

Fuel Cell Seminar & Energy Exposition

Columbus, Ohio

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Dr. Sunita Satyapal

Director

Fuel Cell Technologies Office

Energy Efficiency and Renewable Energy

U.S. Department of Energy

**This award is being accepted on behalf
of the U.S. Department of Energy fuel
cell and hydrogen programs**



**U.S. DEPARTMENT OF
ENERGY**

DOE Fuel Cell Technologies – Recent History



2000

- DOE Hydrogen R&D Program



2003

- Hydrogen Fuel Initiative



2005

- National Hydrogen Storage Project



National Fuel Cell EV Learning Demonstration concludes after seven years — 183 FCVs & 25 H2 fueling stations deployed

Further reduced cost of automotive fuel cells to \$55/kW (2013)



2013

- H2USA Launch



2002

- DOE Hydrogen Program combines EE, FE, NE, BES



2004

- Hydrogen Learning Demonstration



2009

- Hydrogen Storage Engineering Center of Excellence



World's 1st FC&H₂ Energy Station Commissioned (2011)

1970s



A group of scientists and DOE managers set the foundation for DOE fuel cell programs



DOE Targets

Go/no go decision points

RFIs

AMR

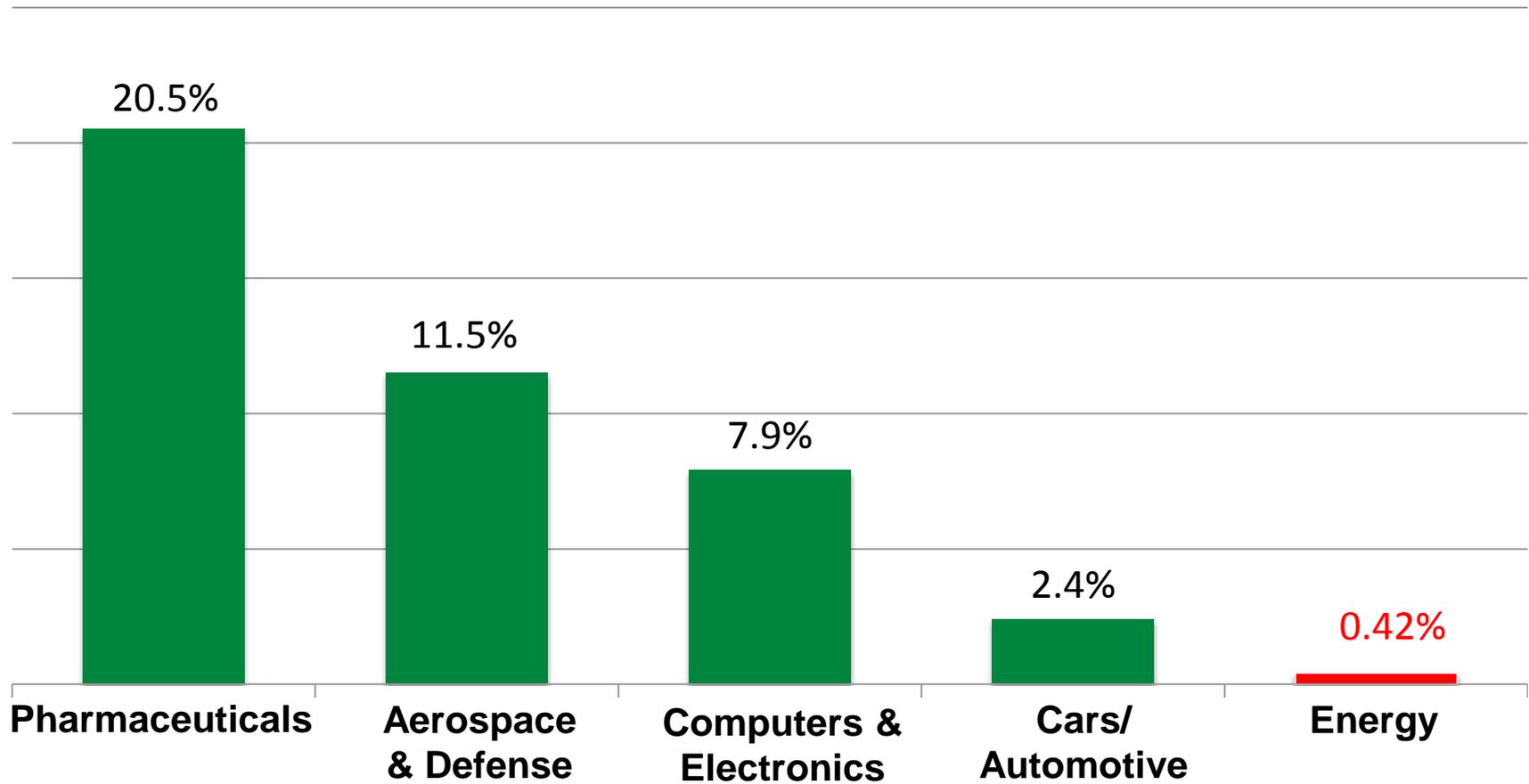
***Workshops,
working groups***

National Laboratories

FOAs

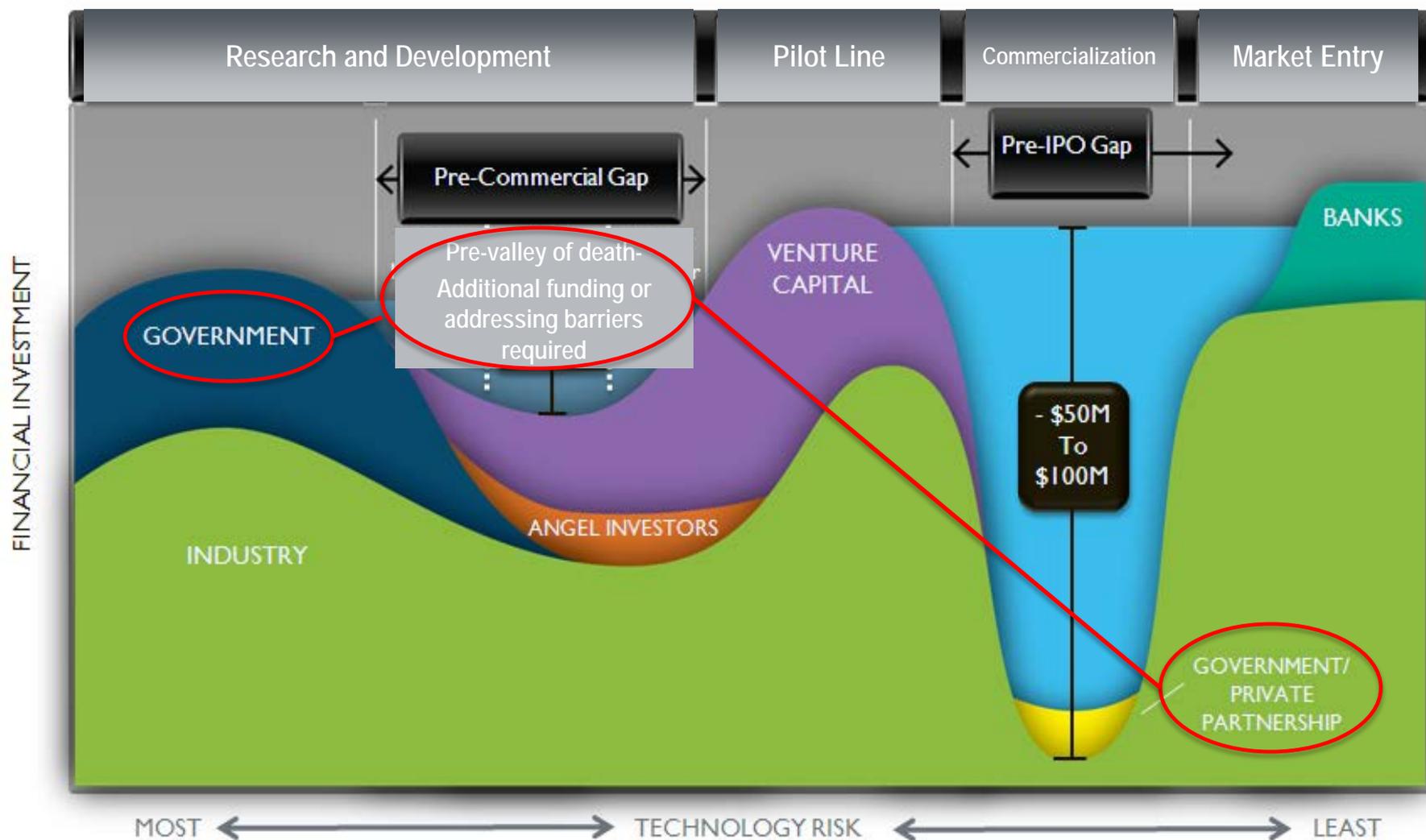
***Partnerships-
PNGV, FreedomCAR, USDRIVE, etc***

Quarterly reports, reviews, etc



Source: American Energy Innovation Council, *Business Plan for America's Energy Future*, 2010

Example Scenario: Government vs. Private Sector Roles

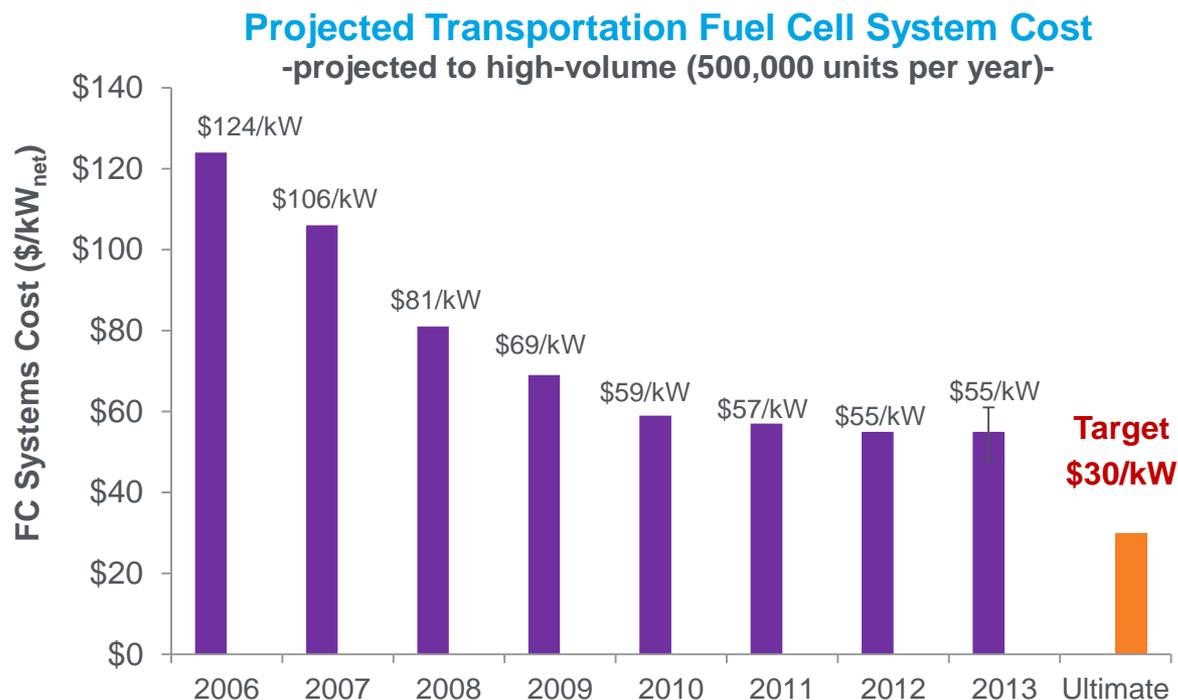


Adapted from SunShot Incubator briefing. Pictorial example, not representative of all industry start ups

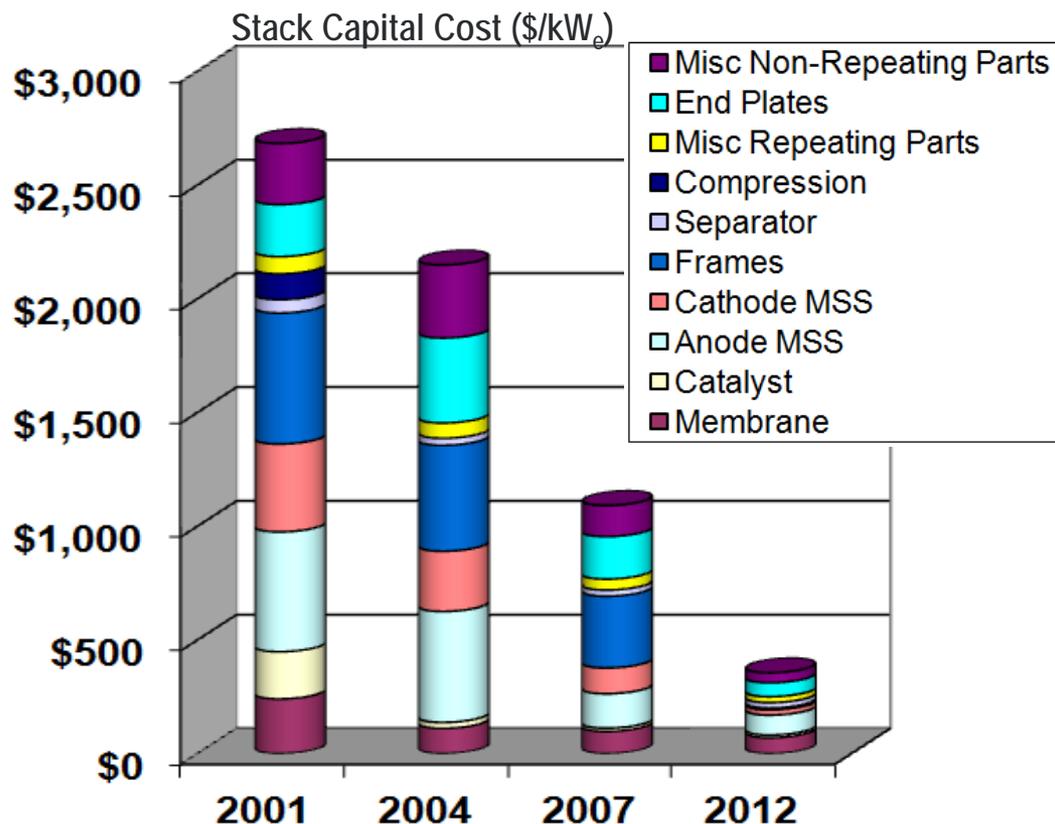


< 75 cents per year per tax payer

Supported R&D that enabled:
>50% fuel cell cost reduction since 2006
Five times less Pt
More than doubled durability



Supported R&D that enabled: >80% cost reduction in electrolyzers in the last decade



Based on Giner, DOE funded project

Developed training materials & reached:

>26,000 code officials & first responders

>10,000 teachers in the last few years

Conducted R&D to enable critical codes & standards



Enabled industry to demonstrate:

World's first tri-generation station

World's first fuel cell forklifts

**World's first fuel cell ground
support equipment for airports**

World's first stationary & backup power units

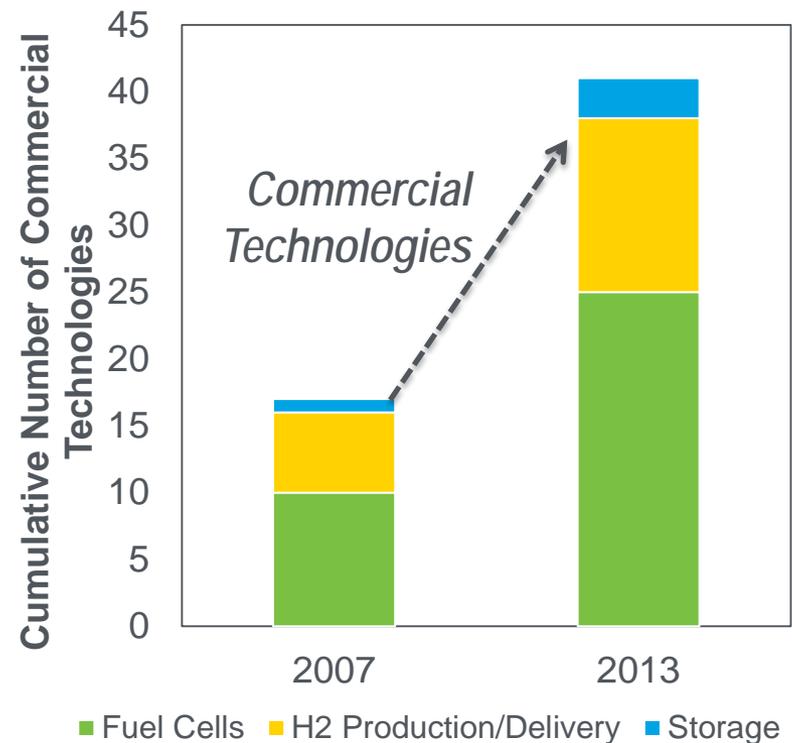
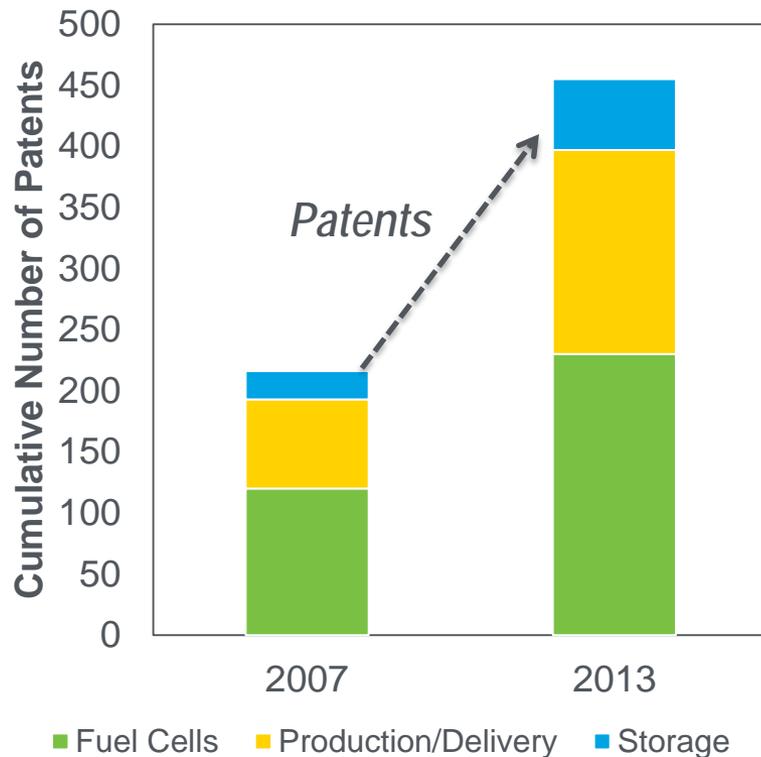
Largest FCEV demo-

183 FCEVs, 25 stations, 3.6M miles

“Tech to Market” Assessing the Impact of DOE Funding

- DOE funding has led to 40 commercial hydrogen and fuel cell technologies and 65 emerging technologies.
- More than 450 PATENTS resulting from EERE-funded R&D:
 - *Includes technologies for hydrogen production and delivery, hydrogen storage, and fuel cells*

Accelerating Commercialization

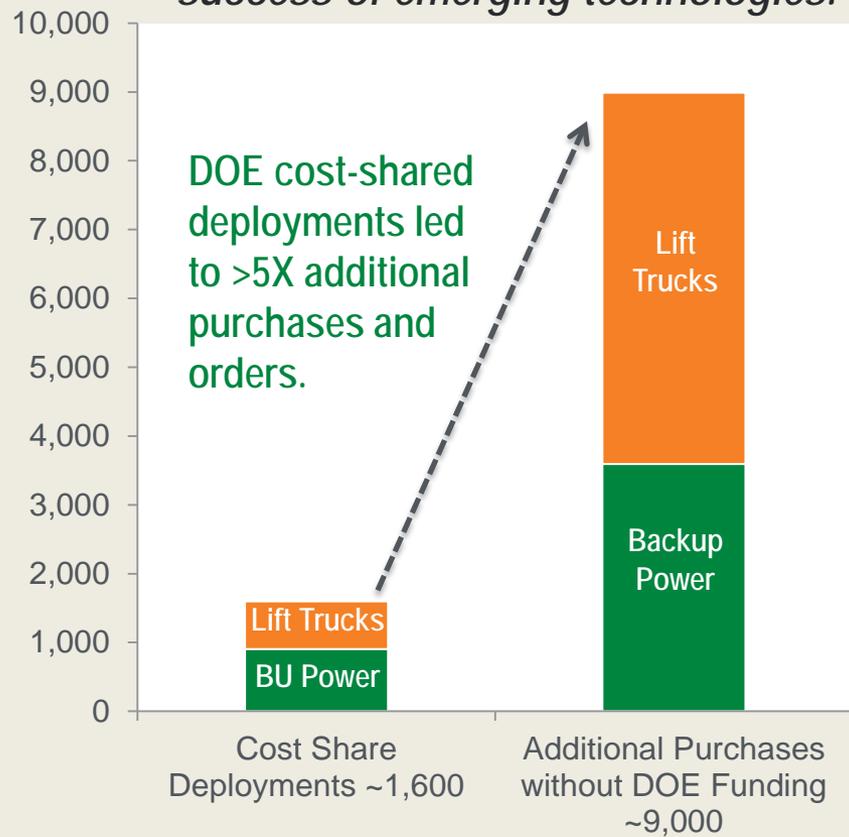


Source: Pacific Northwest National Laboratory, http://www1.eere.energy.gov/hydrogenandfuelcells/pdfs/pathways_2013.pdf

Deployments help catalyze market penetration and ensure continued technology utilization growth while providing data and lessons learned.

Leveraging DOE Funds:

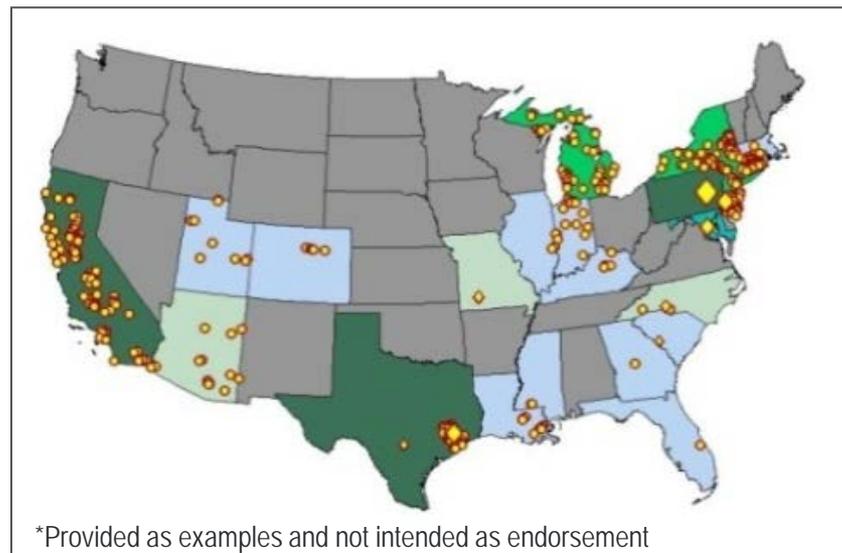
Government as “catalyst” for market success of emerging technologies.



~9,000 ADDITIONAL FUEL CELL LIFT TRUCKS AND BACKUP POWER UNITS PLANNED OR INSTALLED with NO DOE funding

Examples of industry* sectors in DOE ARRA projects

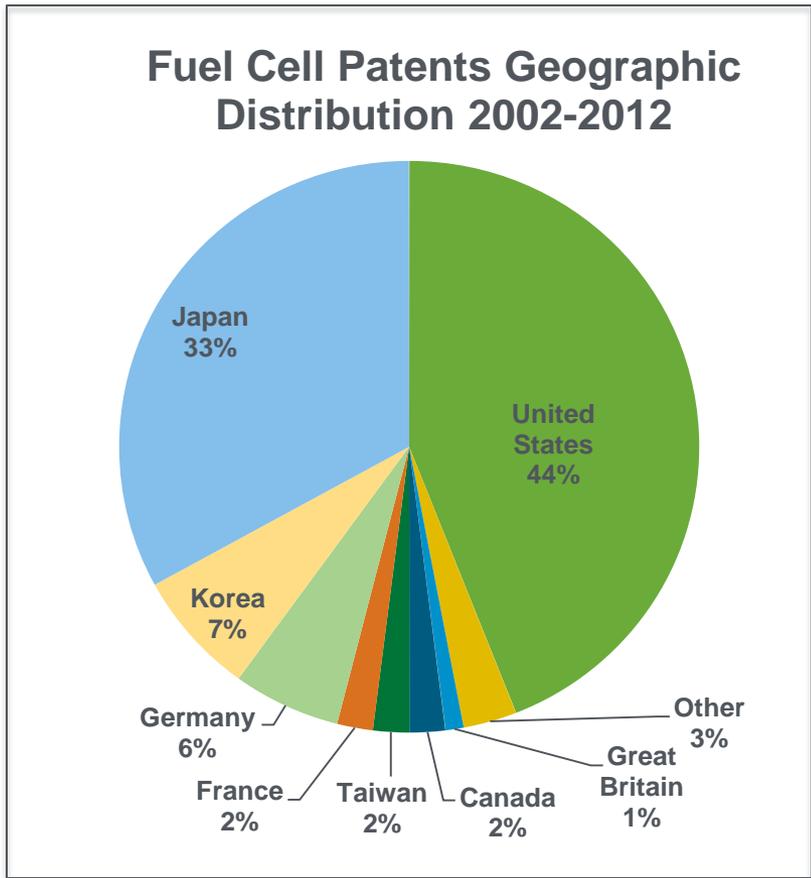
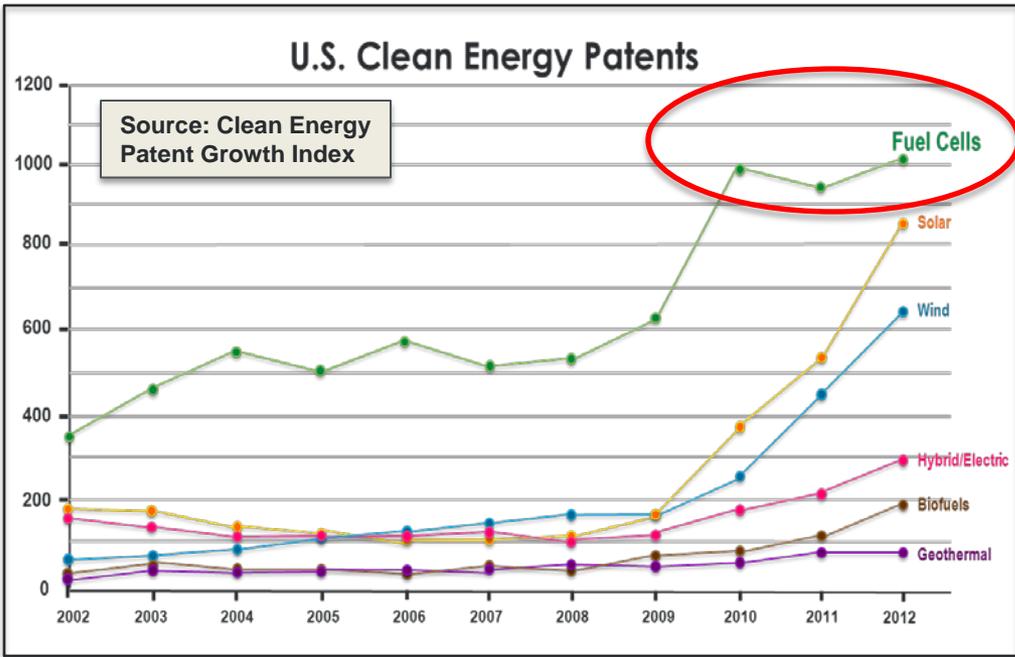
- Telecommunications (e.g. AT&T, PG&E, Sprint, etc.)
- Distribution Centers/Warehouses (e.g. FedEx, Genco, Sysco, Wegmans, Whole Foods, etc.)



Hurricane Sandy was the largest Atlantic hurricane on record.
Winds spanning more than 1,100 miles



>>\$60 billion in damages
**Fuel cells demonstrated the
ability to provide reliable
power in numerous examples**

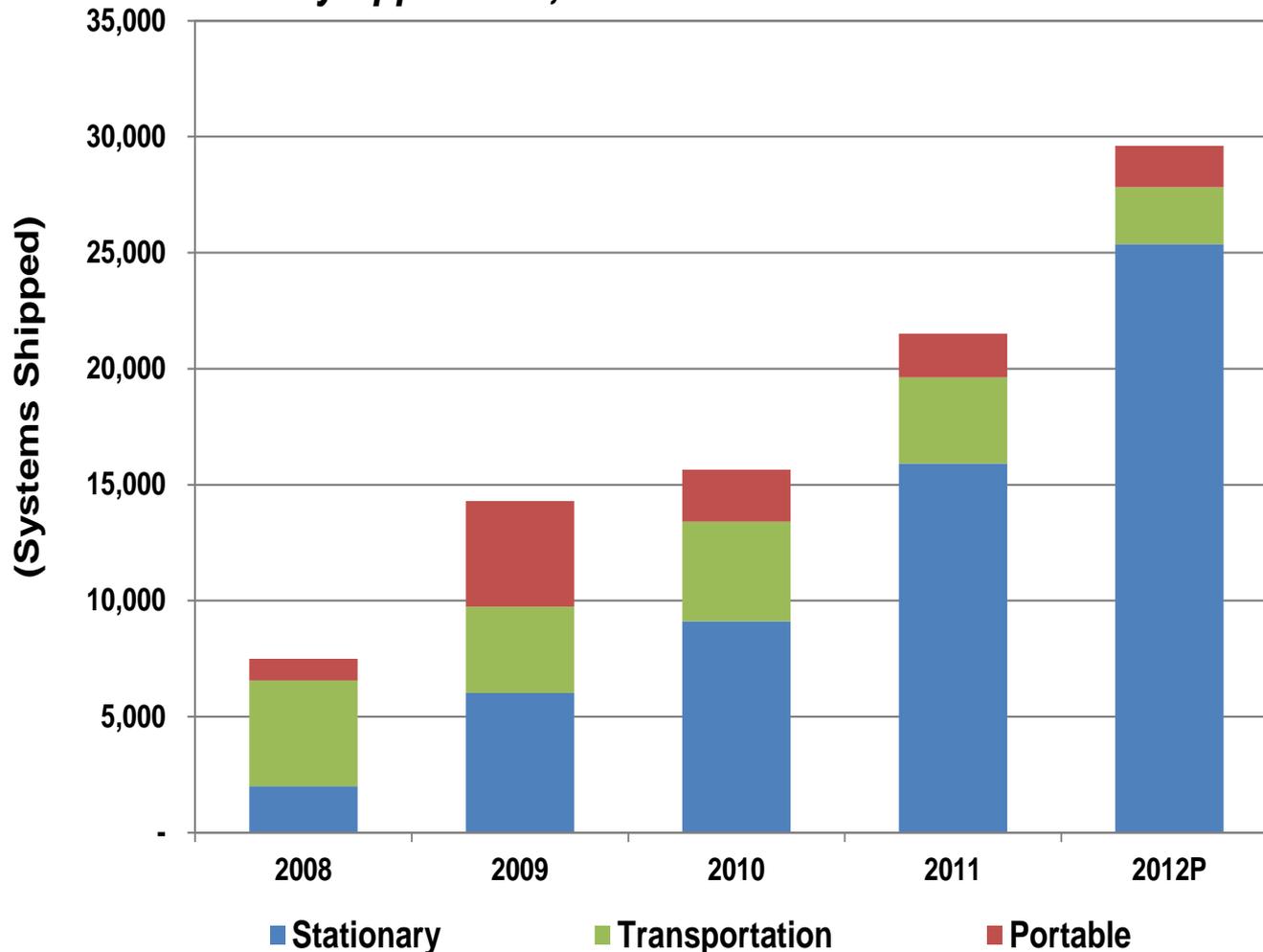


Top 10 companies for fuel cell patents: GM, Honda, Toyota, Samsung, UTC Power, Nissan, Ballard, Panasonic, Plug Power, Delphi Technologies

- Clean Energy Patent Growth Index^[1] shows growth in all clean energy technology patents
- More than 1,000 fuel cell patents issued in 2012

[1] http://cepqi.typepad.com/heslin_rothenberg_farley_/2013/03/clean-energy-patent-growth-index-2011-year-in-review.html

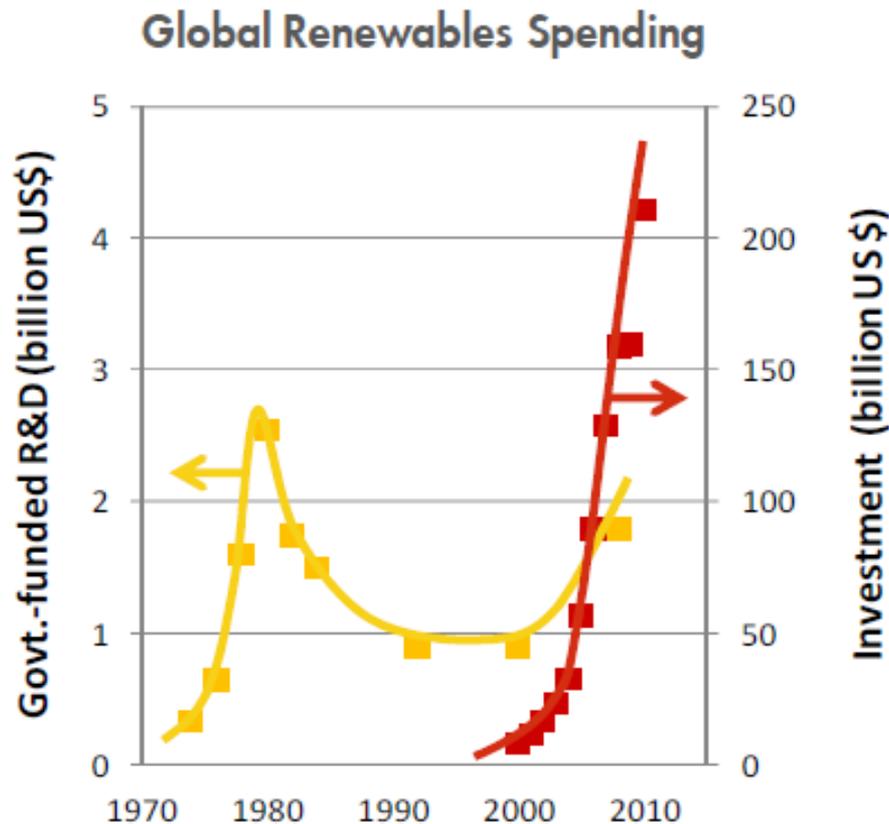
Fuel Cell Systems Shipped by Application, World Markets: 2008-2012



Fuel cell markets continue to grow

- 48% increase in global MWs shipped
- >60% increase in North American systems shipped in the last year

Government funding helps stimulate investment from Industry helping lead to the successful development and commercialization of clean energy technology.



Today, renewable energy is no longer about **‘breakthrough technology’**; it is about **technology breaking through**.

Fuel cells are still an emerging industry- sustained federal and industry investment is essential- strong government-industry partnerships are critical

H₂ USA

Mission: To promote the commercial introduction and widespread adoption of FCEVs across America through creation of a public-private partnership to overcome the hurdle of establishing hydrogen infrastructure.

Current partners include (additional in process):



U.S. DEPARTMENT OF
ENERGY



American Gas Association



DRIVING FOR THE FUTURE

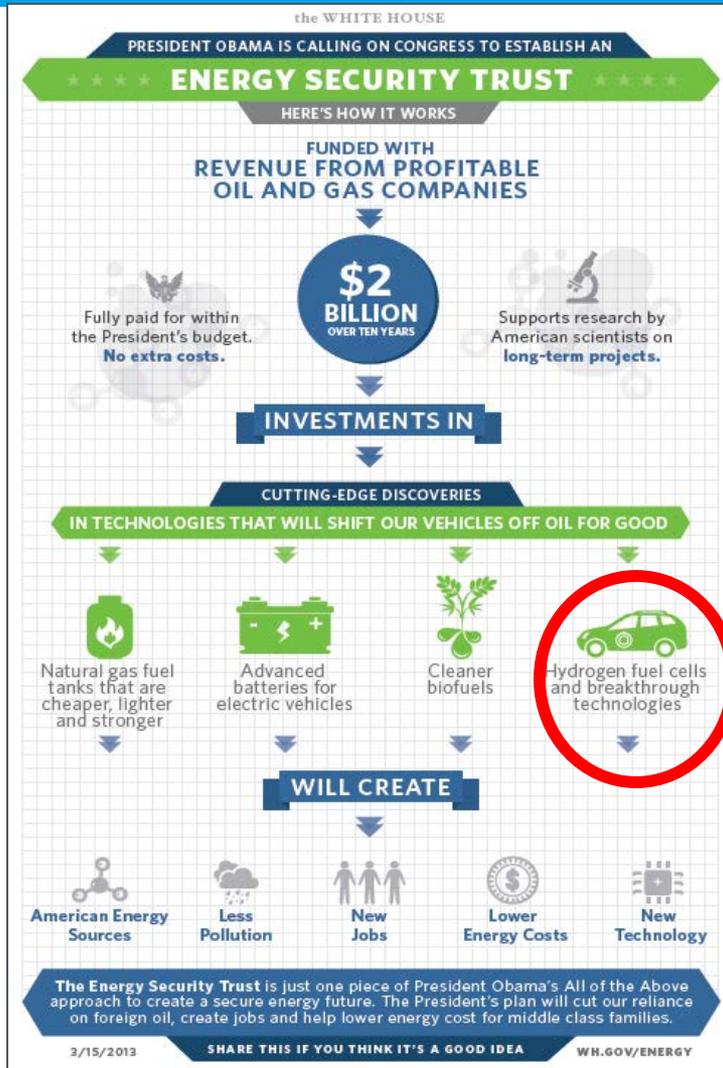


Mercedes-Benz



PROTON
THE LEADER IN ON SITE GAS GENERATION.





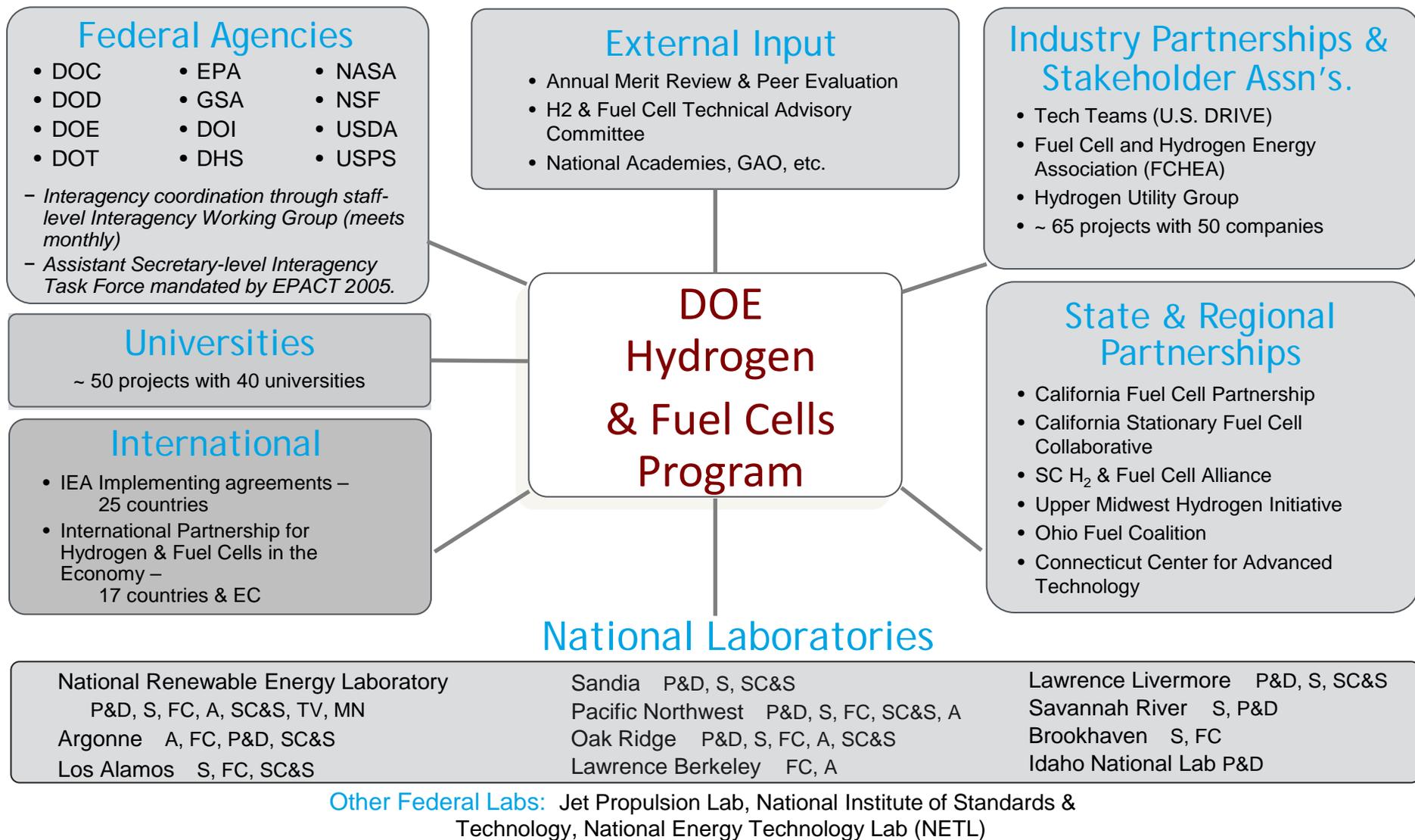
*"We've got to invest in a serious, sustained, **all-of-the-above energy strategy** that develops every resource available for the 21st century."*

– President Barack Obama



"Fuel cells are an important part of our energy portfolio...deployments in early markets are helping to drive innovations in fuel cell technologies across multiple applications."

- Dr. David Danielson Assistant Secretary for Energy Efficiency and Renewable Energy, 2012



P&D = Production & Delivery; S = Storage; FC = Fuel Cells; A = Analysis; SC&S = Safety, Codes & Standards; TV = Technology Validation, MN = Manufacturing

Examples of DOE-funded Partners and Locations – Fuel Cell Technologies Program



Thank You

Sunita.Satyapal@ee.doe.gov



hydrogenandfuelcells.energy.gov