

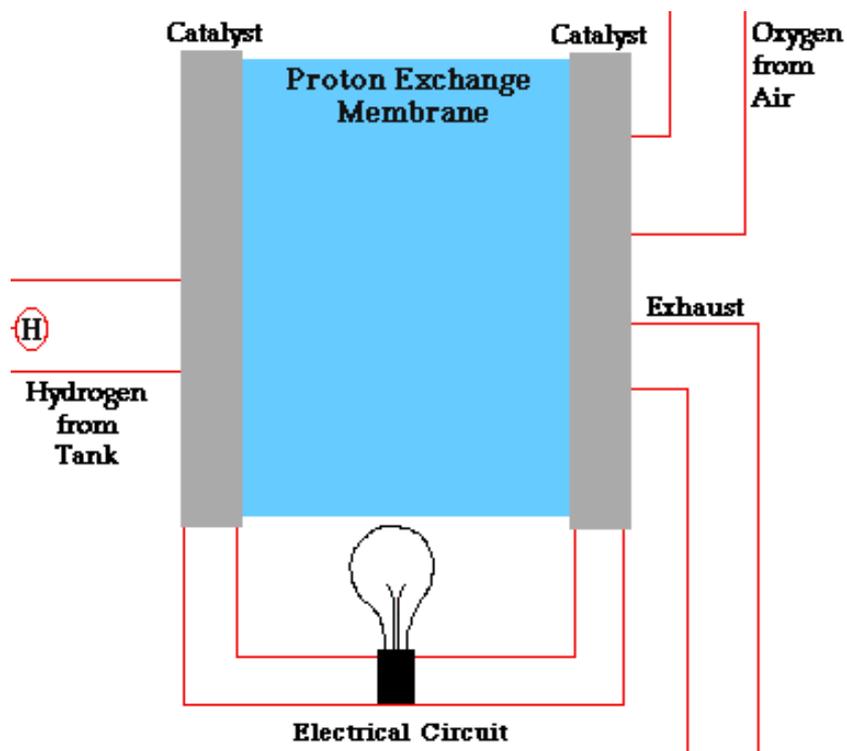


# PEMFC质子交换膜燃料电池商业化 及国产化相关问题

2017年4月



# 技术-什么是燃料电池？



## 一台没有运动部件的发电机!

- 通过化学反应发电
- 燃料是氢气
- 仅排放水，无污染
- 无运动部件
- 稳定，可靠
- 发电效率可达50%以上
- 生产回收环节污染极低

\*以PEM燃料电池为例

# 技术-燃料电池种类

	Low-temperature Fuel Cells		High-temperature Fuel Cells			
	<b>DMFC</b> Direct methanol fuel cell	<b>PEMFC</b> Proton exchange	<b>AFC</b> Alkaline fuel cell	<b>PAFC</b> Phosphoric acid fuel cell	<b>MCFC</b> Molten carbon fuel	<b>SOFC</b> Solid oxide fuel
Electrolyte	Proton-conducting membrane	Proton-conducting membrane	Caustic potash solution	Concentrated phosphoric acid	Molten carbonate	Ceramic
Temperature range	< 100° C	< 100° C	< 100 C	~ 200° C	~ 650° C	800 - 1,000
Fuel	Methanol	Hydrogen	Hydrogen	Hydrogen	Natural gas, coal	Natural gas, coal
Power ranges	Watts/ kilowatts	Watts/ kilowatts	Watts/ kilowatts	Kilowatt	Kilowatts/ megawatts	Kilowatts/ megawatts
Application areas (examples)	Vehicles, small appliances	Vehicles, small generators, domestic supply, block-type heat and power stations	Space	Block-type heat and power stations	Power plants, combined heat and power	Power plants, combined heat and power

\*Sourced from the Canadian Hydrogen and Fuel Cell Association. 2008

# 清能燃料电池-Horizon

- 2003年起开始在国内进行燃料电池研发
- 全球1KW以下燃料电池产销量第一（美国能源部2012年燃料电池行业报告）

U.S. DEPARTMENT OF  
**ENERGY** | Energy Efficiency &  
Renewable Energy

## Horizon Fuel Cell Technologies

Singapore-based Horizon Fuel Cell Technologies was founded in 2003 and currently owns five international subsidiaries, including a new subsidiary in the United States. **Currently, Horizon is the world's largest micro-fuel cell producer and the largest producer of PEM fuel cell stacks below 1,000 W.** Horizon's technology platform consists of fuel cells and their materials, hydrogen supply, and hydrogen storage. Today, Horizon produces compact, lightweight PEM fuel cells at various performance levels, and also delivers hydrogen storage and on-site hydrogen generation solutions for multiple applications.

- 2006年美国时代周刊年度最佳发明



## Best Inventions of 2006

It's been an interesting year in technology. Nintendo invented a video game you control with a magic wand. A new kind of car traveled 3,145 miles on a single gallon of gas. A robot learned to ride a bike and somebody came up with a nanofabric umbrella that doesn't stay wet.

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### TRANSPORTATION

## Hydrogen Bomber

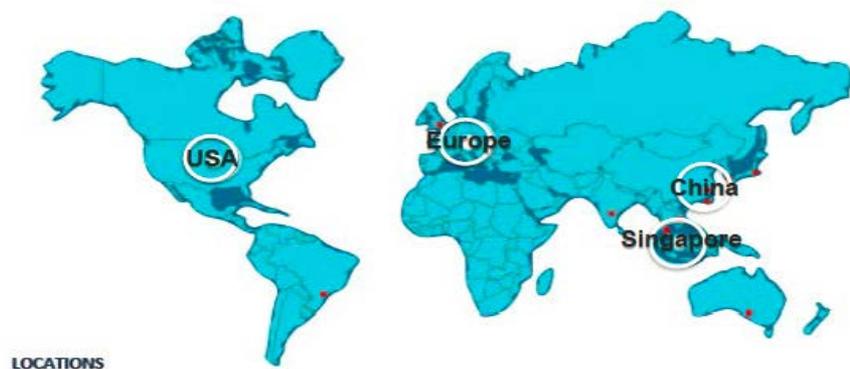
It may be years before you can buy a Chevy powered by hydrogen fuel cells. Tired of waiting, Shanghai-based Horizon Fuel Cell Technologies decided to design and market the H-racer, a 6-in.-long toy car that does what Detroit still can't. It runs on hydrogen extracted from plain tap water using the solar-powered Hydrogen Station, below, and can travel more than 300 ft. in a single fuel-up. The car's miniature scale gives it one advantage over full-size prototypes: since it uses only a trace amount of flammable hydrogen, there's no risk of it pulling a Hindenburg in your living room.



1 of 42  
VIEW ALL

# 清能燃料电池-Horizon

- 累计销售燃料电池超过50万个，其中95%以上外销，通过全球15个分支机构销售至60多个国家和地区



- 全球第一个推出燃料电池充电宝及家用加氢站



# 清能燃料电池-Horizon

- 全球第一个推出商业化无人机燃料电池



- 全球体积最小的甲醇重整燃料电池产品及效率最高的甲醇重整燃料电池产品

## Horizon Fuel Cell Technologies Launches World's Smallest Methanol Reformer Enabled Fuel Cell System

Selasa, 27 Oktober 2015 12:19 WIB | 1.537 Views



World's smallest reformer integrated fuel cell system by Horizon Fuel Cell Technologies (Antara)



# 清能燃料电池-Horizon

## 燃料电池，材料/系统

- 独特的空气流和自增湿技术使结构简单，成本低廉，重量轻的燃料电池设计成为现实
- 新型膜电极密封和电堆组装技术
- 专有材料技术包括催化剂，膜，气体扩散层等材料生产
- 专有的，结构紧凑，轻型燃料电池电堆和系统设计，从0.1W到10KW
- 专有的外围设备和系统集成技术实现特定性能和成本目标

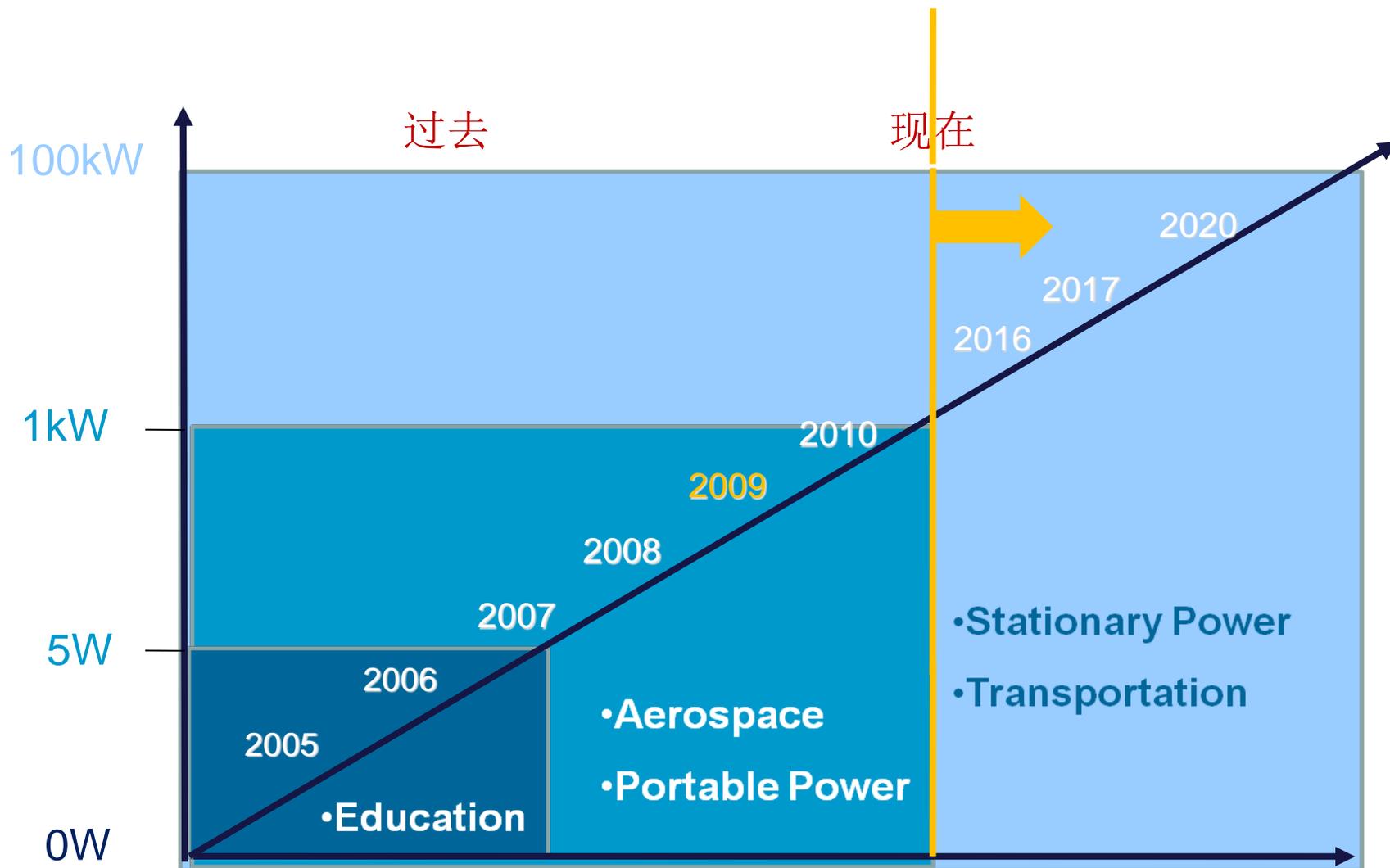
## 氢气产生/发生

- 高效的甲醇重整技术
- 结构紧凑，重量轻，成本低的质子交换膜电解水技术
- 3种不同的化学氢化物产氢技术可以用于UAV，军需移动电源和各种消费者产品运用
- 氢气处理和净化技术
- 超长使用期限催化剂技术，适用于各种产氢方式
- 高质量，低成本零部件和外围设备用于重整器和其他产氢系统
- 现场产氢系统技术和加氢站技术

## 氢气 储存

- 世界上最轻的减压阀（其中一个版本和波音共同开发）。
- 开发并且大规模生产低压，大容量，低成本金属氢化物合金
- 开发和大规模生产安全性高的金属氢化物储氢瓶，在业界首屈一指

# 清能燃料电池的商业化探索



# 清能燃料电池的商业化探索



riversimple



中国移动  
China Mobile



BOEING®



**MICRO:CAB**®  
life without oil™



Singapore Government  
Integrity · Service · Excellence  
HDB InfoWEB  
Housing & Development Board



THE LINDE GROUP

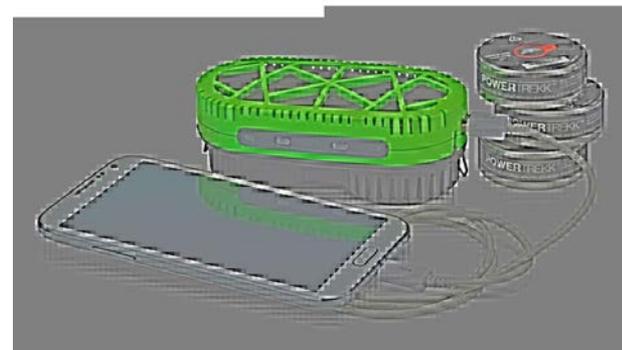
# PEMFC商业化的两大问题

- 燃料来源
- 成本

# PEMFC商业化应用

## 个人电子消费品（1-10W）

- 市场空间大
- 诸多企业做过商业化尝试（Bic, Medis, Horizon等）
- 燃料便利性和成本问题难以解决
- 商业化前景不乐观



# PEMFC商业化应用

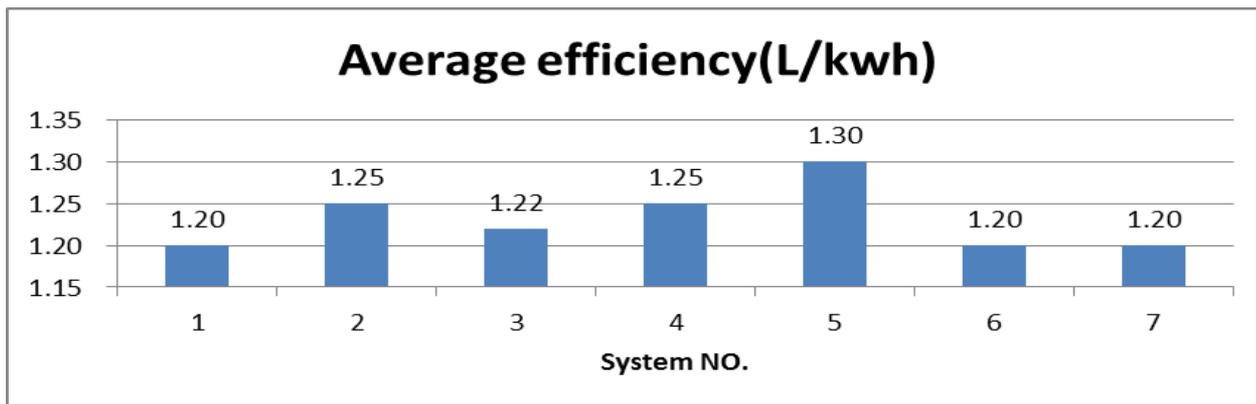
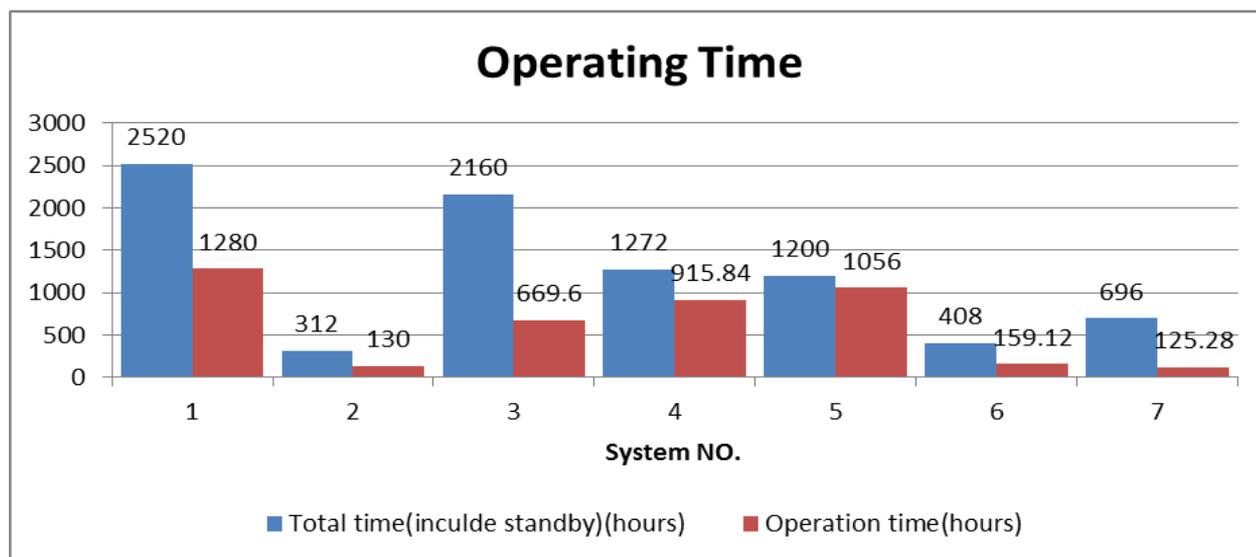
## 小型电源离网发电 ( 50W-200W )

- 解决小型离网设备24/7持续稳定供电问题
- 房车、游艇等离网个人应用，及军事用途
- Smart Fuel Cell 采用直接甲醇燃料电池方案，累计销售上万台
- Ultra Cell、Horizon等采用甲醇重整和氢气两种方案
- 有实际商业化的需求和市场空间



# PEMFC商业化应用

## 小型电源离网发电 ( 50W-200W ) - 离网监控案例



# PEMFC商业化应用

## 无人机 ( 200W-10kW )

- 高系统能量密度，长续航里程
- 有实际需求，商业化需要耐心

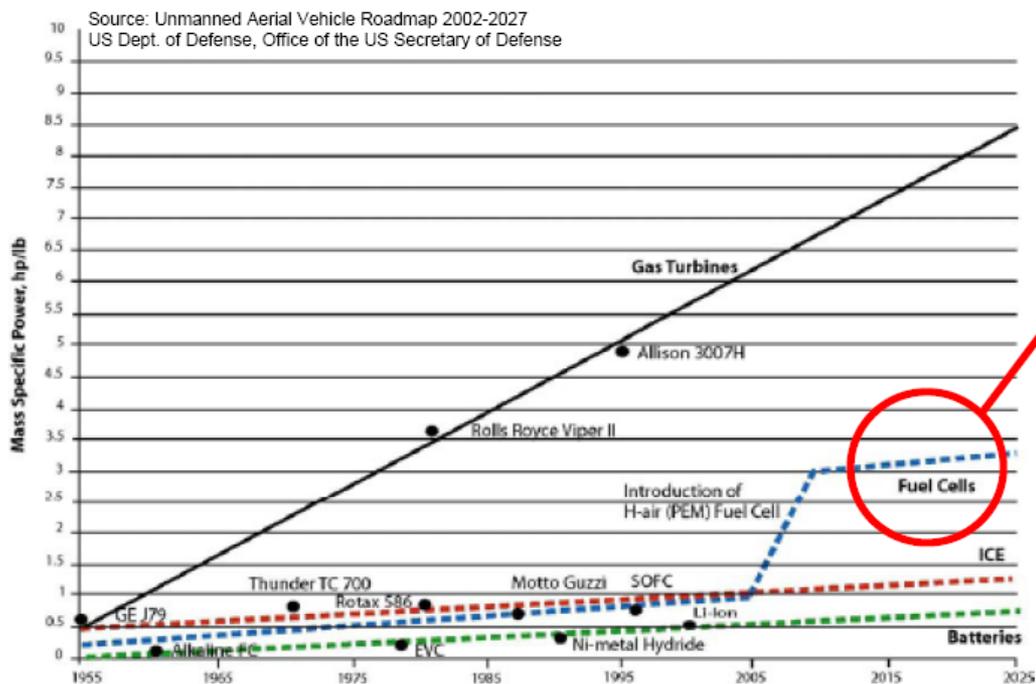
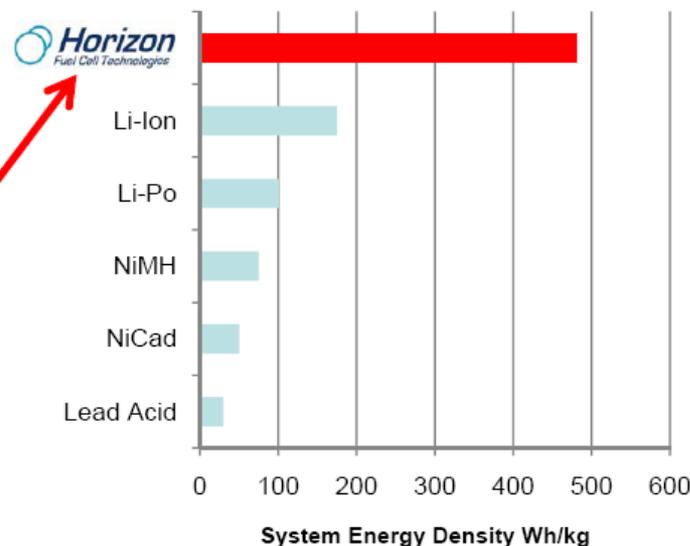


FIGURE 4.1-2: MASS SPECIFIC POWER TRENDS.

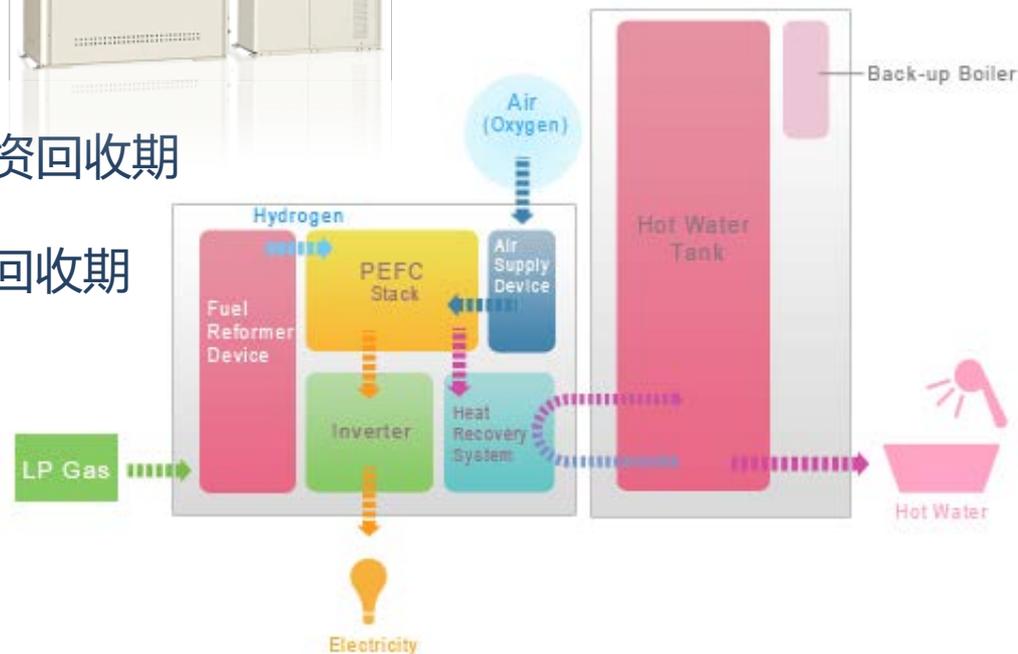


# PEMFC商业化应用

## 家庭热电联供 (1-10kW)



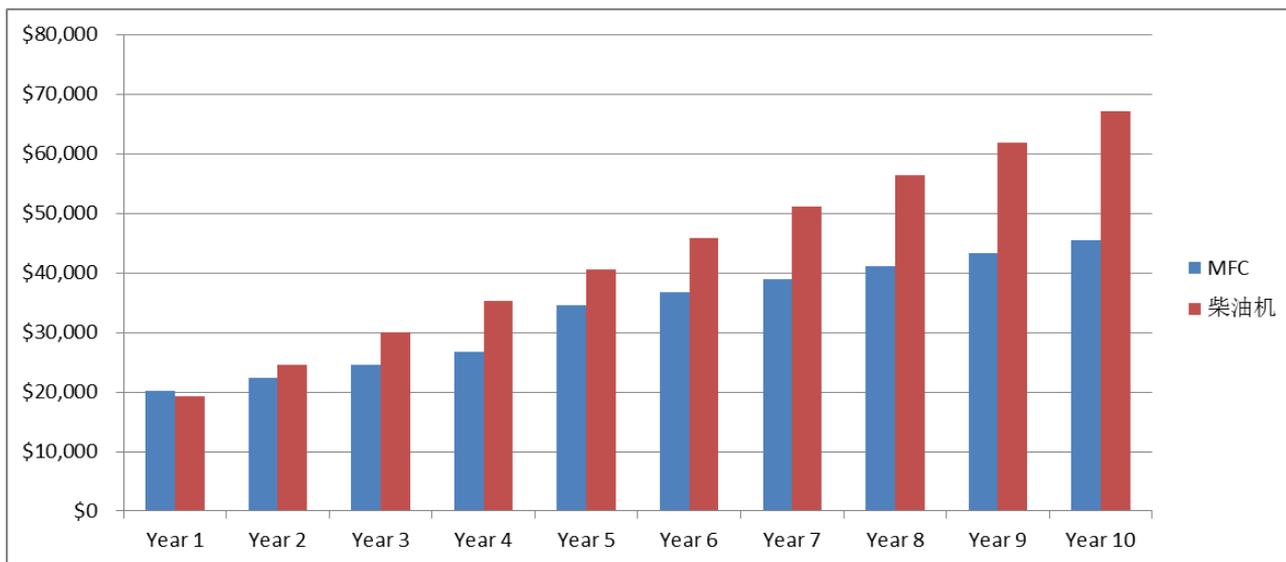
- 日本 Ene.Farm最为成功
- 2015年底累计安装12万户
- 热电联产效率达80%以上
- 2020年目标140万台，7-8年投资回收期
- 2030年目标530万台，5年投资回收期



# PEMFC商业化应用

## 备电及发电 ( 1-10KW )

- 电信基站备电和发电是一个切入点，全球超过600万个基站
- 氢气方案成本过高，甲醇重整是目前最现实的方案
- 长时间备电及连续发电场景甲醇重整燃料电池经济性优于油机



\*每月100小时断电场景



# PEMFC商业化应用

## 交通运输 ( 10-100KW )

- 2013年，现代汽车ix35 FCV



- 2014年，丰田汽车Mirai FCV

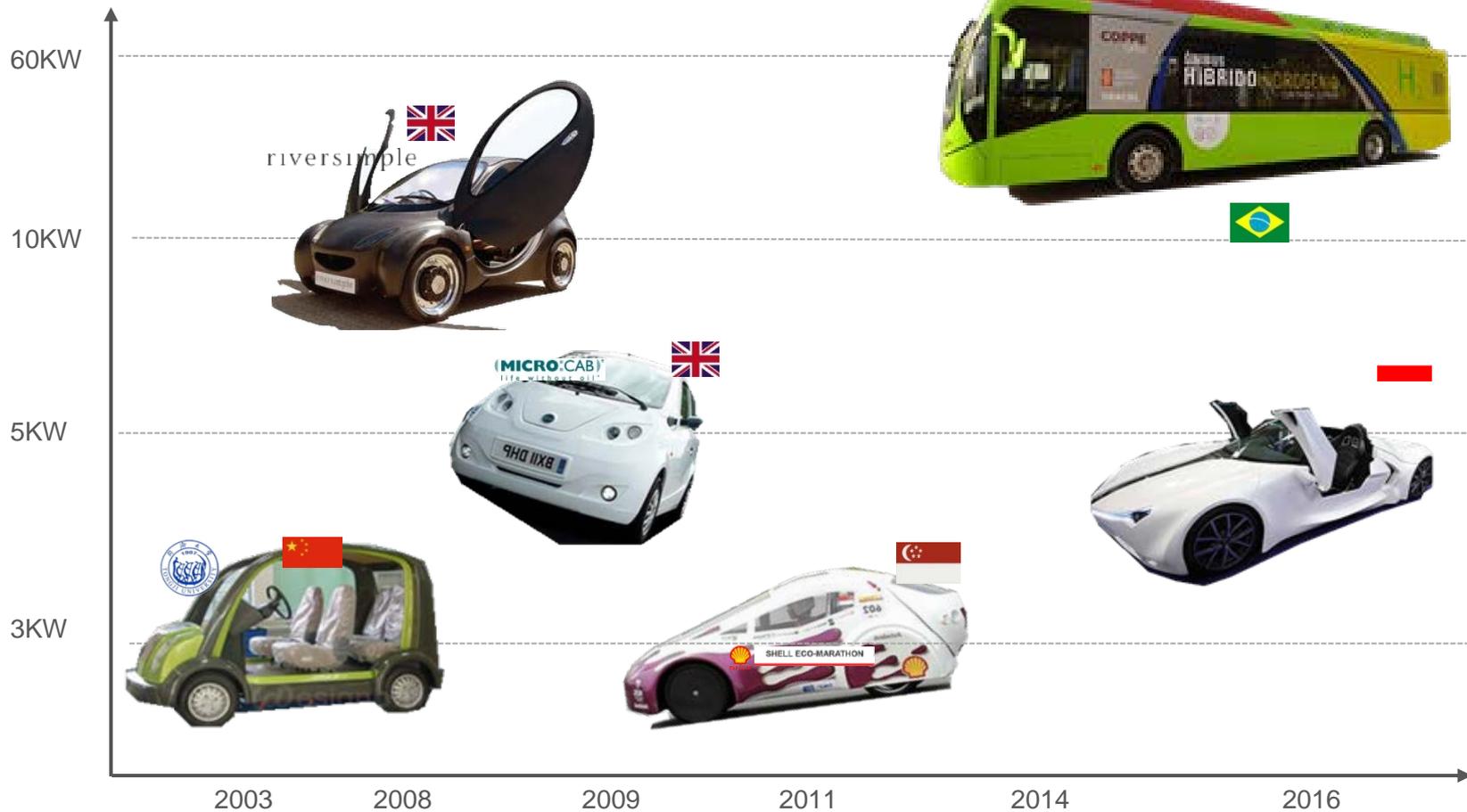
- 2015年，本田汽车Clarity FCV



- 2018-2020年，奔驰、宝马、通用汽车、雷克萨斯等陆续推出FCV

# PEMFC商业化应用

## 交通运输 (10-100KW)



# PEMFC商业化应用

交通运输 ( 10-100KW ) - 为什么FCV会成为新能源车的方向

- 加氢速度快
- 适合长途交通运输
- 可低温运行
- 产业化后较长续航里程锂电池电动车更便宜
- 加氢站网络建设成本低于充电网络建设成本

# PEMFC商业化应用

## 交通运输 ( 10-100KW ) -成本比较

Table 11: Cost of PLDVs by technology as computed in the model for the United States

	<i>Today</i>	<i>2030</i>	<i>2050</i>	<i>Unit</i>
Conventional ICE gasoline	28 600	30 900	32 300	USD
Conventional ICE diesel	29 300	31 700	33 100	USD
Hybrid gasoline	30 000	31 800	33 200	USD
Plug-in hybrid gasoline	32 400	33 200	34 400	USD
BEV (150 km)	35 400	32 800	34 000	USD
FCEV	60 000	33 600	33 400	USD

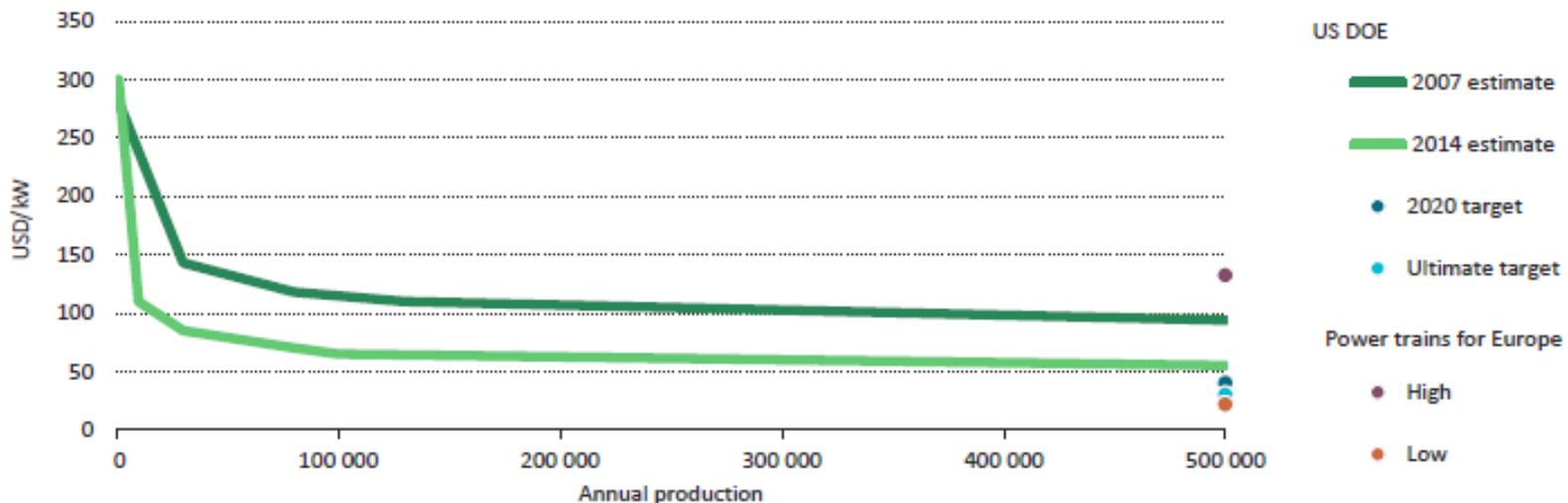
Note: In line with results from the National Academy of Science report on “Transitions to Alternative Vehicles and Fuels” (National Research Council, 2013,) FCEVs become less expensive than plug-in hybrids by 2050. Similar tables showing the costs of PLDVs as computed by the model for Europe and Japan can be found in the Technology Annex.

\*IEA 2015 Technology Roadmap-Hydrogen and Fuel Cell

# PEMFC商业化应用

## 交通运输 ( 10-100KW ) -成本预期 ( IEA )

Figure 11: Production cost for PEMFCs for FCEVs as a function of annual production



Sources: adapted from McKinsey and Co. (2011), *A Portfolio of Powertrains for Europe: a Fact-Based Analysis, The Role of Battery Electric Vehicles, Plug-in Hybrids and Fuel Cell Electric Vehicles*; US DOE (2012), *Fuel Cell Technologies Program Record*; US DOE (2014d), *DOE Fuel Cell Technologies Office Record – Fuel Cell System Costs*.

**KEY POINT:** Although current PEMFC systems for FCEVs cost around USD 300 to USD 500 per kW, cost can be reduced dramatically with economies of scale.

\*IEA 2015 Technology Roadmap-Hydrogen and Fuel Cell

[www.qingnengfc.com](http://www.qingnengfc.com)  
[www.horizonfuelcell.com](http://www.horizonfuelcell.com)

联系人：张弛  
[jack.zhang@horizonfuelcell.com](mailto:jack.zhang@horizonfuelcell.com)