

# Energy Storage Seminar



## **Amber Kinetics**

### **From Investment Perspective**

**By Jason Xu**  
**Jan. 27<sup>th</sup>, 2018**



# Amber Kinetics, From Investment Perspective



- Amber Kinetics brief intro
- General Investment Logics
- Specifics for Amber Kinetics case
- Technology comparison

# Jason Xu, Ph. D.



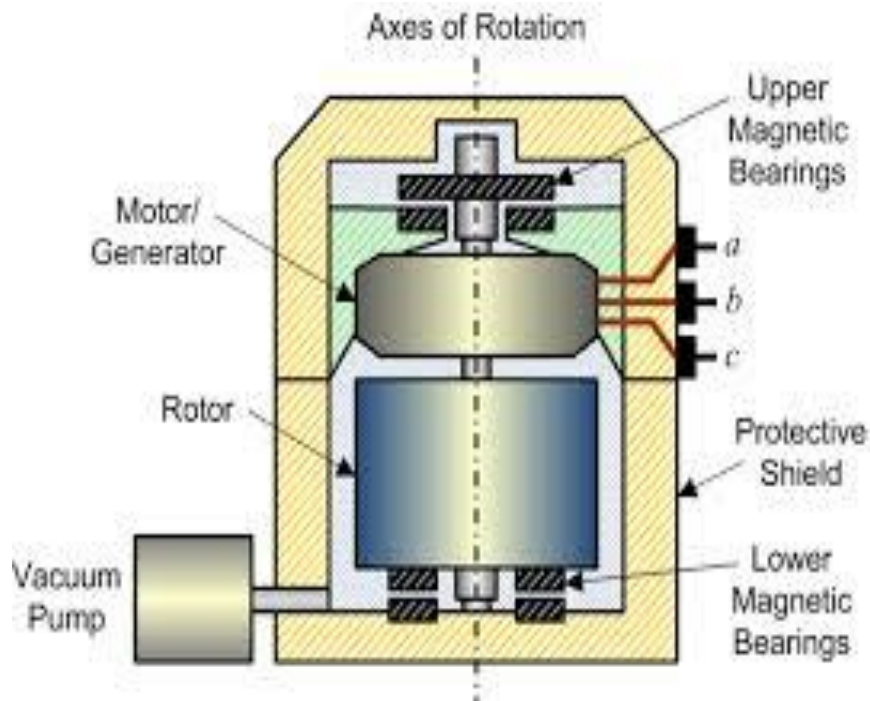
- Sycamore Ventures venture partner (NA), Sycamore Asia partner. Successful investments: Amber Kinetics, Intraminds, Chestnut medicals and several others.
- Has 25 year management experience in business development, marketing/sales, manufacturing/operation, and product development both in US and China.
- Worked in clean-tech & renewable energy industries, semiconductor, medical devices and consumer products.
- Senior advisor for UstarX, HNBC, Makerehome, & Xian Jiaotong U Incubator. Clean Tech Open mentor
- Ph.D. in mechanical engineering from University of Minnesota. BS from Xian ChiaoTung University.

# Old fly Wheel

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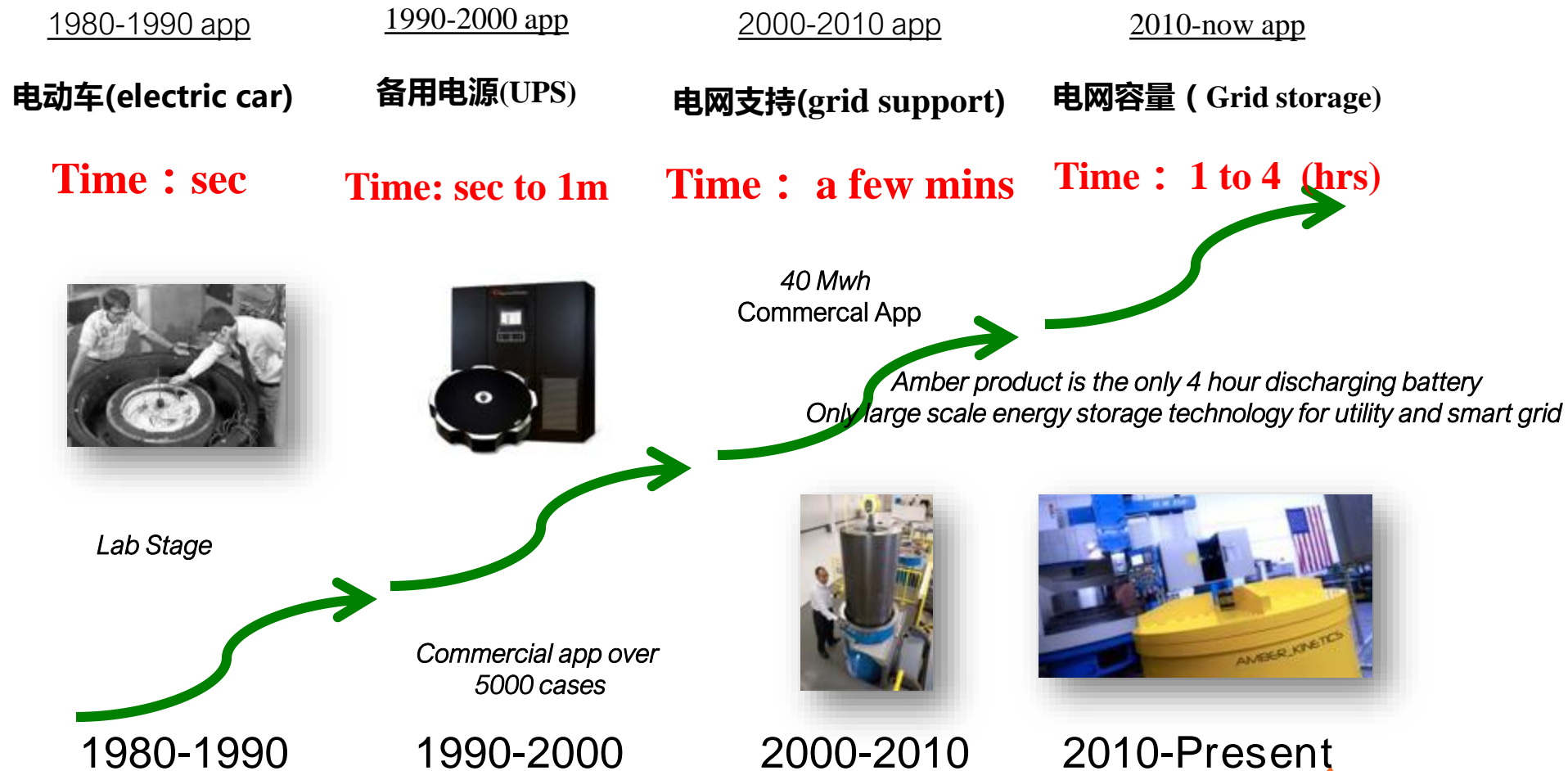


# Fly Wheel Energy Storage Schematic



- Electrical energy input from Grid and drive rotor
- Rotor rotates in high speed to keep the momentum (hours and days)
- If needed, generator converts kinetic energy to electricity for output.

# Fly Wheel Progress & app





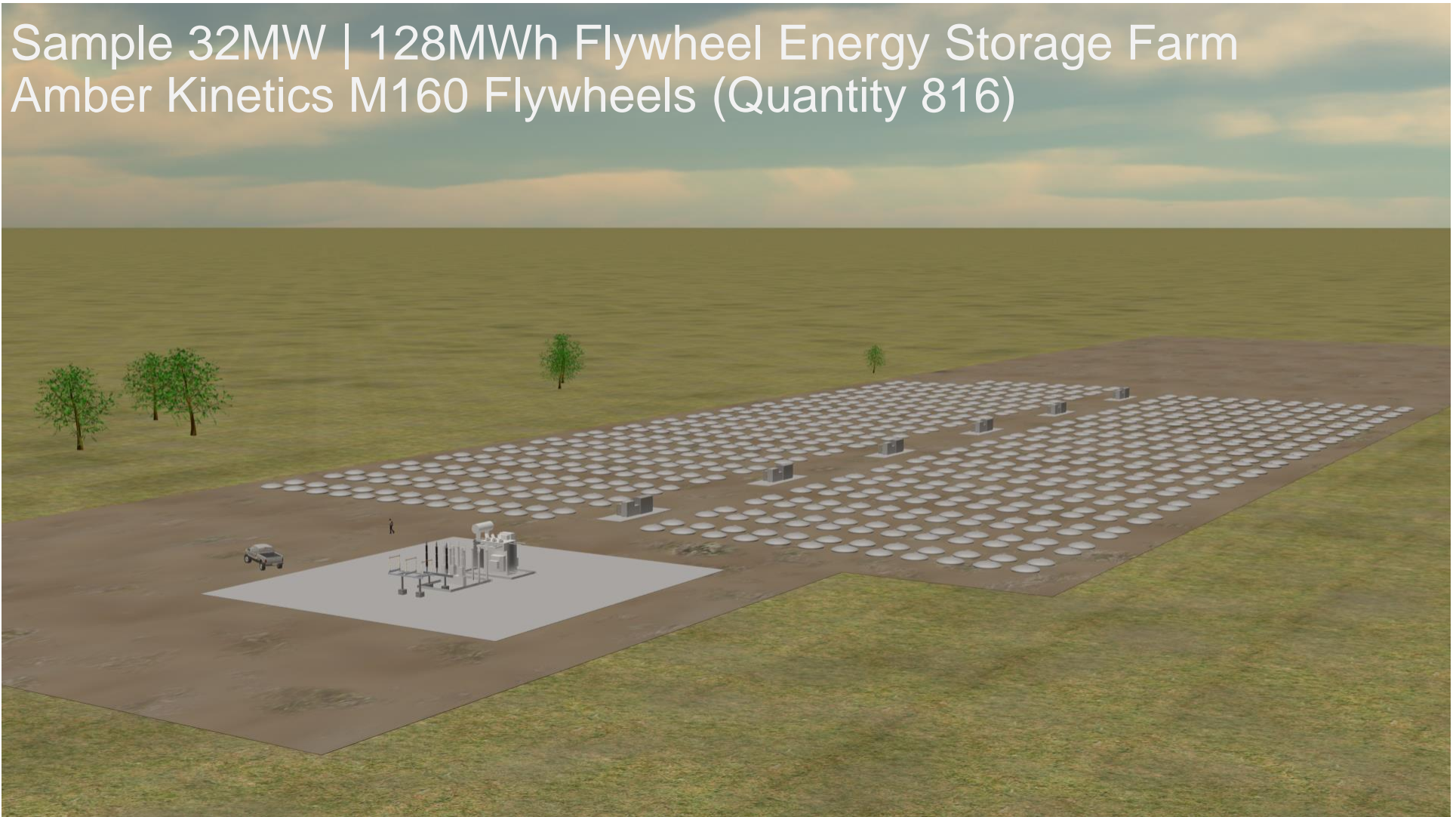
# Amber Kinetics Products



M32/M160 (kwh) :

- 1 ) High speed rotor and its material
  - 2 ) Optimized magnetic bearing
  - 3 ) High efficiency motor /generator
  - 4 ) **The first 4-hour discharge device**
  - 5 ) **Most reliable, minimum loss**
- electromechanical system available

# Sample 32MW | 128MWh Flywheel Energy Storage Farm Amber Kinetics M160 Flywheels (Quantity 816)





# PV Magazine Array changing Technologies first price

## And the winner is ...

**Array Changing Technologies 2017:** A surprise runaway winner to 2017's Array Changing Technologies feature, Amber Kinetics' M32 flywheel storage system impressed the award jury with its potential to provide a practical, chemical-free alternative to lithium-ion storage.

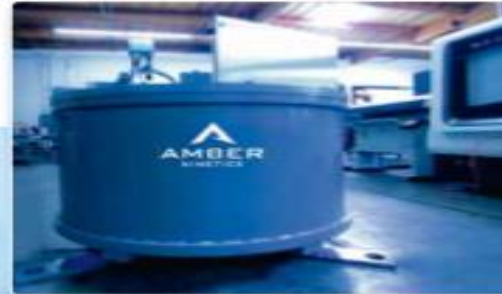


Photo: Amber Kinetics

Array Changing Technologies is pv magazine's annual feature demonstrating the latest and greatest technologies in the downstream sector, and looking to reward those with the highest potential to solve a problem, improve performance, lower costs, and push solar forward.

This year, the feature was split into two parts. In June our first three jury members picked out the top 10 from a huge selection of new products and innovations appearing in the European market in the run up to Intersolar Europe, and

then one month later three more industry experts helped us to select the top products appearing in the USA market as Intersolar North America drew near.

Finally, the six jury members came together to pick an overall winner from the two parts. After plenty of deliberation, the field was narrowed and a winner began to emerge alongside some very close runners up. Amber Kinetics M32 Flywheel was chosen as the overall winner, as a tried and tested technology being brought to new scale and applica-

tions. "This is a great concept for energy storage, and combining it with solar PV generation is an innovative idea," says Rebecca Hott of the U.S. Department of Energy, summing up the jury's opinion of the product.

Flywheel storage is certainly not a new concept. However, the jury saw this product's four hour duration with unlimited cycling, as well as the specified lifetime of up to thirty years with little maintenance required, as something truly array changing in its potential.

### The 2017 Award Jury



**Paula Mills**  
Founder and Chief Analyst of  
SPV Market Research



**Rebecca Hott**  
Science and Engineering  
Technical Advisor with the  
U.S. Department of Energy's  
SunShot Initiative.



**Yusef "Salar Fred" Valencia**  
Chief Marketing Officer of Salar  
at Kinetix (formerly Inspire  
Lab)



**Mark Markiewicz**  
Supply Chain Manager at  
Sunion



**Andrea Gitter**  
Senior Business Development  
Manager EMEA & APAC, Clean  
Energy Associates



**David Fritzsche**  
Managing Director, energy  
plan consult

Amber was reported by Wall Street J, Nature, PBS NOVA, and CBS Sunday Morning

# Amber Kinetics, From Investment Perspective



## Investment Methodology

# General Investment Logics



**4PCB**

# General Investment Logics



**4P:**

**Problem**

**Potential**

**Product**

**People**

# General Investment Logics



**C:**

**Competitive advantage (sustainable)**

**B:**

**Business model**



# General Investment Logics



## Problem

- **Problem Statement**
- **Real pain or itching point**

# Problems (Pain points )

- Large scale grid energy storage is extremely difficult problem world wide:

**Electric supply = demand (at any moment)**

- For micro-grid (Island, military base, industrial park, hospital and data center), storage is for grid stability, UPS and emergency backup

**Amber products can solve all above problems !**



# Problems (Pain points ) - continued

- China lost 57 billion kwh renewable energy in 2016 (someplace >50% of generated)
- Electrochemical battery has problems:
  - 1) performance degradation(cycle),
  - 2) fire/release/ explosion potential,
  - 3) Recycle
  - 4) environmental pollution in manufacturing, operation and disposal

**Amber products can solve all above problems !**



# General Investment Logics



## Potential

- **How big is the opportunity  
(Please don't say HUGE)**
- **TAM vs SAM vs SOM**













# General Investment Logics



- **TAM (Total Available Market)**
- **SAM (Serviceable Available Market)**
- **SOM (Serviceable Obtainable Market)**



# Electric Energy Consumption

Rank ↕	Country ↕	Total TWh ↕	Fossil ↕	Nuclear ↕	Renewable ↕	Inhabitants (millions) ↕	per capita (MWh/a) ↕
—	<b>WORLD</b>	20,900 (20.9 PWh)	68%	11%	21%	7,040	2.97
1	 China	4,830 (4.83 PWh)	78%	2%	20%	1,356	3.56
2	 United States	4,070 (4 PWh)	66%	19%	13%	314	12.96
3	 Canada	543	24%	15%	59%	34.9	15.56
4	 Mexico	246	75%	2%	23%	117	2.1
5	 Brazil	498	17%	1%	82%	199	
6	 Argentina	124	54%	4%	41%	41.1	
7	 Venezuela	102	35%	0	65%	30.0	
8	 Germany	585	57%	15%	25%	81.9	7.1
9	 France	482	9%	75%	16%	65.4	
10	 United Kingdom	347	67%	19%	12%	63.7	

\*For energy storage to be a factor for the grid, assume 10% of consumption.  
 Total world wide energy storage market in kwh is  $10^{11}$ . (1Pwh =  $10^{12}$  kwh)  
 \*This is entirely new market, not replacement market where capital depreciation is an issue

# Energy Storage Application Markets

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## Grid energy storage market

- For Grid Auxiliary service: frequency/voltage regulation, peaking shaving, load shifting, renewable firming, spinning reserve, and black start
- TAM: 10% of electric power generated, \$600,000 Billion (\$300/kwh)
- SAM: (\$30 billion) world wide (0.005% of Total)

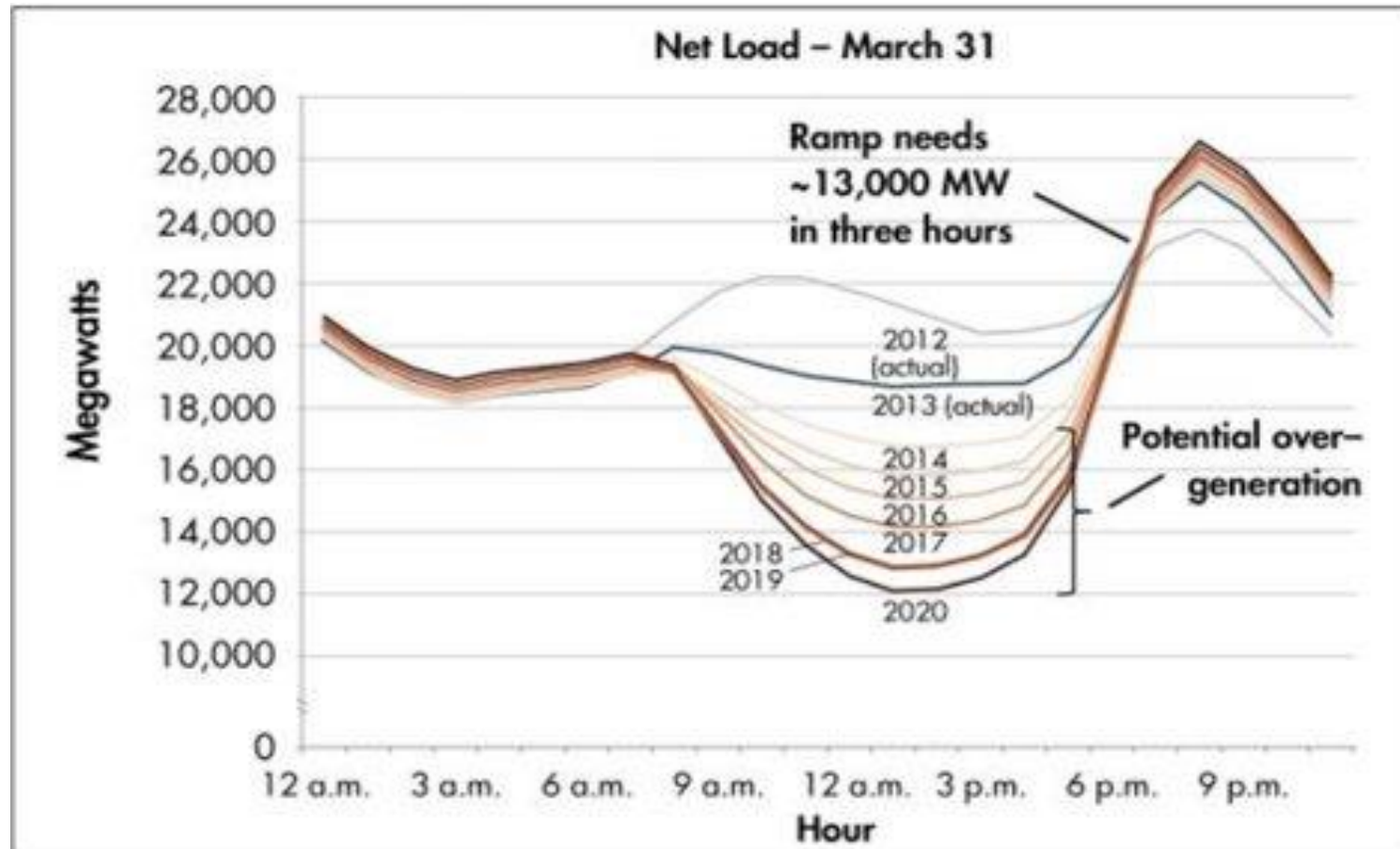
## Micro-grid market

- For Micro-grid (Island, military base, industrial park, hospital and data center), storage is for grid stability, UPS and emergency backup ( \$35 billion)

## Renewable energy market

- If 10% of 57 billion kwh renewable energy were stored ( \$2000 billion at \$350/kwh)

# California Demand Curve



## CA Duck Curve

# Energy Storage Application Markets

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## Peak-valley energy arbitrage market

- Many retail electrical company would invest in energy storage equipment
- Goldman Sachs market analysis: 2016 (\$30 billion) ~ 2020 (\$258 billion)

## Industrial market

- Telecommunication base power supply market
- High-speed rail system energy storage system
- Replace lead acid batteries and diesel engine in industrial UPS and emergency backup market (Nigeria)

## Power energy storage market

- Electrical car charging station
- Car braking storage units

## Residential market (future market)

- to compete with Tesla Power Wall (in Third or forth tiered Cities in developing countries)

## Smart grid market (future market)

# General Investment Logics



## Product

- **MVP**
- **How different is your product from competition?**
- **Product market need fit**
  - **Would customers be willing to pay for your product?**
  - **How much will they pay?**



# General Investment Logics



## People

- Education background
- Work experience
- Problem definition and description
- Market understanding
- Decision making
- Learning ability

# Amber Management Team

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**Ed Chiao *CEO & Co-Founder***

Entrepreneur with experience in 3 prior start-ups, acquired for combined \$400 million  
Prior roles include product management, operations, sales, and business development  
Won Chinese Institute of Engineering Award (awarded by Dr. Steven Chu)  
B.S. Electrical Engineering, University of California Los Angeles



**Seth Sanders, Ph.D. *Chief Scientist & Co-Founder***

Recognized as Leading Scientific Expert in Flywheel & Power Conversion Technologies  
Professor of Electrical Engineering, UC Berkeley  
B.S., M.S., Ph.D. Electrical Engineering, M.I.T.



**Michael Potter *Chief Financial Officer (Interim)***

CFO at Canadian Solar, served on Company Board of Directors  
SVP and CFO, STATS ChipPAC  
Senior Auditor at KPMG, Honeywell & Allied Signal



**Wei-Tai Kwok *Chief Operating Officer***

COO at Andalay Solar; led turnaround effort for publicly listed company  
VP at Suntech Power; established U.S. MFG operations  
VP Operations at NRG Solar  
B.A. Economics & Political Science, Yale University

# General Investment Logics



**C:**

**Competitive  
Advantage  
(sustainable)**

# Competitive advantage (sustainable)



- 1) The only 4 hours discharge storage fly wheel system
- 2) Least amount of operation loss, can store energy for weeks
- 3) No performance degradation, limitless cycles
- 4) 20 year performance guaranty, 30 year expectancy
- 5) No temperate requirement
- 6) No fire, release and explosion danger
- 7) recyclable
- 8) No pollution in manufacturing and operation, environmental friendly
- 9) Owns IP and know how

# General Investment Logics



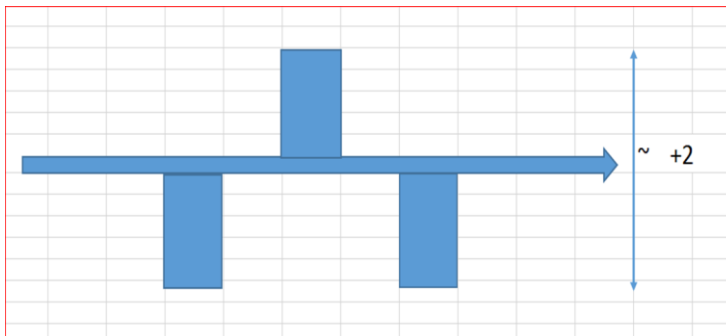
## **B:**

# **Business Model**

# Business Model

AMBER\_KINETICS

- (1) Integrated Equipment Supplier for Grid, renewable, micro-grid energy storage markets**
- (2) Grow the company to become energy and energy service provider**
- (3) SAS (Storage as a Service model)**



(Grid)+2 effect



## Technology Comparison



# Comparison with all other Fly wheel technologies



**Amber has two revolutionary breakthrough:**

**1 ) The only 4 hours discharge storage device at rated power;**

**2 ) Least amount of operation loss, can store energy for weeks**

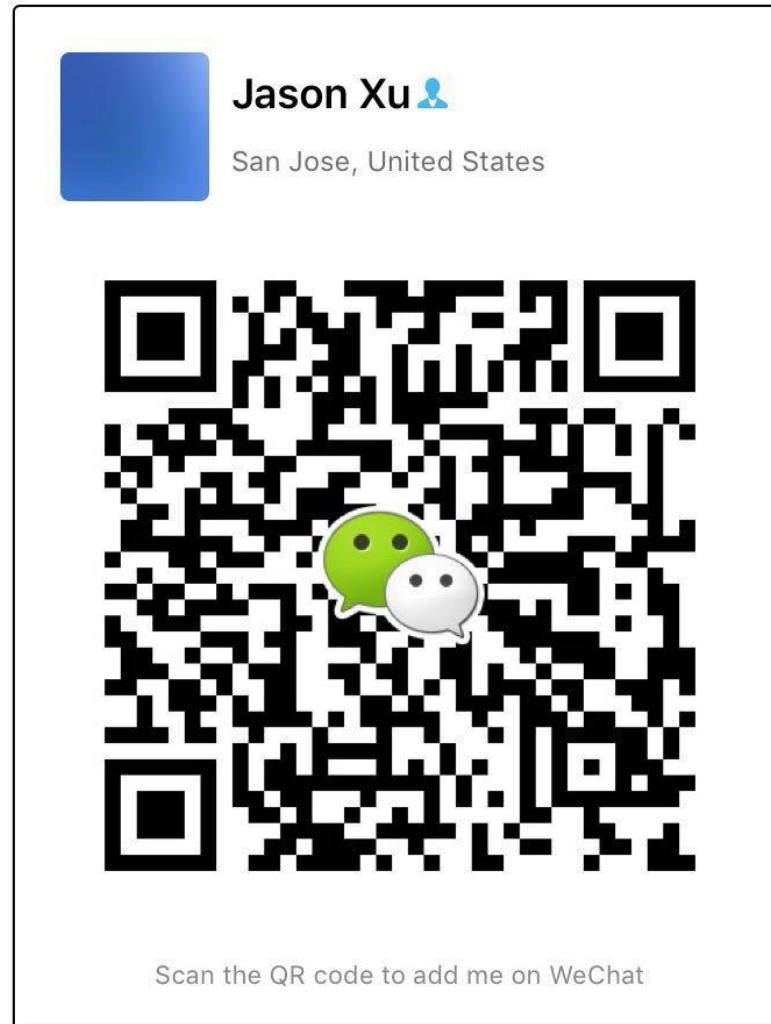
**Amber fly wheel is the most reliable mechanical and electrical system for energy storage**

## Comparison with all other energy storage technologies



- 1) No performance degradation, limitless cycles
- 2) 20 year performance guaranty, 30 year expectancy
- 3) No temperate requirement
- 4) No fire, release and explosion danger associated chemical battery
- 5) recyclable
- 6) No pollution in manufacturing and operation, environmental friendly

# Amber Kinetics, From Investment Perspective



**THANK YOU**