



Fuel Cells & Hydrogen in Transportation: Global Trends & Drivers



International Partnership
for Hydrogen and Fuel Cells
in the Economy

**World Future Energy Summit
Abu Dhabi Sustainability Week 2017**

**Tim Karlsson
Executive Director,
International Partnership for Hydrogen & Fuel Cells
in the Economy (IPHE)**

January 17, 2017



What is the IPHE?

An inter-governmental partnership that provides a policy oriented forum to share information and collaborate on initiatives to accelerate the cost-effective transition to clean energy and transportation systems that includes using fuel cell and hydrogen (FCHs).

Member partners are doing research, demonstrations and/or implementing policies to increase the use of FCHs in the economy.



Australia



Austria



Brazil



Canada



China



European Commission



France



Germany



Iceland



India



Italy



Japan



Republic of Korea



Netherlands



Norway



Russian Federation



South Africa



United Kingdom



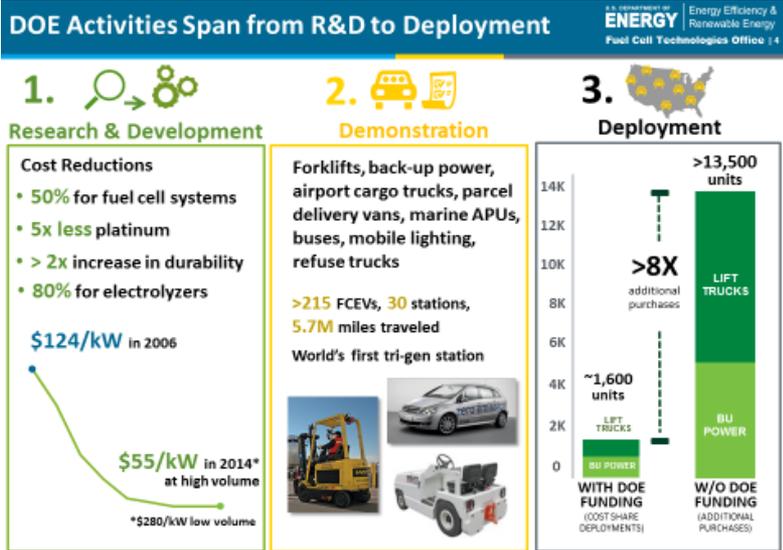
United States



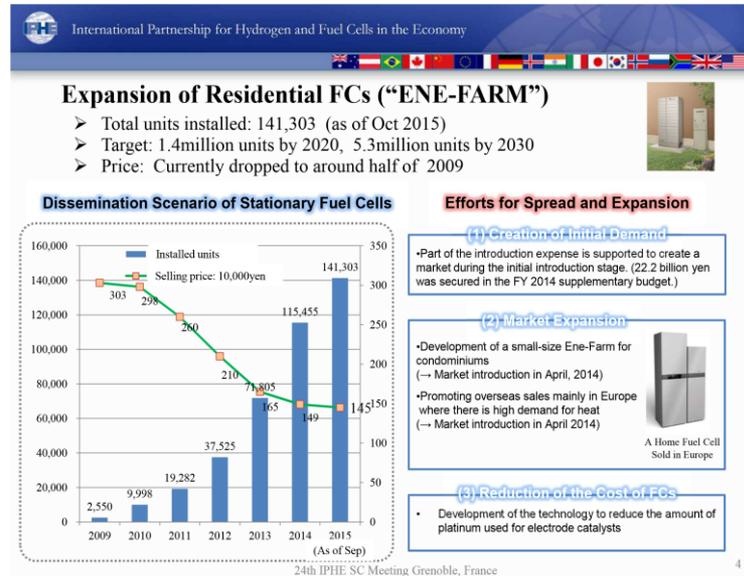
Trends: Significant Cost Reductions

Sustained global research, development, and demonstrations by industry and government have led to a significant level of technology maturity and early market deployment:

- In Japan, more than 180,000 FC-based Combine Heat and Power units are installed;
- Back-up telecom power systems - over 7,800 units shipped or on order in the U.S.;
- In US, over 11,600 warehouse material handling units in operation or on order.



Source: IPHE Workshop *Getting to 2020 & Beyond*, Grenoble France 2015



24th IPHE SC Meeting Grenoble, France



Trends: Fuel Cell Electric Vehicle Numbers

Sustained global research, development, and demonstrations by industry and government have led to a significant level of technology maturity and early market deployment.

Country	# of Cars	# of Buses	# of Fork Lifts	# of Stations	# of <5 kW Stationary Units
United States	331	33	>11,600	>65	-
Germany	103	14	16	22	~1000
Japan	>900	Demo only	4	86	>180,000
France	110	-	60	5	9
United Kingdom	42	18	-	14	Demo only
China	60	40	-	4	-

Source: Member Statements <http://www.iphe.net/partners.html>



Trends: Role of Demonstrations

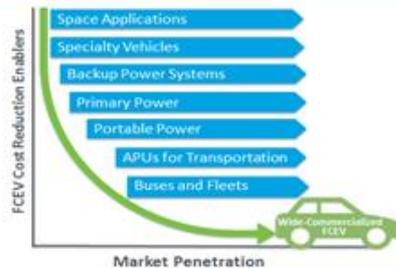
Early market demonstrations from specialty vehicles to backup power systems to fleet applications is crucial in developing the systems and supply chains necessary for broader deployments.

Early Market Strategies Increase Volume

U.S. DEPARTMENT OF ENERGY
Energy Efficiency & Renewable Energy
Fuel Cell Technologies Office | 10

Early Markets enable:

- Fuel cell **cost reduction**
- **Robust supply base**
- **Emerging infrastructure**
- **Customer acceptance**



Early Markets Applications Recently Deployed in the U.S.



Fuel Cell Tow Trucks

Fuel Cell Bus Fleets

Forklifts

Backup Power

Source: IPHE Workshop *Getting to 2020 & Beyond*, Grenoble France 2015



Country Update China

- A prototype tram powered by hydrogen fuel cells was unveiled at the CSR Sifang factory in Qingdao on March 19, 2015.



- ✓ A three-car tram capable of carrying as many as 380 passengers; Run for 100 km at speeds up to 70 km/h;
- ✓ Additional testing is being completed at CSR Sifang's facility in Qingdao;
- ✓ Foshan city is going to be the first customer, a fuel cell tram line and hydrogen refueling stations are in design.

23rd IPHE SC Meeting Wuhuan, China

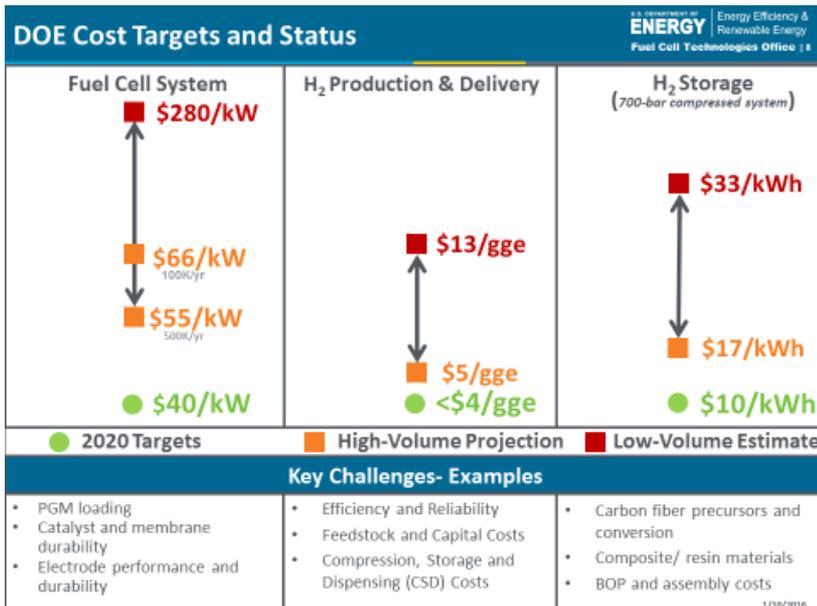


Trends: More Cost Reductions & Market Focus

Need more work across the innovation spectrum

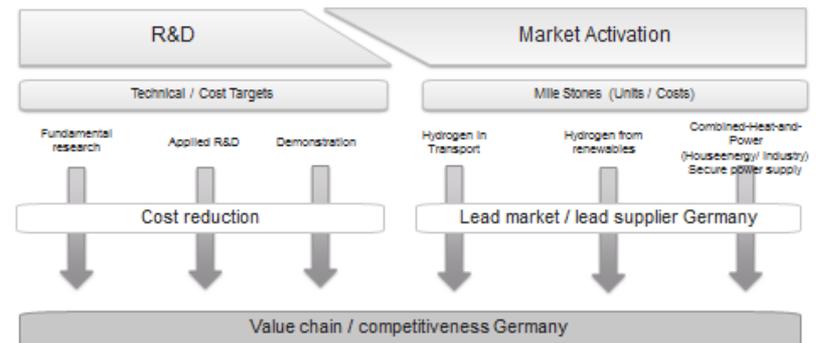
- Cost reductions in the FC system and Hydrogen management

Need internationally consistent market framework structures such as robust technical Codes, Standards and Regulations.



Source: IPHE Workshop *Getting to 2020 & Beyond*, Grenoble France 2015

Continuation of the National Innovation Program Hydrogen and Fuel Cell Technology 2016-2026 Program Structure





Trends: Energy & Transport System Integration

Recognition of the longer-term opportunity and need for hydrogen as an integrator.

Significant technical research and economic analysis is necessary to understand the efficient and effective integration of the systems and the business cases to make it happen.



Vast promise, huge challenges

IEA outlines critical steps to advance hydrogen and fuel cells.
30 June 2015

“... In a future energy system largely based on renewable energies, hydrogen could play a pivotal role by connecting different layers of infrastructure to link energy supply and demand. **Hydrogen can enable new energy vectors used to supply transport, buildings and industry by bridging surplus renewable power into the energy demand sectors**”

Source: *Key Point: Energy system today and in the future* IEA



Drivers: National Circumstances

Energy Security

- Security of energy supply with ability to switch sources

Energy Efficiency

- More effective use of variable generation – at grid and at community/facility scale; and,
- A move from centralized to distributed energy generation.

Economic Growth

- Transition of energy and transport systems are leading to new products and supply chains; and,
- Governments (taxpayers) need to realize their R,D&D investments through jobs and economic wealth driven by the private sector.

Environmental Performance

- Climate change goals for energy & transportation systems; and,
- Clean Air obligations (e.g., NO_x, SO_x, Particulates) in Air Sheds.



Drivers: Necessary Conditions to Act

1. Clear Industry Deployment Plan

- Vision on the roll-out of their product lines

2. Perceived Competitive Advantage Over Incumbent Technology

- More comfortable, easier to use, quieter, smoother, simpler, cheaper

3. Defined Financial Framework

- Trajectory to robust market conditions

4. Economic Impact

- Jobs, Taxes, Trade, Supply Chain Development

5. Environmental Impact

- Improve Local Air Quality, GHG Reductions, Noise Abatement

6. Energy Efficiency and Security

- Complements new clean energy generation, enables ease of energy management



Tim Karlsson

Executive Director, IPHE

e-mail tim.karlsson@iphe.net

Phone: +32 (0)2 541 82 76

website: www.iphe.net