

Wind Energy Policy

A wide-angle photograph of a lush green field of grass blowing in the wind. The grass is vibrant green and appears to be a type of ornamental grass or reed. The field stretches to a flat horizon line. The sky above is filled with soft, white and grey clouds, with a hint of blue visible near the horizon. The overall scene is bright and natural, suggesting a clean, renewable energy theme.

Kate Maisel
Alyssa Bruner

Sri Pisupati
Jake Simon

Thesis Statement

Long-term policies promote wind industry growth because investor uncertainty associated with short-term policy inhibits development.



Outline

Introduction

- The role of electricity and the role of wind

- History of the wind growth

Comparing the United States to New Zealand

- Policy timeline

- Case Study

- Tax incentives in the United States

- Policy in New Zealand

- Growth Comparisons

World Leaders

- Feed in Tariff Policy

Factors Affecting Wind Integration

Conclusion



The Role of Electricity

- 40% of worldwide primary energy consumption comes from electricity
- 20% of electricity generation from renewables
- Wind makes up 2% of global electricity generation (2010)
- Generating more electricity by wind will help meet growing demand for electricity with less of an impact on the environment

If wind provides 20% of US electricity needs by 2030:

- Electricity sector CO2 emissions down by 825 million metric tons per year
 - A cumulative total of 7,600 million metric tons of CO2 emissions would be avoided by 2030
- Reduced water use by 4 trillion gallons/year
 - As additional wind generation displaces fossil fuel generation, each megawatt-hour generated by wind could save as much as 600 gallons of water that would otherwise be lost to fossil fuels

The Role of Wind

- A renewable electricity source
- Negligible air emissions
- Negligible fuel operating costs
- Diversifies electricity portfolio
- Income source for rural landowners
- Tax revenues for local communities
- Growth in sectors that support wind
 - Manufacturing
 - Engineering
 - Construction
 - Transportation



History

- Increase in electricity prices in the 1970's caused by oil shortages
- California's federal and state tax credits caused immense growth
- Federal tax credit expired in 1985 bringing growth to an abrupt halt
 - Still, in 1986 California had 1.2 GW, 90% of global installations at that time!

History

- Europe took the lead pushed by aggressive policies enacted between 1975-1985
- Global industry growth
 - Improved technology
 - Increase in turbine power and productivity
 - Prices decreased drastically
- Germany becomes the new leader
 - By 2000, Europe had 12,000 MW installed power while the US had only 2,500!

History

- Federal production tax credit (PTC)
 - Did little to promote growth until just before its expiration in 1999
 - Extended 2 times, ended in 2003, reinstated 2004
 - Intermittent policy led to sporadic growth
- Renewable Portfolio Standards
 - Small percentage of electricity supply from renewable resources
- By 2005, USA back as the world leader in new wind energy
- Today the capacity is around 60,000 MW in the US, exceeded only by China

New Zealand vs. United States: Policy Comparisons and Growth Outlook

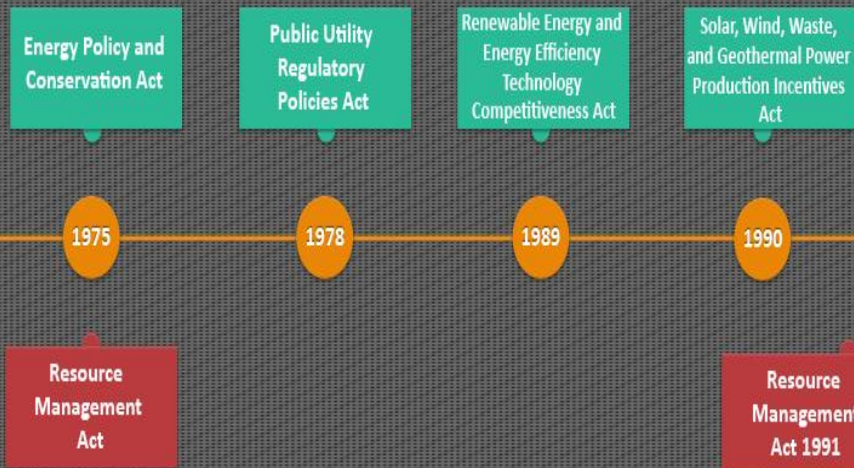
Policies Outline

- New Zealand Policies
- United States Policies
- Differences & Similarities

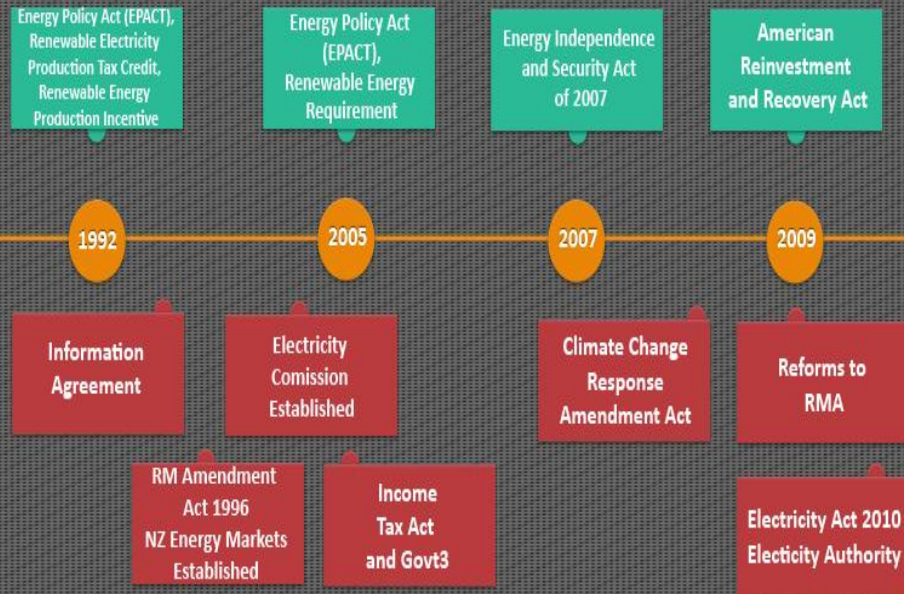
Wind Outlook Outline

- New Zealand Wind Energy Outlook
- United States Wind Energy Outlook
- Compare & Contrast each outlook
- Recommendations

United States Wind Policy Over the Years



United States Wind Policy Over the Years



New Zealand Wind Policy Over the Years

New Zealand Wind Policy Over the Years

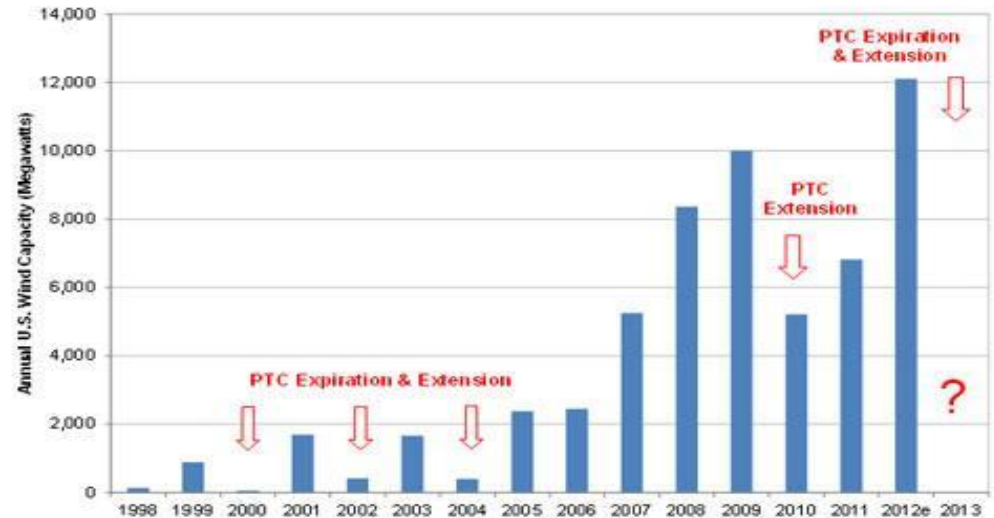
A Closer Look: United State's Tax Credits

- Production Tax Credit
 - Allows owners of qualified renewable energy facilities to receive tax credit for every kilowatt-hour of electricity generated (approximately 2.3 cents per kWh)
- Business Energy Investment Tax Credit
 - Allows owners to receive tax credits worth up to 30% of the value of the facility

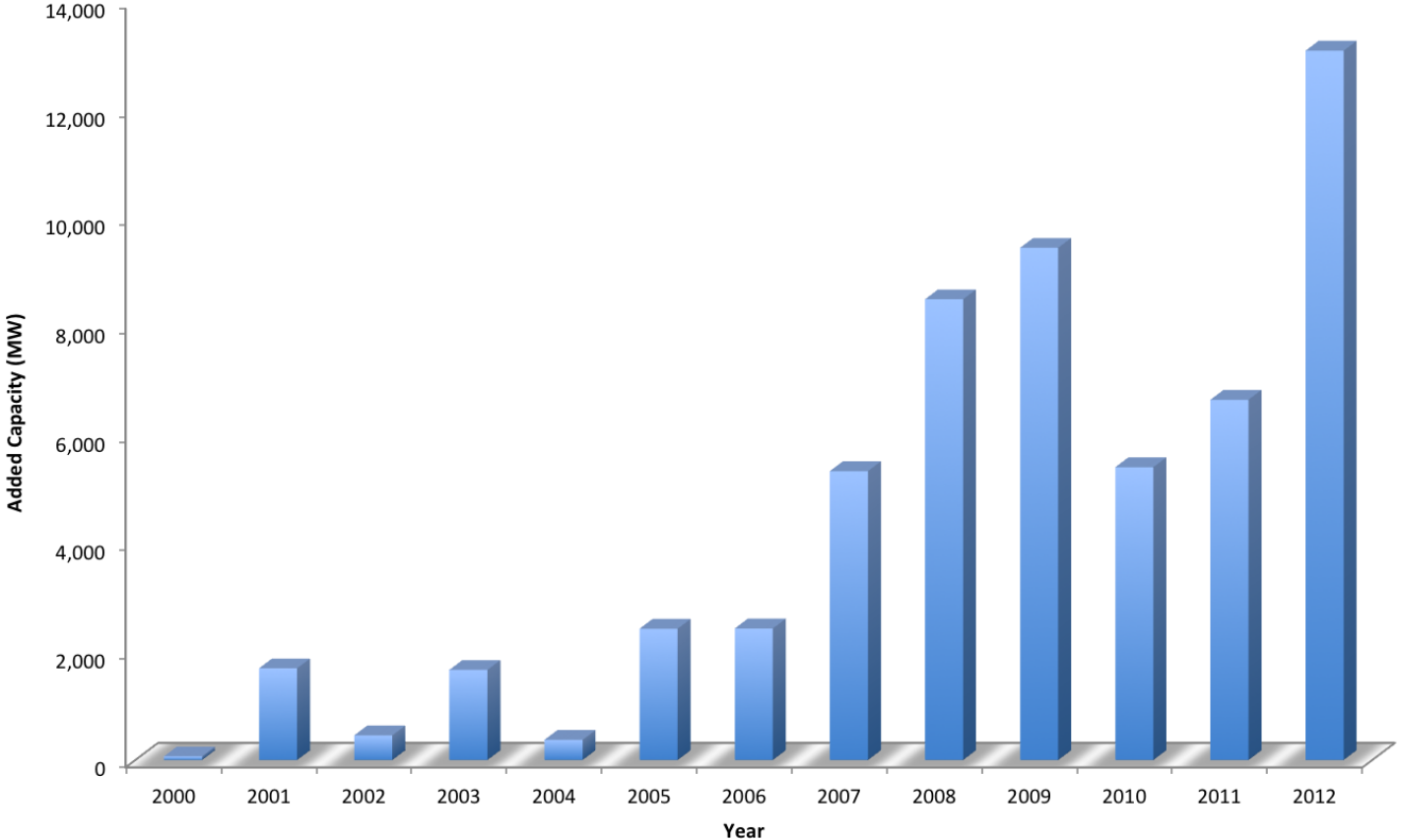
Challenges for the Production Tax Credit

- Sporadic, short term renewals
- Lapses in PTC cause dramatic slowdown in wind projects
- After reinstating the policy, the industry takes time to regain its footing

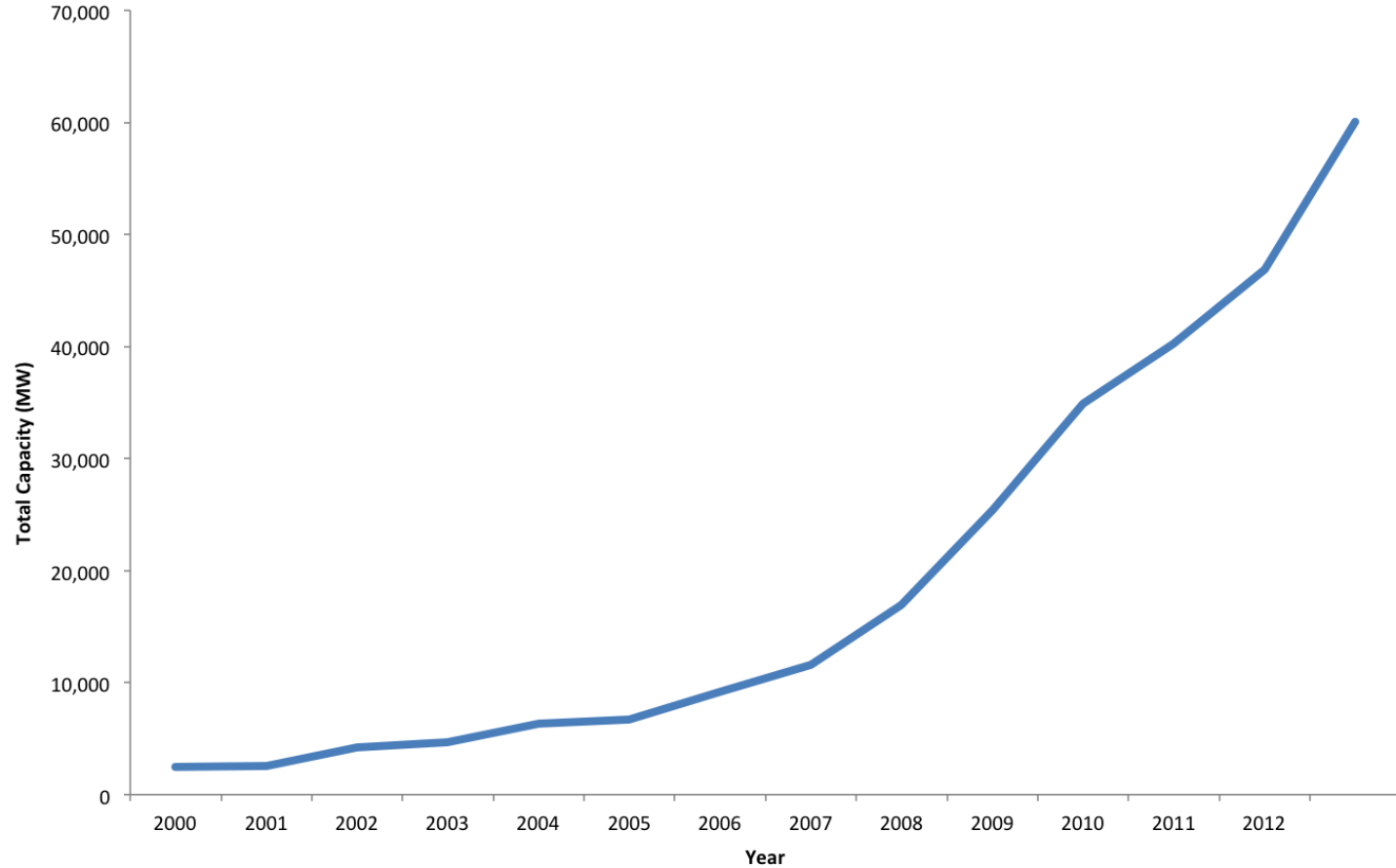
Impact of PTC Expiration on Annual U.S. Wind Installations



US Added Capacity (MW) per Year



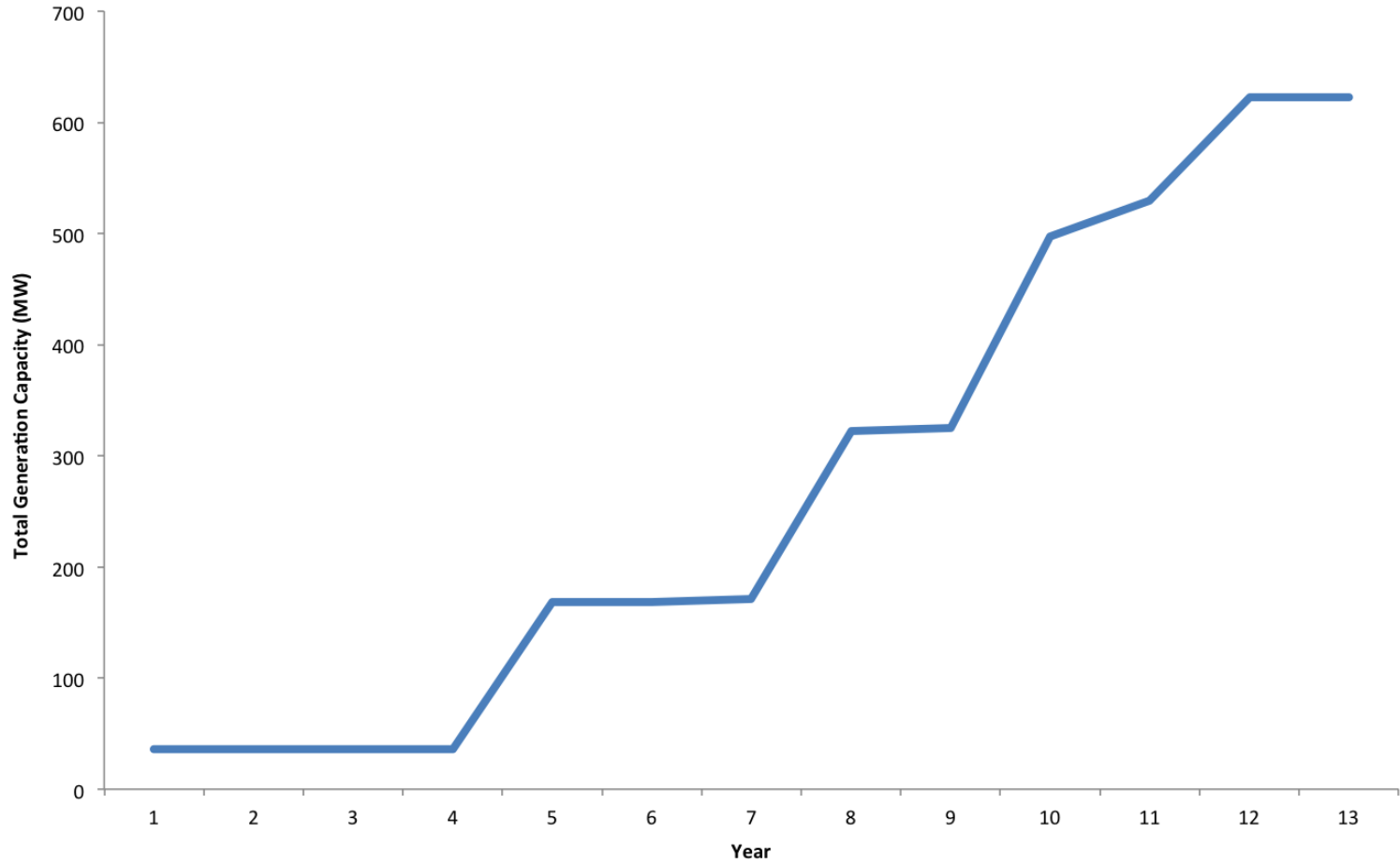
US Total Wind Generation Capacity (MW) vs Time



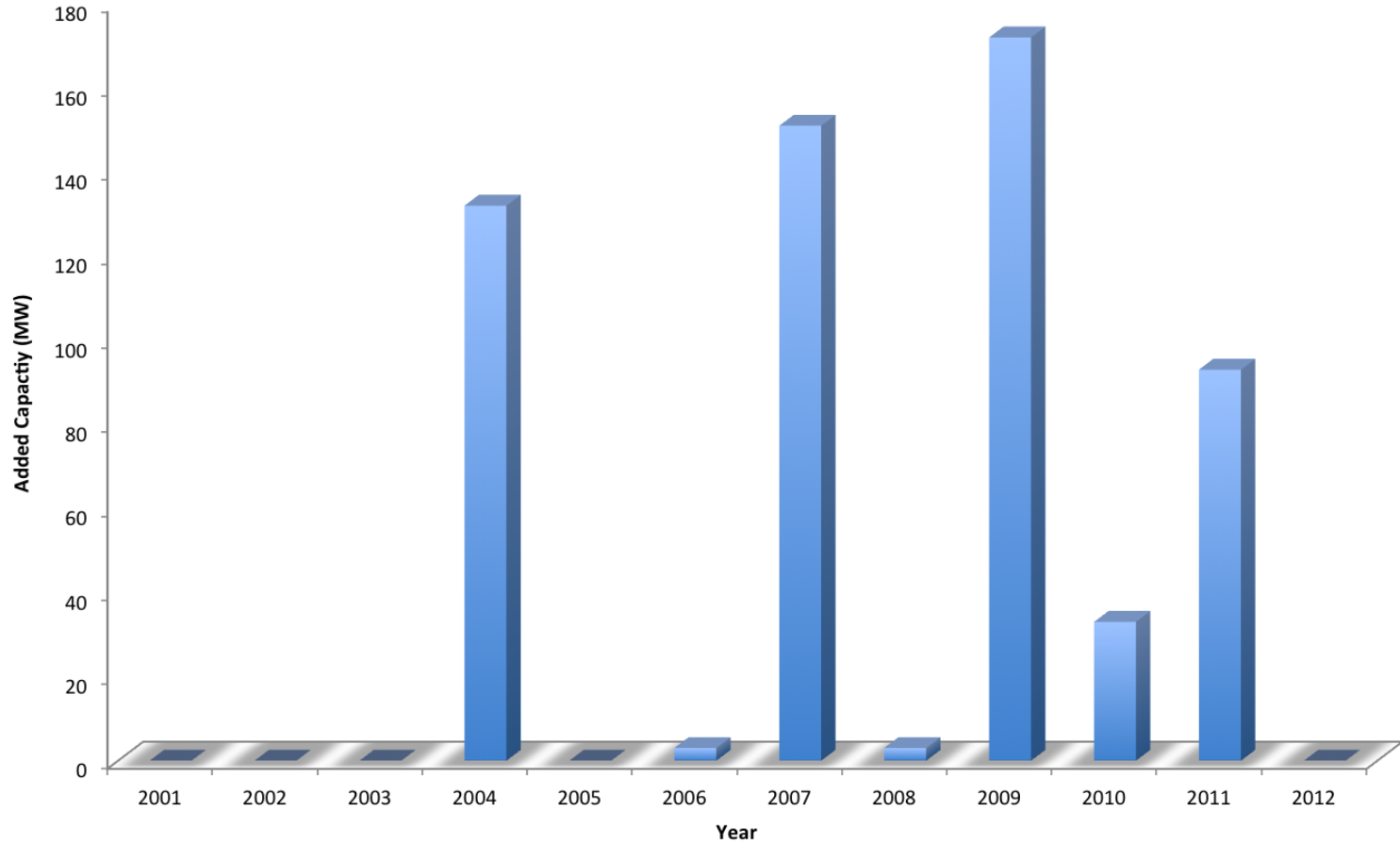
New Zealand's Policies

- NO Production Tax Credit (a form of tax incentives)
Eric Pyle, the Chief Executive Officer of The New Zealand Wind Energy Association
- NO subsidies or tax incentives
- NO incentives = NO motivation
- Not a level playing field
- Already have incentive schemes for solar
- Possibility to fuel the future
- Should implement incentives but not as sporadic --> NEEDS long term plan

New Zealand Total Wind Generation Capacity (MW) vs. Time



New Zealand Added Capacity (MW) per Year



Why Incentives Work

MOTIVATION IS KEY

- Energy Policy Act of 1992, the Renewable Electricity Production Tax Credit (PTC)
- The Business Energy Investment Tax Credit (ITC)
 - **To qualify for either the PTC or the ITC, these projects must begin construction by December 31, 2013**
 - **Rob Gramlich, the Senior Vice President of the American Wind Energy Association**
- Not perfect but can still increase growth
- Current Issue - President Barack Obama has asked Congress to permanently extend the tax credit at a price tag of \$24.7 billion over the next 10 years.

PROOF

- **1980-** California - first tax incentives to promote wind industry
- **1985-** tax credits expired... correlation between the growth of the wind energy market and the incentives that the government gives

New Zealand Outlook

ALL RENEWABLES

CURRENT: **74 %** percent of the electricity generated in New Zealand comes from renewable energy sources

TARGET: **90%** by 2025

Expected to increase even more over the next 20 years, with wind energy contributing the majority of that increase.

WIND ENERGY

CURRENT: **3.94 %** percent of the electricity generated by wind in New Zealand

TOTAL CAPACITY: **623** MW

TARGET: **20%** by 2030

New Zealand government plans to increase their total wind energy output by 16% in only 17 years.

United States Outlook

WIND ENERGY

CURRENT: **4.1 %** percent of the electricity generated by wind in the United States

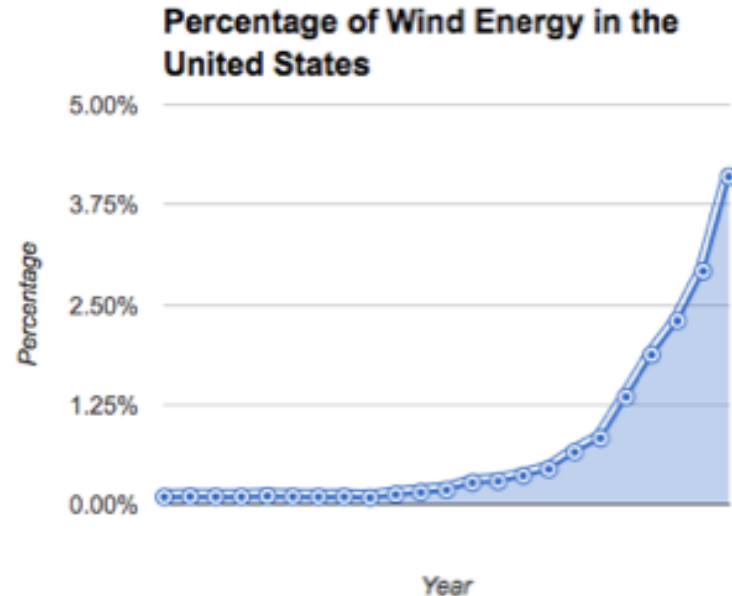
TOTAL CAPACITY: **60,007 MW**

TARGET: **20%** by 2030

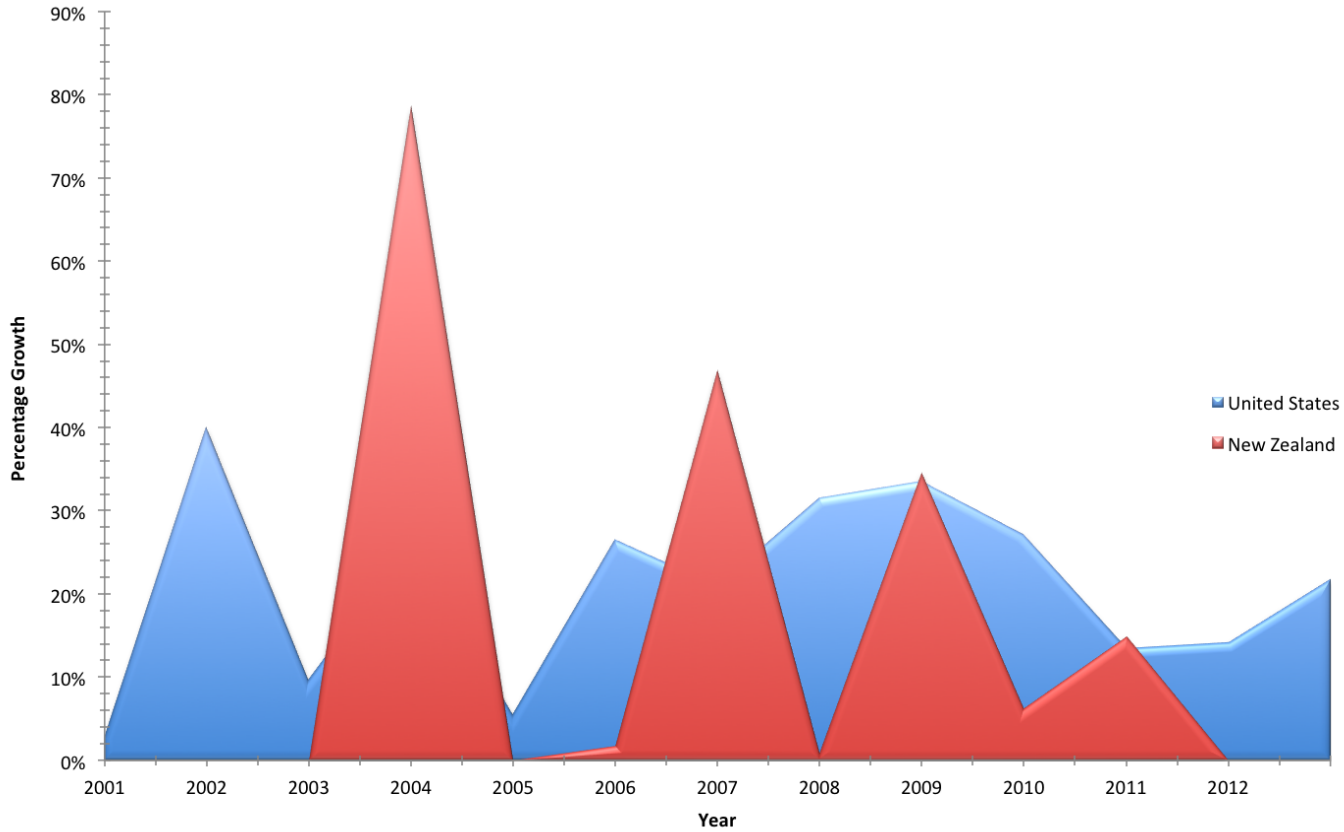
The U.S. is leading the world in new wind installations and has the potential to be the world leader in total wind capacity

Would cost upwards of \$43 Billion

-Energy Efficiency and Renewable Energy Plan by D.O.E.



Percentage Wind Growth (Capacity) by Year



Comparative Analysis

NEW ZEALAND

New Zealand Wind Energy Association (**NZWEA**)

(**AWEA**)
Smaller county means not as much wind production needed to reach target

Have a National policy statement on renewable Electricity generation (**NpsrEg**). This policy provides governmental direction on the benefits of renewable electricity generation and requires all councils to make provision for it in their plans

UNITED STATES

American Wind Energy Association

Able to increase wind production at a much larger capacity

No national policy to guide or track wind production

BOTH

roughly ~4% of total electricity generated from wind
outlook of 20% wind energy by 2030.

	United States	New Zealand	United States is greater than New Zealand by a factor of...
Population	313900000	4433000	70.81
Total GWh electricity produced	3414602	42400	80.53
GWh Produced by Wind	140000	1672	83.73
Percentage of electricity produced by Wind	4.10%	3.94%	--
20 percent goal of wind (GWh)	682920.4	8480	80.53
Increase of about (GWh)	542920.4	6808	79.75
Total Increase	15.90%	16.06%	--
Increase per year until 2030 [outlook] (%/yr)	0.883	0.892	--

ISSUES in reaching 20% goal

E X P E N S E S

M A T E R I A L S

T R A N S M I S S I O N

Offshore Potential

Offshore wind energy policy in the United States and New Zealand could be an easy way to bridge the gap towards 20 percent of electricity generated by wind energy by 2030.

In the U.S. there are currently three farms that have been proposed and approved but not yet installed or operational.

Cape Wind - Mass **

Delaware Offshore Wind Farm

American Canyon Gulf of Mexico Offshore Wind Farm

No offshore wind farms outside of (EUROPE & CHINA)

United States and New Zealand can model their offshore efforts after successful ones.

December 3, 2013

HUFF
POST GREEN

Edition: U.S. ▼

Search The Huffington Post



FRONT PAGE

POLITICS

BIZ

MEDIA

WORLD

SCIENCE

TECH

HEALTHY LIVING

Green Energy • Climate Change • Animals • Saving Strays • Girls in STEM • Keystone XL Pipeline • Fracking



Climate Change's Biggest Threats Are Those We Aren't Ready For: Report



Keystone's First Leg About To Open

Cape Wind Project In Massachusetts Faces Deadlines For Tax Credit

By JAY LINDSAY 11/30/13 09:15 AM ET EST **AP**



*To qualify for a tax credit that would cover a major portion of its capital costs, Cape Wind either must begin construction by Dec. 31 or prove it's incurred tens of millions of dollars in costs by then.

Bottom Line

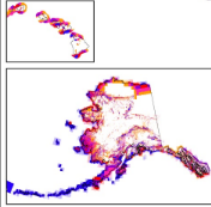
Both can learn a lot from each other

NZ SHOULD ADOPT INCENTIVE BASED TAX CREDITS

**BOTH US & NZ SHOULD ADOPT MORE LONG TERM
POLICY PLANS + KEEP OFFSHORE AN OPTION**

United States - Wind Resource Map

This map shows the annual average wind power estimates at a height of 50 meters. It is a combination of high resolution and low resolution datasets produced by NREL and other organizations. The data was screened to eliminate areas unlikely to be developed onshore due to land use or environmental issues. In many states, the wind resource on this map is visually enhanced to better show the distribution on ridge crests and other features.



Wind Power Class	Resource Potential	Wind Power Density at 50 m (W/m ²)	Wind Speeds ^a at 50 m (m/s)	Wind Speeds ^a at 50 m (mph)
3	Fair	300 - 400	6.4 - 7.0	14.3 - 15.7
4	Good	400 - 500	7.0 - 7.5	15.7 - 16.8
5	Excellent	500 - 600	7.6 - 8.0	16.8 - 17.9
6	Outstanding	600 - 800	8.0 - 8.8	17.9 - 19.7
7	Superb	800 - 1000	8.8 - 11.1	19.7 - 24.6

^aWind speeds are based on a Weibull k value of 2.0

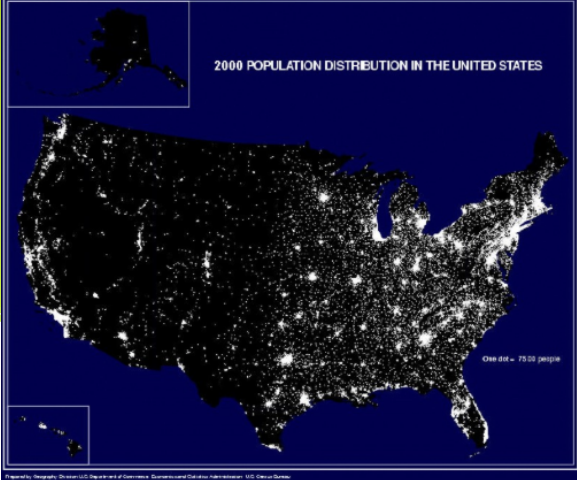
U.S. Department of Energy
National Renewable Energy Laboratory

Existing High-Voltage Transmission System

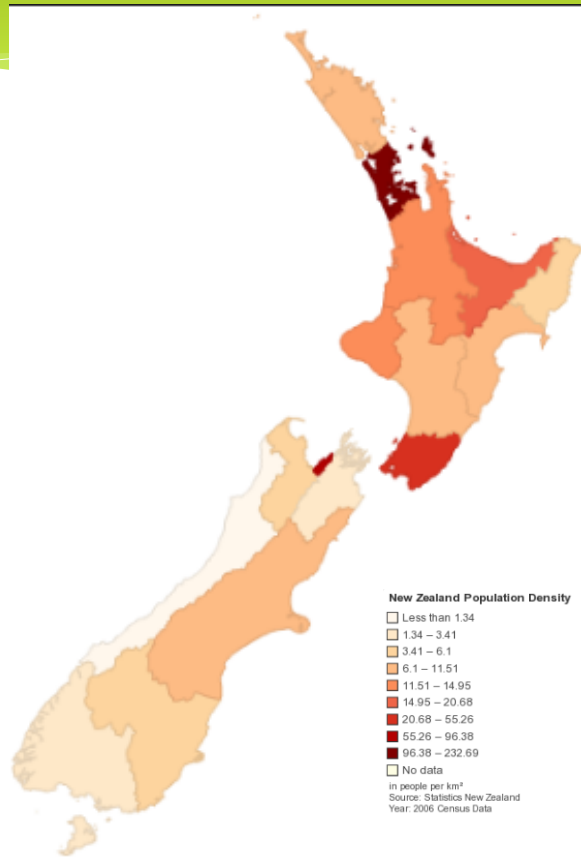
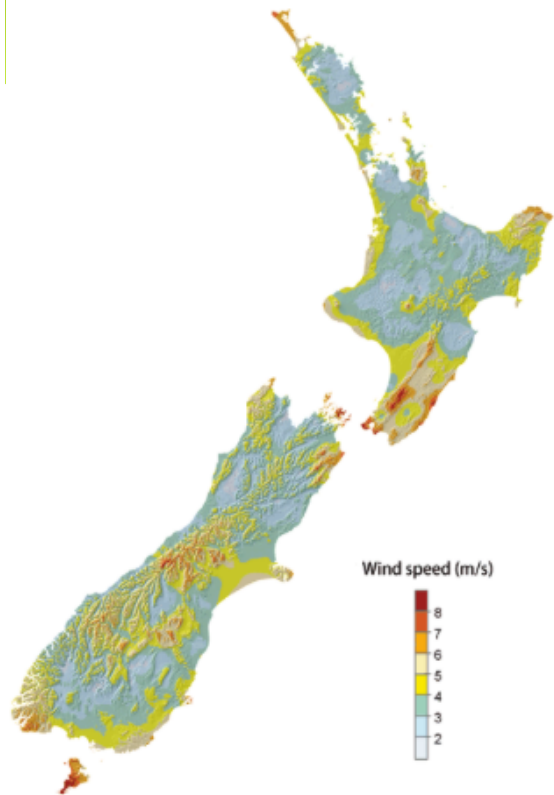
- Existing Transmission (kV)**
- 345 - 360
 - 361 - 500
 - 501 - 800
- DC Lines**
- 100 - 250
 - 251 - 500
 - 501 - 800



2000 POPULATION DISTRIBUTION IN THE UNITED STATES



Popularity: Popularity: 2000 U.S. Department of Commerce, Department of Statistics Administration, 100 Census Bureau



Improving Wind Energy Policy

- Feed in Tariffs
- European Wind Markets
- World Leaders in Wind



A Long Term Policy: Feed in Tariffs

- Performance-based incentive that guarantees renewable electricity generators a set price for the generation from their utility
- Utilities enter into long-term contracts with generators at specified rates
- Enacted in at least 65 countries
- Responsible for about 45% of global wind capacity

Case Study: European Wind Market

- Length of FIT contract and guaranteed grid access
- Investors attach HIGH premiums to certainty of investment return
 - One-year extension of an original 5-year agreement on average increases wind investment by 6 percent annually
 - Guaranteed grid access almost doubles wind investment in one year

Challenges for Wind Policies

- Setting the 'right' level of support is difficult
- Higher subsidies do not necessarily correlate with increased wind capacity
 - higher financial support induces wind projects in low quality sites with **less** favorable wind conditions

Best Way to Attract Investors:

- Enact a long-term feed-in tariff contract which guarantees investment stability
- Provide favorable grid access conditions
- Provide low administrative and regulatory barriers

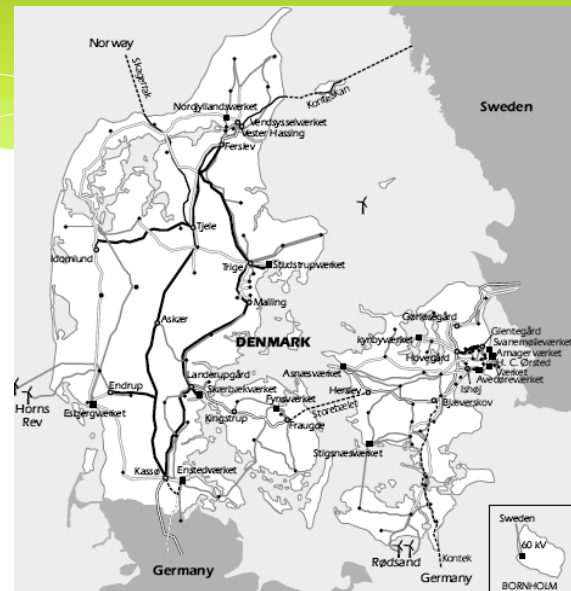
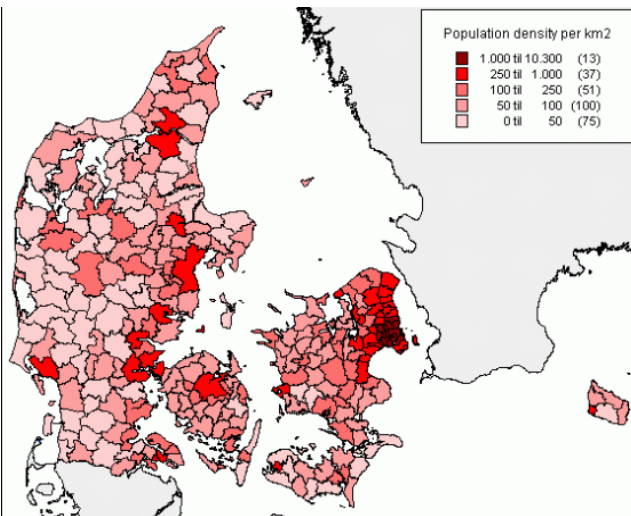
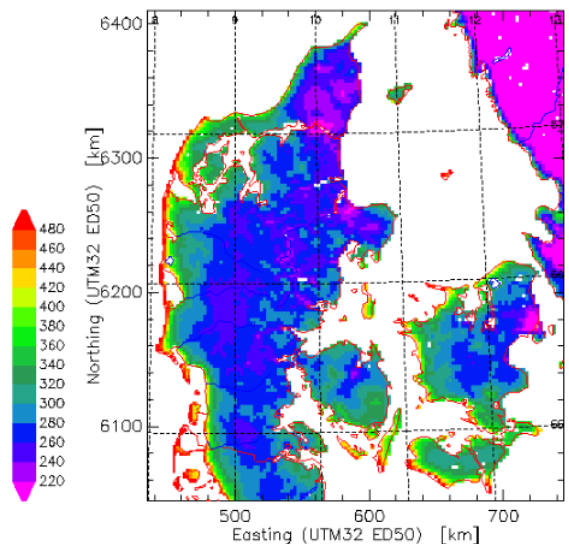
World Leaders

Germany, Denmark, and Spain are consistently ranked the top performers according to their annual investment growth rate, total installed capacity and realizing the full potential of wind resources.

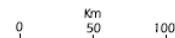
Denmark

- 28% electricity from wind; 4162 MW installed capacity
- FIT – implemented in 1993
 - Feed-in premium: green electricity producers get the market price plus a fixed premium, exposing producers to market dynamics
 - Applies to the lifetime of the production unit, means high level of certainty
- Renewable Energy Portfolio Standard – passed in 2003
- 2009 environmental premium added to market price
- Community Ownership model– communities pool investment resources to install and run wind farms; annual revenue share proportional to investment
- Strong interconnections with other countries
- Outlook:
 - 50% by 2020
- Other resources:
 - Construction of additional coal-burning plants banned
 - Self sufficient in oil and natural gas from North Sea

Denmark



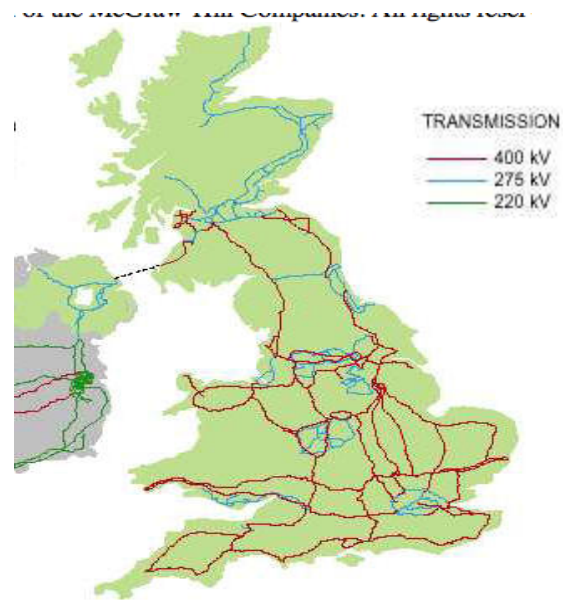
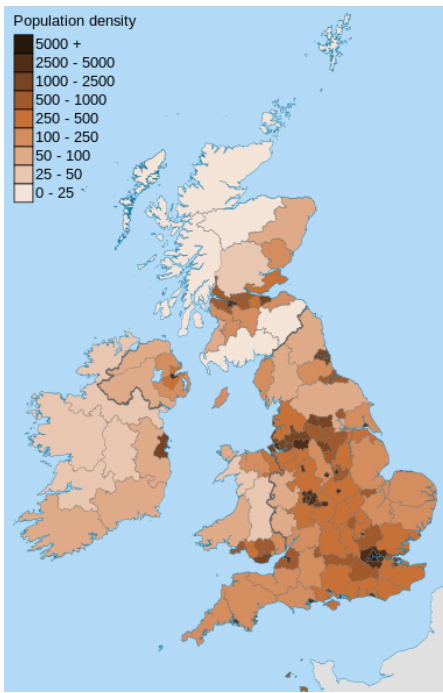
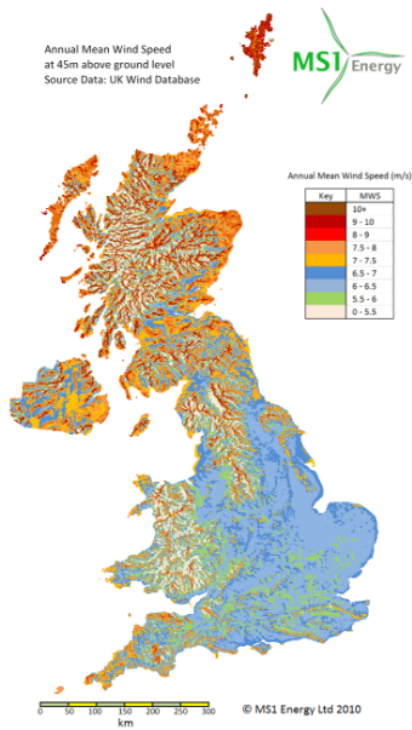
- Transformation 400/150 kV or 400/132 kV
- Transformation 150/60 kV or 132/50 kV
- Central power station
- 1 circuit 400 kV transmission line or cable
- == 2 circuits 400 kV transmission line or cable
- - - 1 circuit 220 kV transmission line
- 2 circuits 220 kV transmission line
- 1 circuit 150 kV or 132 kV transmission line or cable
- == 2 circuits 150 kV or 132 kV transmission line or cable
- - - HVDC cable
- ⚡ Offshore windfarm



United Kingdom

- 5% of electricity from wind; 8,445 MW installed capacity
- World leader in offshore since 2008
- Capacity equal to the rest of the world combined
- FIT – pay generators for electricity they generate, use, and for unused exported back to the grid
- Renewables Obligation – requires a portion of suppliers' electricity to be sourced from renewables
- Outlook:
 - 15% by 2020
 - Offshore to 18 GW
- Other resources
 - Coal production has declined
 - Oil and gas reserves are still being found

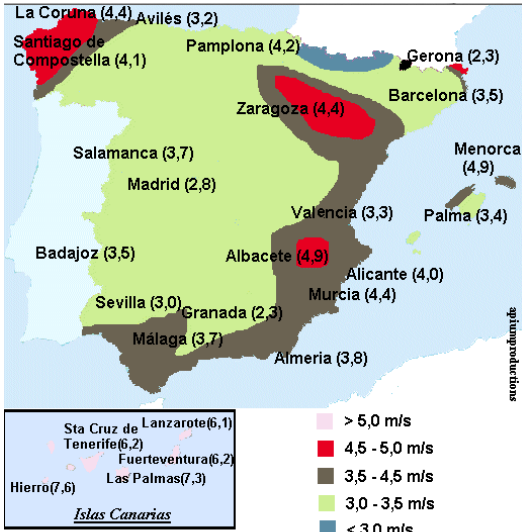
United Kingdom



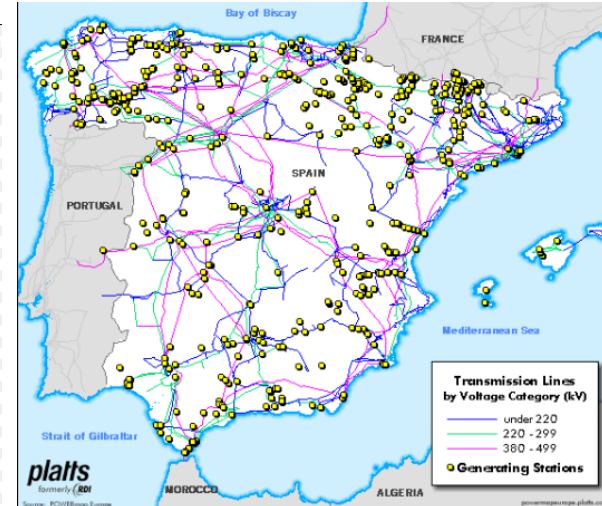
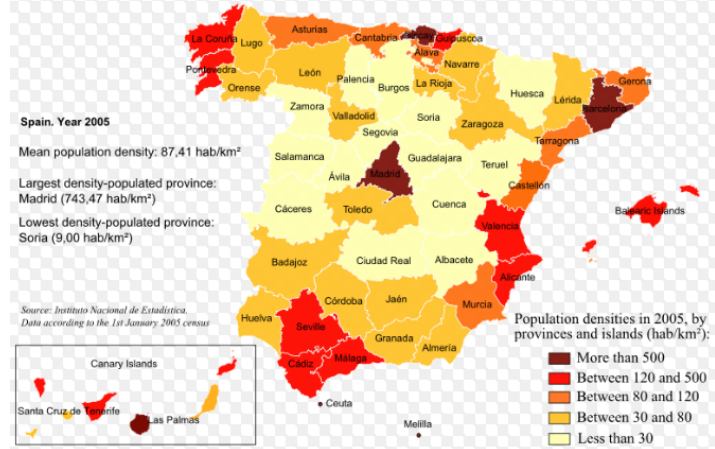
Spain

- 18.1% electricity from wind; 22,796 MW installed capacity
- By law, companies get 7-8% return on investments in renewable energy
- Producers choose between fixed tariff or feed-in premium
- Now:
 - No more new incentives for renewable energy installations after 2012
 - 7% tax on all existing generation installations (including renewables)
 - No more market price plus premium option
- Outlook:
 - Industry income reduction of 15% this year
- Other Resources:
 - Insufficient coal reserves
 - Limited natural gas
 - Imports large amounts of coal and petroleum
 - Relies heavily on hydro

Spain



DISTRIBUTION OF THE SPANISH POPULATION (2005)



Germany

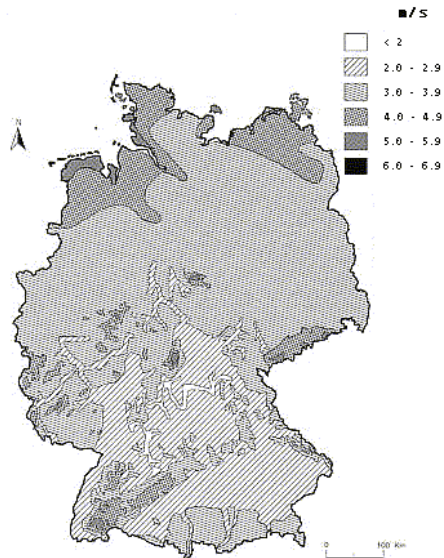
- 8% of electricity from wind
- 31,331 MW installed capacity
- Growth in 2012: 1038 MW onshore and 105 MW offshore
- Renewable Energy Sources Act (EEG)
 - Formed the basis for the strong expansion of renewable energies by establishing a secure financial environment
 - Fixed tariff or feed-in premium options
 - FIT – rates constant for 20 years
 - 9 cents/kWh for wind
 - Priority connection to the grid
 - Grid operators are obligated to expand the capacity

Germany

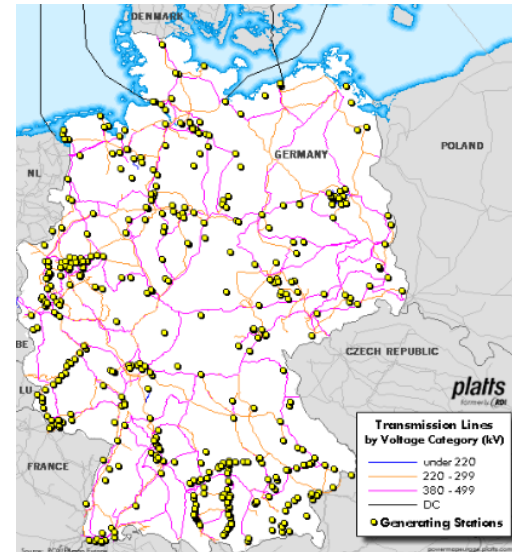
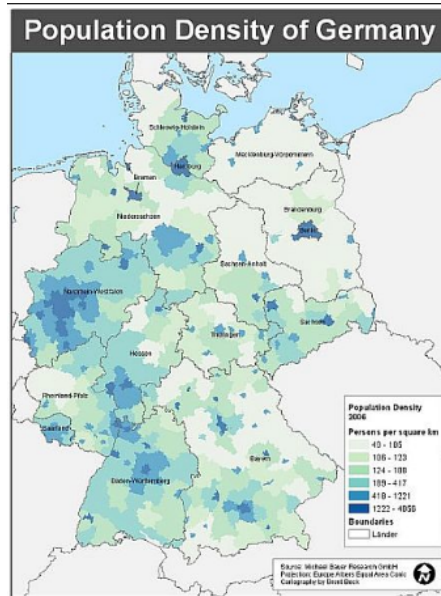
- Community Ownership model
 - Nearly half is locally owned
- Increasing wind and solar energy has been a key factor in driving down wholesale electricity prices
- Outlook:
 - 50% wind by 2050
 - Onshore capacity to 45 GW
 - Offshore capacity to 85 GW
- Other resources
 - Coal is the second most important source of energy
 - Small reserves of oil and gas in northern Germany

Germany

Jahresmittel der Windgeschwindigkeit (m/s)
und mittlerer Energieertrag in % bezogen auf 5 m/s



Quelle: Internationales Wirtschaftsforum Regenerative Energi

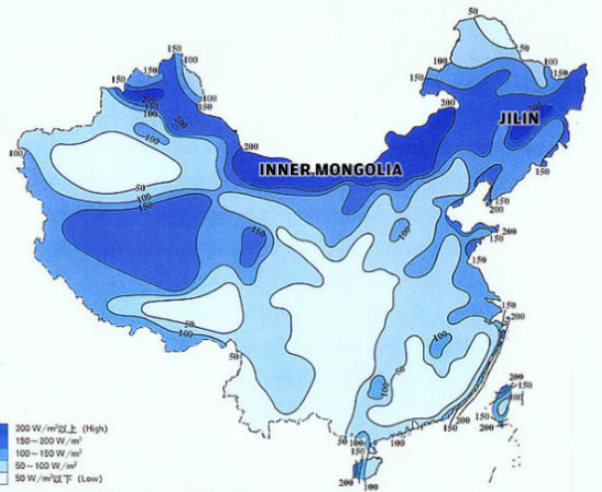


China

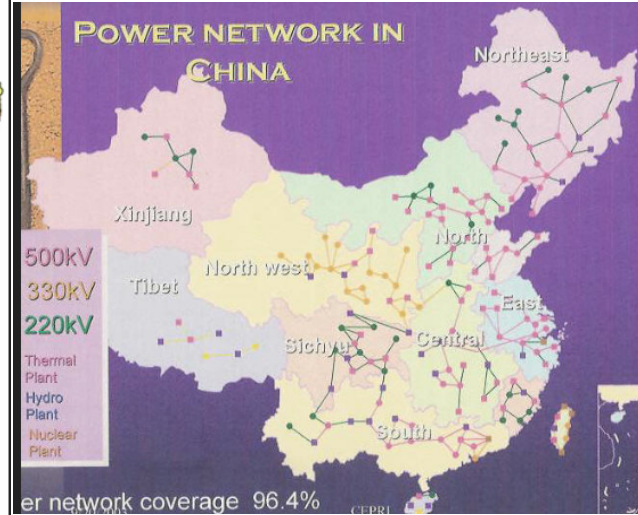
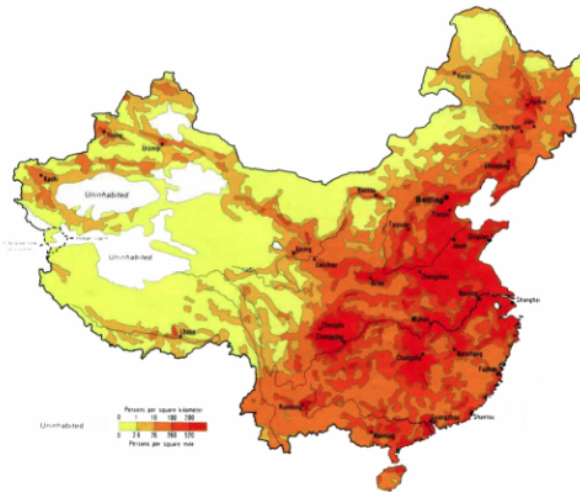
- 2% of electricity from wind
- 75,324 MW installed capacity
- Annual capacity additions of 10 GW for the past 4 years
- Reliable financial support for renewable energy generators
- FIT has encouraged wind capacity growth since 2006
- Outlook: 200 GW by 2020
 - 170 GW from onshore
 - 30 GW from offshore
- Challenges: connection, curtailment and funding shortfalls
- Other resources:
 - Coal is the major source of energy; ranks third in reserves
 - Peaked supply of oil and natural gas
 - Highest hydro capacity in the world
 - Plans to increase nuclear capacity

* China has identified wind power as a key growth component of the country's economy

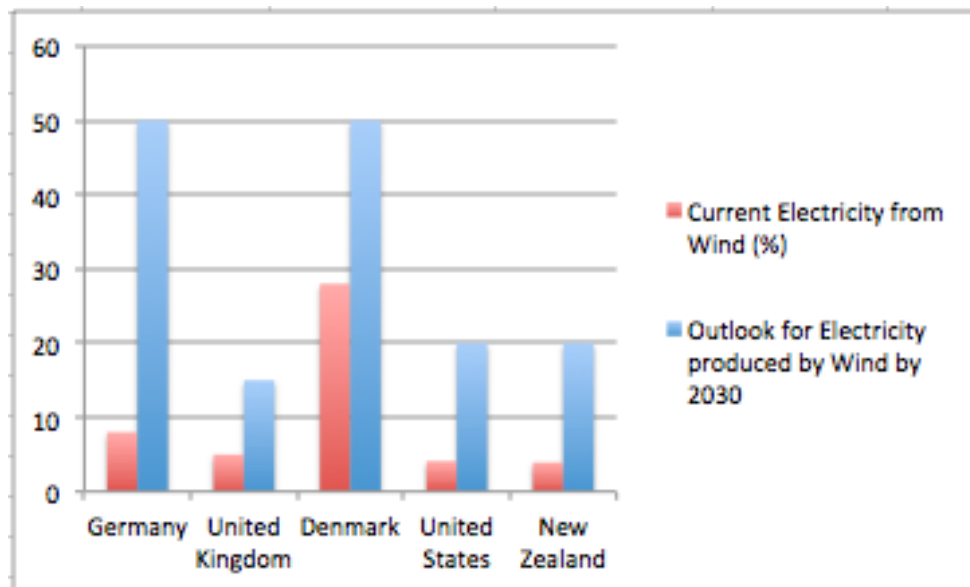
China



China: Population Density



	Germany	United Kingdom	Denmark	Spain	China	United States	New Zealand
Population (million)	81.89	63.23	5.59	47.27	1,351	313.9	4.43
Electricity from Wind (%)	8.00%	5.00%	28.00%	18.10%	2.00%	4.10%	3.94%
Outlook	50 % by 2050	15% by 2020	50% by 2020	--	--	20% by 2030	20% by 2030
Increase each year (%/yr)	1.11	1.25	2.75	--	--	0.883	0.892
Total Installed Wind Capacity (MW)	31,332	8,144	4,162	22,796	75,564	60,007	623



Factors Affecting Wind Integration

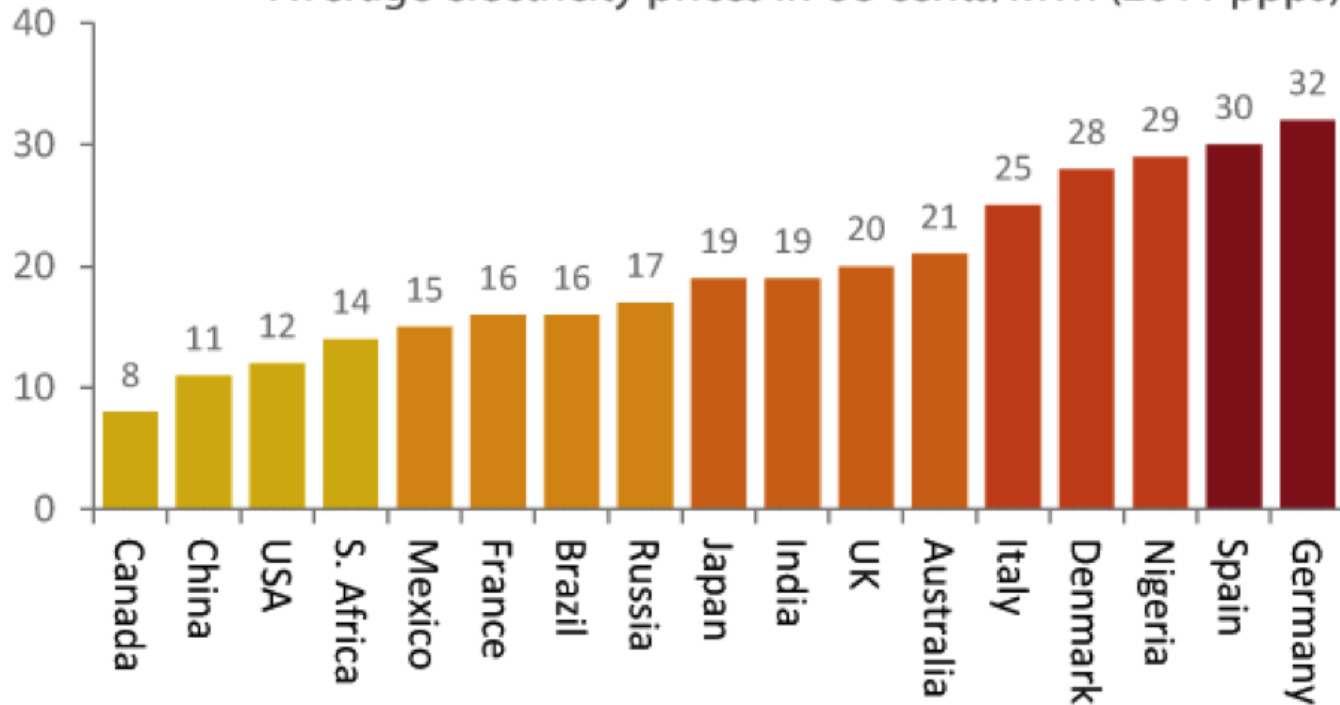
- Electricity Prices
- Land Requirements
- Material, Manufacturing, and Labor Constraints
- Transmission and Grid Requirements
- Intermittency

Electricity Prices

- Competitive markets are more conducive to renewable development
- High initial capital costs are necessary, but lower wind energy costs follow
- This high capital cost makes up 80% of production cost

Electricity prices relative to purchasing power

Average electricity prices in US cents/kWh (2011 ppps)



Data: average prices from 2011 converted to USD using purchasing power parities

Sources: IEA, EIA, UN

shrinkthatfootprint.com

US Electricity Prices (cents) vs Time

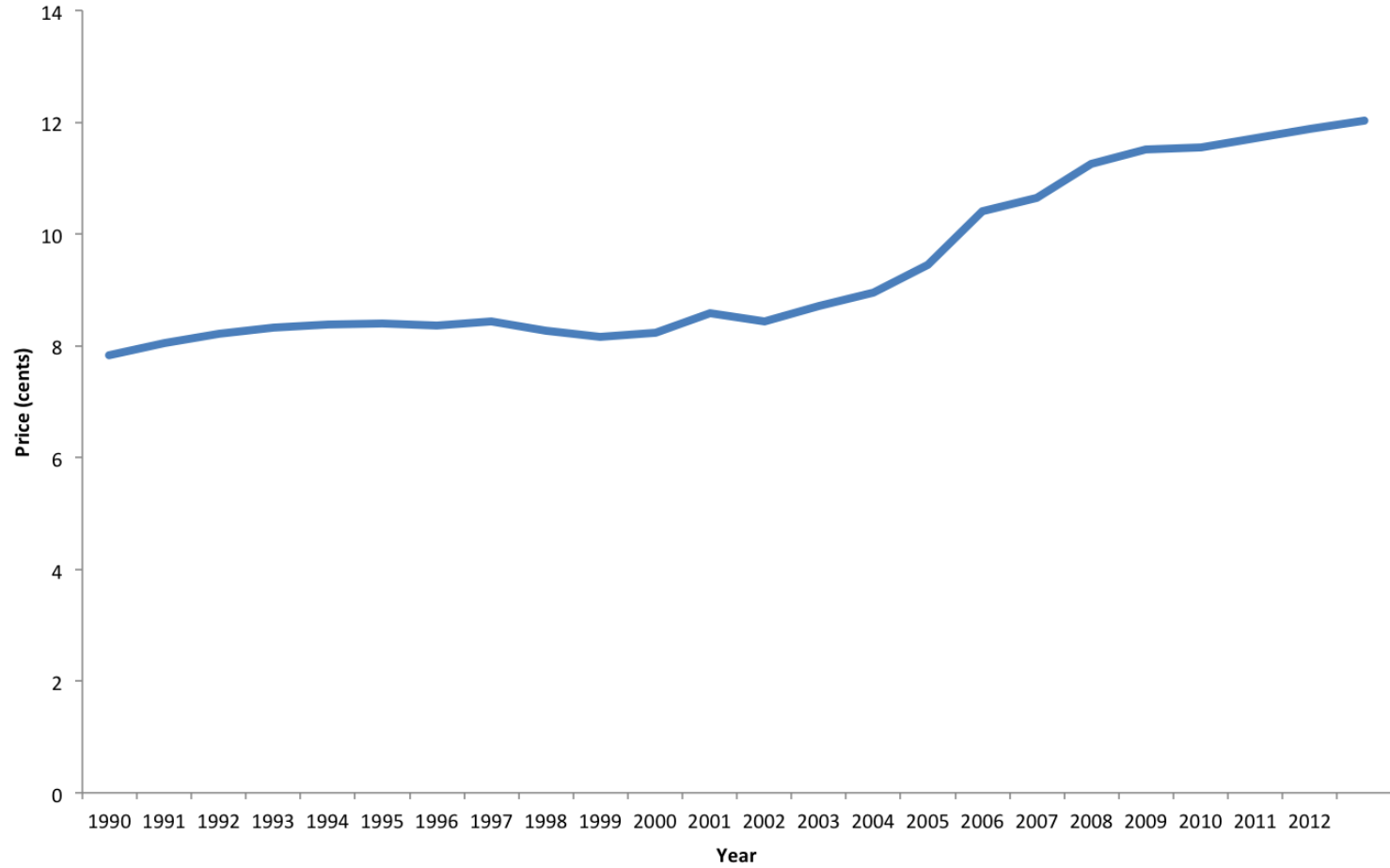
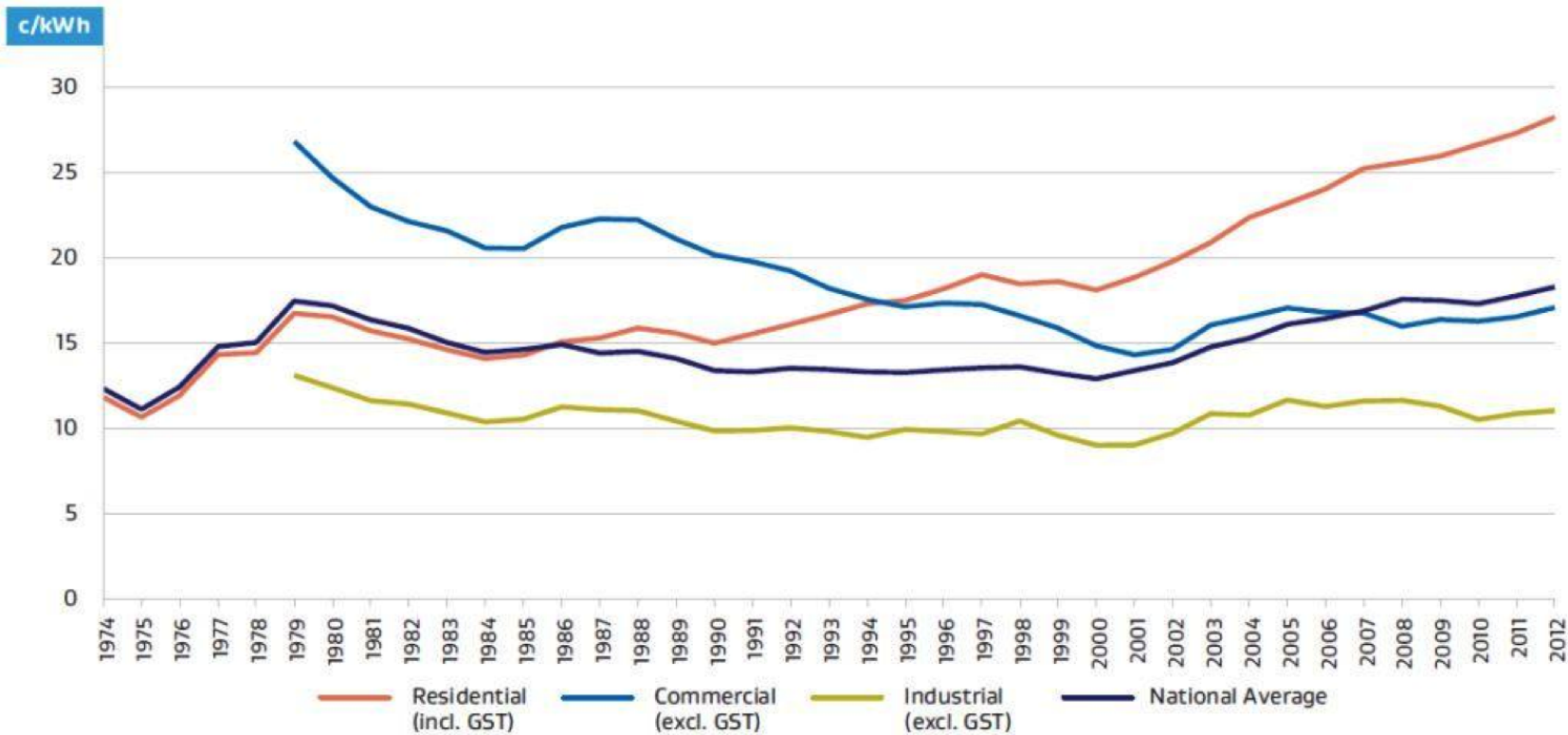


Figure F.5b: Electricity Consumer Prices (Real 2012 Prices)



Land Requirements

- 1 kW of power requires:
 - 1000 square meters of land for wind
 - 100-250 square meters for solar
 - 1-10 square meters for coal
 - .5-5 square meters for gas
- Improvements in inefficiencies can drive down land requirements

Transmission & Grid Requirements

- Many of the optimal sites are not served by current electric grid
- New transmission infrastructure may be required
- Construction can face environmental opposition
- Transmission lines cross many individual properties

Material, Manufacturing, and Labor Constraints

- Material constraints
 - fiberglass
 - resins
 - permanent magnets
- Manufacturing constraints
 - address strategies for developing and securing supply chains
 - need consistent policies to encourage investment
- Limited labor
 - need more qualified work force
 - decreasing number of engineers and scientists

Intermittency

- Diversify sources
- Sun and wind combined
- Energy storage
- Demand side management
- Market structures
- Smarter transmission networks



Conclusion

- To be successful in the long term and for the wind industry to stand on its own in the future, countries should enact long term policies promoting consistent growth
- This will decrease investor uncertainty and lead to supported development
- A predictable long term policy is more likely to be effective than exaggerated short term fiscal incentives
- There is no perfect wind energy policy but each country can learn and improve their policy through communication and collaboration



Sources

<http://www.wind-energie.de/en/policy>

<http://www.britannica.com>

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/65898/5942-uk-energy-in-brief-2012.pdf

http://www.irena.org/DocumentDownloads/Publications/IRENA_GWEC_WindReport_Denmark.pdf

http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2013/02/27/000158349_20130227084149/Rendered/PDF/wps6376.pdf

<http://theenergycollective.com/michael-davidson/259871/transforming-china-s-grid-integrating-wind-energy-it-blows-away>

<http://www.iea.org/statistics/statisticssearch/report/?&country=USA&year=2011&product=ElectricityandHeat>

http://www.eia.gov/sites/default/files/totalenergy/data/monthly/pdf/sec7_5.pdf

http://www.windpoweringamerica.gov/wind_installed_capacity.asp#yearly

Sources

http://www1.eere.energy.gov/wind/pdfs/2012_wind_technologies_market_report.pdf

<http://thinkprogress.org/climate/2013/02/11/1574101/global-wind-capacity-increased-almost-20-in-2012-to-282-gigawatts/>

<http://www.forbes.com/sites/toddwoody/2013/01/18/u-s-installed-record-13-2-gigawatts-of-wind-energy-in-2012/>

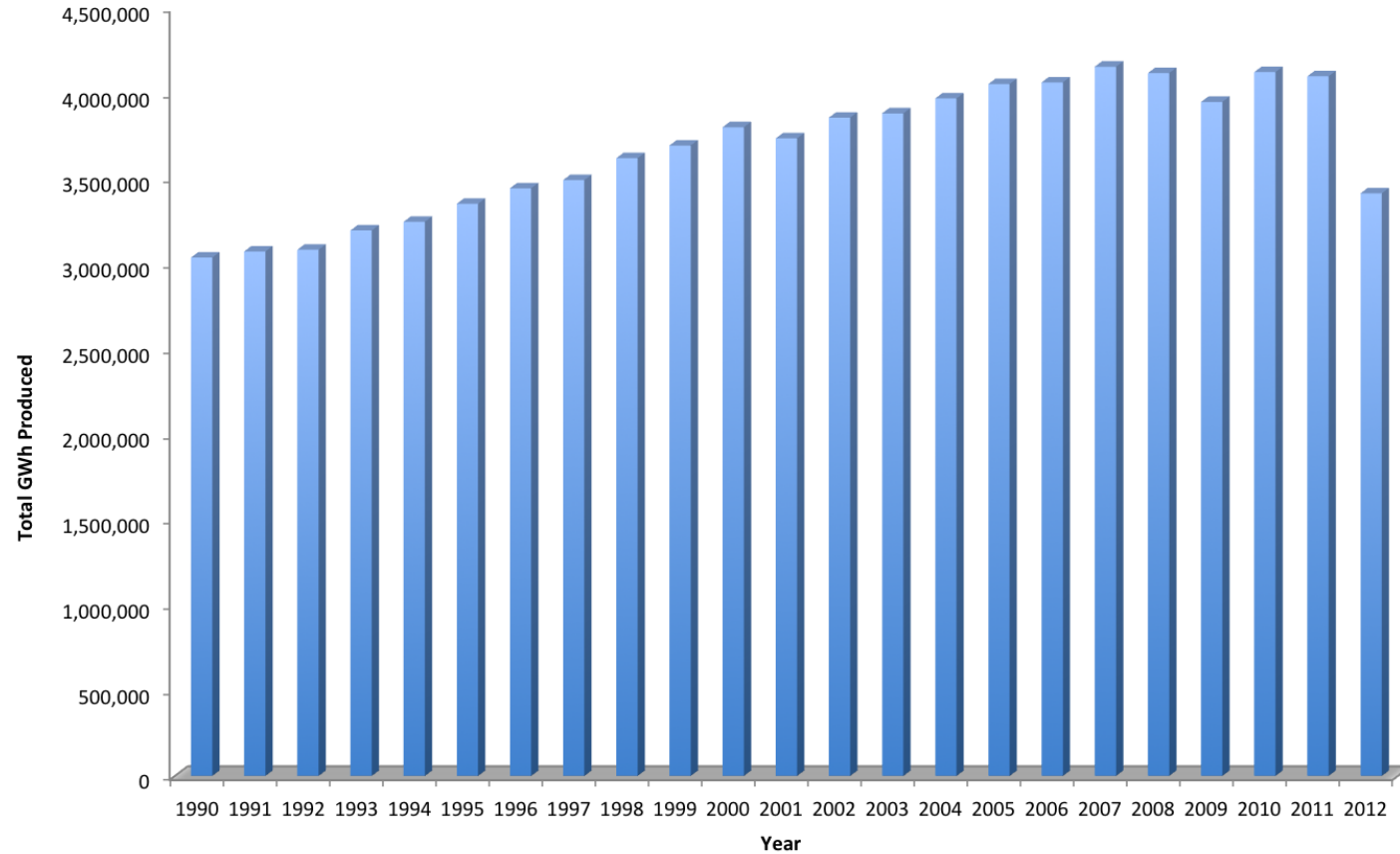
<http://awea.files.cms-plus.com/FileDownloads/pdfs/2010-Annual-Market-Report-Rankings-Fact-Sheet-May-2011.pdf>

<http://www.indexmundi.com/g/g.aspx?c=nz&v=79>

http://www.med.govt.nz/sectors-industries/energy/image-library/energy-data-and-modelling/electricity/elec-Fig1b.bmp/image_view_fullscreen

<http://www.evwind.es/2010/02/22/new-zealand-wind-power-capacity-grew-by-just-over-50-during-2009-with-a-record-171-megawatts-installed/4196>

US Total GWh Produced vs. Time



New Zealand Total GWh Produced vs. Time

