Batteries and Their Applications

Hanko Song
VP of Sales, Microvast Power Solutions, Inc.

Advisory Board Meeting
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FSEC Energy Research Center

UNIVERSITY OF CENTRAL FLORIDA

Hanko Song

VP of Sales, Microvast Power Solutions, Inc.

Past Experience:

Over 12 years of sales and marketing experience in Automotive Li-ion battery industry, he is responsible of the company sales and marketing. Mr. Song joined Microvast since 2007, during his first years in the company, he was in the position of Li-ion battery material research and development and its industrialization. Since 2008, he was responsible of the company branding, marketing analysis, as well as international sales and marketing, and was in charge of several key overseas projects. He was assigned as VP of Sales in Microvast Power Solutions, Inc. since March 2019.

Mr. Song is graduated in Hunan University in China with a master degree in chemical engineering.

The Company

Microvast was founded in Houston, TX, USA in December 2006. The company specializes in the research and development, design, production and sales of lithium-ion battery systems. Microvast is a leading provider of Electric Vehicle Power Solutions, and is also focused on material handling, port, and other heavy-duty applications.

The company has set up its R&D target as "**Fast Charging, Long Life, and Safe.**" battery technology in 2008, which is considered the only way towards urban transport electrification.

Microvast R&D and manufacturing facility, Huzhou, Zhejiang, China.

Microvast R&D Target in 2008

Microvast set its R&D target of **Fast Charging, Long Life, and Safe** battery technology back in 2008.

10-20 Minute Fast Charging

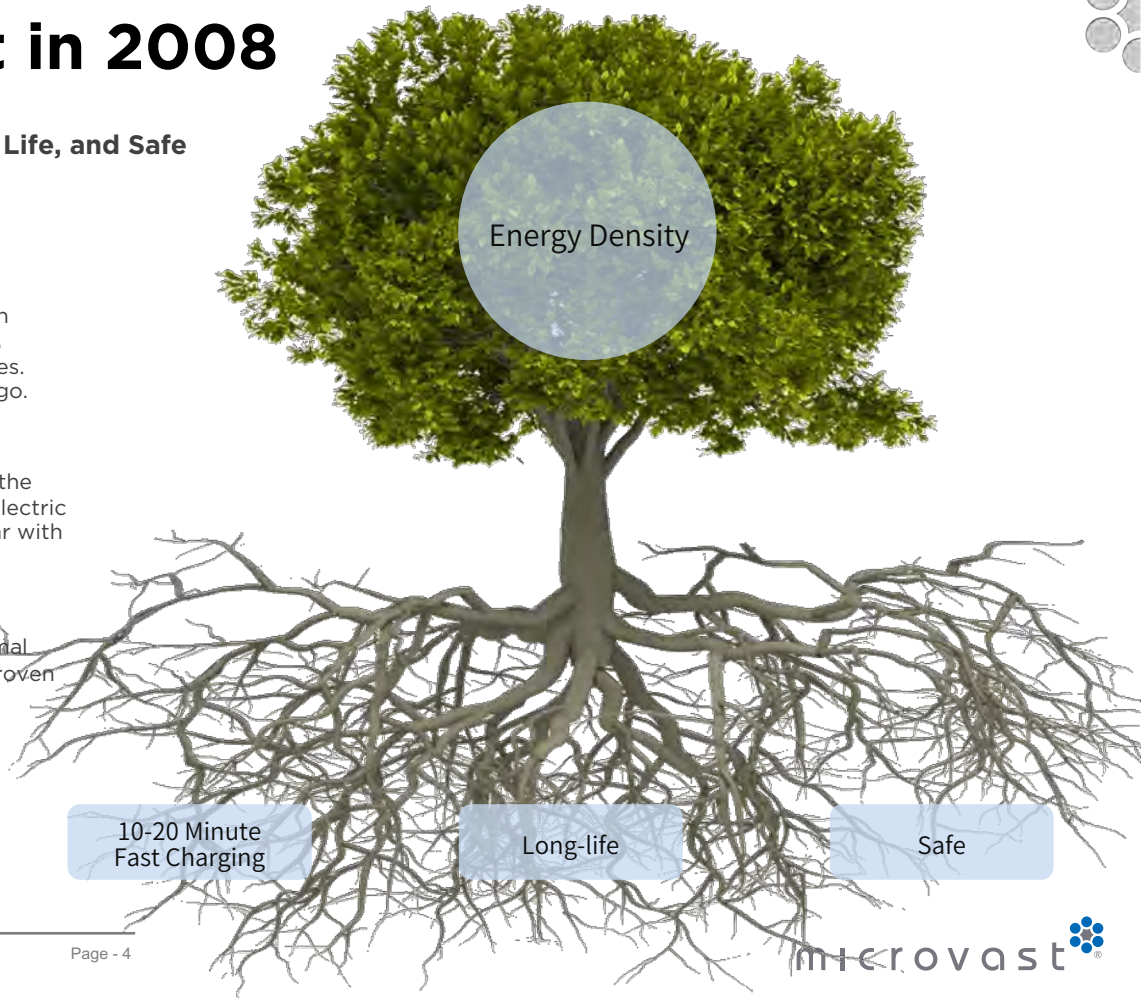
Fast Charging is the key of mobility and convenience for an Electric Vehicle. With Microvast Fast Charging technology, electric vehicles can be fully recharged within 10-20 minutes. There is no need to wait for several hours before ready to go.

Long Life

The battery systems is designed to last as the same life of the vehicle, reducing the total cost of ownership (TCO) of an electric vehicle. Furthermore, this makes a second-hand electric car with more value.

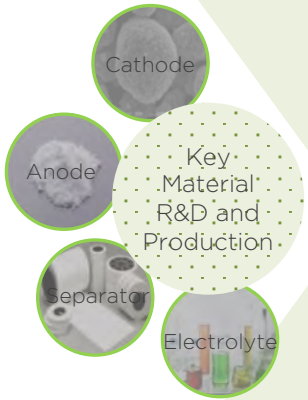
Safe

With Microvast patented Li-ion chemistry and Smart Thermal Liquid (STL) technology, our battery system is safe with proven operational records since 2011.



Vertical Integration

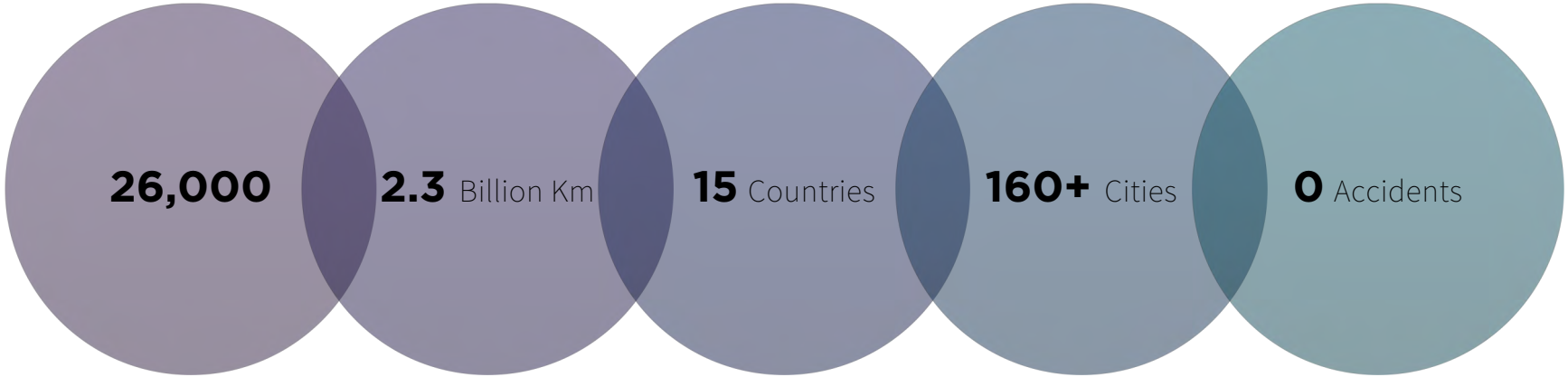
- Microvast vertical integration strategy extends from **core battery chemistry**, including cathode and anode materials, electrolyte, and membrane separators, to **application technologies** including battery management systems (BMS) and other power electronics.
- By integrating the process from raw material to system assembly, Microvast is able to provide customized solutions with reduced project development time and controllable cost.
- Vertical integration also allows us to control product quality from top to bottom with our high standards.



- Material Technology Know-How
- Reduced Development Time
- Efficient Quality Control
- Cost-Effective

Operational Records

Since 2006



Battery systems in operation on-board EVs

Mostly for Public Transport
EV 40% | PHEV 50% | HEV 10%

Accumulated operation mileage

In operation in China, UK, Germany, Netherlands, Belgium, Kazakhstan, Singapore, South Korea, Japan, Thailand, Malaysia, New Zealand, USA, Russia

In operation with Microvast battery system

No operational accidents caused by battery system

**Data shown above updated by Aug 2018.*

Clean City Transit (CCT)

Fast Charging Electric City Buses

Electrification of City Buses

- City buses usually operate in fixed routes;
- The daily operation range is around 200~250 Km;
- Drivers breaks and/or shift by end of each loop, which usually takes 10-20 minutes before next loop;
- Fleet operation.

Fast Charging Full Electric City Buses

- Not necessary to install BIG and HEAVY batteries with limited battery life; Install a SMALL and LIGHT battery pack that is enough for single trip or half day operation, which can also be customized by routes operation requirements;
- Fast Charging (10-20 minutes) the bus in terminals during driver breaks and between driver shifts.
- Long life battery that lowers the Total Cost of Ownership (TCO);
- **Gradually form the first layer of charging network for E-buses.**

Fast Charging Electric Taxis

Electrification of Taxis

- Taxis operate in downtown area;
- The daily operation range is around 500 Km;
- Drivers usually have one hour for lunch/dinner break and shifts twice everyday;
- Fleet operation.

Fast Charging Full Electric Taxis

- Install a battery pack with 300 Km range;
- Fast Charging electric taxi twice every day during the driver breaks period, no interrupt the existing operation profile;
- Long life battery (600,000 km) that lowers the Total Cost of Ownership (TCO);
- **Form the second layer of charging network for e-Taxis.**

Fast Charging Electric Cars

Electrification of Private Cars

- High price, mainly rely on license measures to promote in the first-tier cities;
- Limited by charging infrastructure; Requires the fast-charging capability especially in emergency occasions;
- Concerns on battery life, and how to trade a used car?

Fast Charging Full Electric Cars

- **Use the first and second layers of charging network in downtown areas for e-Buses and e-Taxis;**
- Install a battery pack with 300 Km range;
- Fast Charging capability in emergency; range anxiety will not be an issue any longer
- Long life battery (600,000 km) makes second hand car trade possible.

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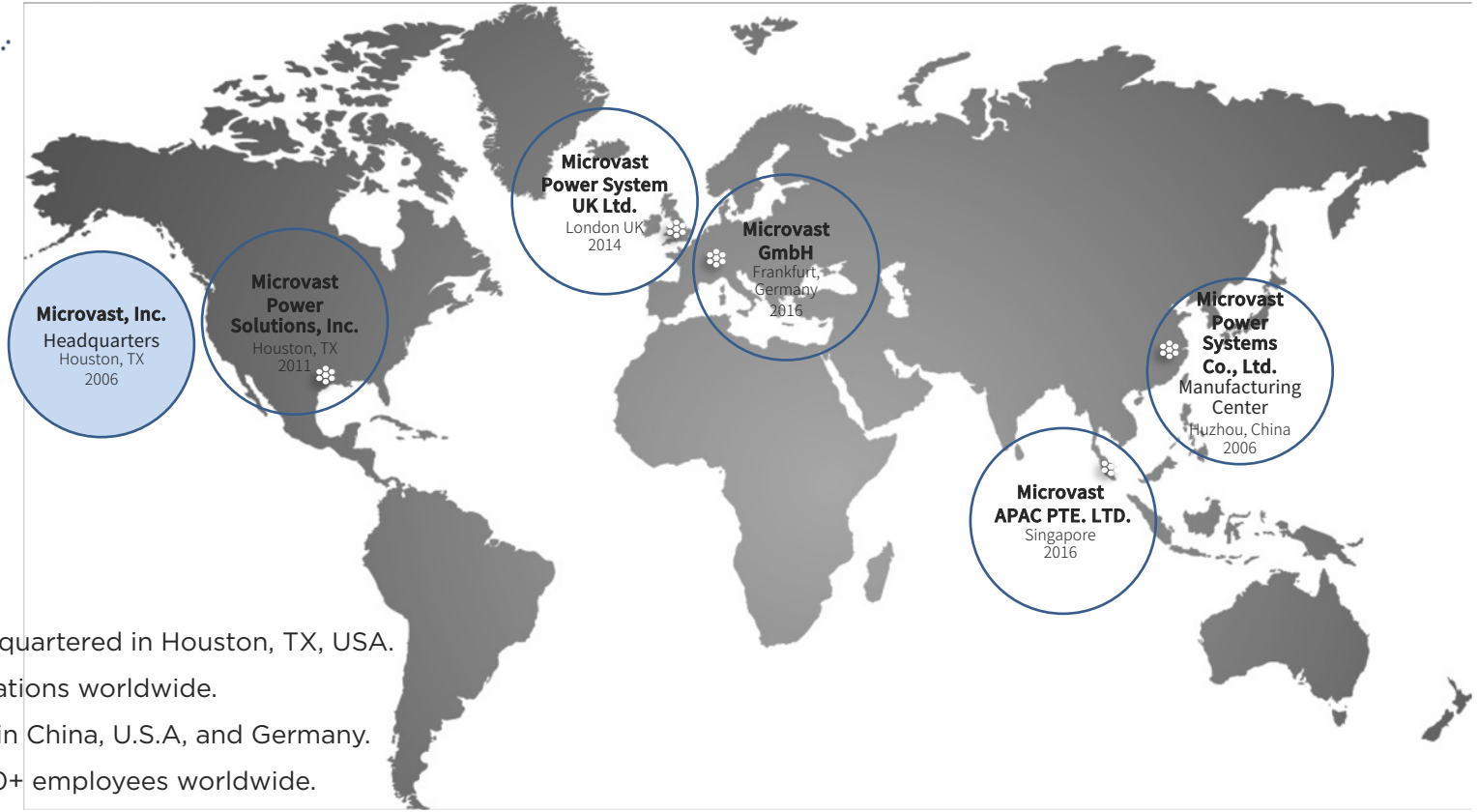
Global Network



- Headquartered in Houston, TX, USA.
- 5 locations worldwide.
- R&D in China, U.S.A, and Germany.
- 2,000+ employees worldwide.

R&D

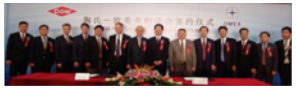
Battery Material, Cell, and Battery System Product Development.

In China, USA, and Germany. Over 500+ R&D staff (30+ PhDs, and 100+ master degree);

With over 426 patents and patent applications which covers the whole Li-ion battery chain, including battery material (cathode, anode, separator, and electrolyte), cell, pack, BMS, powertrain, and related equipment.

Microvast Technology Center, Huzhou, Zhejiang, China

Microvast Milestone



Same senior management team created OMEX Environmental in 2000, world-class advanced membrane tech developer which sold to DOW Chemical at 2006 which is now key solution of DOW water & process solutions division.

2006

DECEMBER
Microvast was founded.

2009

Microvast Gen I Fast Charging battery, LpTO, was launched.

LpTO™

2011

MARCH
The first fast charging full electric bus fleet in China started its commercial operation in Chongqing.

JUNE
Microvast has received investments from IFC and Ashmore.

IFC International Finance Corporation | Ashmore

2013

OCTOBER
Microvast launched its Gen II Fast Charging battery technology, LpCO with higher energy density and long cycle life.

LpCO®

2014

MAY
Microvast won 1,000 units of hybrid electric bus battery system order for NBfL operating in London, UK.

NOVEMBER
A fleet of full electric buses with Microvast Fast Charging technology started its operation for the APEC China 2014 Summit in Beijing.

2015

MAY
Microvast launched its MVPack technology, which provides 10-15 minutes fast charging and long life features for electric taxi and electric passenger cars.

MVPACK®

2016

MARCH
Microvast launched its non-flammable battery technology.

JUNE
Microvast received two 2016 FT/IFC Transformational Business Awards.

2017

APRIL
Microvast launched its Gen III Fast Charging battery MpCO, which has higher energy density and is the most cost-effective solution.

MpCO™

2006 -2017

microvast®

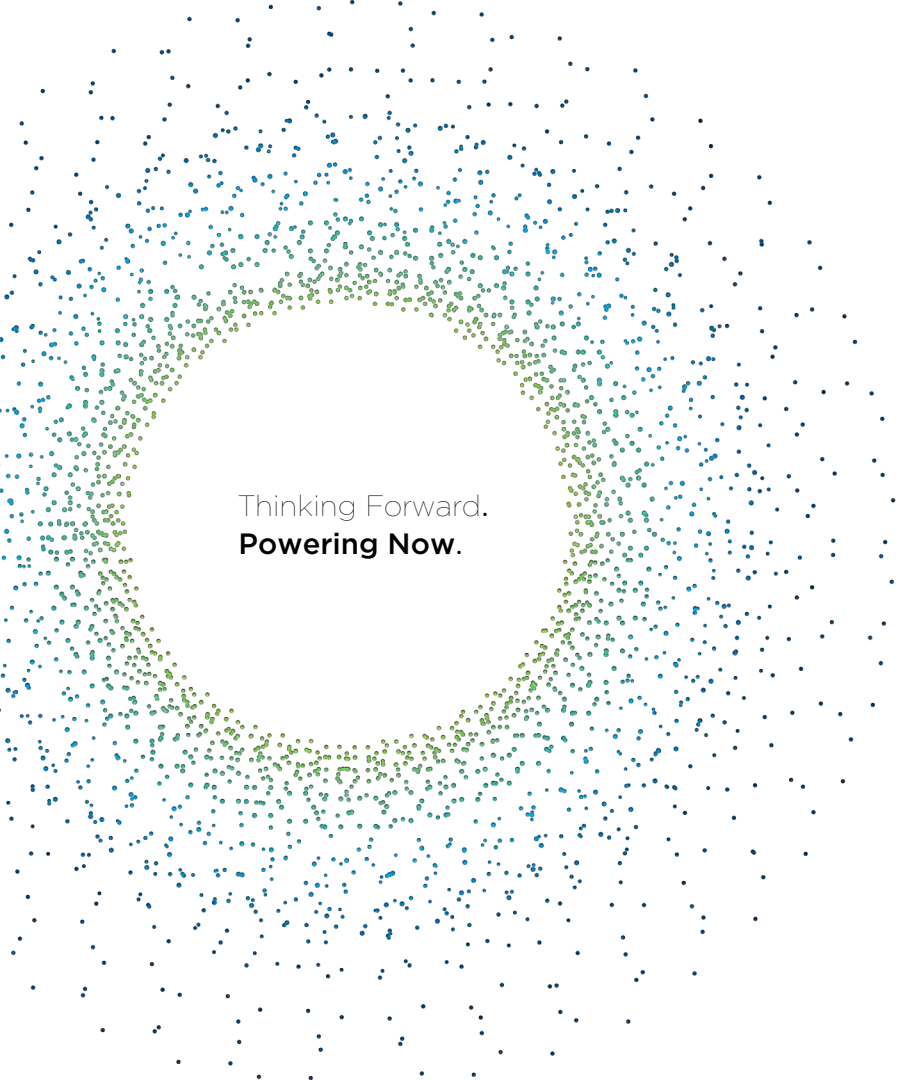
Cell & Pack Automatic Production

- Highly automated pouch cell production line (Phase II) for automotive applications, much less personal is required.
- Intelligent MES management system automatically generate and manage manufacturing, quality control, and equipment maintenance data.
- The automatic module production and semi-automatic PACK assembly line significantly improves production efficiency and ensures product quality stability;
- Intelligent product management system that combines ERP and MES;
- Production line with a strong traceability.

Production Capacity

- Phase I in operation since 2010, with 1GWh production capacity by 2015.
- Phase II was in operation since end of 2016, including technology center, engineering center, electrolyte production, material production, and pack production. Capacity has reached 4GWh by end of 2018.
- Phase III has started its construction since Mar 2017, with a planned production capacity of 11GWh.

Microvast manufacturing facility (Phase I and II), Huzhou, Zhejiang, China.



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