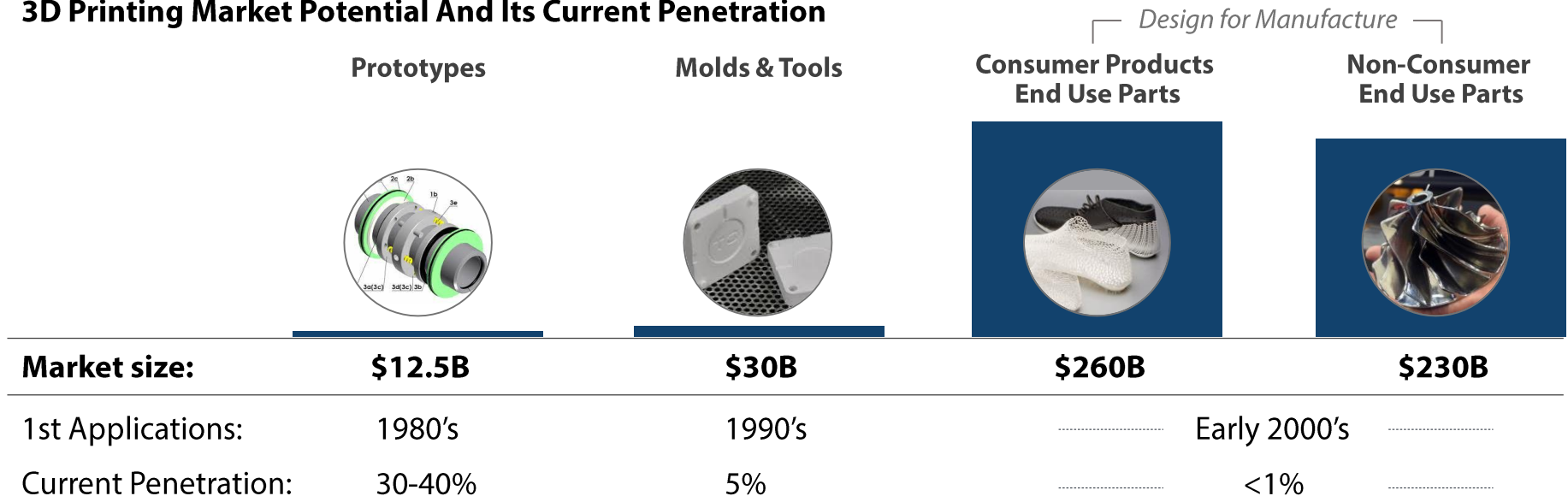


For example, these structural nodes all support the same weight, but the part on the right weighs 75% less and is 50% smaller than the original part on the left.

3D printing is in its infancy

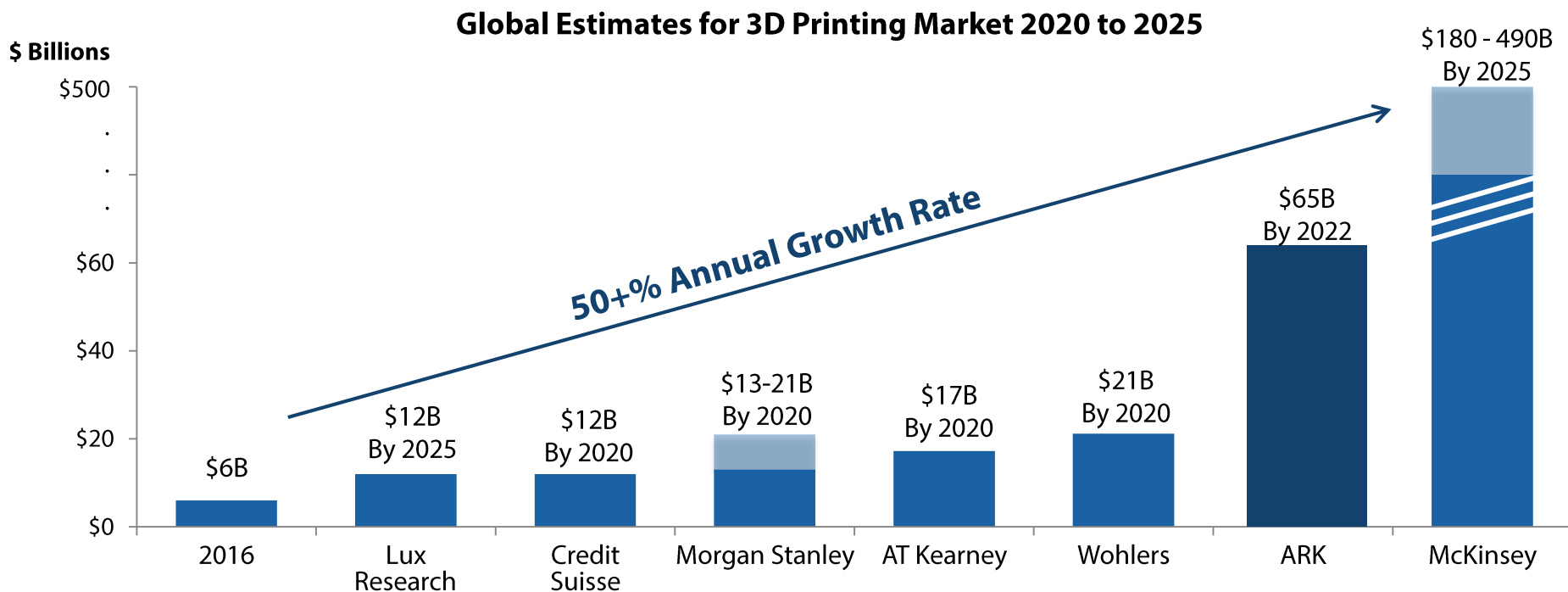
- ARK's research shows that 3D printing for end use parts should be the next frontier.

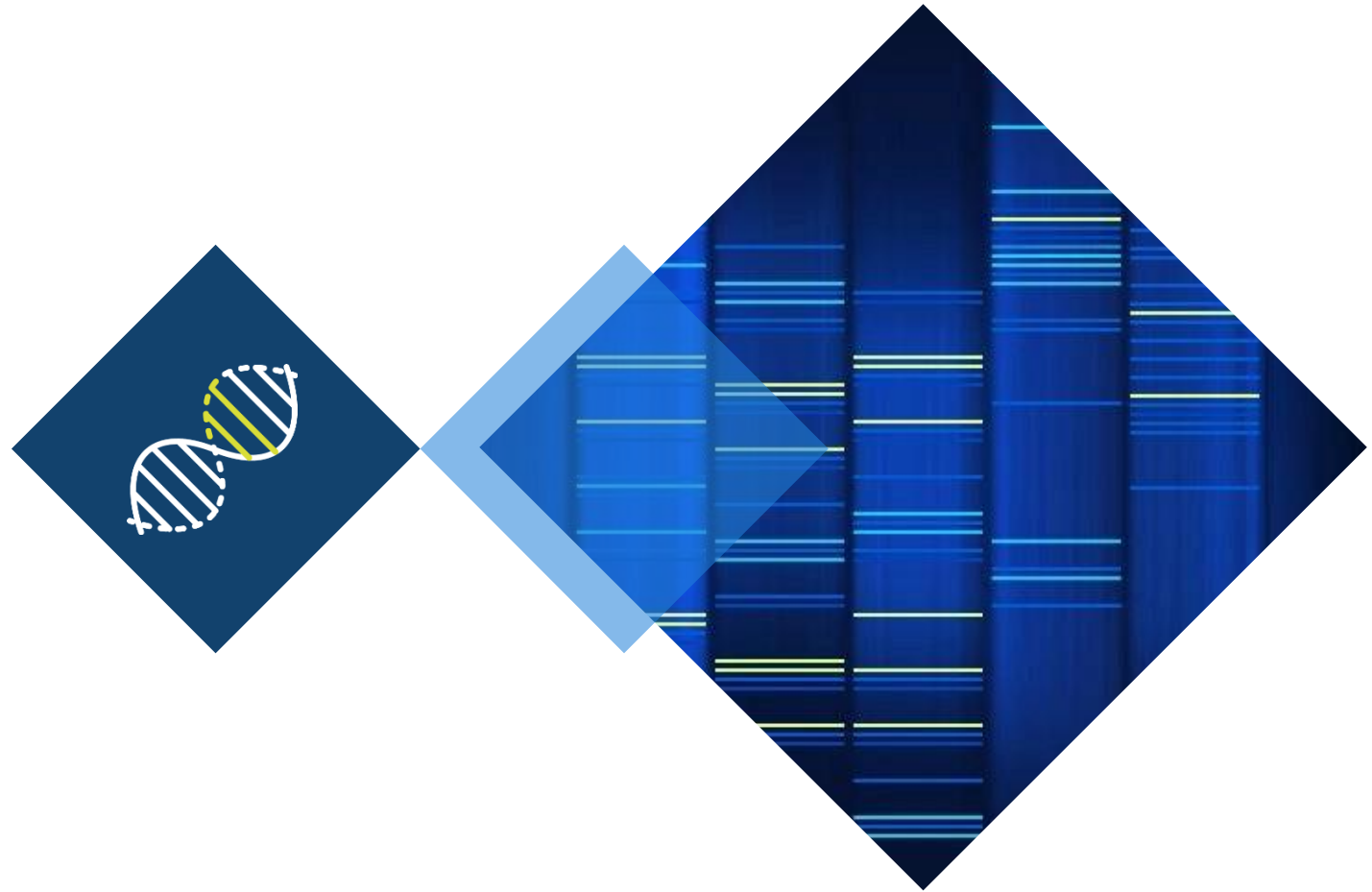
## 3D Printing Market Potential And Its Current Penetration



## The 3D printing market could increase nearly ten-fold by 2022

- ARK's research predicts the 3D printing market could grow to \$65 billion by 2022.



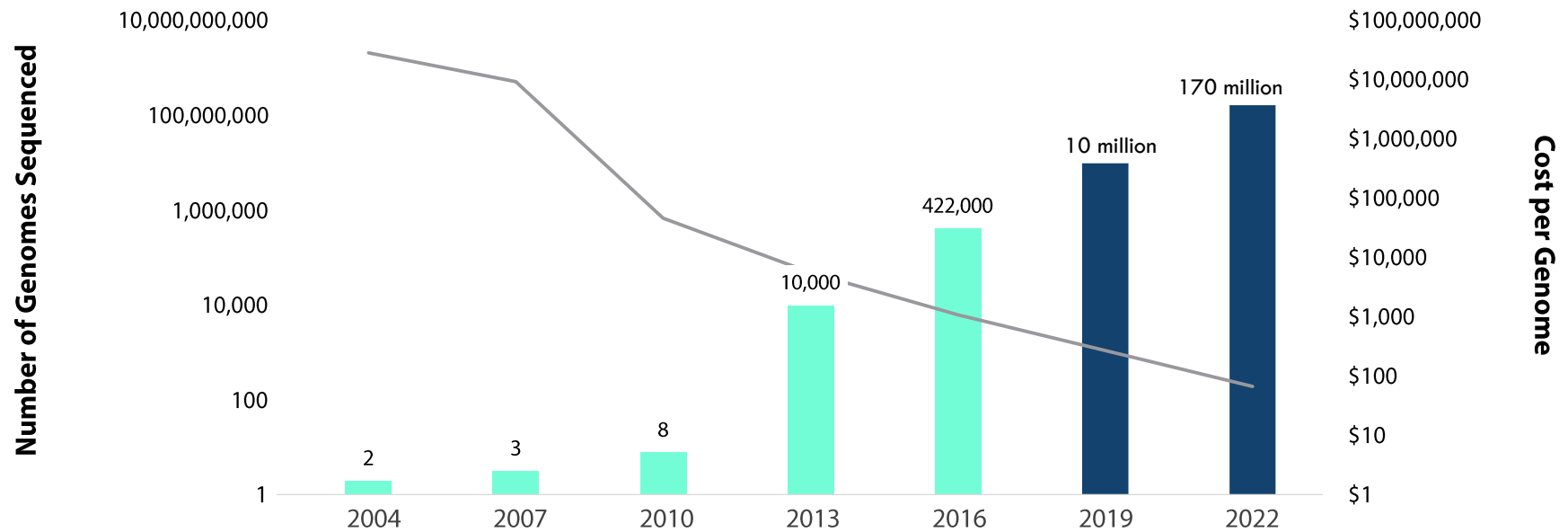


*Research by Manisha Samy*

Research shows the number of human genomes sequenced should soar

- By 2022, the cost of sequencing or “reading” the DNA of a full human genome should drop below \$100, creating an explosion in the number of whole human genomes sequenced.
- ARK believes that CRISPR is a genome-editing platform that will address the world’s most salient health issues. It is like a “molecular swiss army knife” with a rapidly expanding number of tools that perform different functions:

**Genomes Sequenced As Cost Per Genome Declines**  
(log scale)

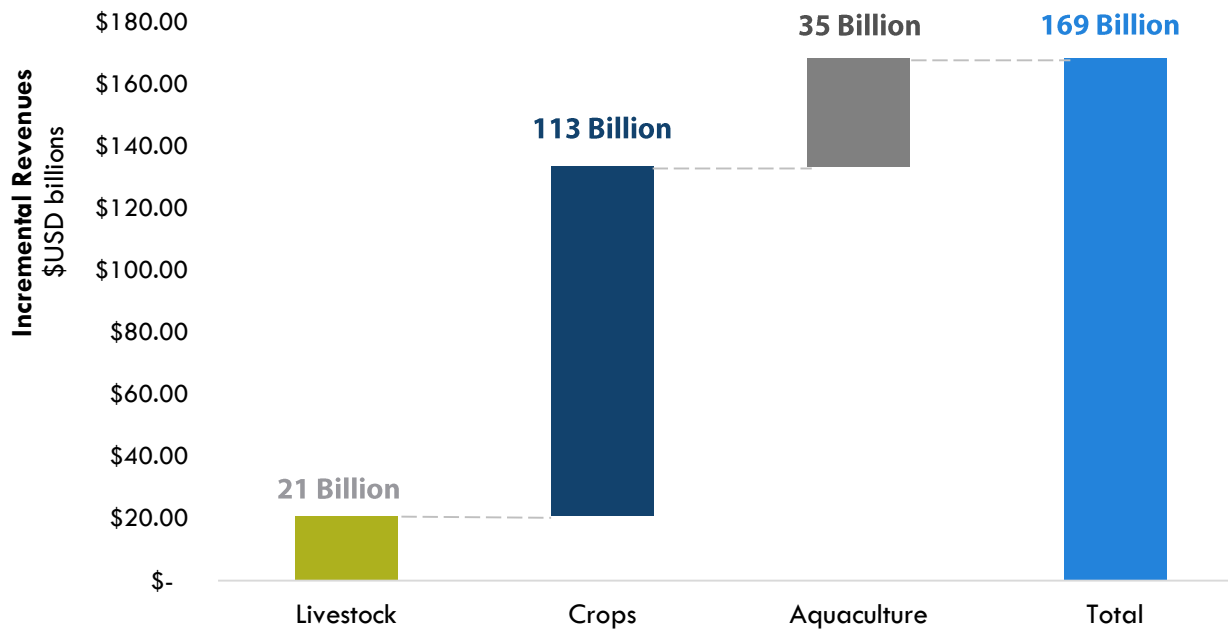


Forecasts are inherently limited and cannot be relied upon.  
Sources: ARK Investment Management LLC, 2017

## Use Case: Agriculture

- By 2025, CRISPR could expand the agricultural market by an estimated \$170 billion, sustaining projected growth in the global population.

**Global Agriculture Market Expansion with CRISPR Technology**  
(2016 to 2025)



CRISPR should have the first commercial impact in agriculture:

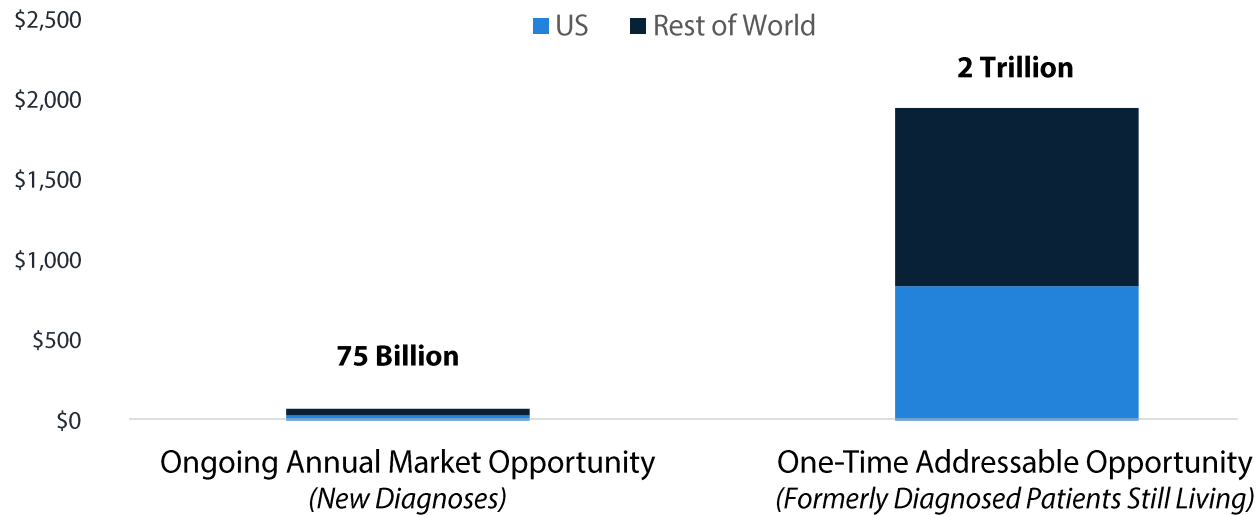
- 2020: CRISPR could enable the first commercial waxy corn variety
- 2025: CRISPR may increase food yield by an estimated 585 trillion calories
- 2025: CRISPR may increase agricultural productivity enough to feed an additional 800 million people

## Use Case: Monogenic Disease

- CRISPR should dominate the \$75 billion annual addressable monogenic disease market. Only 5% of diseases caused by a single gene have any available treatment today.

### CRISPR's Total Addressable Market: Monogenic Diseases

(prices based on cures, \$USD billions)



- CRISPR can address 10,000 monogenic diseases, of which only 5% have any treatments today
- 1 in 100 live human births results in a monogenic disease
- ARK expects CRISPR to enter human trials in 2018



# APPENDIX

ARK's Big Ideas 2018

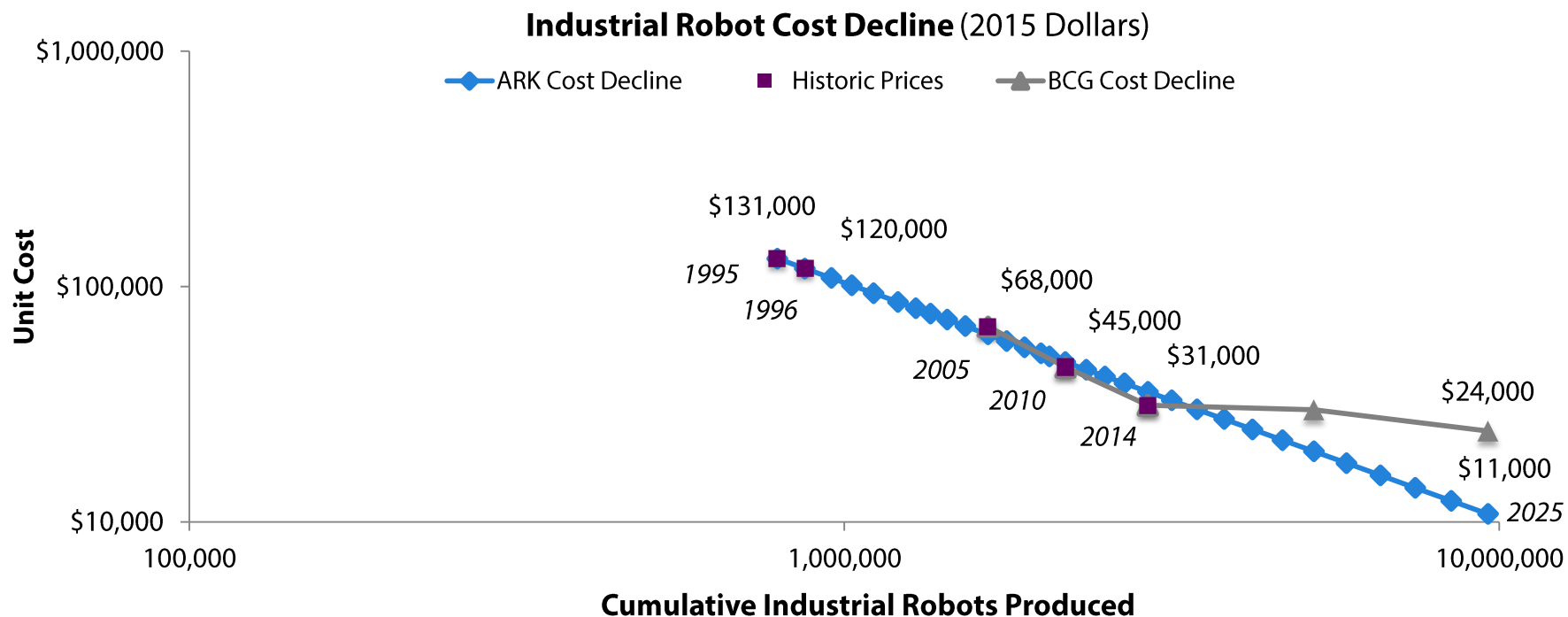




Research by Sam Korus

## Robot costs are dropping

- Industrial robots are continuing to decline in cost, expanding the addressable market.



Forecasts are inherently limited and cannot be relied upon.  
Sources: ARK Investment Management LLC, 2017

Data from: Sources: United Nations Economic Commission for Europe, International Federation of Robotics, Boston Consulting Group (BCG)

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### Traditional Industrial Robots



Industrial robots are defined by ISO 8373:2012 as an automatically controlled, reprogrammable, multipurpose manipulator programmable in three or more axes, which can be either fixed in place or mobile for use in industrial automation applications.

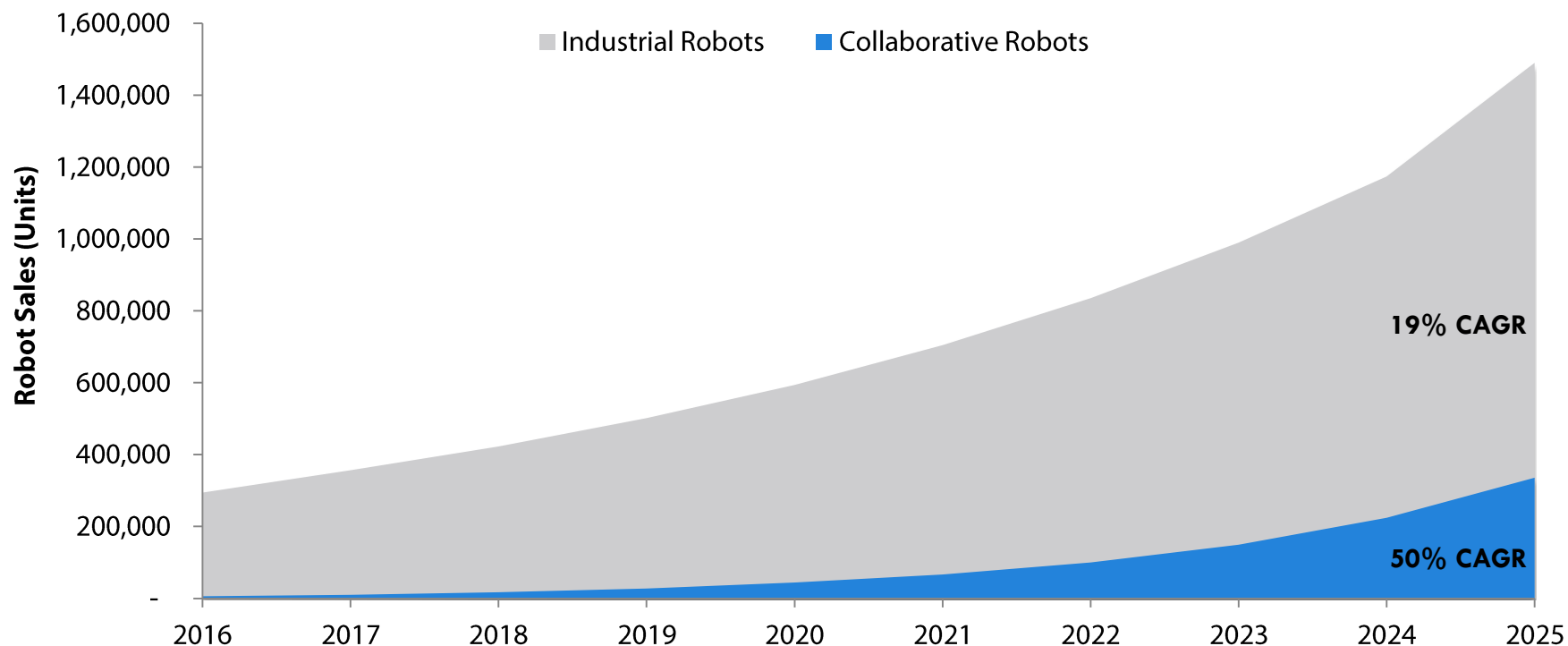
### Current Collaborative Robots



A collaborative robot (“co-bot”) is a robot designed to share a workspace with humans and may have direct physical interaction with humans. (Collaborative robot can be a subset within the broader industrial robot definition.)

ARK believes collaborative robots should gain market share

## Collaborative Robots Relative to Total Industrial Robot Sales



# (REFERENCE) ARK DISRUPTIVE INNOVATION STRATEGY

PORTFOLIO COMPOSITION*		TOP 10 HOLDINGS		Elements*	Weight
3D Printing	10.7%	<b>STRATASYS LTD</b>		3D Printing	<b>6.6%</b>
Gene Therapy	9.1%	<b>INTELLIA THERAPEUTICS INC</b>		Gene Therapy	<b>6.4%</b>
Bioinformatics	7.9%	<b>TESLA INC</b>		Autonomous Vehicles, Development of Infrastructure, Energy Storage, Big Data/ Machine Learning, IoT	<b>6.3%</b>
Big Data & Machine Learning	7.5%	<b>TWITTER INC</b>		Social Platforms, Big Data/ Machine Learning, Digital Media	<b>4.3%</b>
Instrumentation	7.5%	<b>ILLUMINA INC</b>		Beyond DNA, Bioinformatics, Instrumentation	<b>4.1%</b>
Autonomous Vehicles	7.0%	<b>ATHENAHEALTH INC</b>		Big Data & Machine Learning, Cloud Computing, Bioinformatics	<b>3.7%</b>
E-Commerce	6.2%	<b>EDITAS MEDICINE INC</b>		Targeted Therapeutics, Gene Therapy	<b>3.6%</b>
Cloud Computing	6.1%	<b>BAIDU INC - SPON ADR</b>		E-commerce, Cloud Computing, Big Data/ Machine Learning, Autonomous Vehicles	<b>3.2%</b>
Social Platforms	4.8%	<b>AMAZON.COM INC</b>		E-commerce, Cloud Computing, Big Data/ Machine Learning, Digital Media, Autonomous Vehicles, Robotics, Bioinformatics	<b>3.0%</b>
Robotics	4.7%	<b>NVIDIA CORP</b>		Big Data/ Machine Learning, Autonomous Vehicles	<b>2.8%</b>
Beyond DNA	4.4%				
Digital Media	3.8%				
Internet of Things	3.7%				
Targeted Therapeutics	3.6%				
Molecular Diagnostics	3.0%				
Mobile	2.8%				
Blockchain & P2P	2.4%				
Energy Storage	2.0%				
Stem Cells	1.0%				
Next Generation Oncology	0.8%				
Development of Infrastructure	0.6%				
Alternate Energy Sources	0.01%				
					<b>44.1%</b>

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\*Elements as defined by ARK Invest. Source: ARK Investment Management LLC. As of 31 Mar., 2018

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