# Energy Challenges and Developments

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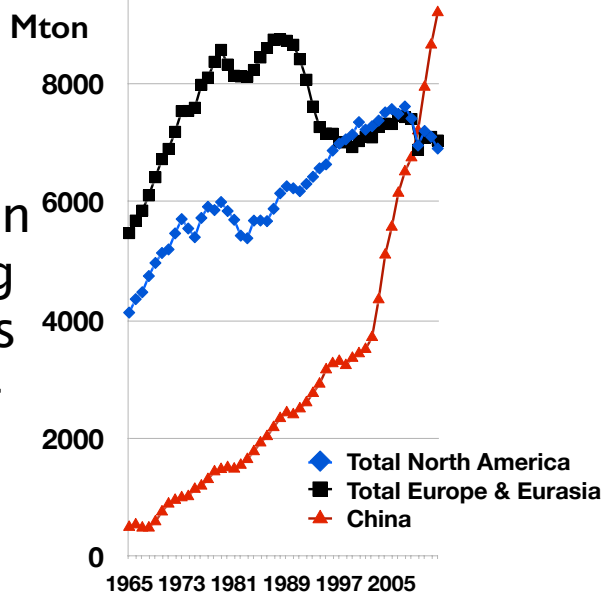
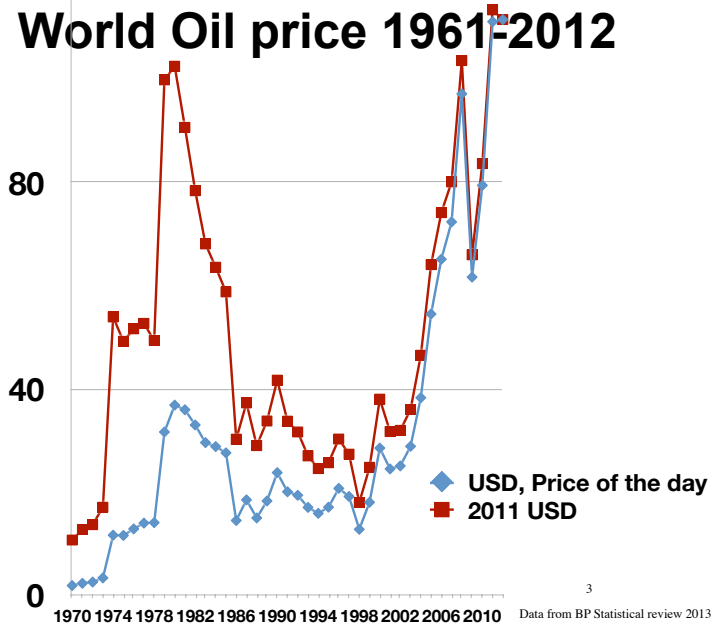
Editor in Chief, Energy Science and Engineering

## CO2-emission leading regions 1965-2012




Data from BP

## World Oil price 1961-2012




Data from BP Statistical review 2013

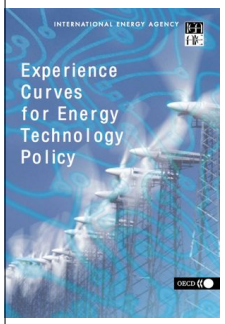


## State of the Union 2013: The President's Remarks on Energy

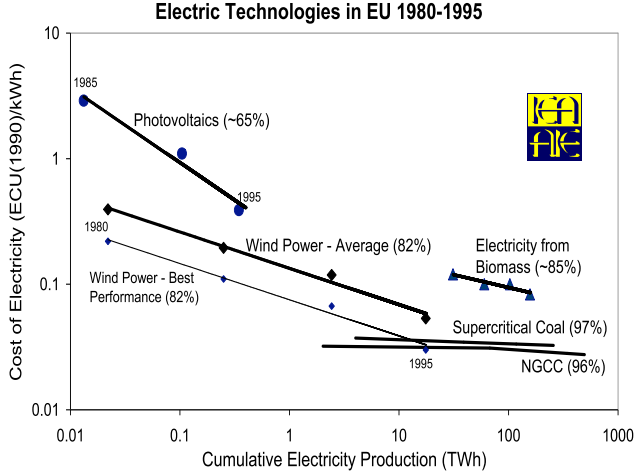

"After years of talking about it, we are finally poised to control our own energy future. We produce more oil at home than we have in fifteen years. We have doubled the distance our cars will go on a gallon of gas, and the amount of renewable energy we generate from sources like wind and solar -- with tens of thousands of good American jobs to show for it. We produce more natural gas than ever before -- and nearly everyone's energy bill is lower because of it. And over the last four years, our emissions of the dangerous carbon pollution that threatens our planet have actually fallen."

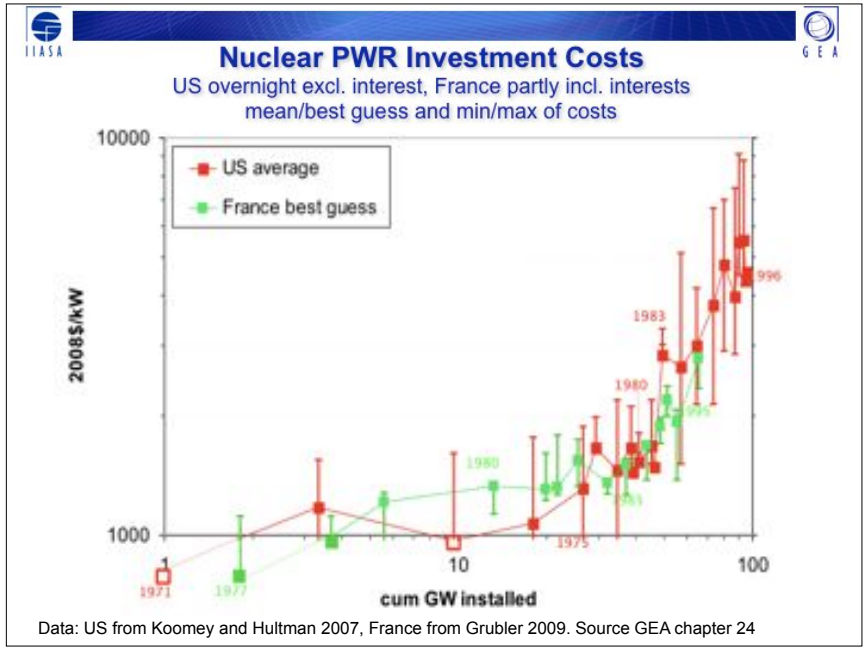


# Industrial learning by experience

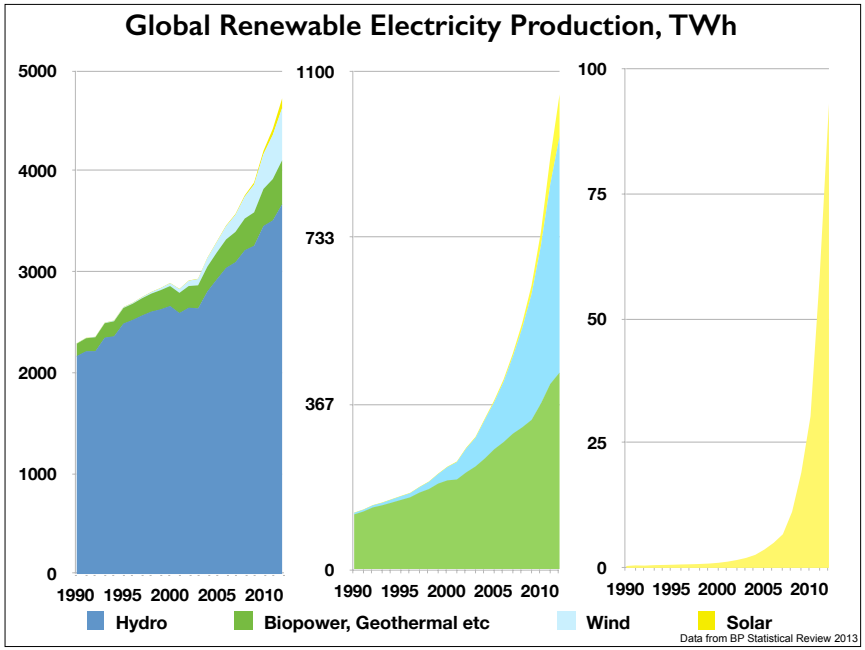


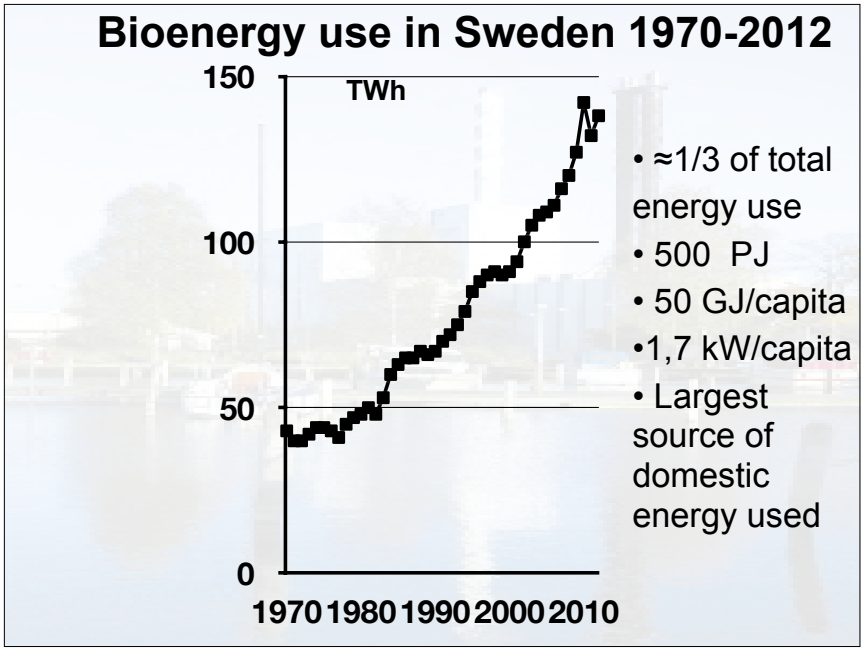

**Prof. Clas-Otto Wene, Chalmers Univ. of Technology, 2000**



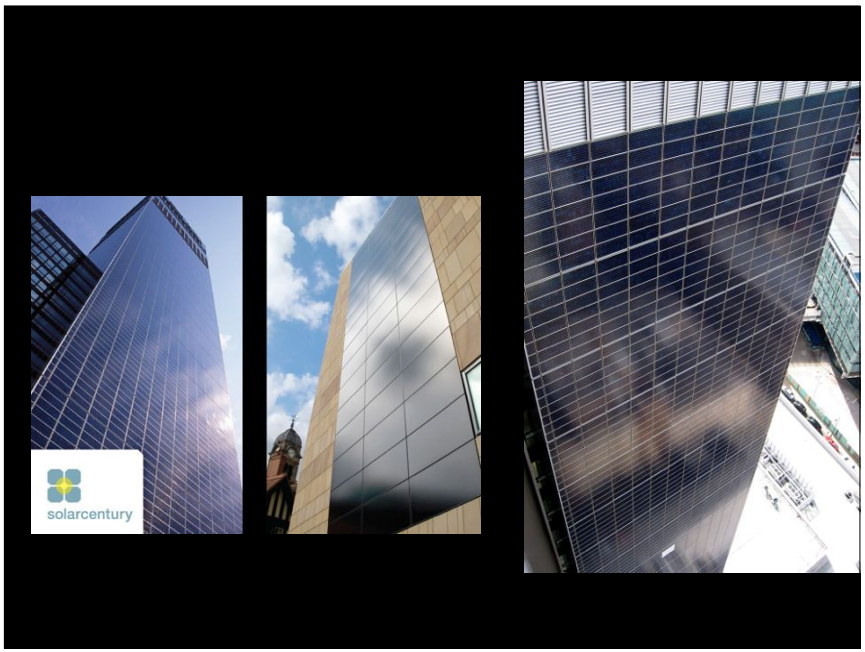




Data: US from Koomey and Hultman 2007, France from Grubler 2009. Source GEA chapter 24

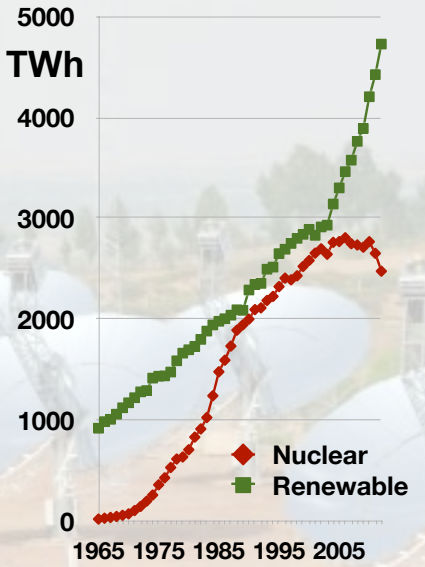

Global Renewable Electricity Production, TWh
5000
4000
3000
2000
1000
0
1100
733
367
0
100
75
50
25
0
1990 1995 2000 2005 2010
1990 1995 2000 2005 2010
1990 1995 2000 2005 2010
Hydro
Biopower, Geothermal etc
Wind
Solar
Data from BP Statistical Review 2013


Bioenergy use in Sweden 1970-2012
TWh
150
100
50
0
1970 1980 1990 2000 2010
• ≈1/3 of total energy use
• 500 PJ
• 50 GJ/capita
•1,7 kW/capita
• Largest source of domestic energy used


Solar PV:
No land, no extra cost as alternative surface material.


solarcentury

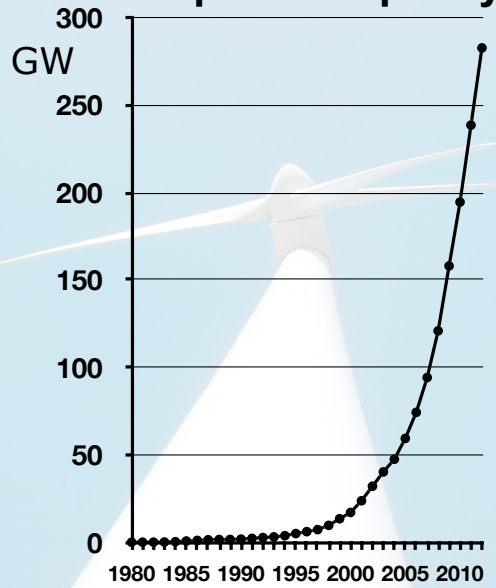
## Non-fossil electricity generation globally, 1965-2012





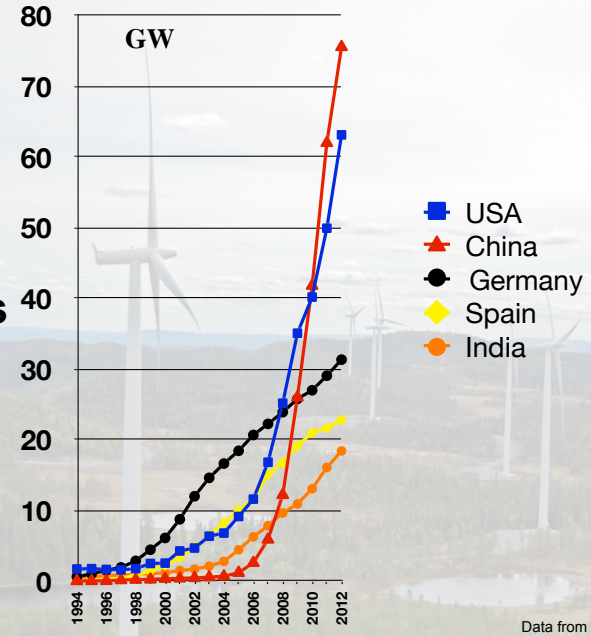

Data from BP Statistical Review 2013

## Global Wind power capacity 1980-2012



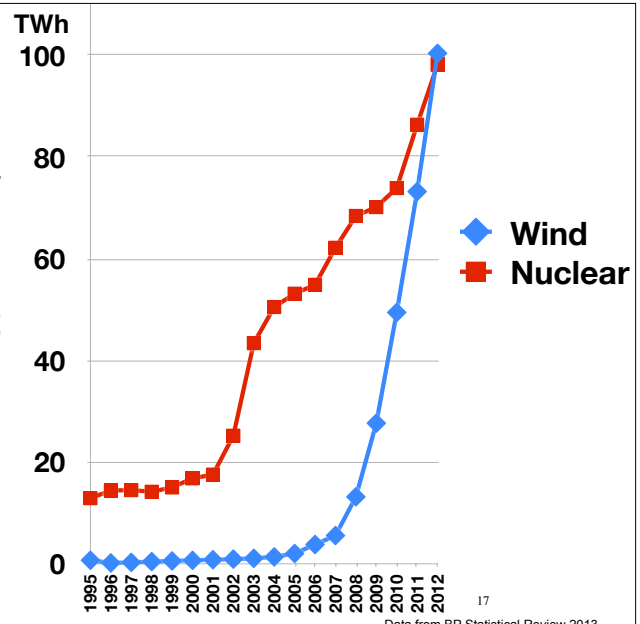

Data from GWEC

## Wind power in leading countries




Data from GWEC

## Electricity produced in China 1995-2012




Data from BP Statistical Review 2013

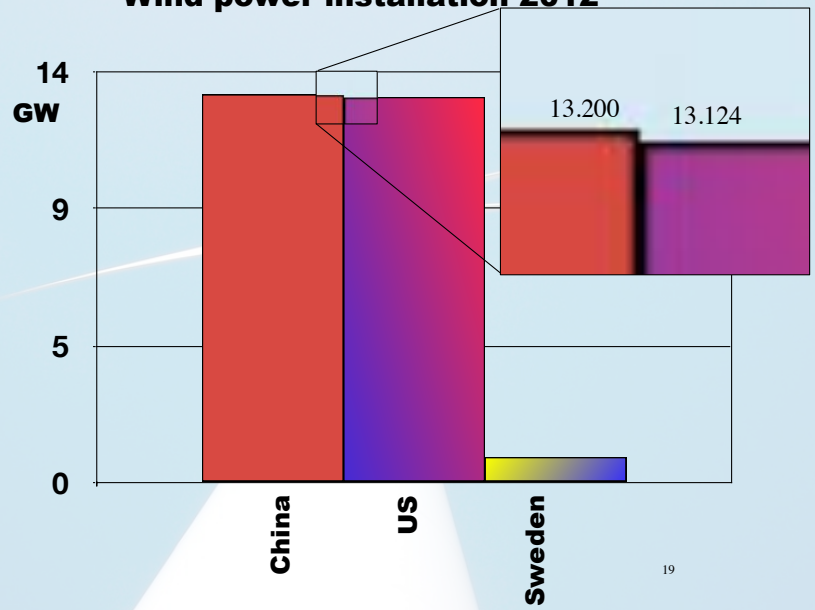


## State of the Union 2013: The President's Remarks on Energy

"Four years ago, other countries dominated the clean energy market and the jobs that came with it. We've begun to change that. Last year, wind energy added nearly half of all new power capacity in America. So let's generate even more. Solar energy gets cheaper by the year -- so let's drive costs down even further. As long as countries like China keep going all-in on clean energy, so must we.

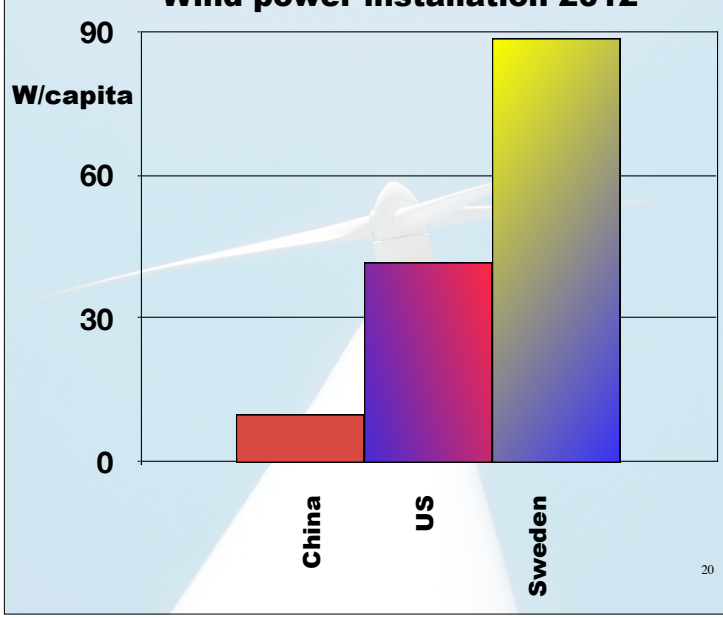


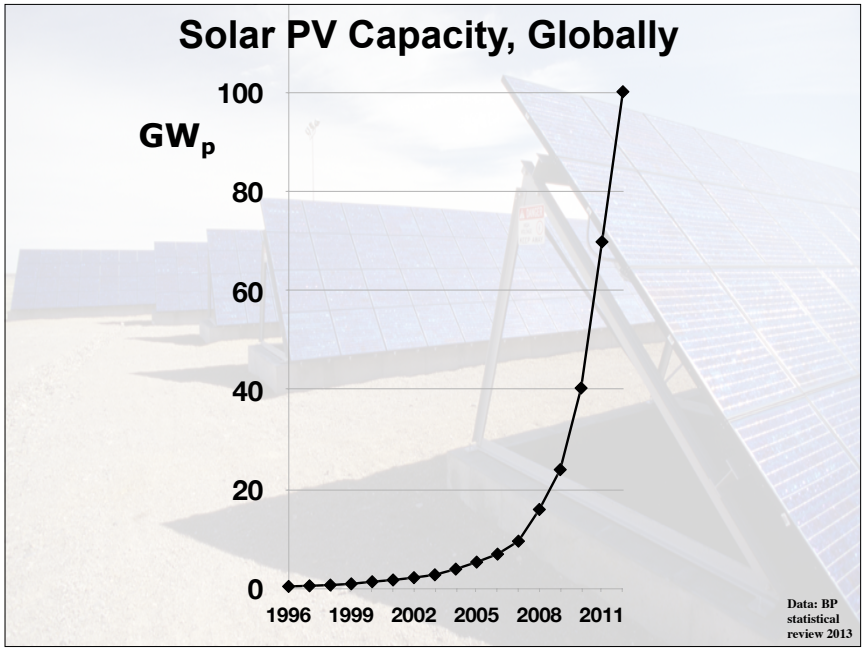
## Wind power installation 2012

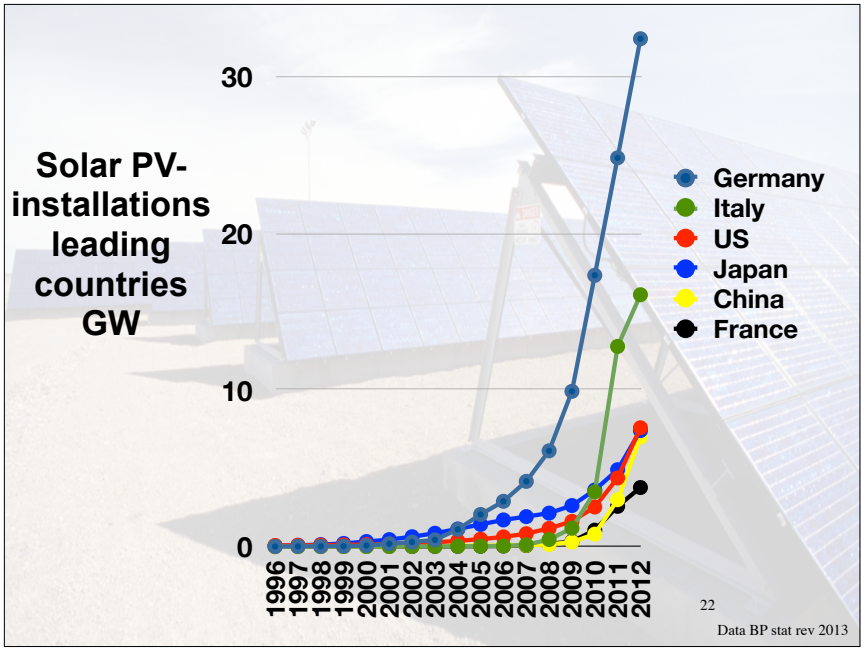





## Wind power installation 2012

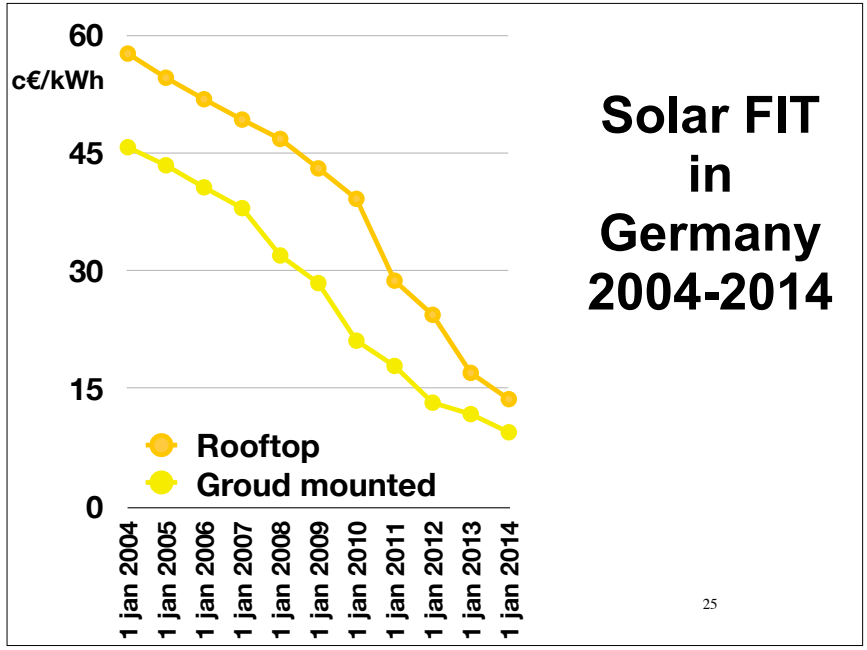



Solar PV Capacity, Globally
GWp
100
80
60
40
20
0
1996 1999 2002 2005 2008 2011
Data: BP statistical review 2013


Solar PV-installations leading countries GW
30
20
10
0
1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012
Germany
Italy
US
Japan
China
France
22
Data BP stat rev 2013


In Japan, one solar roof-top is installed every 2 minutes!
http://www.greentechmedia.com/articles/read/america-installs-a-solar-system-every-four-minutes
http://www.j-pec.or.jp/information/doc/pdat_h24koufu_20130522.pdf


CHINADAILY.com.cn
Newspaper
Home / Epaper / Davos at Dalian Special
Nation set to become the world's largest solar power
Updated: 2013-09-12 07:53
!
China is expected to overtake Germany to become the world's largest solar power generating country this year, said Zhang Xiaoqiang, deputy director of the National Development and Reform Commission, on Wednesday at the Summer Davos Forum.
The nation's installed photovoltaic power capacity as of Dec 31 was 6.5 million kilowatts, according to the China Electricity Council. China will add at least 10 million kW of capacity every year from 2013 to 2015, the State Council, the cabinet, has said.
The rapid growth will enable China to have a total installed solar capacity of 35 million kW by 2015.
http://www.chinadaily.com.cn/cndy/2013-09/12/content_16963217.htm




# Solar FIT in Germany 2004-2014

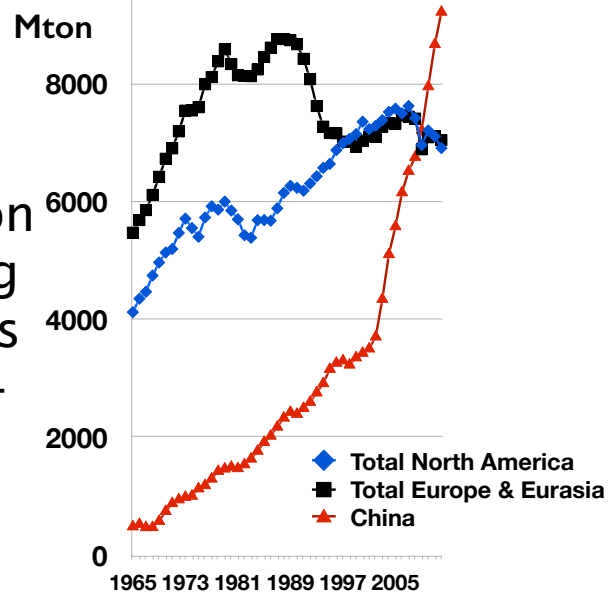
25

# Cost continue to fall


26

http://www.solarbuzz.com/node/5246

# CO2-emission leading regions 1965-2012




Data from BP

## China RE development plan

### 2020 Targets to review

In all, the non-fossil-fuel sources will up to 15% share of primary energy

| | | | |
|---|---|---|---|
| Hydropower: 300GW<br>Wind power: 30GW<br>Solar power: 180 MW | be increased to | 380GW<br>200GW<br>50GW or more | +25%<br>+500%<br>+27 000% or more |
| Biomass for power: 30 GW<br>Bio-liquid fuel : no targets | be reduced to | 15 GW,<br>developing as far as possible | |

2012/9/6 CREIA/NCSC 15

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***US Wind electricity prices averaged $40/MWh! Well, maybe $62, but still low.***

In announcing a recent report released by the US Department of Energy (DOE) and prepared by Lawrence Berkeley National Laboratory (Berkeley Lab), Berkeley Lab actually noted that, "The prices offered by wind projects to utility purchasers averaged $40/MWh for projects negotiating

about:blank


US Wind Power Prices Down To $0.04 Per kWh | CleanTechnica

contracts 2011 and 2012, spurring demand for wind energy."

That's $0.04 per kWh. Even if you add in the $0.022 Production Tax Credit (PTC), that's $0.062 per kWh.

As the reader who shared this with me aptly emphasized, "This is a low number. It's not just the LCOE of wind. It includes real estate, transmission, taxes and profits. It's the 'delivered to the door' cost of electricity, not just the generation price."



FINANCIAL TIMES

August 8, 2013 6:12 pm

# Renewables: A rising power

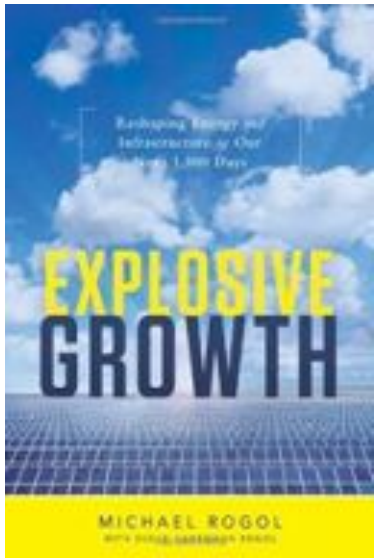
By Pilita Clark, Environment Correspondent

## Plunging prices are finally making solar power competitive with conventional sources of energy

"We're at a point now where demand starts to be driven by cold, hard economics rather than by subsidies and that is a game changer," says Jason Channell of Citigroup.

Another global bank, UBS, says an "unsubsidised solar revolution" has begun that could eventually supply as much as 18 per cent of electricity demand in parts of Europe.

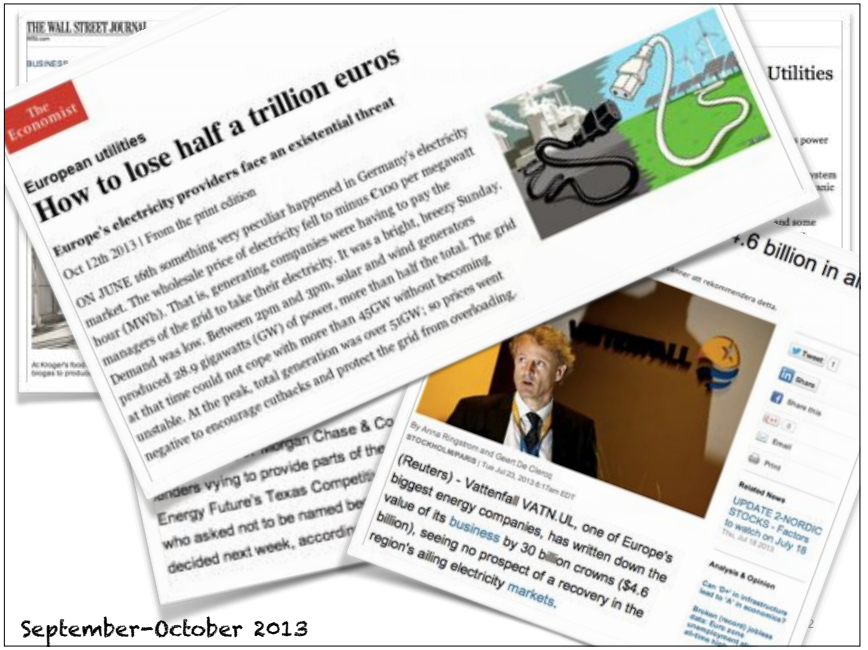
"Purely based on economics, we believe almost every family home and every commercial rooftop in Germany, Italy and Spain should be equipped with a solar system by the end of this decade," it said in a research note. Such an outcome would have enormous implications for a conventional power industry long accustomed to its coal, gas or nuclear plants being the sole source of its customers' electricity.




**Negative network effects will transform the economics and operations of our infrastructure within 1,000 days. Are you prepared to benefit from the massive value creation that will come with game-changing shifts in energy and other industries? In this comprehensively researched economic analysis, noted consultant Michael Rogol shows how to rapidly build small and midsize companies into hundred-million-dollar enterprises within a thousand days. If you do not adjust to market conditions, you put your business at substantial risk including possible annihilation. The clock is ticking.**

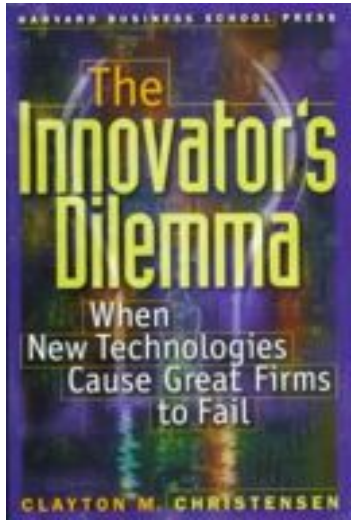
***The book was published 13 Dec 2011. Today 695 days have passed, a thousand days will have passed on in just about 300 days.***






September-October 2013

# Disruptive innovations




- Solar and wind power are too expensive…
- Intermittent power is not sufficient...
- Solar and wind do not fit our business model...

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## NRG Skirts Utilities Taking Solar Panels to U.S. Rooftop

By Christopher Martin & Naureen S. Malik - Mar 25, 2013 2:38 PM GMT+0100

**NRG Energy Inc. Chief Executive Officer David Crane said, consumers are realizing "they don't need the power industry at all."**

http://www.bloomberg.com/news/2013-03-24/nrg-skirts-utilities-taking-solar-panels-to-u-s-rooftop.html

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