NREL/DOE EERE QC/Metrology Workshop

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






Energy Systems Integration Facility
Golden, CO
December 9-10, 2013

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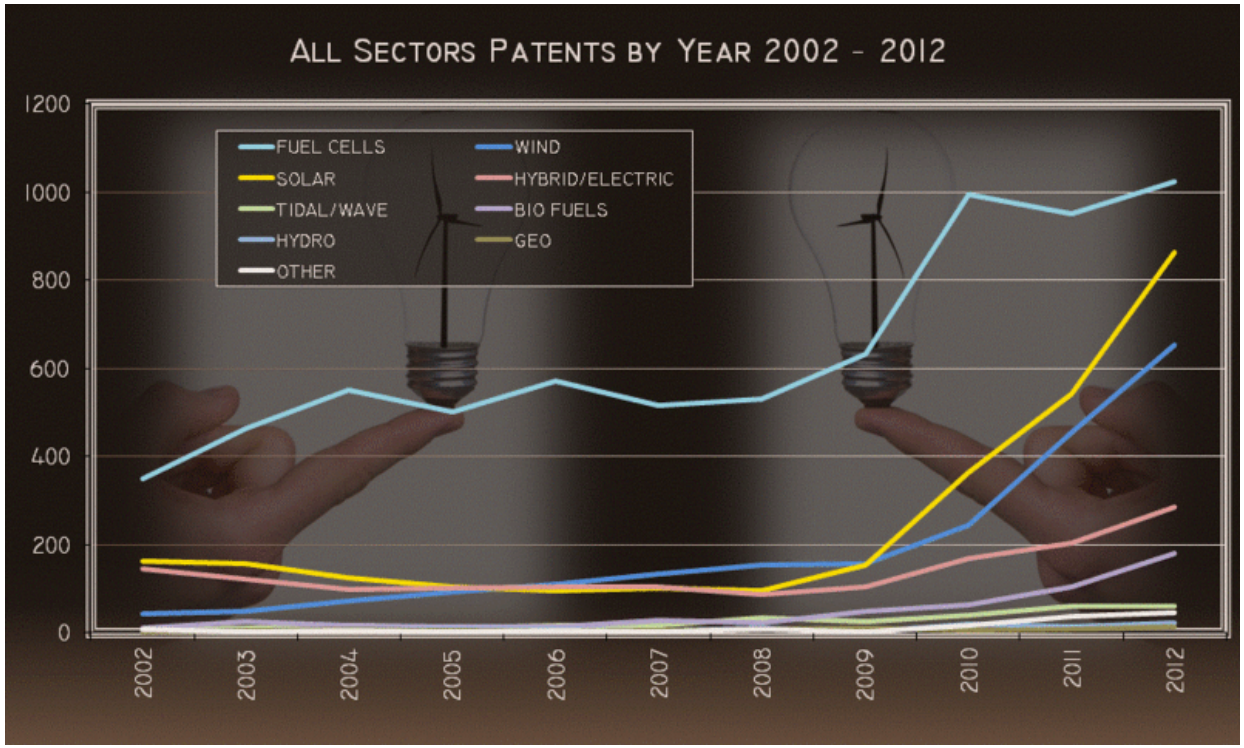
Fuel Cell Technologies Office

Clean Energy Patents Reflect Emerging Growth



Clean Energy Patent Growth Index[1] shows that fuel cell patents lead in the clean energy field with over 1,000 fuel cell patents issued worldwide in 2012.

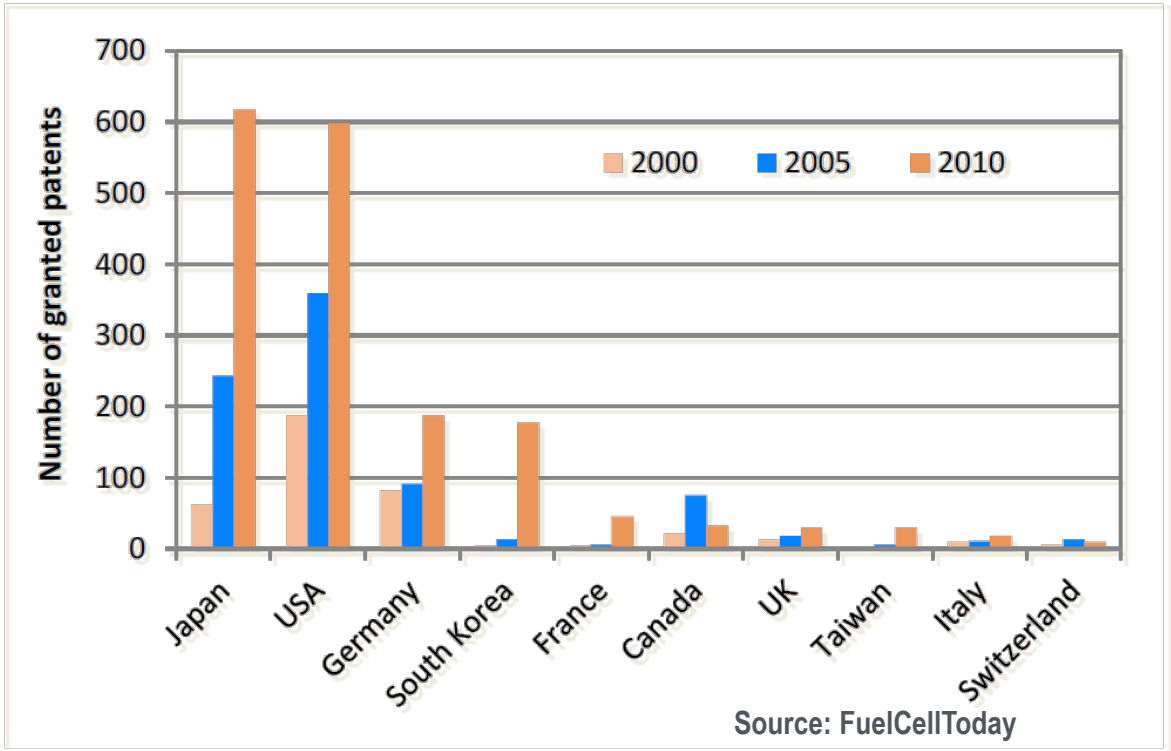
- **Solar and wind are catching up (!) as well as hybrid/electric vehicle and bioenergy technologies**
- **Colorado - shining brightly in clean energy - patents double in 2012**

[1} http://cepgi.typepad.com/heslin_rothenberg_farley_/

Patents and Job Creation (fuel cells)

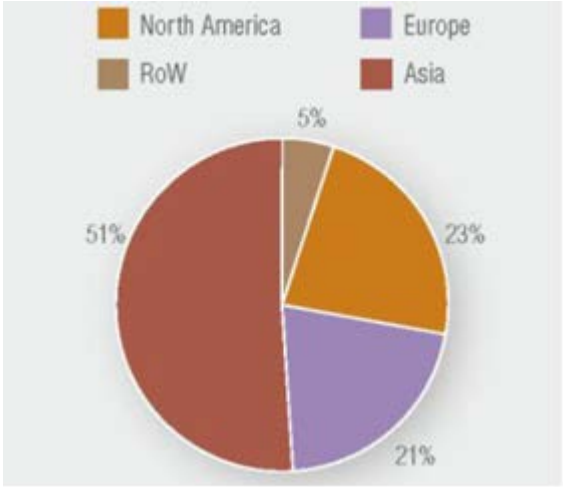
Significant growth in number of patents filed by Japan, Korea, Germany, U.S.
Job creation projections show significant growth in Asia and Europe.

Annual granted fuel cell patents per country of origin (top ten)



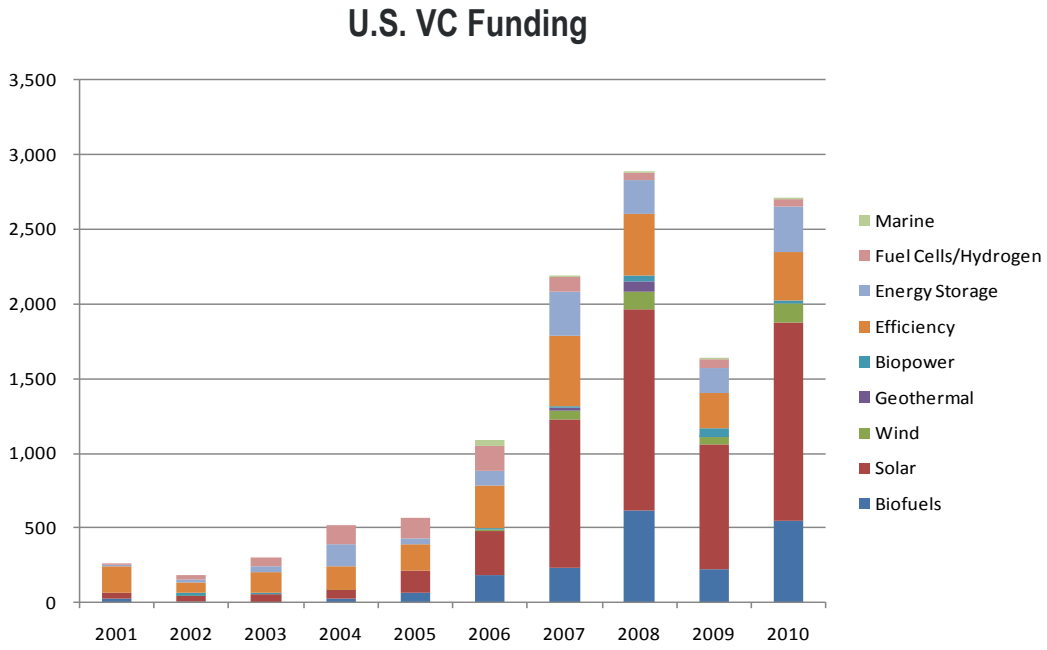
Source: FuelCellToday

Job Creation by Region of Production 2009-2019



Source: FuelCellToday

VC funding of clean energy technologies is small but growing

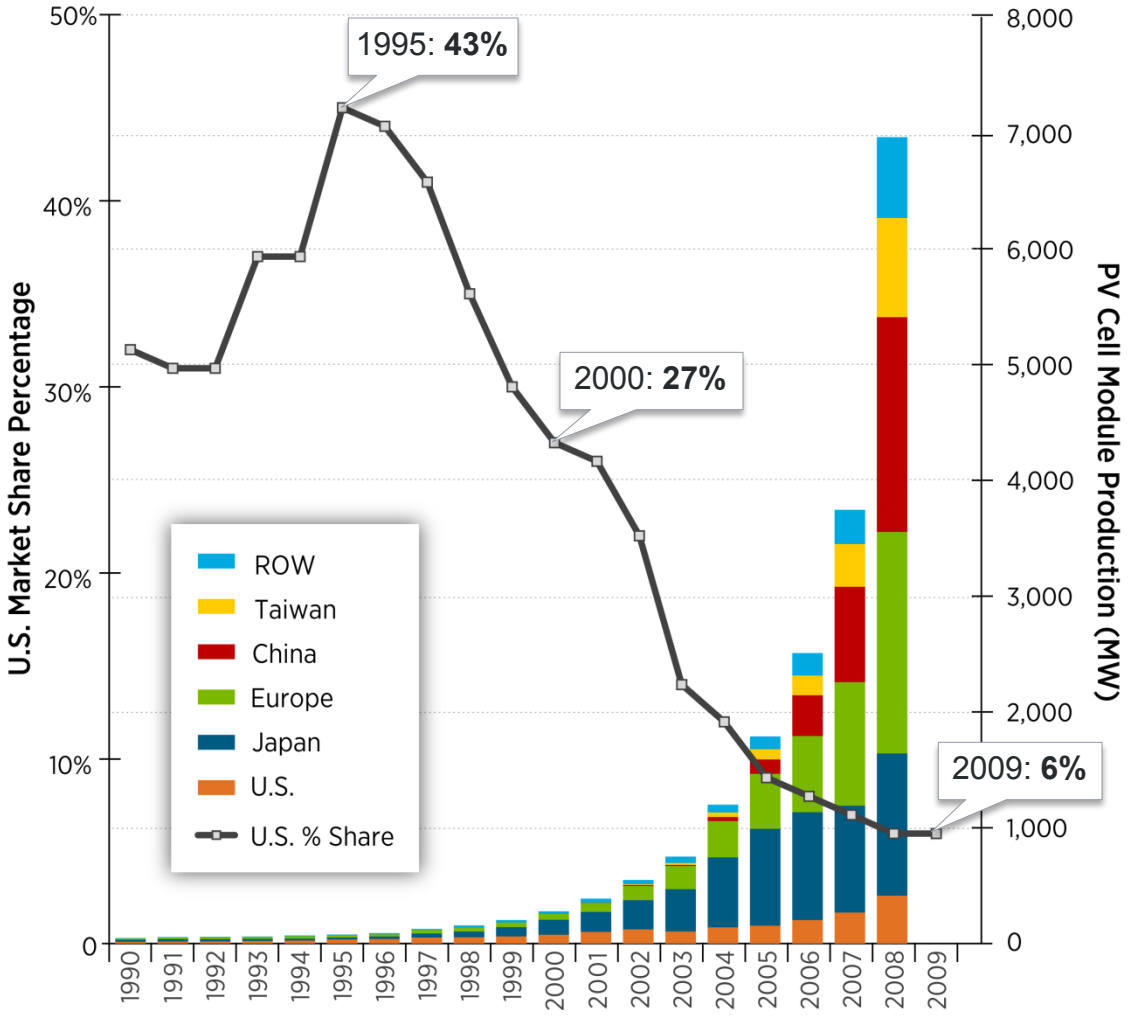


Source: Bloomberg New Energy Finance, as of June 8th, 2011.
Completed and disclosed deals only.

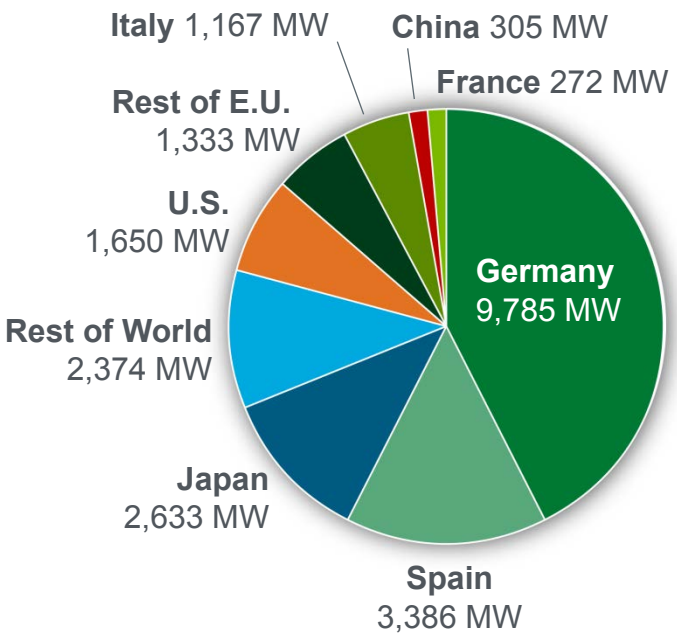
* Source: www.cleanedge.com/reports/pdf/Trends2009.pdf

U.S. share of PV production has fallen significantly over the last 10 years

Global & U.S. Annual PV Production by Region



Cumulative Installed PV
(through 2009)



President Obama's Manufacturing Focus

"The path towards sustainable energy sources will be long and sometimes difficult. But America cannot resist this transition; we must lead it. We cannot cede to other nations the technology that will power new jobs and new industries – we must claim its promise."

President Obama, Inaugural Address 2013

"If we want a robust growing economy, we need a robust manufacturing sector. … We cannot remain the world's engine of innovation without manufacturing activity."

President Obama

Presidential Manufacturing Priority

Advanced Manufacturing Partnership

National Science & Technology Council

Advanced Manufacturing National Program Office

National Network for Manufacturing Innovation

The Clean Energy Manufacturing Initiative (CEMI)

The Clean Energy Manufacturing Initiative was launched on March 26, 2013 at the opening of the Carbon Fiber Technology Facility, part of the DOE Manufacturing Demonstration Facility at Oak Ridge National Lab.

CEMI Motivation/Focus

- The Clean Energy Manufacturing Initiative is an integration of manufacturing efforts across all offices of EERE to (1) increase U.S. manufacturing competitiveness by **increasing energy productivity** in the manufacturing sector and (2) increase U.S. competitiveness in **manufacturing clean energy products**.
- Investment in clean energy has grown nearly fivefold in recent years from $54B in 2004 to $269B in 2012. Trillions will be invested in the decades to come. The clean energy technology sector represents an economic opportunity for the nation who manufactures these technologies.
- The Clean Energy Manufacturing Initiative integrates the unique manufacturing efforts in all offices within EERE and orients these efforts to increasing U.S. manufacturing competitiveness.

Clean Energy Manufacturing Initiative Achievements

- Created a platform for collaboration on manufacturing between offices on cross-cutting manufacturing issues, sharing best practices, reducing duplication
- Commenced competitiveness analysis with three technology offices to evaluate competitiveness drivers in those sectors
- Commenced a partnership with the Council on Competitiveness to identify manufacturing competitiveness drivers

CEMI - Partnerships & Engagement for New Insights

Clean Energy Manufacturing Initiative & Council on Competitiveness Partnership = American Energy & Manufacturing Competitiveness Partnership

- State and define key barriers, challenges, and opportunities in U.S. competitiveness in manufacturing
- Generate possible solutions and models where the U.S. public and private sectors can work together to advance the Initiative's goals.

Regional Engagement

- Showcase regional Clean Energy Manufacturing activities, opportunities, priorities, and success stories
- Highlight EERE and Federal Clean Energy Manufacturing resources, including Investing in Manufacturing Communities
- Seek input on how the Initiative can strengthen national & regional manufacturing competitiveness

Developing diagnostics for MEA manufacture

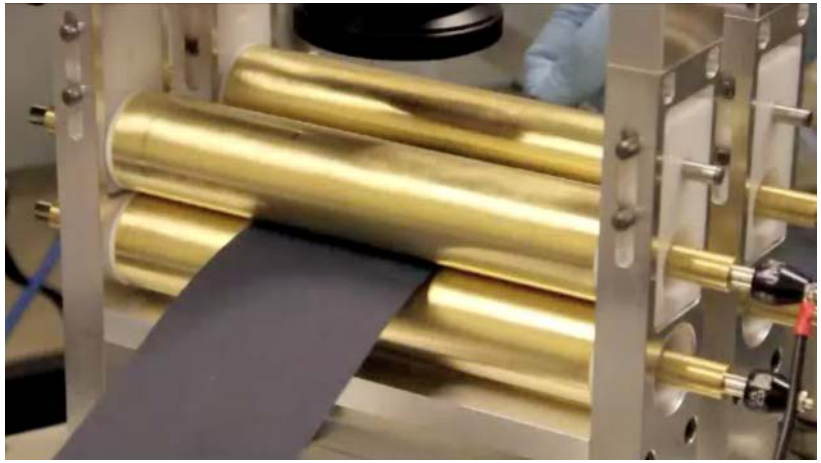
Achieved areal image of catalyst layer uniformity, technique can be scaled up for in-line testing

Project Approach:

Evaluate and develop in-line diagnostics for MEA component quality control, and validate in-line

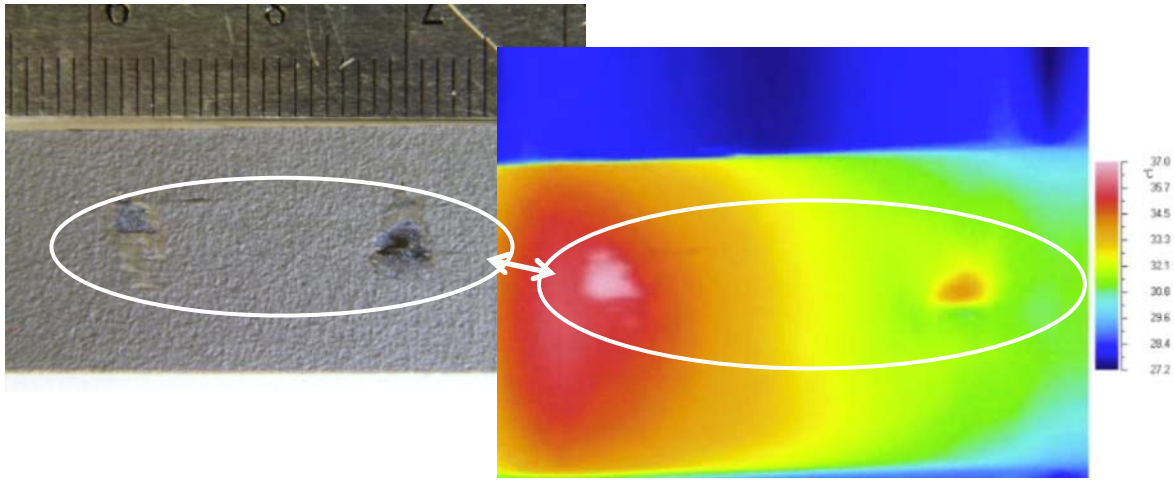
Investigate the effects of manufacturing defects on MEA performance and durability to understand the accuracy requirements for diagnostics

Integrate modeling to support diagnostic development and implementation



Example:

- DC excitation of catalyst-coated membrane causes thermal response
- Defects change catalyst layer resistance, thus altering the thermal response
- IR camera provides rapid, quantifiable 2D data



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Workshop Objectives

Purpose

- Discuss current status/state-of-the-art for QC/QA and metrology in manufacturing processes relevant to EERE Offices
- Discuss critical process and material inspection and metrology needs for manufacturing technologies relevant to the Office
- Discuss similarities in materials and processes inspection and metrology needs

Workshop Output:

- Identify opportunities for collaboration across EERE Offices to address shared challenges
- Develop plans and strategies to address synergistic opportunities and accelerate collaborations with and transfer of these technologies to industry

Additional slides

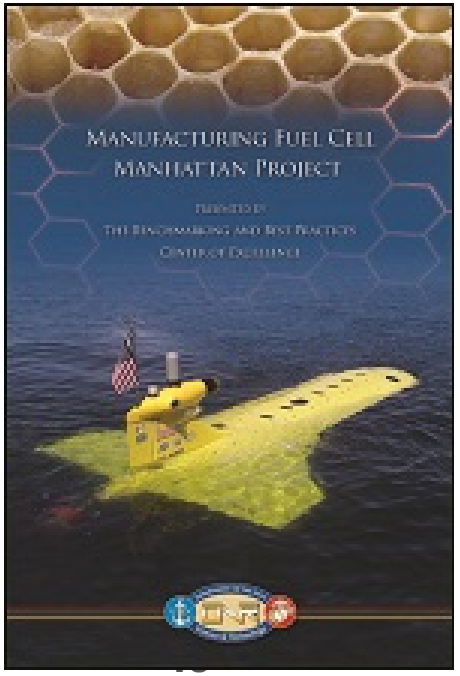
Key interactions

CEMI collaboration and other EERE Offices involved in clean manufacturing

- Increased funding for manufacturing R&D across the board
- Increased EERE focus on energy productivity resources for manufacturers
- Development of competitiveness analysis and strategies
- A clean energy manufacturing portal
- Regional and national summits
- New partnerships and engagement opportunities

DOD, as needed. Past interactions include:

- DPAC
- Manhattan Project



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