Disruption of Transportation – & Implications for Society

California Transportation Commission

Presentation to: **Technology Policy Forum**

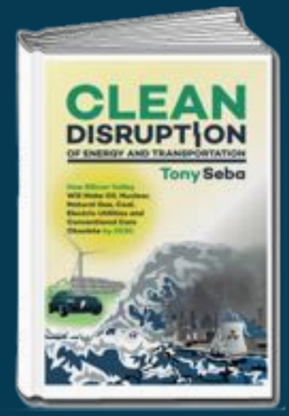
3 Aug 2017

Sacramento, CA

RethinkX

Tony Seba

www.tonyseba.com



A STROLL DOWN

Memory Lane

5th AVE NYC

1900

Where is the car?

US National Archives

: Fifth Ave NYC on Easter Morning 1900

5th AVE NYC

1913

Where is the horse?

George Grantham Bain Collection

Photo: Easter 1913, New York. Fifth Avenue looking north.

TECHNOLOGY

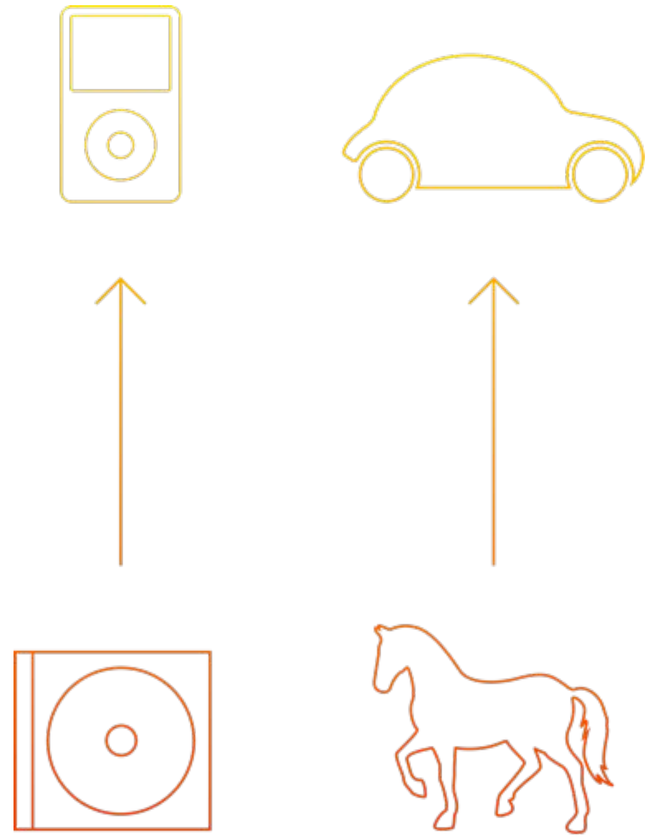
Disruption

Rodin – Thinker
Photo: Tony Seba

What is a Disruption?

WHEN A NEW PRODUCT OR SERVICE HELPS
create a new **market**

AND
significantly **weaken**,
transform, or
destroy an existing product,
market category / industry



FAST FORWARD TO 1985

1985

‘Expert’ Disruption Forecasts

AT&T hired McKinsey & Co to forecast cell phone adoption by the year 2000

THEIR (15-YEAR) PREDICTION

900,000

SUBSCRIBERS

THE ACTUAL NUMBER WAS

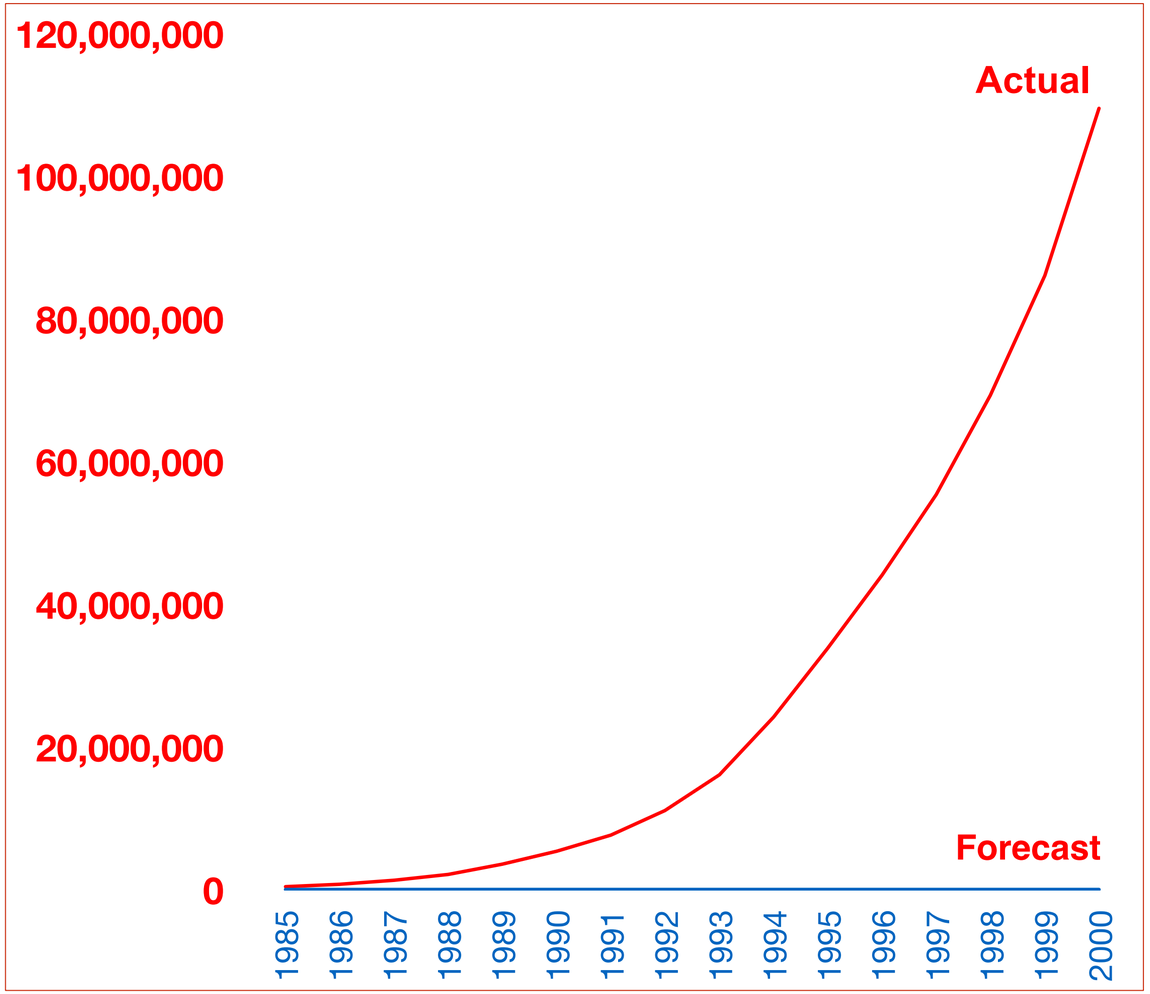
109 million

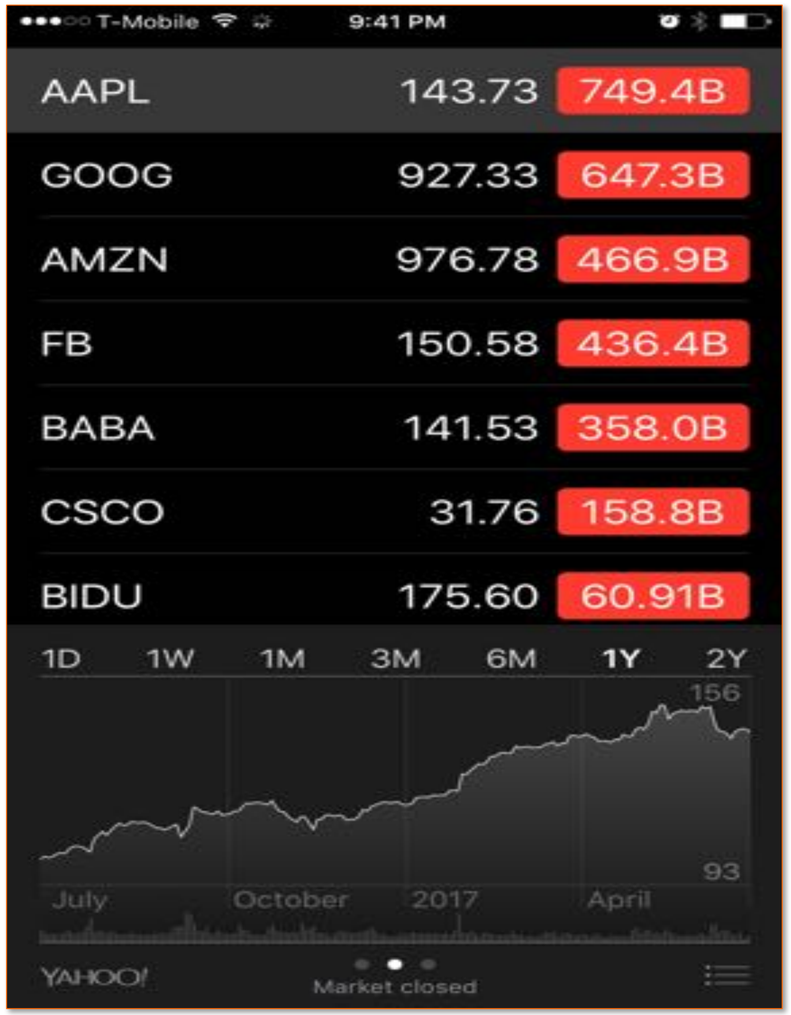
They were **off** by a factor of:

120x

Motorola DynaTAC 8000X from 1984. Source: Wikimedia, Source: Economist

AT&T Disrupted - while $$ Trillions Created





- AT&T's landline telephony market was disrupted
- It missed out on multi-trillion dollar opportunities!

Sources: Subscriber Data : CTIA Companies: Company Stock date source: Yahoo!

It's usually the **'experts'** and **'insiders'** who **dismiss** Disruptive Opportunities

"There's no chance that the iPhone is going to get any significant market share. No chance...."

***Steve Ballmer**, CEO Microsoft, 2007*

"**The iPhone's impact will be minimal**. It will only appeal to a few gadget freaks. Nokia and Motorola have nothing to worry about."

***Bloomberg Analyst**, 2007*

"It's important that [Internet] expectations aren't cranked too high. The total number of users is still very small..."

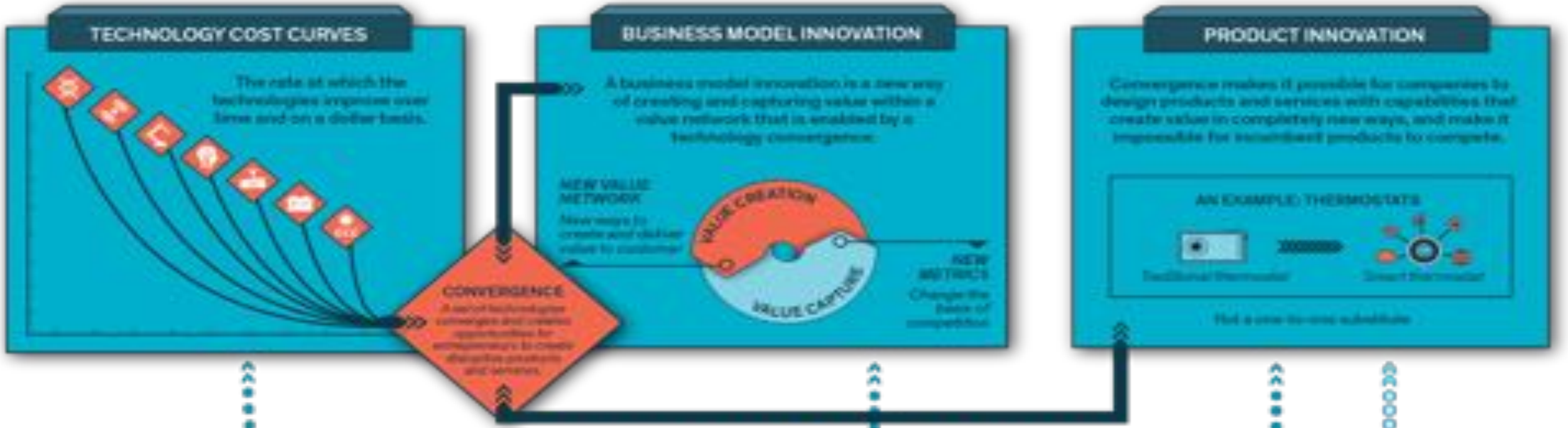
Why do smart people
at smart organizations
consistently fail
to anticipate or lead
Market Disruptions?

Rodin – Thinker
Photo: Tony Seba

Seba Technology Disruption Framework™

HOW DISRUPTIONS HAPPEN

A disruption is when new products and services create a new market and significantly weaken, transform or destroy existing product categories, markets or industries.



DISRUPTION MODELS

New products or services disrupt existing markets in one of four ways:

FROM ABOVE

A new product is initially superior and more expensive, but gets cheaper at a faster rate than the market, while improving performance.

Example: Smartphones

BIG BANG

When launched, a new product is better, faster and cheaper than mainstream products.

Example: Google Maps driving directions API

ARCHITECTURAL

A new product radically changes the way products and services are produced, managed, delivered and sold.

Examples: Distributed Solar PV and Batteries

FROM BELOW

A new product is initially inferior to mainstream products, but improves its performance while decreasing costs at a faster rate than incumbent products.

Example: Personal computers

DISRUPTION ACCELERATORS

Open Access Technology Development

Open access to technology and capital lowers costs, increases the speed of product development and lowers barriers to entry.

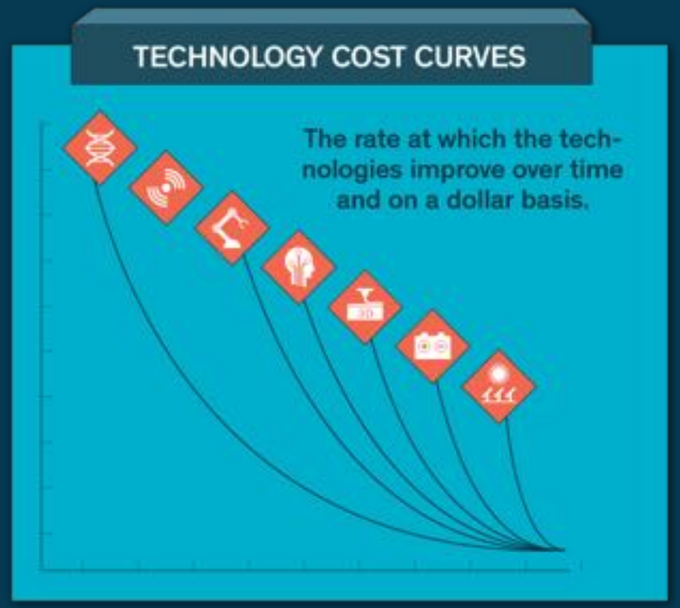
EXAMPLES: open source, open knowledge, open APIs, crowdfunding

Conceptual Innovations

New concepts, methods, models, frameworks and software architectures that enable totally new ways of doing things.

EXAMPLES: TCP/IP, blockchain

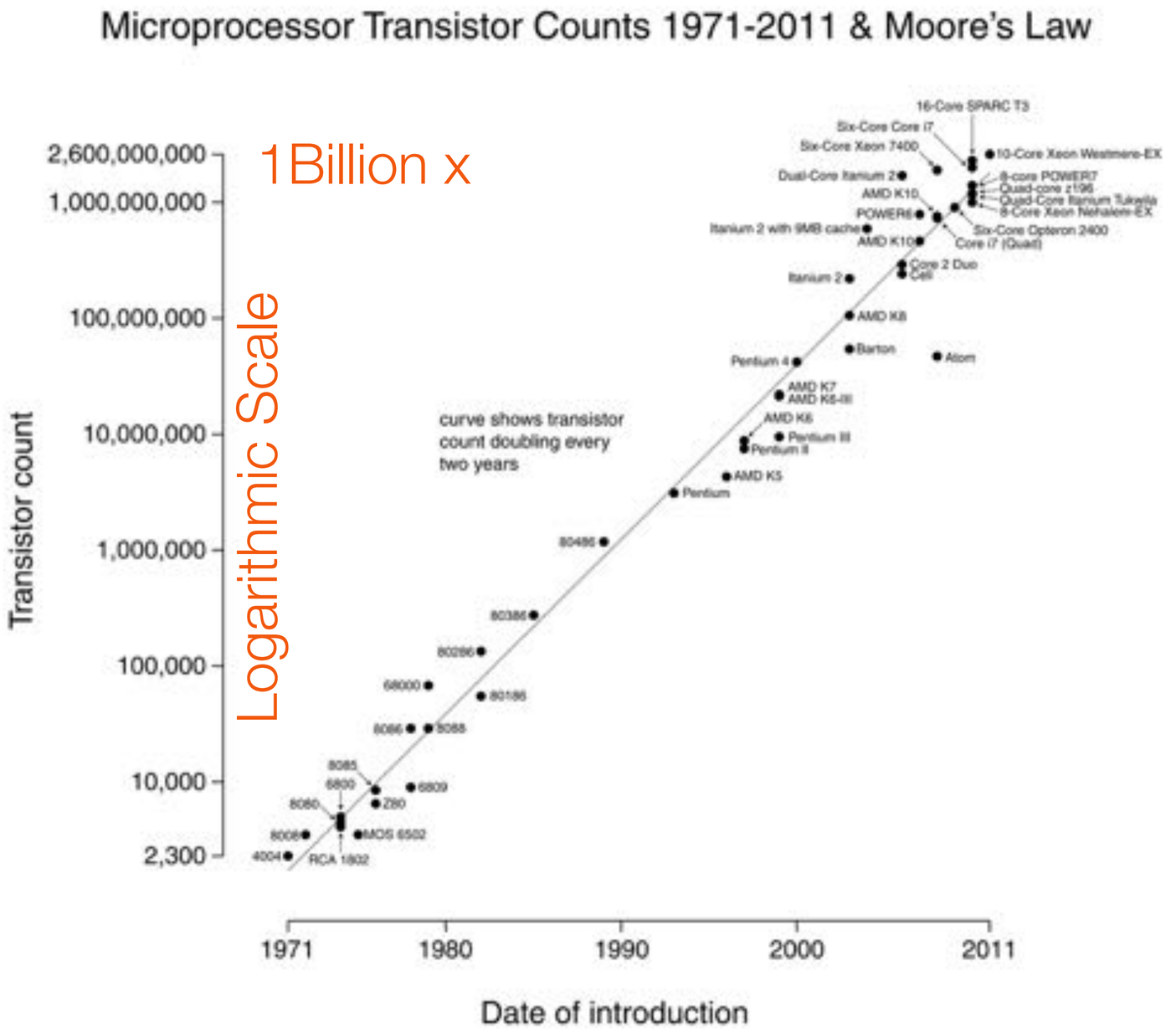
MARKET/SYSTEMS DYNAMICS



Technology Cost Curves

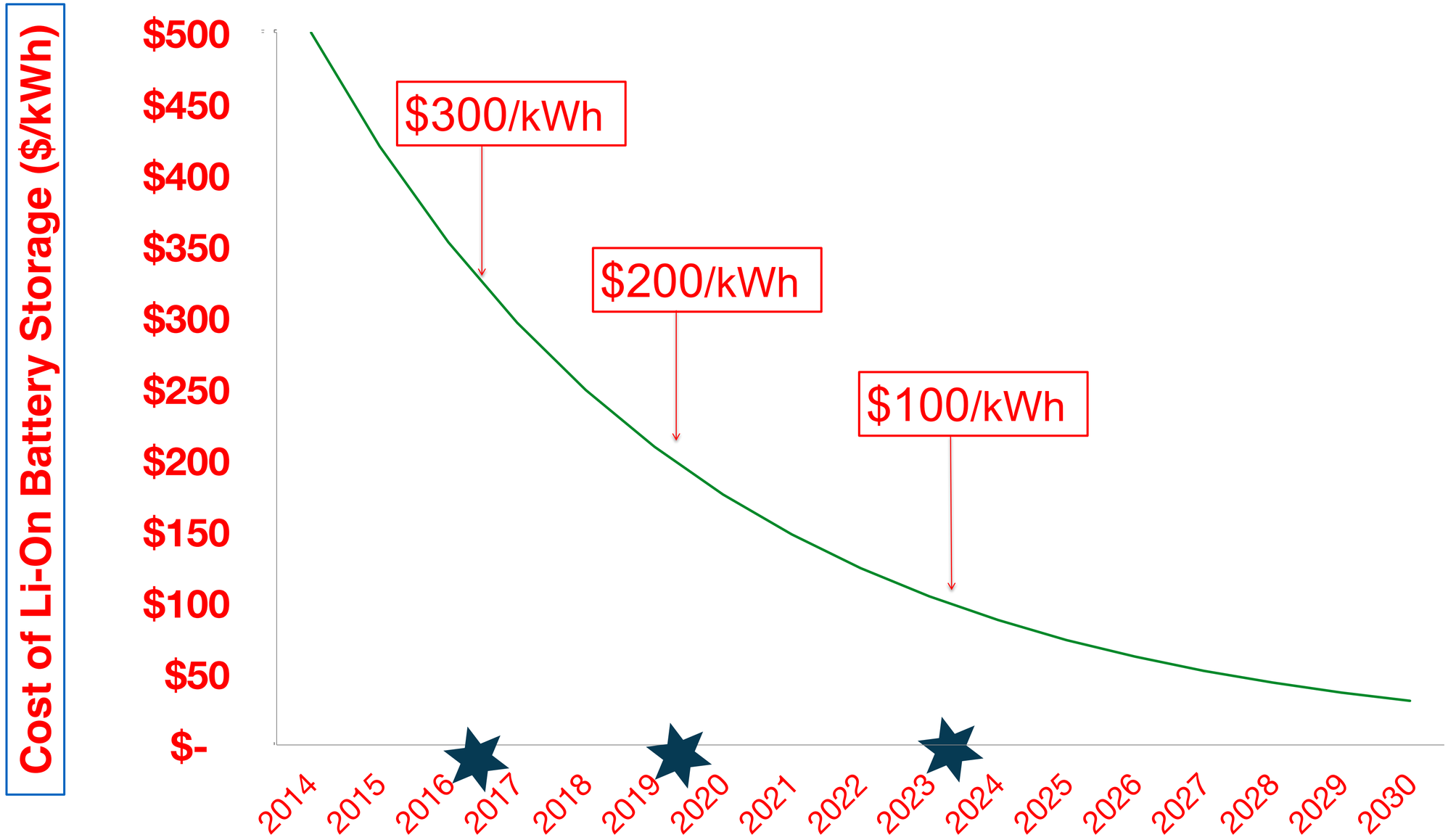
Computing: Moore's Law (1971 - 2011)

- # of transistors doubles (roughly) **every two years**.
- Annual improvement rate **~41.4%**
- Exponential growth in # of transistors



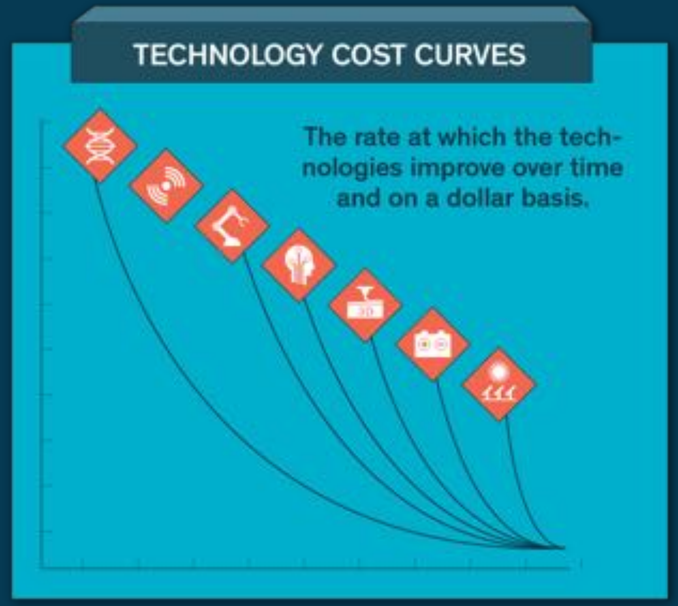
Source: Wikipedia

Projected cost of Li-ion Battery $/kWh



Assumption: 16% /year Technology Cost Curve

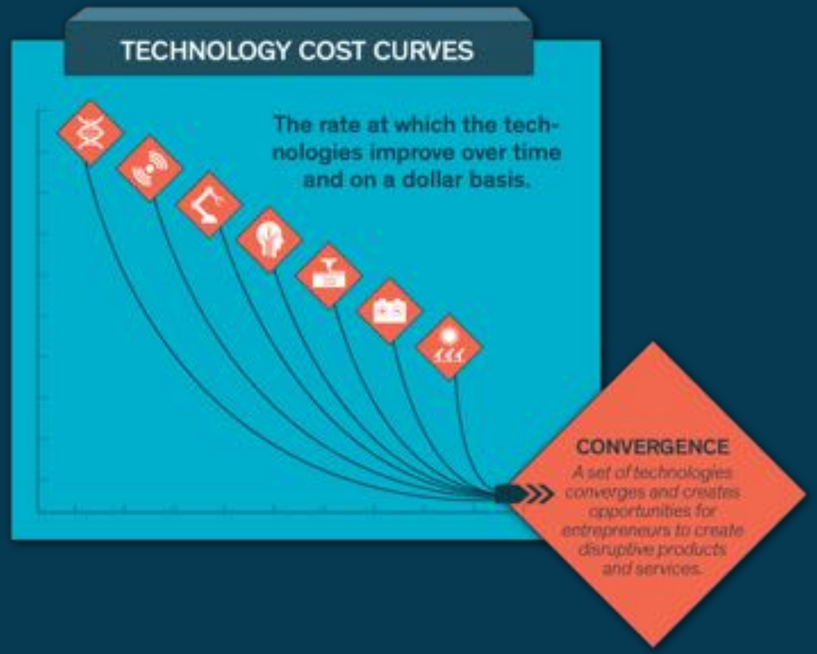
Source: Clean Disruption



Key Technologies

2017: Key Technologies

1. Sensors / Internet of Things
2. Artificial Intelligence / Machine Learning
3. Robotics
4. Solar PV
5. Energy Storage
6. 3D Printing
7. 3D Visualization
8. Mobile Internet & Cloud
9. Big Data / Open Data
10. Unmanned Aerial Vehicles / Nano Satellites
11. Blockchain / eMoney / eFinance



Technology Convergence

Convergence 2007 - Smartphone

- **Technology convergence in 2007 to make the smartphone possible**

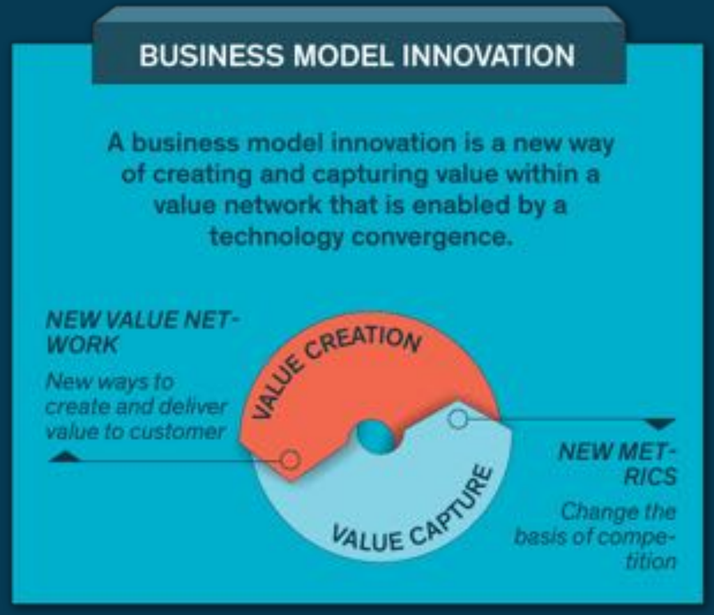
- **Data Storage** – Kryder's Law
  - Hard Disk $ cost per bit down **50% every 18 months**

- **Digital Imaging** – Hendy's Law
  - Pixels per $ - **59% / year**

- **Network Capacity** – Butter's Law of Photonics
  - The $ cost of transmitting a bit decreases by **50% every 9 months**

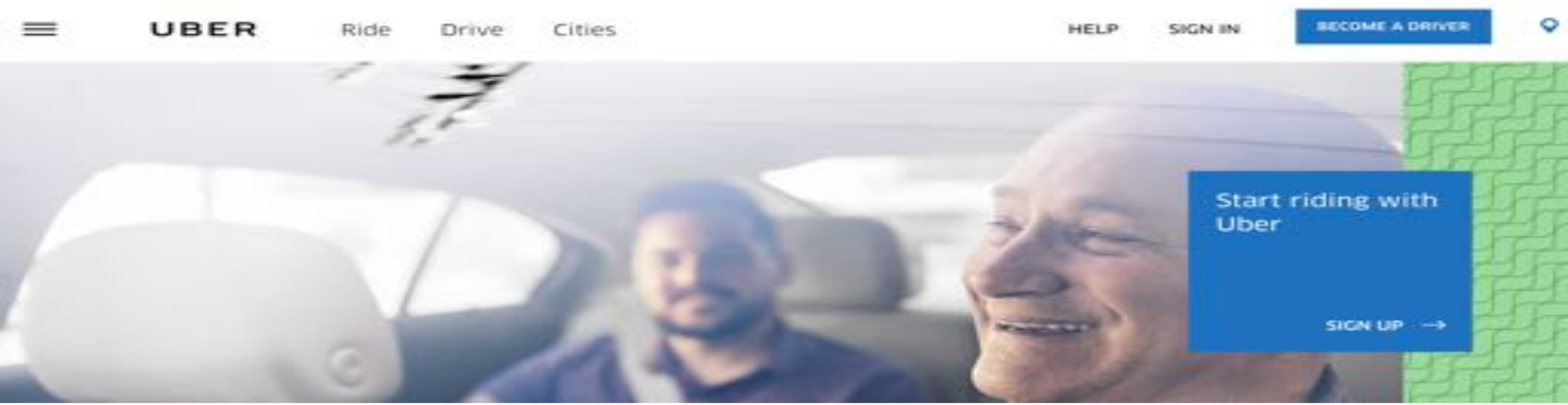
- **Touchscreen, Li-ion batteries, computing, sensors...**

Source: Wikipedia Image: apple.com



Business Model Innovation

Business Model Innovation:
Ride-Sharing (Uber, Didi, Lyft, Ola...)



- **Uber Bookings > US Taxi Industry Revenues (2016)**
- New York City = 500,000 Ride-Hailing Rides per day (1)

Source: RethinkX

Business Model Disruption

Business Model

Innovation

is as important & disruptive as

Technology Innovation

Seba Technology Disruption Framework™

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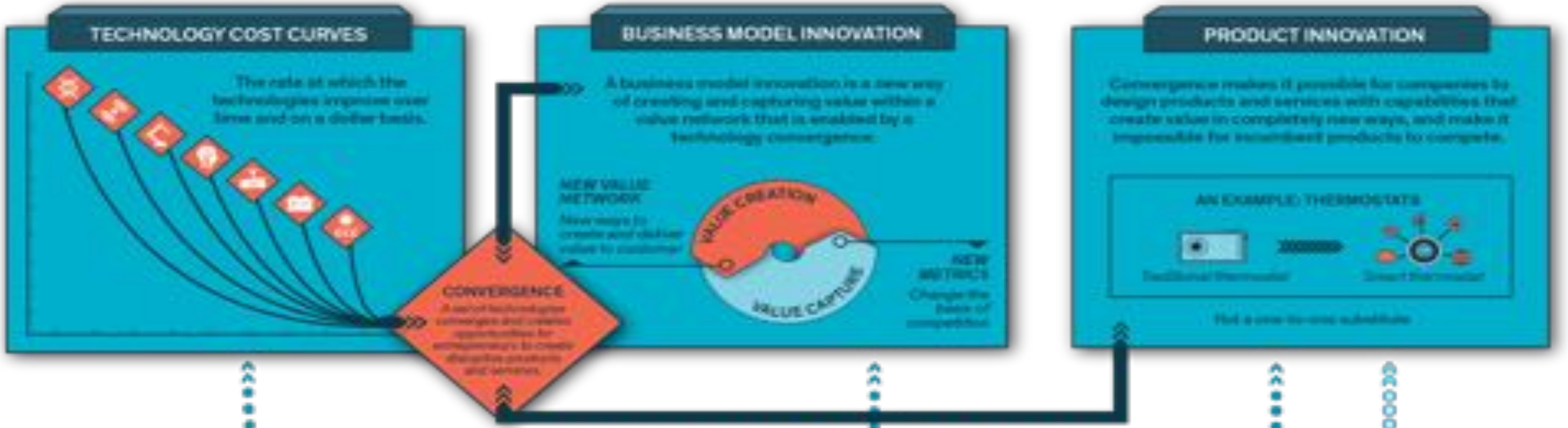

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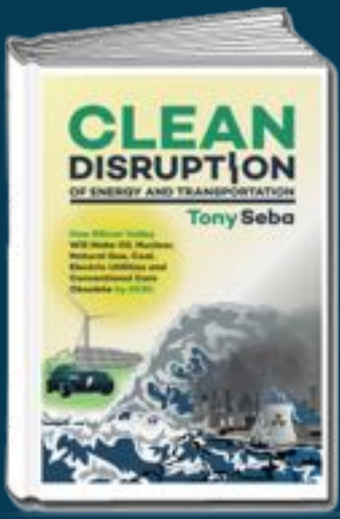
MARKET/SYSTEMS DYNAMICS

DISRUPTION OF TRANSPORTATION

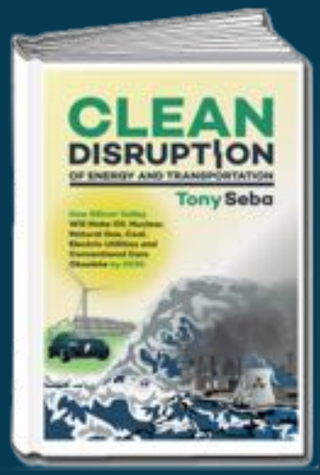
1. Electric Vehicles
2. Self-Driving
3. Transport-As-A-Service



RethinkX

The Electric Vehicle Disruption

Photo: © Tesla Motors



IS THE ELECTRIC VEHICLE Disruptive?

(You always need to ask)

Rodin – Thinker
Photo: Tony Seba

1. Maintenance - Gasoline Car: 2,000+ moving parts (1)

1. EVs: 10X cheaper to Maintain

ICE (Gas) Vehicle	Electric Vehicle (EV)
2,000+ moving parts (1)	**18 moving parts** (1)
Transmission, driveshaft, clutch, valves, differentials, pistons, gears, carburetors, crankshafts...	
	

- EVs **100X** fewer parts
- Tesla: **Infinite Mile** Warranty! (2)

Source: (1) Baron Funds, (2) Tesla Blog

2. EVs are 10X cheaper to charge/fuel

- It costs **$15,000** to fill up a (gas) Jeep Liberty over five years (Consumer Reports)
- An Electric Jeep Liberty would cost **$1,565** in electricity
- Improvements in software and power electronics to increase this >10X

Image Source: jeep.com

Assumptions:

12,000 miles/year

Tesla Roadster: 4.6 miles per kWh.

Ave retail electricity in the U.S.: 12 ¢/kWh

5 year-cost = (60,000 miles * 0.12 $/kWh) / 4.6 miles/kWh = $1,565.

Sources: Consumer Reports, DOE, Clean Disruption

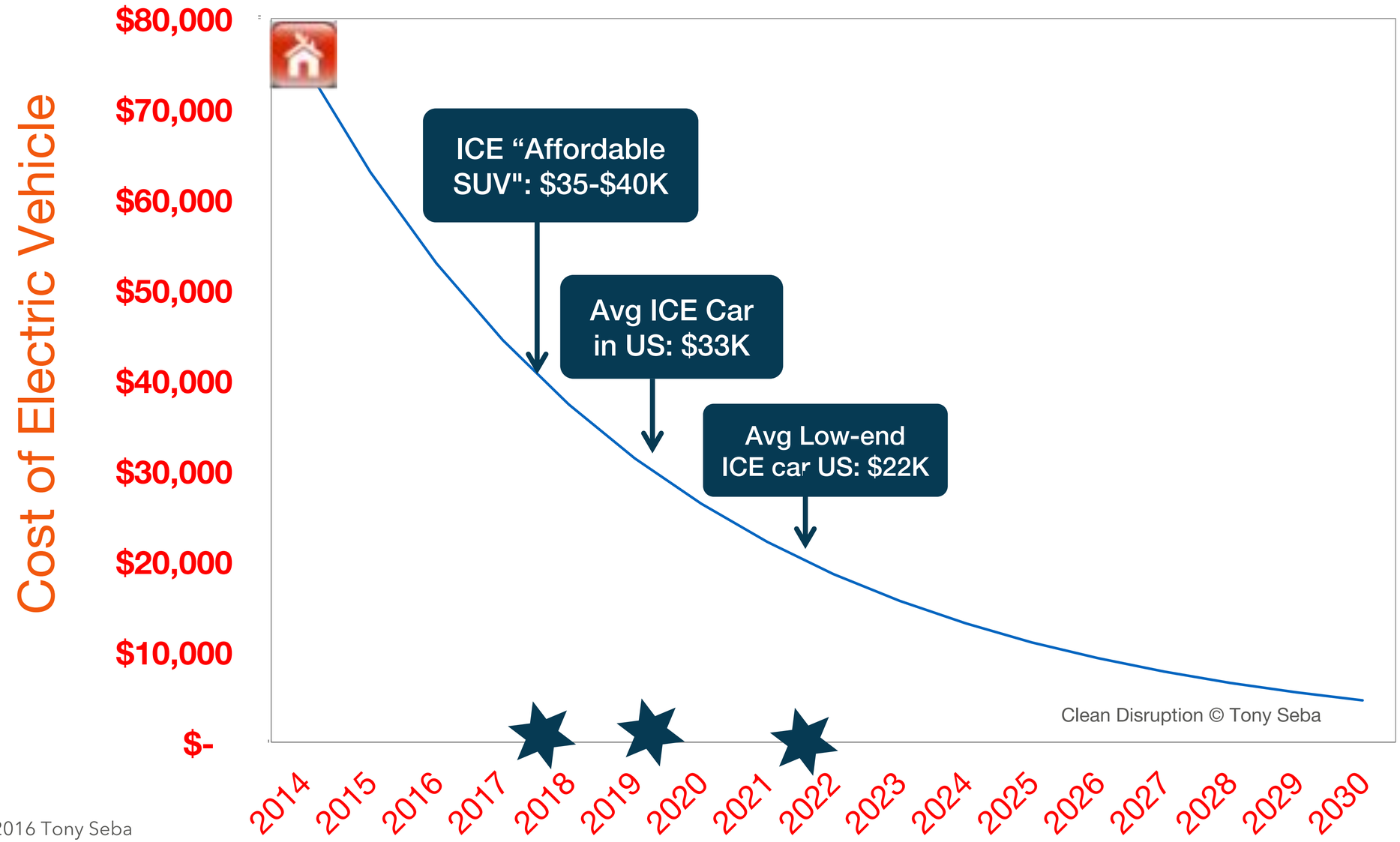
3 – EV Lifetime 500,000+ miles

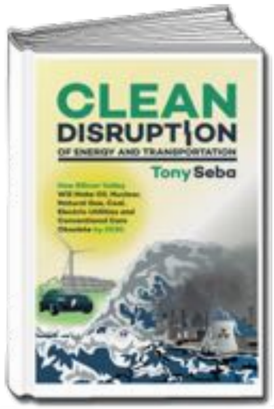
- **EV powertrains** can last **500,000 miles** **vs 140K-200K ICE**
- Tesla building **1,000,000 mile** Powertrain
- **That's 5x-7x ICE vehicles** (1)

(1) RethinkX

Anticipating Disruption from Above – Electric Vehicles

Cost of EV with 200-mile (320 Km) range





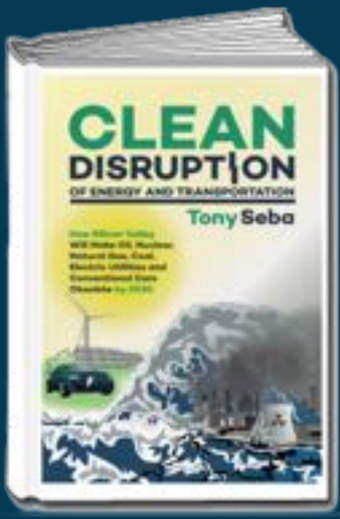
Assumptions:

- 4 miles/kWh,
- 50kWh batteries,
- 16% yearly battery cost improvement,
- EV Cost = 3X battery

Source: Clean Disruption

The Autonomous Vehicle Disruption

Image: Wikipedia



THE VERGE

August 25th, 2016

World's First Self-Driving Taxi Debuts In Singapore

*The first ever self-driving taxis **have started picking up passengers** in Singapore.*

MIT spinoff NuTonomy will be offering rides in 2.5 sqmi business district 1-North. Delphi also announced autonomous trial in Singapore.

Photo : The Verge

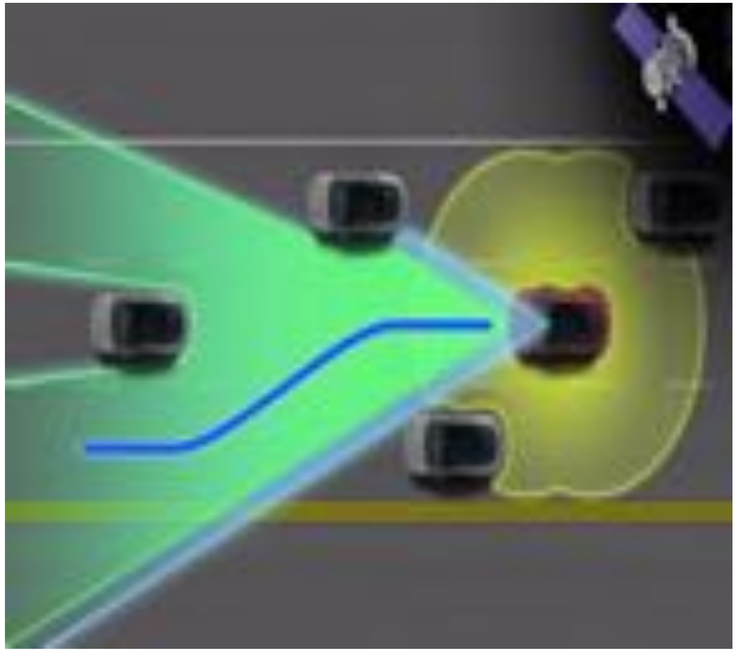
Source: The Verge

44 Corporations Working on Autonomous Vehicles

electrek

April 25, 2017

TESLA TO TRANSITION TO **LEVEL 5 - FULLY SELF-DRIVING - 2019**



"*U.S. National Highway Traffic Safety Administration (NHTSA)*: ***Tesla with Autopilot 40% Safer.***" *(1) Jan 2017*

*Elon Musk: "**From** Parking Lot in **California** to Parking Lot in **New York** without touching controls by **Dec 2017**." (2) April 2017*

"***Level 5 Autonomy*** *in two years [**2019**]. "* *(2)*

Sources: (1) Fortune, (2) Electrek

WHAT ABOUT THE **COST** of Autonomous Vehicles?

Year 2000: World's 1_{st} 1-TeraFlops Computer

ASCI RED - Sandia National Labs

- Space = 1,600 sq ft **(150 m2)**
- Power Consumption = 850 kW
- **Cost = $46 million**

Image: Extreme Tech

Source: Wikipedia

Exponential Tech Improvement: GPU NVIDIA Drive™ PX

Dual Drive PX 2 GPU Platform

8 TFlops

- Power Consumption = 250 W

3,400x improvement

Cost = ~**$600**

~653,000x improvement

✓ Xavier® (Q4 2017): **20 TFlops**

✓ **1,000x** improvement by **2025**

NVIDIA CEO Jen-Hsung Huang

Image and Data Sources: NVIDIA

Autonomous Vehicles = Computer on Wheels

- Computer Platforms = network effects
- Winners Take All: only two O/S Survive (PC, Smartphone, Tablets...)

ALL YOU NEED is **ONE Platform** to Achieve LEVEL 4-5

Cool! I can

and also

while NOT driving!

BUT WHAT'S THE

Disruptive Impact?

Rodin – Thinker
Photo: Tony Seba

Transportation As A Service (TaaS)

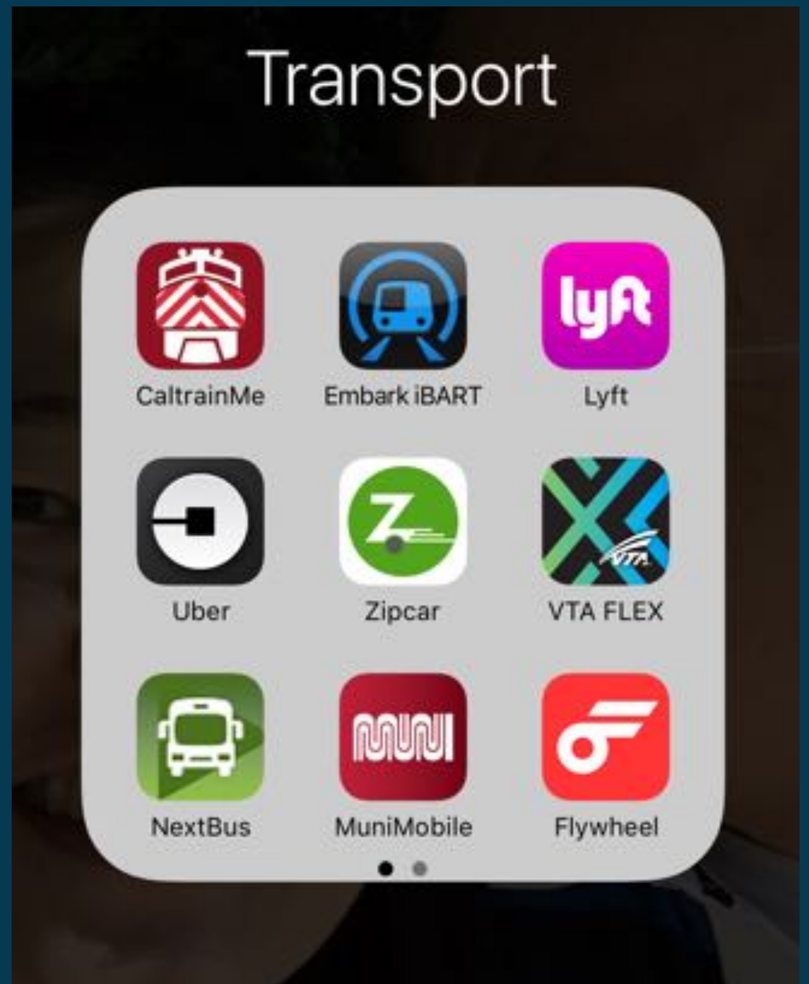


Photo Tony Seba

Cars: Huge Waste of Space and Money

- Cars = 2nd largest Capital Expense
  - Ave. new car costs = $33k
- **Cars are parked 96% of the time!** (1)
- **4% Asset Utilization** is a disruption waiting to happen!

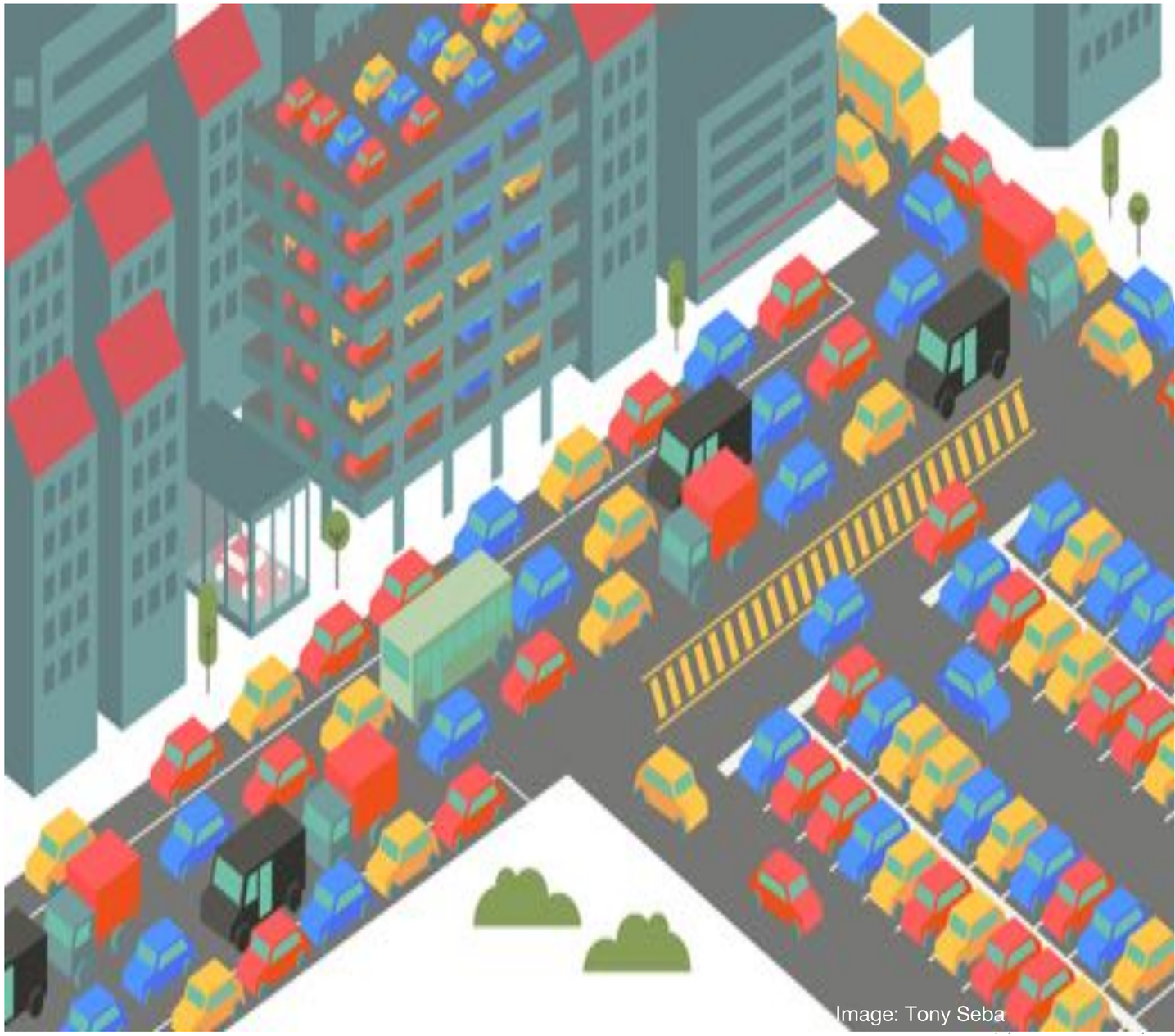
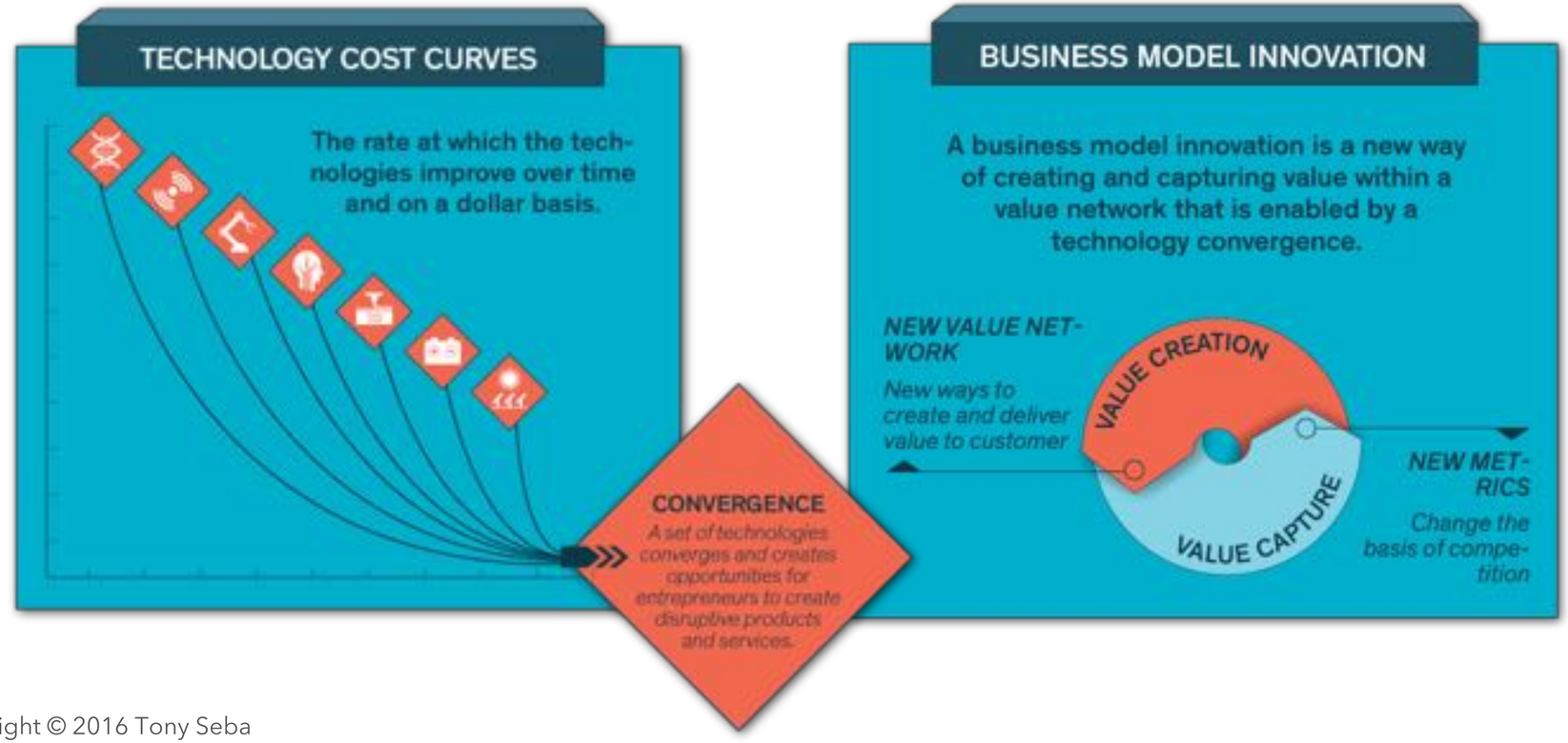


Image: Tony Seba

On Demand + AUTONOMOUS + ELECTRIC:

Convergence of **Technology** & **Business Model** Innovation

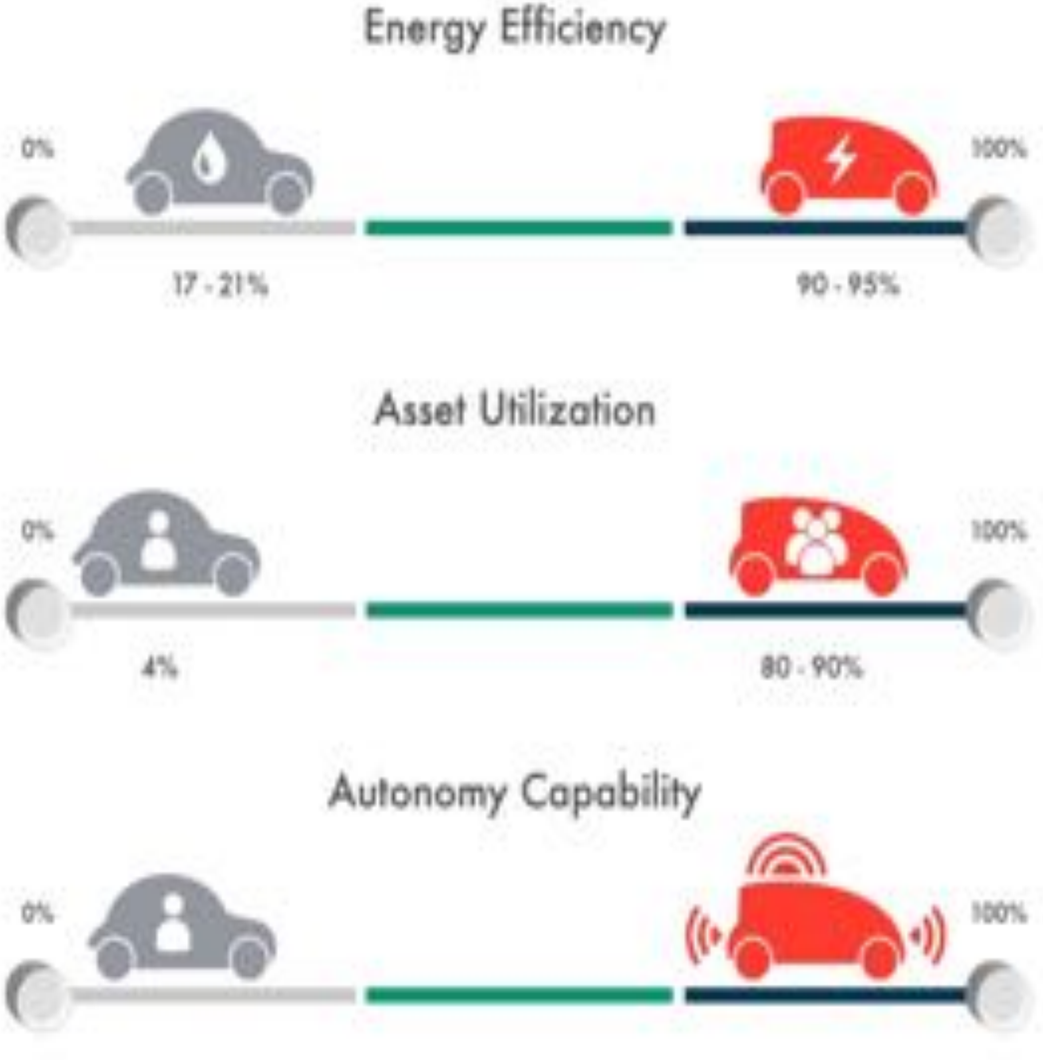


Rodin – Thinker
Photo: Tony Seba

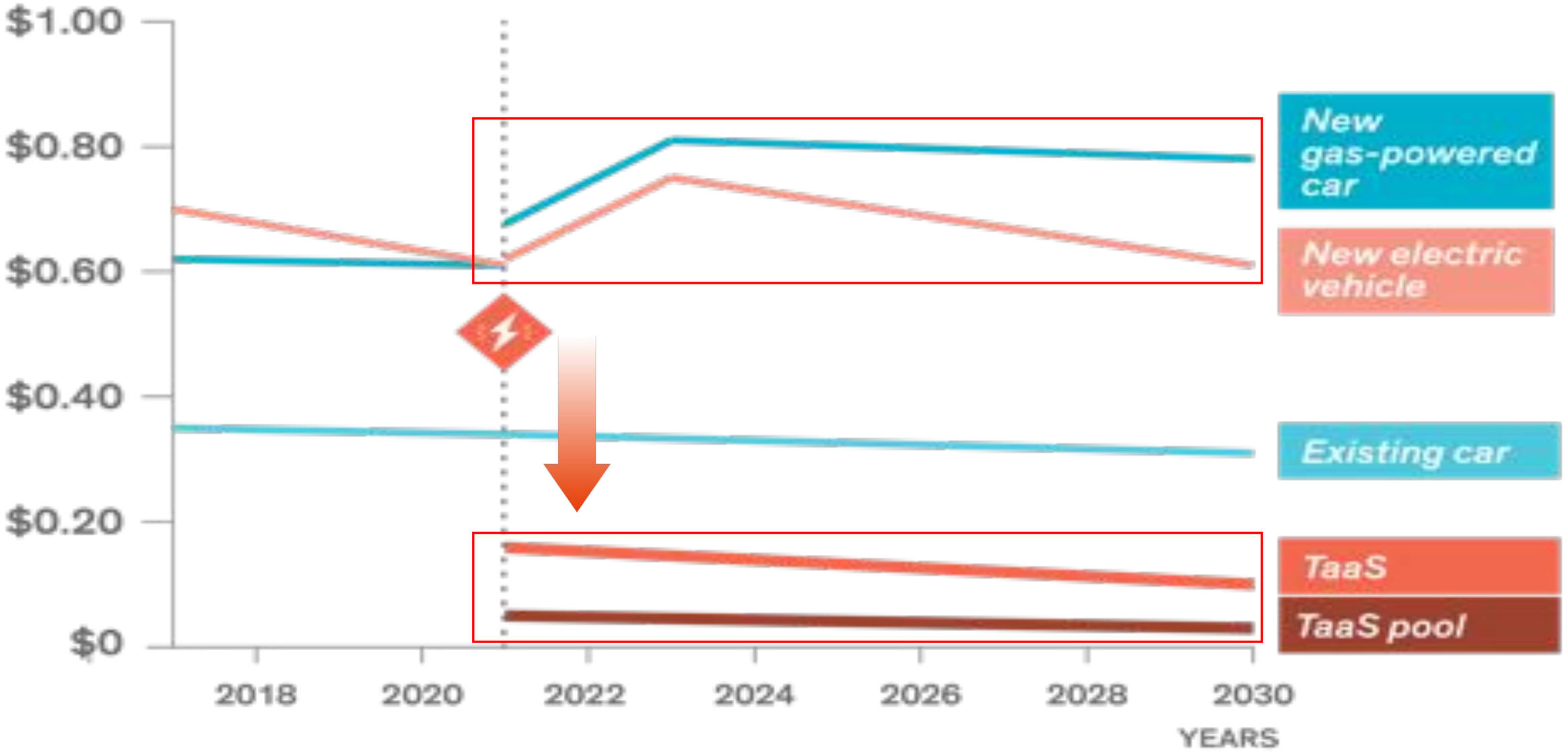
TaaS - Transport-as-a-Service: On Demand, Autonomous, Electric (AEV)

- Transport As A Service (TaaS)
  - **Ride-Hailing (on demand)** biz model
  - **Electric Vehicle** tech
  - **Autonomous Vehicle** tech

- Driving time goes from **4%** to **40%**
- Vehicle Asset Utilization goes **UP 10X**
- Cars can **drive 100,000 miles/year** (up from 10k miles/yr)



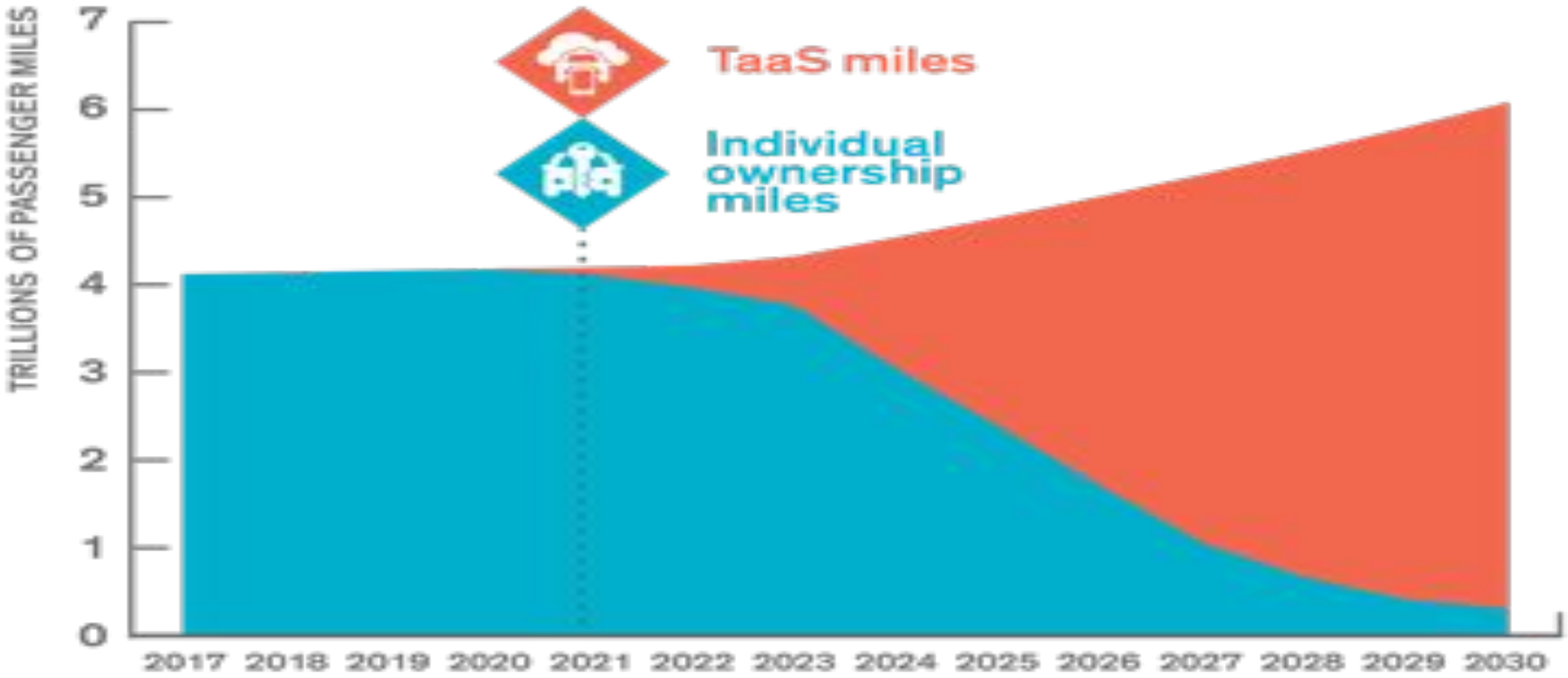
TaaS: 4x-10x Cheaper than IO Vehicles



Rethinking Transportation 2020-2030

RethinkX

95% of Passenger Miles TaaS (AEV) by 2030



RethinkX

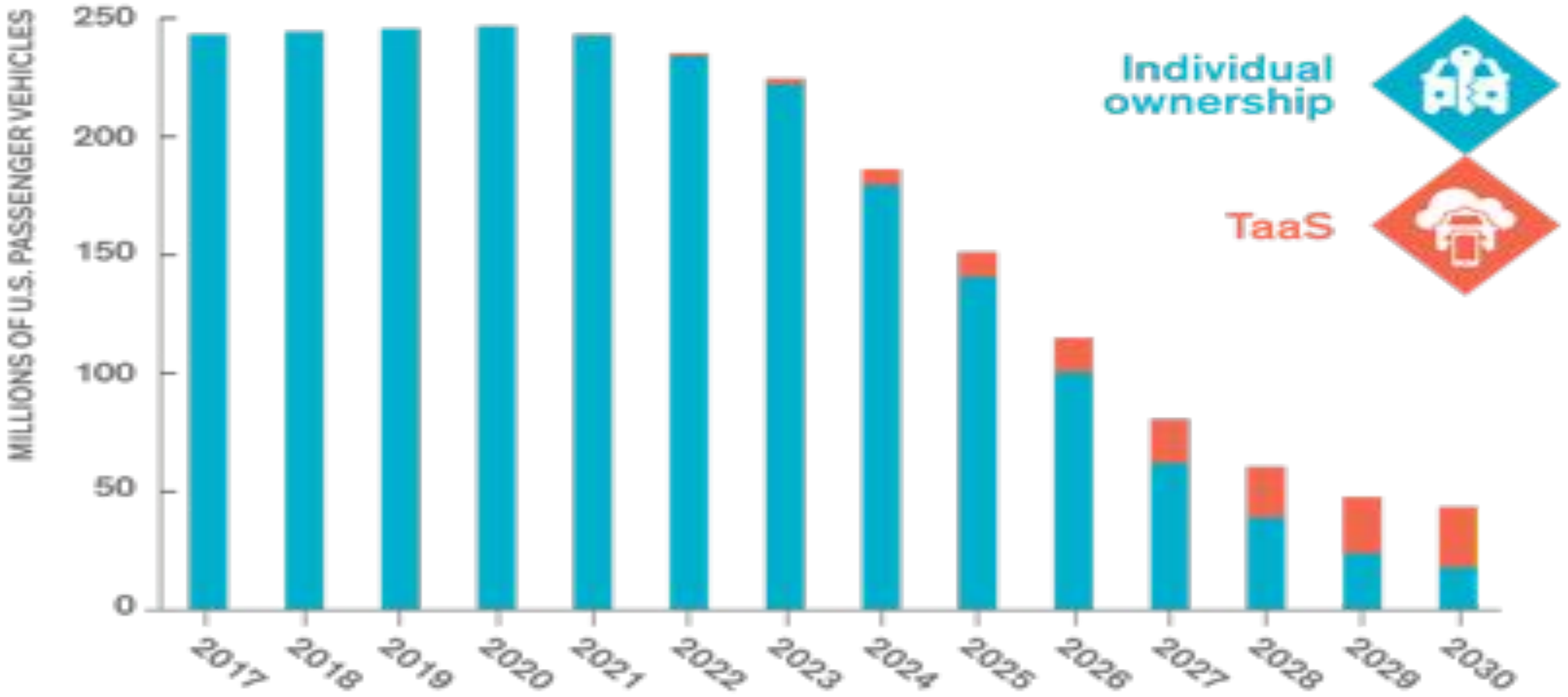
Transportation As A Service (TaaS)

On Demand

Autonomous Electric Vehicles (AEVs)

Owned by FLEETS, not individuals

U.S Vehicle Fleet Shrinks by 80%

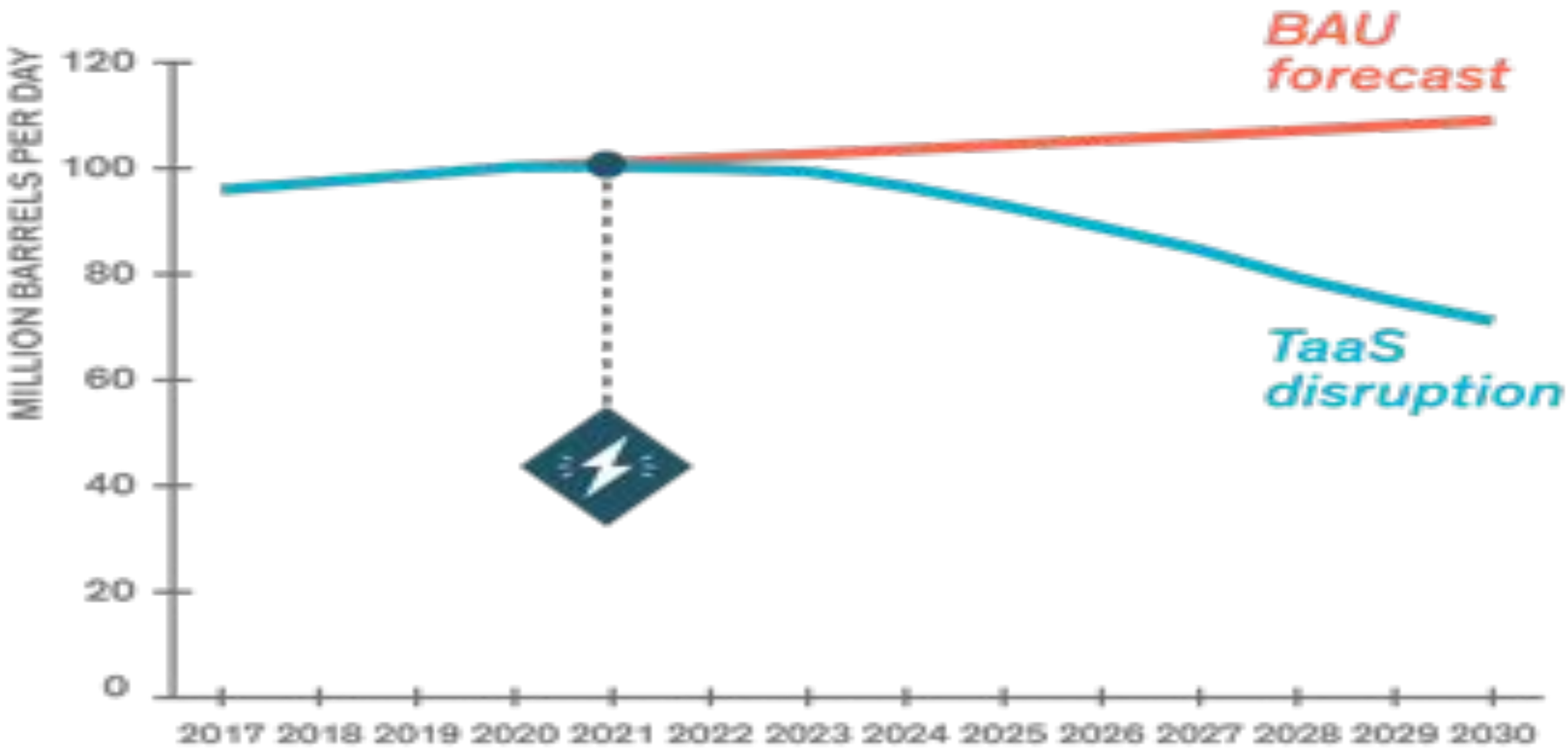


RethinkX

Disruption of Oil

RethinkX

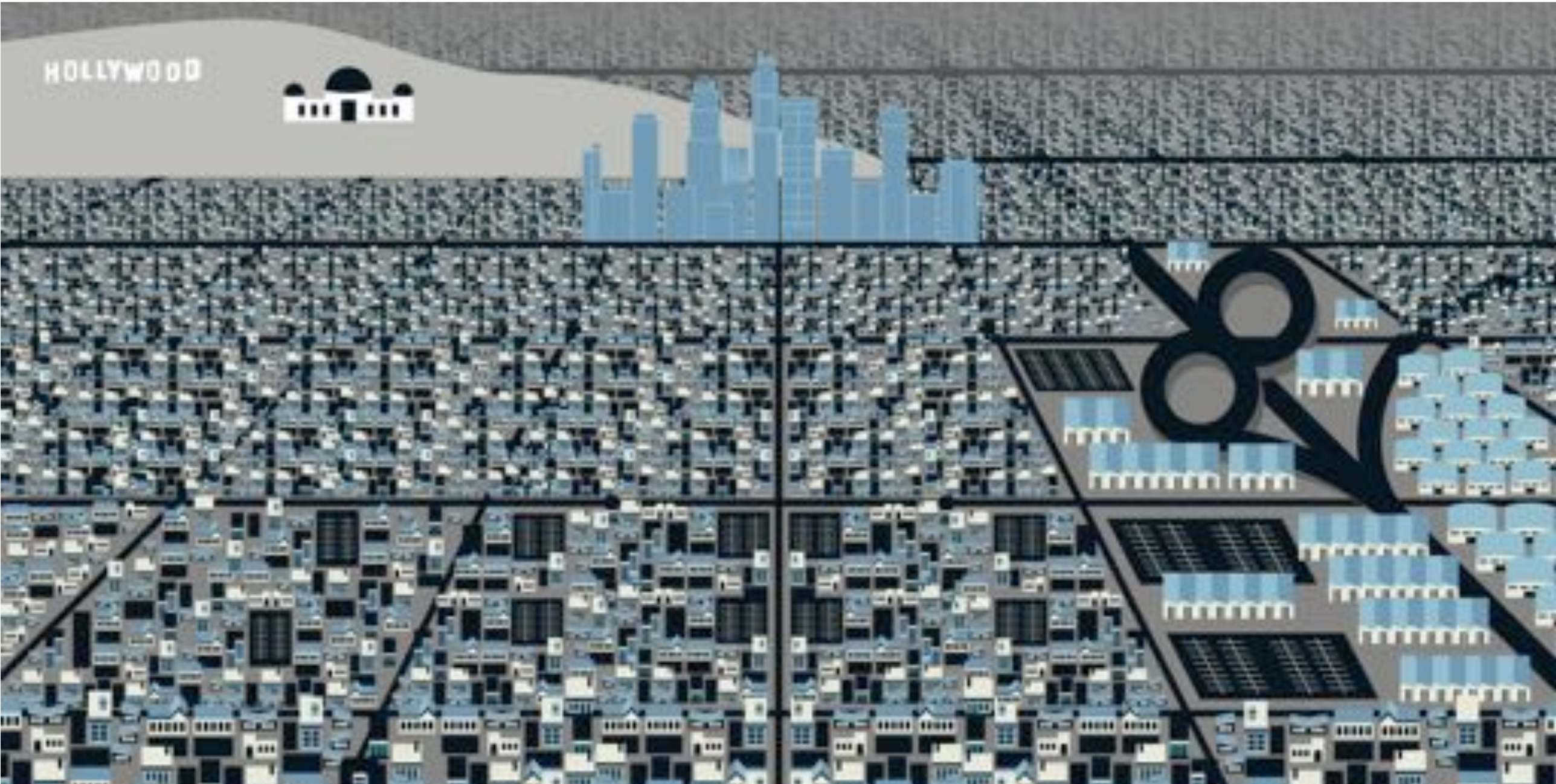
Global Oil Demand Peaks at 100mpd 2020 Drops to 70mpd 2030



RethinkX

Implications

TaaS Disruption - Parking Obsolete: 80%+ Vacant



TaaS Disruption Implications

Financial & Social

- **Financial**
  - Saving per Household: **$5,600+ / yr**
  - U.S. Disposable Income increase by **$1 Trillion / year**
  - Productivity increase of **$1 Trillion / yr** - time freed from driving
- **Social: Increased mobility for all**
  - Elderly / Pensioners
  - Disabled
  - Young
  - Poor, Unemployed, Underemployed

Source: RethinkX

TaaS Disruption Implications
Environmental & Geopolitical

- **Environmental**
  - **80%** decrease energy consumption
  - **90% decrease in CO2 emissions**
  - Decreased use of **materials** (20 vs 2000 & 200k vs 500k)

- **Geopolitical**
  - Oil Energy Independence
  - Foreign Policy: energy security less critical

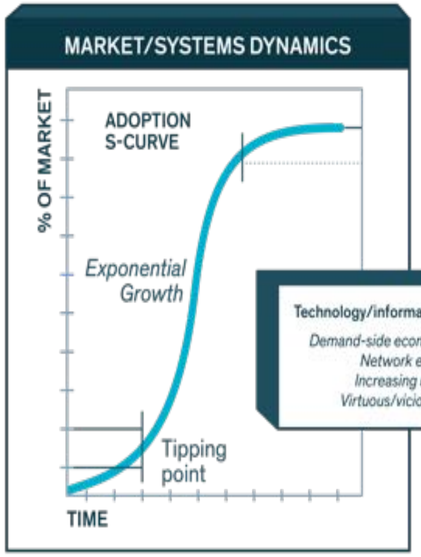
Source: RethinkX

Back to the Future

On the Cusp of Clean Disruption of Energy & Transportation

We are here

2017



2030

This Disruption is NOT in the Future
It is NOW!

Photo: Tony Seba

Thank You!

RethinkX.com/Resources

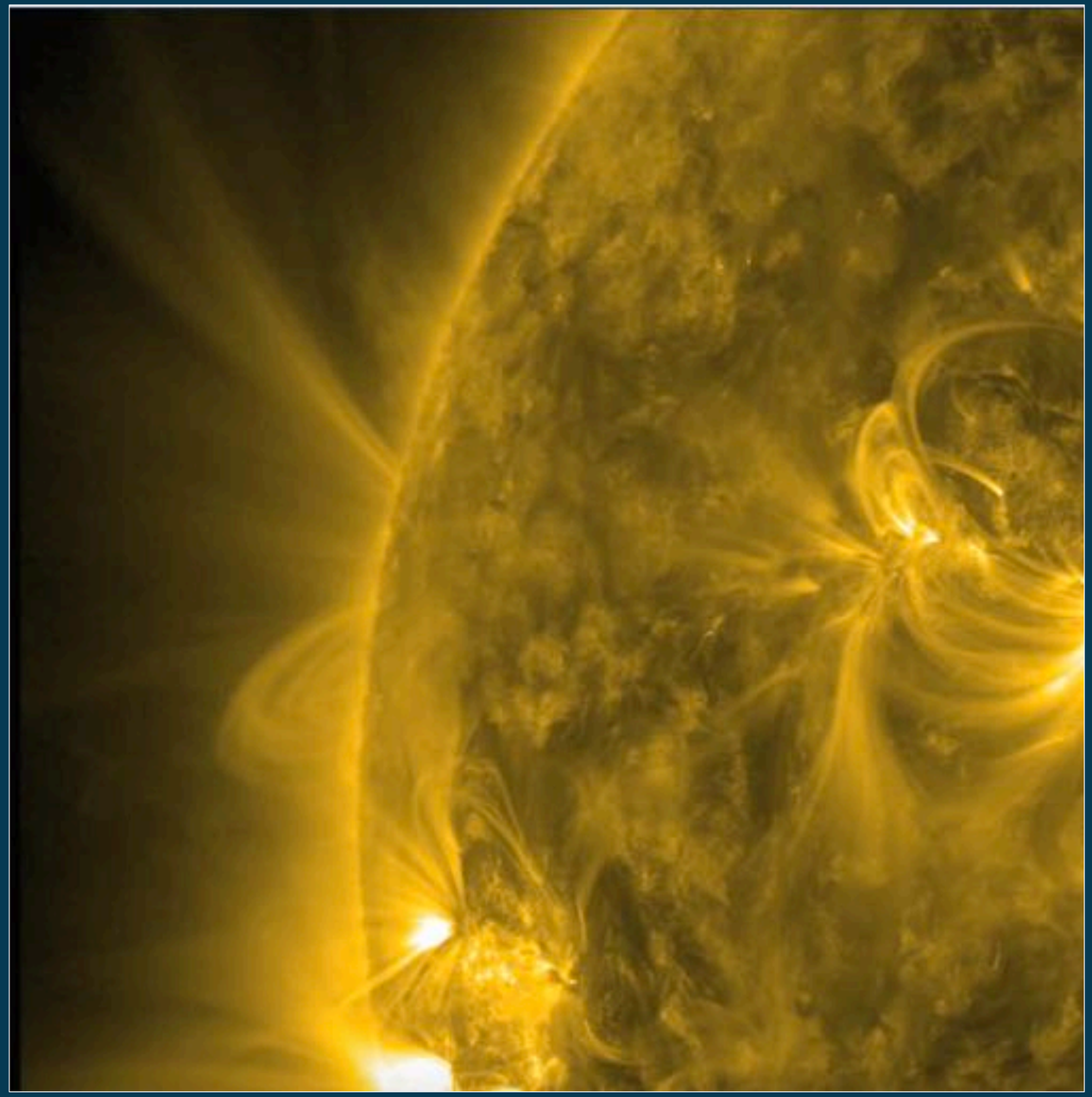


Photo: NASAa

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