CLEANTECH PATENTING: A DYNAMIC, MATURING LANDSCAPE

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USPTO Cleantech Partnership Meeting

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Dynamic, Maturing Landscape

- Danger of cleantech “bubble”? What is the “buzz” status in 2011?
- Cleantech Forum (SF, March 2011)

  * This year’s theme: Convergence of cleantech and information technology; dramatic updates with Japan nuclear disaster (dynamic)

  * Cleantech investment forums now reaching 10 years (maturing)

Discussion Agenda

Today's talk: trends, data, and case studies in cleantech innovation & patents

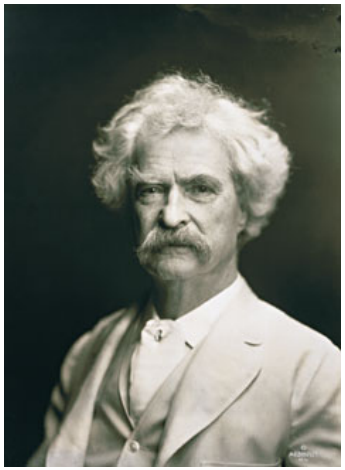
- Introductory perspectives on cleantech innovation
- Cleantech patent landscape
- Sub-topics for focus in cleantech
  - Government funding influences on cleantech
  - Nanotech influences on cleantech
  - U.S. vs. Europe vs. East Asia
  - Deep shale natural gas drilling (Marcellus Shale)

Cleantech – The Big Picture

- *The Clean Tech Revolution: The Next Big Growth and Investment Opportunity*, Ron Pernick and Clint Wilder, 2007
- Investment themes (VCs, Corporate Venturing)
- Moral themes: “Should be required reading for any responsible citizen of this planet.”

A Mark Twain Consideration for Cleantech?

- "Do good when you can, and charge when you think they will stand it."



Defining Cleantech

- "Cleantech refers to any product, service, or process that delivers value using limited or zero nonrenewable resources *and/or* creates significantly less waste than conventional offerings." (BROAD!?)
- "Cleantech covers four main sectors: energy, transportation, water, and materials."

  (Pernick/Wilder)

Practical Point on Defining Cleantech

- Which patent applications link to USPTO's greentech accelerated examination program?
- USPTO: "The claims must be directed to a single invention that materially enhances the quality of the environment, or that materially contributes to:
  - (1) the discovery or development of renewable energy resources;
  - (2) the more efficient utilization and conservation of energy resources; or
  - (3) green house gas emission reduction..."

January 2011 State of the Union Address

Obama: "...clean energy breakthroughs will only translate into clean energy jobs if businesses know there will be a market for what they're selling. So tonight, I challenge you to join me in setting a new goal: by **2035**, 80% of America's electricity will come from ***clean energy sources***. Some folks want wind and solar. Others want nuclear, clean coal, and natural gas."

Innovation Debate Re: Cleantech's Future

"*I am only interested in technologies that have a 90% chance of failure but, if they succeed, would change the infrastructure of society in radical ways*."

Vinod Khosla (Si Valley Cleantech VC leader)

"*Technology breakthroughs are unlikely to be the answer. Accelerated deployment of existing technologies will get you down the cost curve much more rapidly than a breakthrough*."

Joseph Romm, editor of *Climate Progress*

2011 Q1 Cleantech Venture Investments

- Measured by dollars invested, cleantech venture investment was up by 52 percent compared to the previous quarter ($1.69 billion) and was also 31 percent higher than the same period a year ago ($2.28 billion).
- The leading sector by amount invested was solar ($641 million), followed by transportation ($311 million) and materials ($296 million).

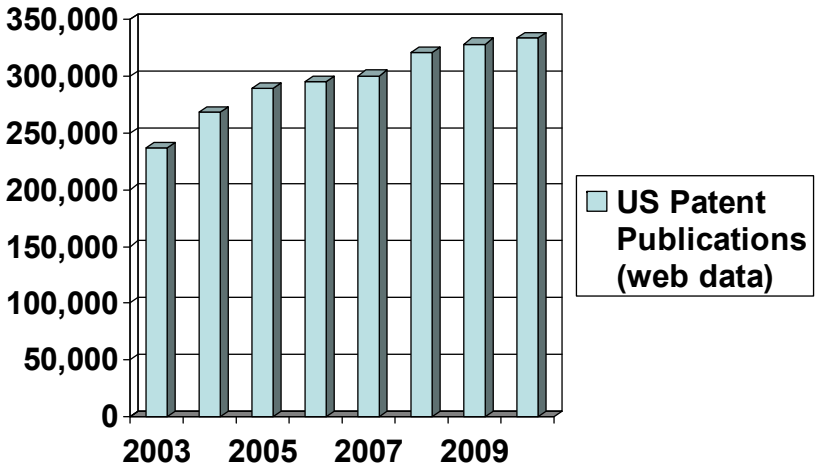
(Source: The Cleantech Group)

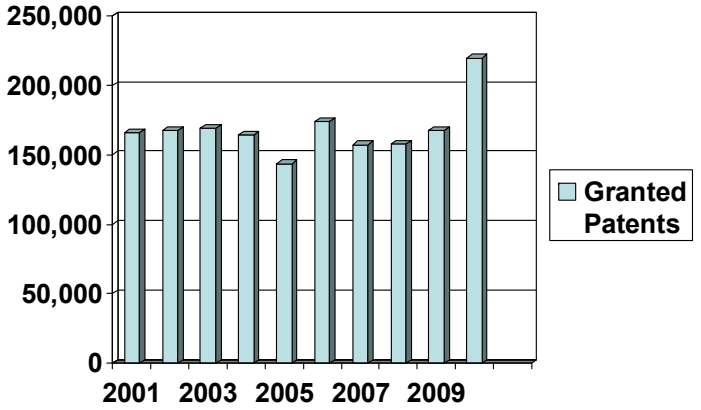
Broad Trends in Cleantech Patenting

- Patent filing and granting per year is generally increasing and cleantech is no exception
- Our annual patent research also indicates increases in cleantech patenting
- Clean Energy Patent Growth Index (CEPGI): 2010 Year in Review

  "U.S. patents for clean-energy technologies in 2010 were at an all time high…Clean energy innovation is clearly far outpacing technology in general."

U.S. Pat. Appl'ns Publishing or Granting Per Year

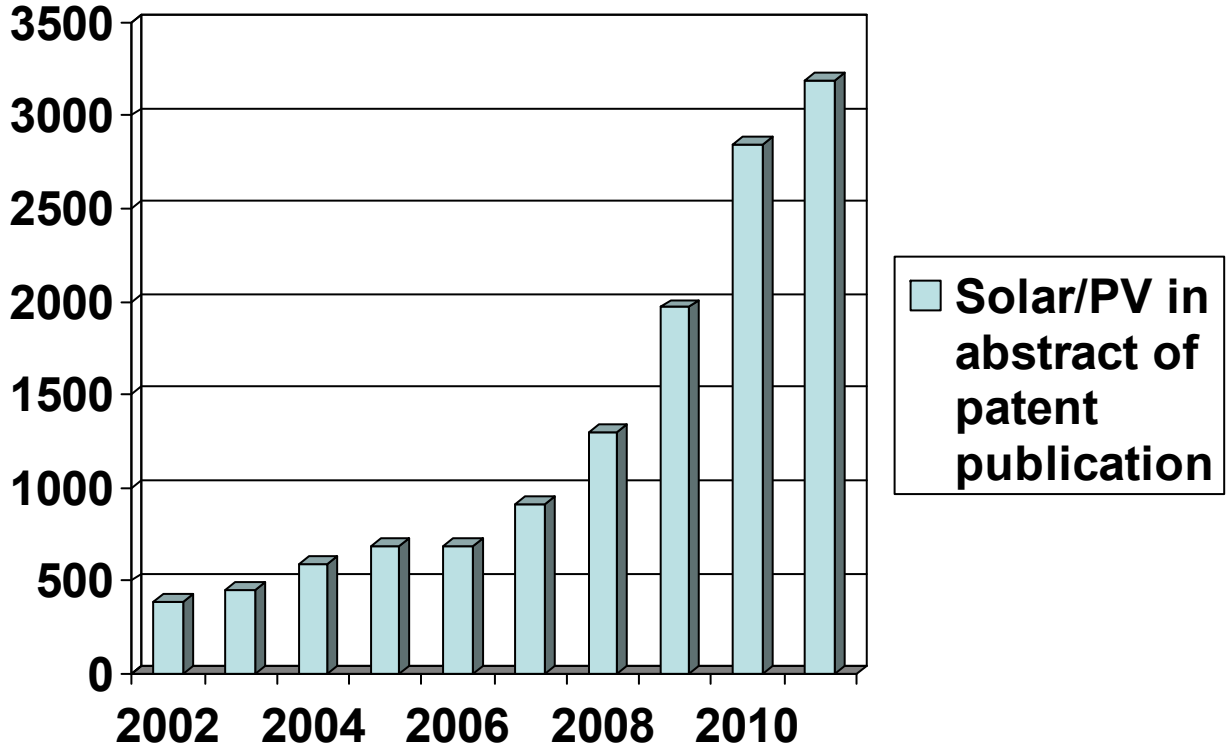




13% increase from 2006 to 2010

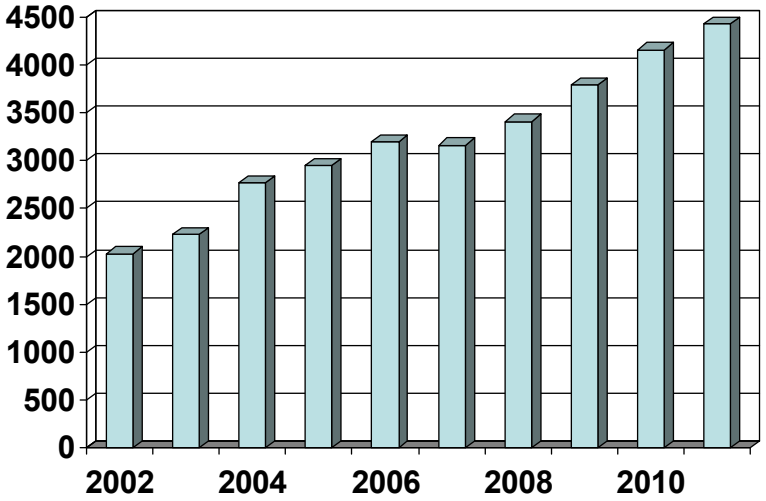
"spike" for granted patents in 2010"

U.S. Solar Patent Publication Data

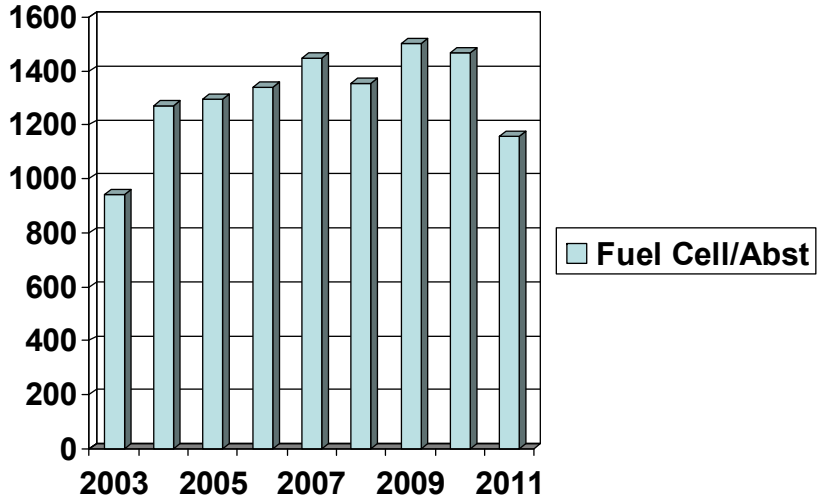


Solar sector increasing faster than broader set of patents

Batteries vs. Fuel Cells Debate (Cars)



More battery patenting and rising faster



Fuel cell patenting not rising

Sectors in Cleantech for Granted Patents

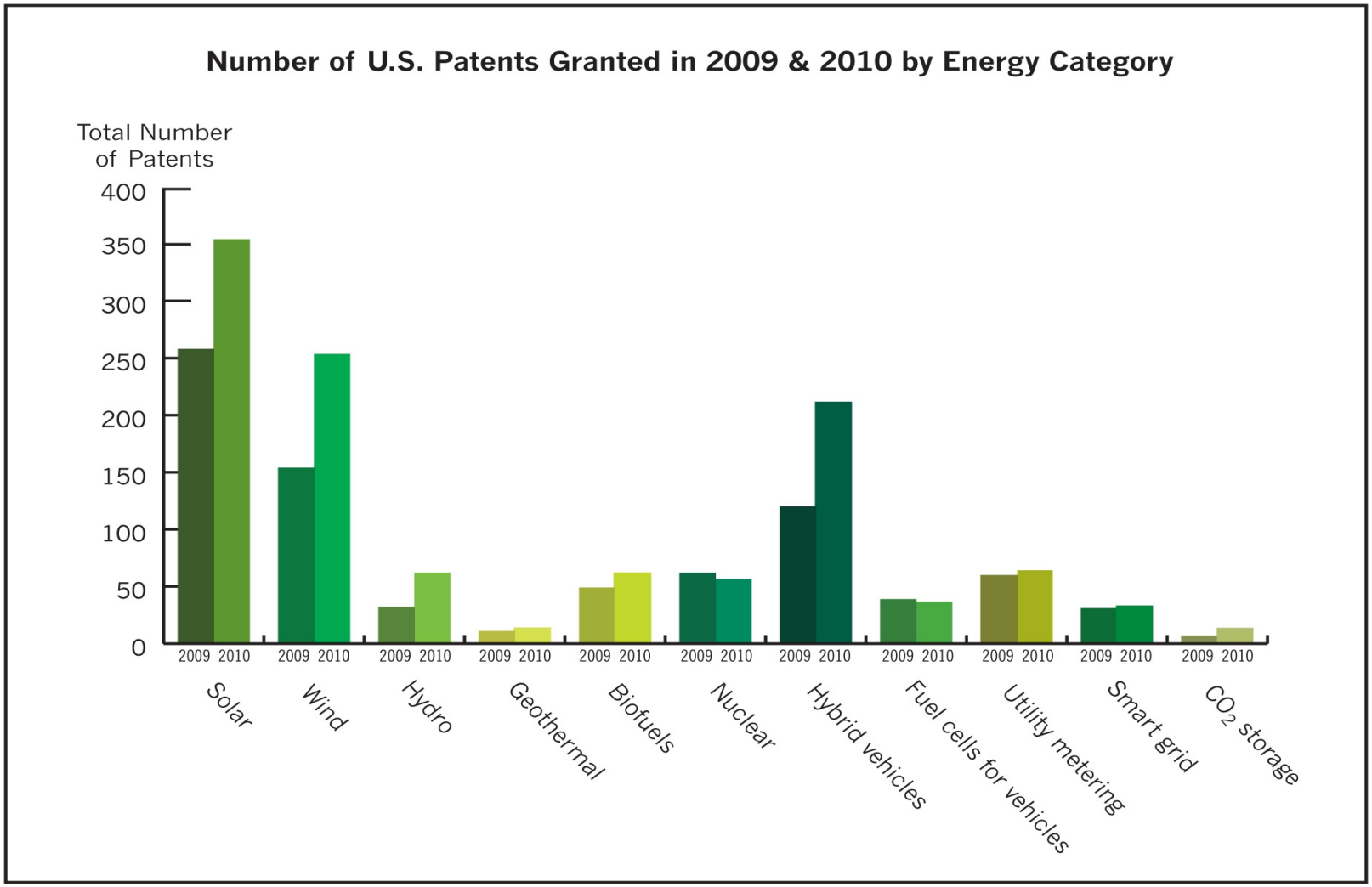
• Foley's annual Cleantech Patent Report focuses on all U.S. utility patents that issue in a particular year that are directed to anyone of the following eleven cleantech energy categories:

- Solar energy
- Wind energy
- Hydro energy, including wave and tidal
- Geothermal energy
- Biomass/biogas/biofuel energy
- Nuclear energy
- Hybrid vehicles
- Fuel cells for vehicles
- Utility metering
- Smart grid technologies
- CO_2 storage or sequestration

Overview of Analysis

- Each U.S. patent is reviewed to determine the following information, scope, and characteristics of the patents (includes PAIR review):
  - Total number of patents for each cleantech category
  - Total number of “apparatus” or “system” claims in each patent
  - Total number of “method of making” claims in each patent
  - Total number of “method of using” claims in each patent

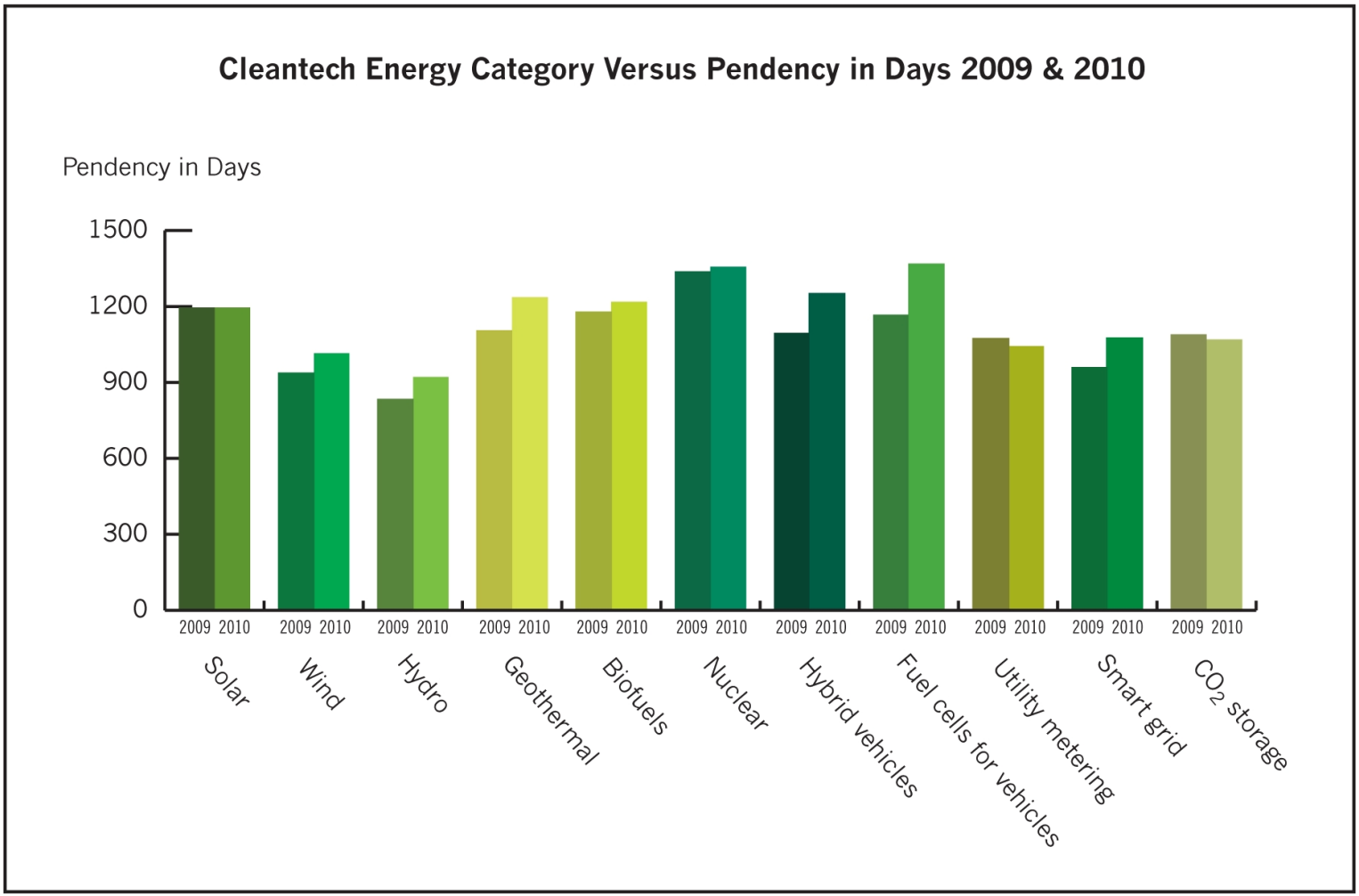
Breakdown of Granted Patents



Breakdown by Total Claims

Cleantech Energy Category	2010 Number	2010 Percent	2009 Number	2009 Percent
Solar***	**6074**	31.5	4,678	33.2
Wind***	**4009**	20.8	2,710	19.2
Hydro/wave/tidal	1084	5.6	510	3.6
Geothermal	267	1.4	185	1.3
Biomass/biogas/biofuel	1028	5.3	904	6.4
Nuclear	898	4.7	852	6.0
Hybrid vehicles***	**3108**	16.1	1,783	12.7
Fuel cells for vehicles	517	2.7	492	3.5
Utility metering	1217	6.3	1,122	8.0
Smart grid technologies	649	3.4	561	4.0
CO_2 storage or sequestration	430	2.2	300	2.1
Total	**19,281**	**100**	**14,097**	**100**

Pendency


Cleantech Energy Category Versus Pendency in Days 2009 & 2010
Pendency in Days
1500
1200
900
600
300
0
2009 2010
Solar
Wind
Hydro
Geothermal
Biofuels
Nuclear
Hybrid vehicles
Fuel cells for vehicles
Utility metering
Smart grid
CO_2 storage

Demographics of Patent Owners – Countries

The Top 10 breakdown of 2009 and 2010 patent ownership countries for all cleantech categories is as follows:

Country	2010 Number	2010 Percent	2009 Number	2009 Percent
United States	673	57.7	478	58.1
Japan	145	12.4	111	13.5
Germany	114	10.0	81	9.8
South Korea	43	3.7	35	4.3
Taiwan	26	2.2	18	2.2
Canada	20	1.7	14	1.7
Great Britain	13	1.1	12	1.5
Denmark	28	2.4	10	1.2
France	20	1.7	9	1.1
China	13	1.1	4	< 1.0

Sub-Topics for Focus

- Government funding influences on cleantech
- Nanotech influences on cleantech
- U.S. vs. Europe vs. East Asia
- Deep shale natural gas drilling (Marcellus Shale)!?

Government Funding Influences

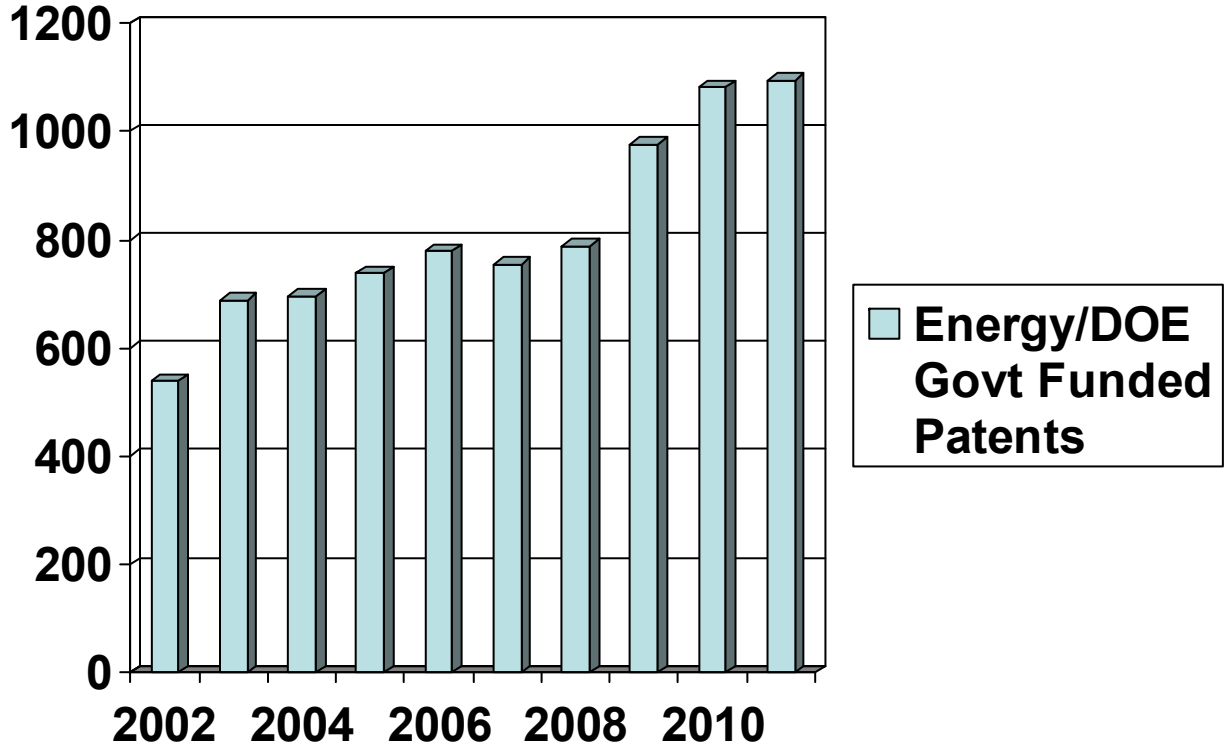
- Universities – federal grant money
- Bayh-Dole's impact on cleantech?
- DOE Programs – ARPA-E, loan guarantees, grants
- Technology transfer from federal laboratories – licensing

Measure Use of Government Funding Clause

- 35 U.S.C.§202(c)(6). An obligation on the part of the contractor, in the event a United States patent application is filed by or on its behalf or by any assignee of the contractor, to include within the specification of such application and any patent issuing thereon, ***a statement specifying that the invention was made with Government support and that the Government has certain rights in the invention***.

- For published patent applications, 47,145 (1.8%)
- 7,459 of these refer to Energy or DOE (16%)

Use of Government DOE Clause Increasing



New Programs for Licensing from Federal Laboratories

- Recently announced lower licensing fee program from federal laboratories for startups: "America's Next Top Energy Innovator" challenge
- Expanded DOE web portal for searching patented technologies available for licensing

Case Study: Universal Display Corp.

- Funding from DOE and various DOD agencies including DARPA
- Recent DOE award winner for solid state lighting
- Founded in 1994 from university research
- Professor Stephen Forrest et al., Princeton University; University of S. California
- Efficient light emission, OLEDs (e.g., personal electronics, TVs, computer displays, solid state lighting); PHOLEDs
- Currently publicly traded (about 80 employees)
- IPO 1996
- Very large patent estate (patent count over 1,000)
- Emphasis on patent licensing rather than direct manufacture

Nanotech Influences on Cleantech

- National Nanotechnology Initiative (NNI) launched more than ten years ago now (billions spent each year on nanotech research)
- Energy applications of nanotechnology critical (Professor Smalley)

Why Nano?

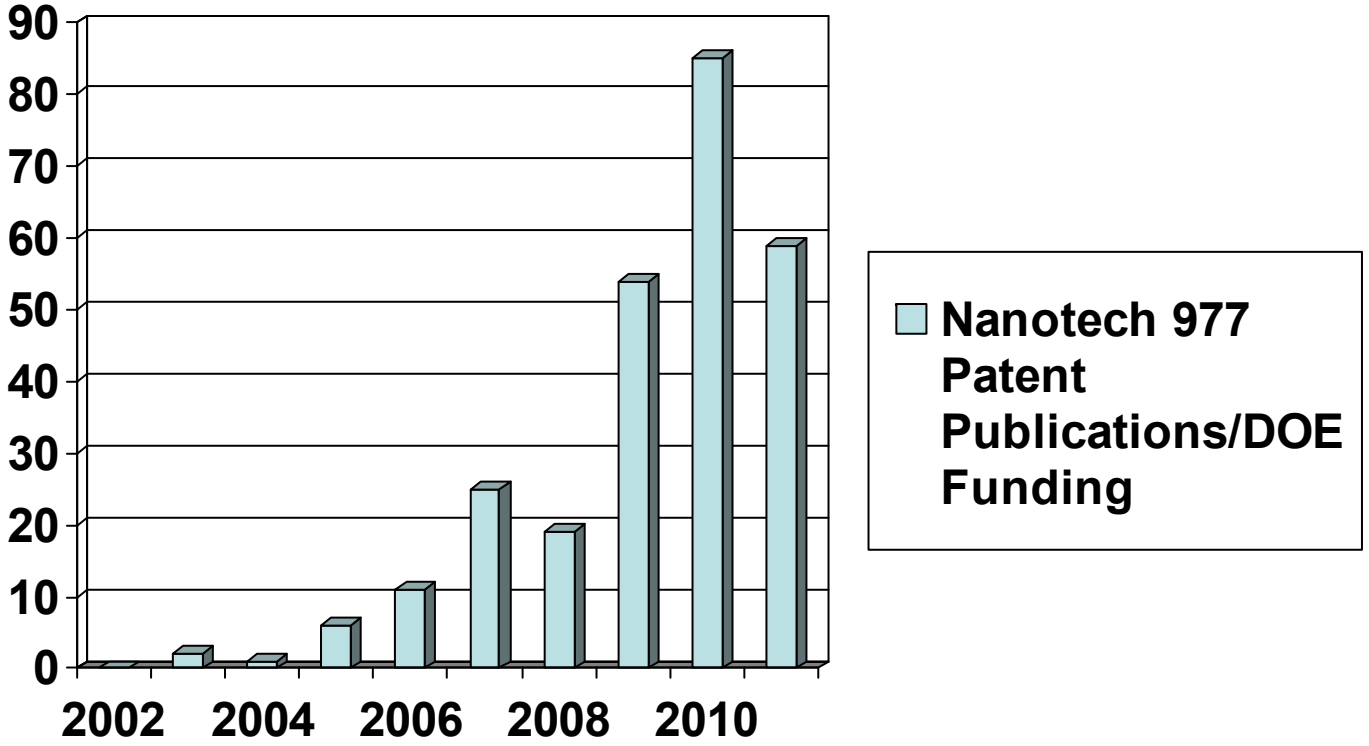
- "Nanotechnology and clean tech are in many ways a natural fit. ... Nanotech could end up enabling many next-generation clean technologies such as advanced batteries, water-desalination and water-filtration membranes, building insulation, and of course, solar power."

  The Clean Tech Revolution, Pernick & Wilder, 2007

Nanotechnology Class 977 Useful Starting Point

- 6,848 nanotech 977 granted patents as of April 19, 2011
- 8,398 nanotech 977 patent publications as of April 21, 2011
- Track nanotubes, nanowires, fullerenes, quantum dots, nanoparticles, graphene, etc.
- High surface areas; high efficiencies
- Nanotech impact on solar (NNI nanosolar initiative): 215 patent publications refer to solar or photovoltaic in the abstract; 32 granted patents; fullerene derivatives
- Mitsubishi Chemical announces new sales in OPV
- Wind turbine materials, fuel cells, batteries, etc.

Government Clause for Energy



Case Study: A123 Systems

- Nanoscale electrode, lithium ion battery technology
- Name taken from the math used to calculate forces between nanoparticles
- Early patent filings at MIT (Professor Yet-Ming Chiang)
- DOE grant money
- 2001 DOE SBIR Phase I grant, $100,000
- 2001-2002, more early patent filings from A123
- 2003 – Phase II Grant

Case Study: A123 Systems

- 2005 – manufacturing and selling to first customer (Black & Decker); $32M raised
- 2009 - $249M match fund grant from DOE
- **2009 – largest IPO of 2009! (nanotech or cleantech IPO?)**
- 2009 – licensing DOE IP
- 2011 – 14 granted patents assigned to A123 (not licensed)
- Approximately 2,000 employees

International: Is the U.S. Falling Behind?

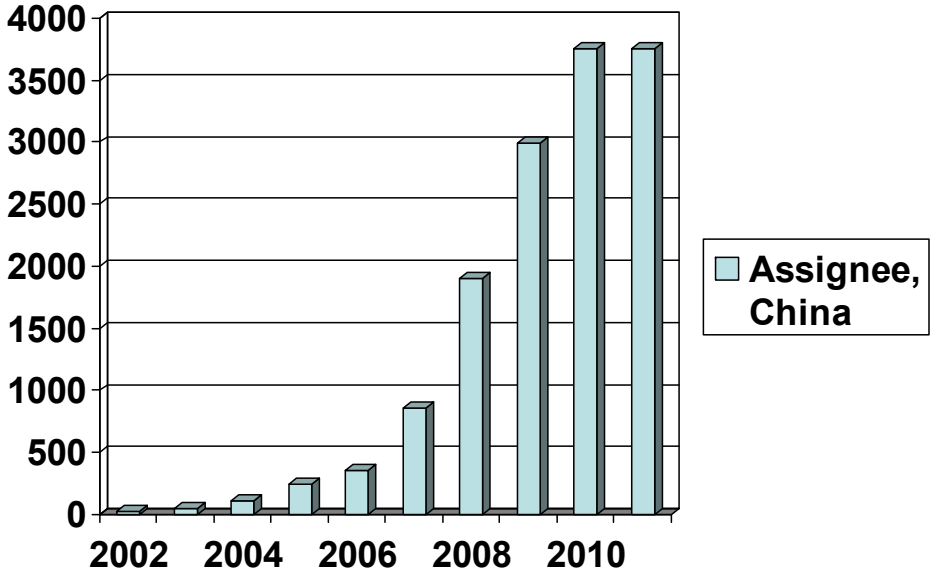
- German innovative laws in solar to generate stable, long-term demand
- U.S. companies like First Solar more a "German success story" than a U.S. success story (per Tom Friedman)
- China prioritizing cleantech and patenting (if we could be "China for a day," per Tom Friedman)

Latest WIPO Data for PCT Filings 2010

- **China:** **56.2%** ↑ !
- **S. Korea:** **20.5%** ↑
- Japan: 7.9% ↑
- Germany: 2.2% ↑
- United States: -1.7% ↓
- France: -0.6% ↓
- United Kingdom: -3.7% ↓

U.S. Patent Publications

- China growing rapidly despite lower income in China



Case Study: General Electric

- Big industrial players like GE need price certainty (per Jeff Immelt, CEO)
- GE brand: “Ecomagination”
- Immelt: new head of White House Council on Jobs and Competitiveness
- "We think GE has something to teach businesses all across America," Obama said.
- Wind turbines (“We grew our wind business in Europe.”)
  - Fortress of patents (301 U.S. GE patents mention wind turbine and 164 mention wind turbine in the abstract)

Case Study: GE Transportation

- GE Transportation: exporting energy efficient, environmentally cleaner diesel train engines globally including to China (Erie and Grove City, PA)
- Innovation driven by EPA regulations
- Creative engineering program with local Gannon University (Erie, PA)
  - e.g., Engineering Professor Aggarwal patenting extensively with GE Transportation

Deep Shale Drilling to Recover Natural Gas?

- Whether or not it is “cleantech,” deep shale gas drilling will impact “cleantech” heavily and globally
- Large “new” domestic energy source
- Hydraulic fracturing – an old process
- Horizontal drilling – newer process
- Combination of two critical
- Current center of action: western Pennsylvania, Marcellus Shale

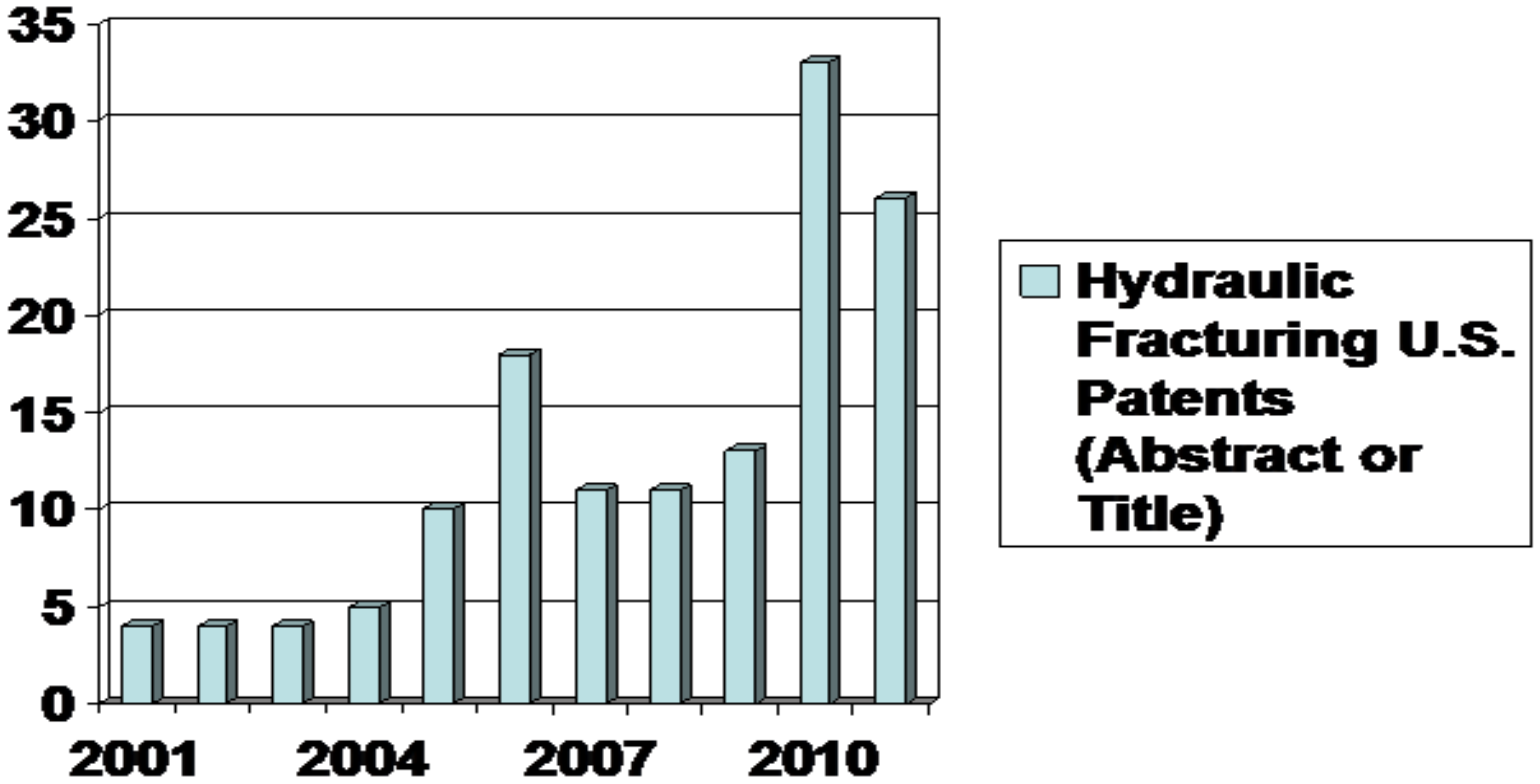
Deep Shale Natural Gas Recovery Innovation

- Innovation in the drilling process
- Large Water Usage:
  - Innovation in treating the used “flowback” water (water purification traditionally part of cleantech)
  - Prevention of water pollution

Imminent China Shale Rush

- China has more shale gas than the U.S.?
- China wants to replicate the U.S. technological/commercial shale gas push
- China has identified shale gas as one of the country's top targets for technological breakthroughs in the 2011-2015 five year plan

Rise in Hydraulic Fracturing Patenting

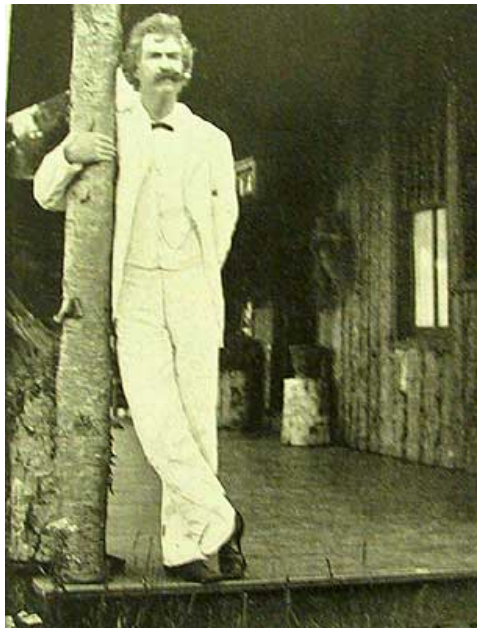


Hydraulic Fracturing Patent Increases

- Since 2008, over 300 patent publications publish each year mentioning hydraulic fracturing. Before 2006, this number was less 200.
- 2010 was a record breaking year for hydraulic fracturing at the USPTO. Patent search results showed 257 patents were issued in 2010 which referred to HF. The trend continues for 2011. In stark contrast, from 1981 to 2003, the USPTO only issued about 50 HF patents a year.

Mark Twain on Water

- “My works are like water. The works of the great masters are like wine. But everyone drinks water.”



In Brief: Points for USPTO to Consider?

- Minimize restrictions on those that apply for greentech accelerated examination
- Allow easy identification of the green tech applications/patents
- Work more with the private sector on useful patent information for investment
- Useful to have one class or a few classes for cleantech; e.g., 977 analogy

Closing Points

- Cleantech is no longer new – it is maturing but it is dynamic:
  - China
  - DOE initiatives
  - Cheap natural gas from Marcellus Shale
  - Recent events such as Japan nuclear disaster and Gulf oil spill disaster
  - Information technology
  - Future laws and regulations to stimulate more cleantech innovation

Contact Information

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Foley Sources:

- Cleantech Energy Patent Reports (John Lazarus, Foley & Lardner LLP, lead author)
- www.nanocleantechblog.com
  (Foley blog covering both cleantech and nanotech; Steve Rutt, editor)

Slides and reports available upon request