

# Wind Power

## Now and the Future

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The material in this report is gathered from many pieces of research (listed on last page) plus key individuals who have contributed from their extensive backgrounds.

The intent of this paper is to primarily focus on Wind Turbines however due to the interplay of many forms of generation, referral to other forms of renewable energy is necessary. The present status of our generating capacity will be compared to other countries and in particular to future projections the United States. The present economic climate plus financial incentives must be considered in how they have affected us now and how they will affect us in the future.

President Obama has called for the United States to double the production of renewable energy in three years and to secure 25 percent of its electricity from renewable resources by 2025.

### **What's our Plan?**

President Obama Outline:

1. Nat'l Renewable Electricity Standard (RES) 25% Renewables by 2025
2. High Voltage interstate Superhighway
3. National climate change legislation recognizing wind in reducing greenhouse gas emissions.

DOE study based on 20% wind scenario:

- Reduce coal use by 18%
- Electric sector natural gas by 50%
- Avoid construction of 80,000 MW of new coal-fired power plants.
- Creation of 500,000 jobs
- \$450 billion economic impact by 2030.

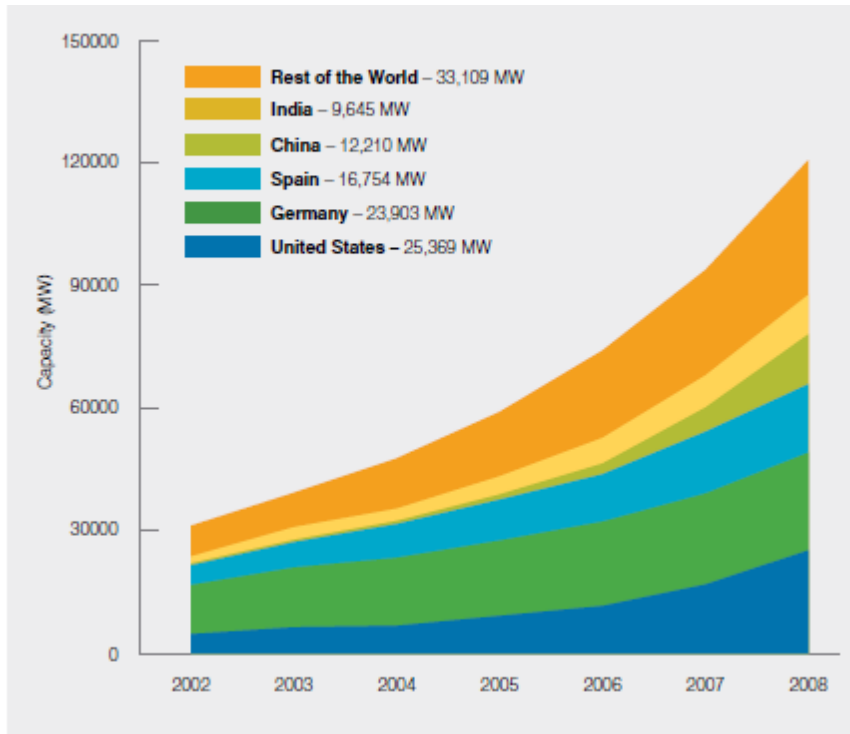
### **MW Status**

Last year the wind power industry installed 8,500 megawatts (MW) which was 42% of the new generating capacity added in the US in 2008. This brought total generating capacity to 25,369 MW, putting the U.S. ahead of Germany (23,902 MW).

The industry growth has averaged 32% annually (2004-2008). 2009 appears to have a 20% growth rate.

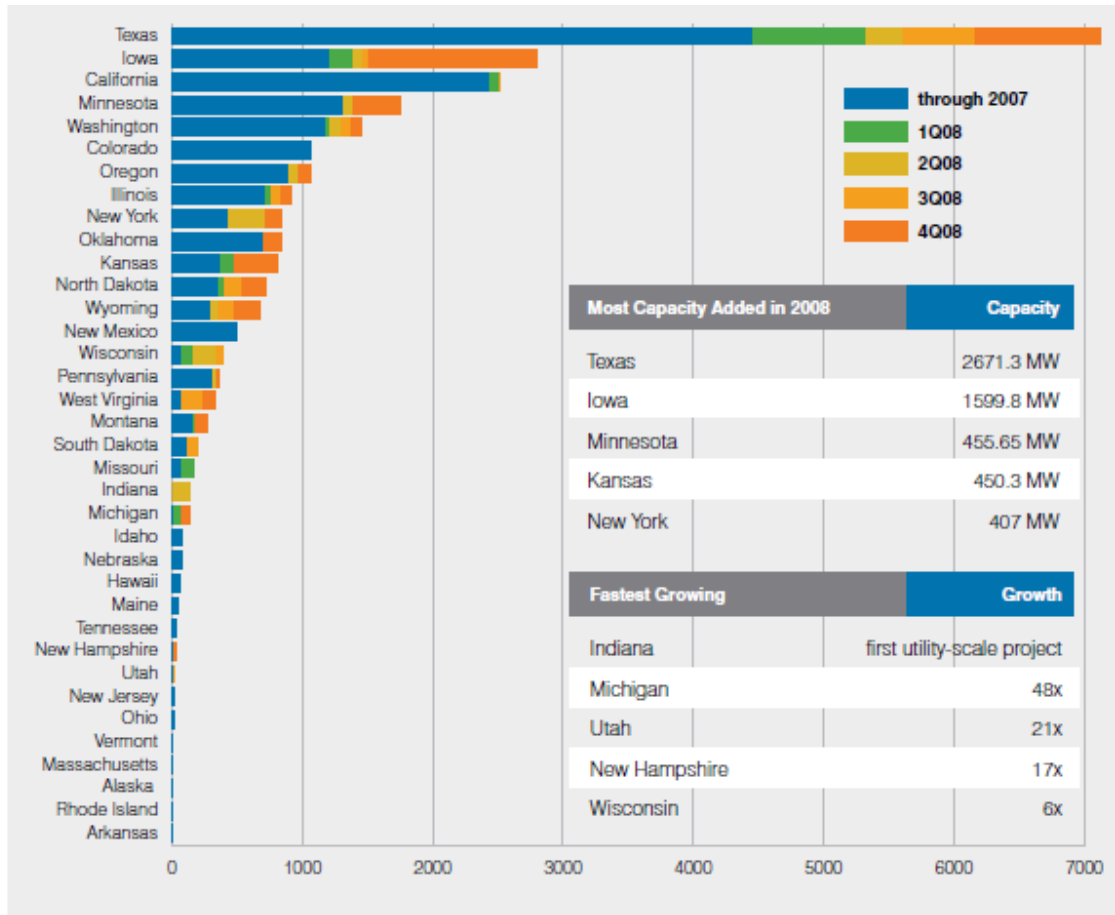
Utility scale wind systems are generating electricity at a lower cost which is as low as 3-6 cents per kilowatt-hour.

### **World Wind Power Capacity Growth**



ANNUAL STATISTICS ON U.S. WIND ENERGY

## Wind Power by State



Annual Statistics of U. S. Wind Energy

## Economic Standing

Observing the growth trends of the industry it appears that the cumulative growth will continue however according to industry attendees of the American Wind Energy Association (AWEA) wind show that was just held in Chicago in May, there is a slowing of construction taking place in 2009. Projections for installations will grow by 5,000 MW. This number is affected by the present economic recession and the speed of putting into effect stimulus measures and renewable energy policies.

The Financial effect from economic recession:

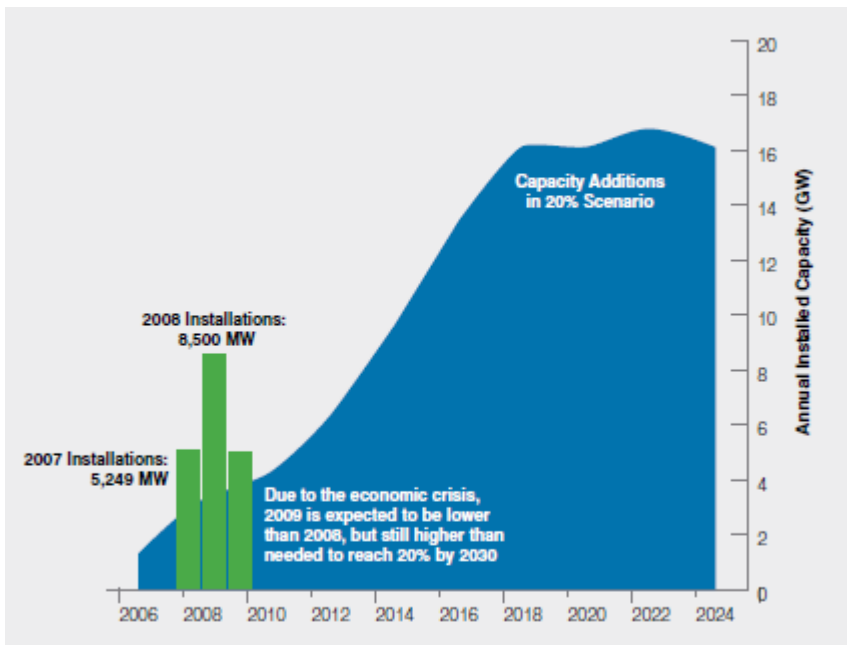
- Slowdown in order intake
- Customers not paying advances for deliveries beyond near term
- Industry wide orders contract to 1-2 years vs. 2-3 years.
- Increase in cost of capital can restrict project development.

Credit markets basically stopped new debt deals in the 4<sup>th</sup> qtr. of 2008 and the 1<sup>st</sup> qtr. of 2009. Normally equity if the marginal dollar in a transaction and, accordingly, earns a significant premium. In the current market, debt is the marginal dollar, which is harder to find than equity.

The marginal dollar is the last dollar obtained from investors. The cost of the marginal dollar can increase greatly when demand for capital outstrips supply, but it becomes relatively cheap when credit is looser. Hence return on investment for equity investors have dropped, while debt spreads have widened, more than offsetting any gains from low interest rates.

As credit markets begin to reopen, only the projects with the strongest metrics are being considered. Lenders are looking to finance projects with strong sponsors, better power purchase agreements with financially strong parties, limited or no financial hedges, lower technology risk, and significant higher debt service coverage ratio'

### **Actual Annual Installation Compared to 20% Scenario**

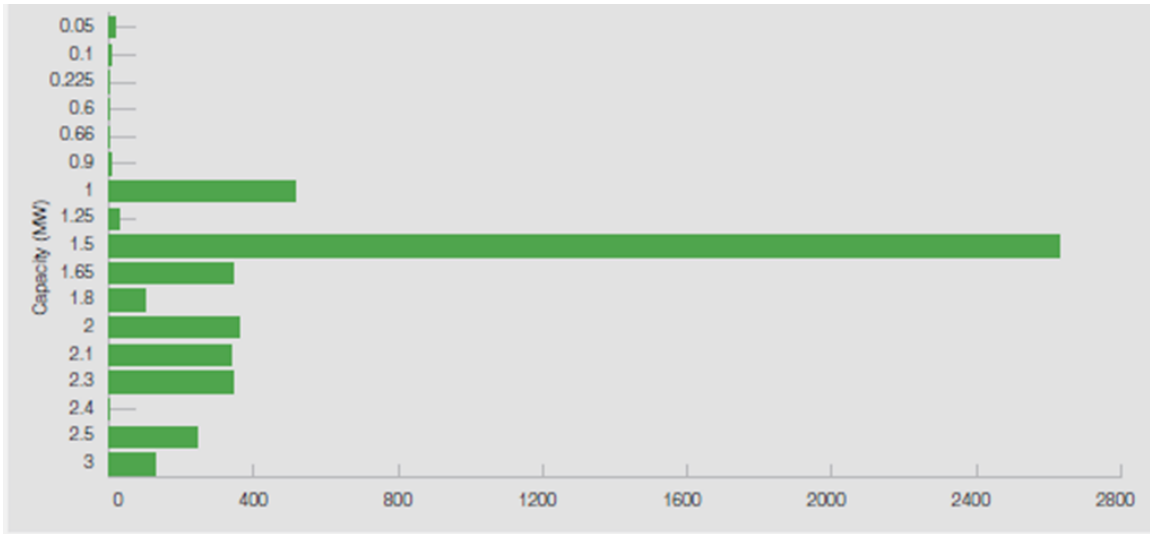


American Wind Energy Association – DOE 20% by 2030 report

### **Wind Turbines Being Built**

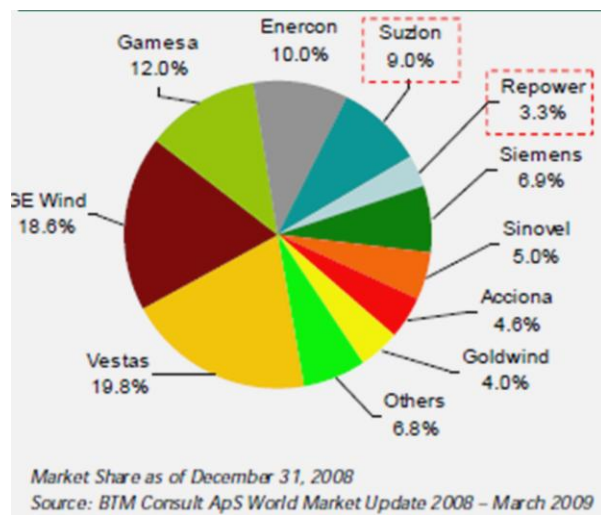
Turbine size now averages 1.67MW with most widely installed units at 1.5MW and the largest reached 3.0MW in Kansas. Units in the 5MW range are being developed.

## Distribution of Turbines installed in 2008 by Capacity



There has been a strong rise in domestic wind turbine components for wind turbines. 70 manufacturing facilities were opened, expanded or announced in the past 2 years (2007 – 2008), including over 55 in 2008 alone.

## Major Manufacturers in Wind power



GE, Vestas, Siemens, Suzlon, Gamesa, and Acciona have a manufacturing presence in the United States presently.

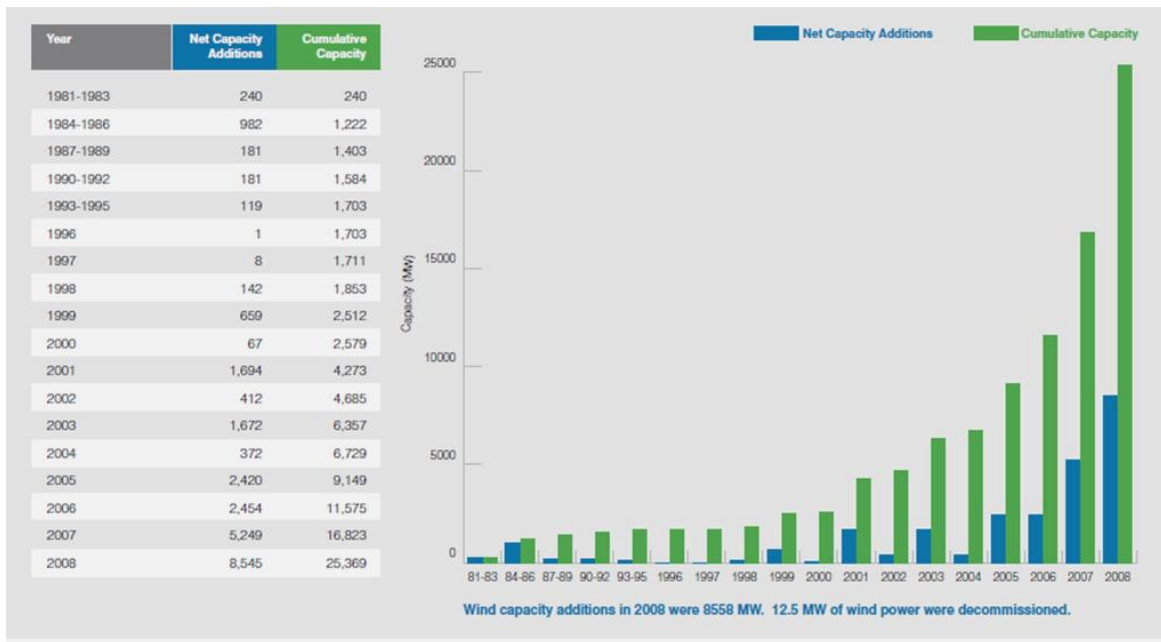
## Top 20 U.S Wind Power Owners:

Company	MW under "managing ownership"
NextEra Energy Resources	6290.1
Iberdrola Renewables	2063.4
MidAmerican Energy	1939.5
Horizon-EDP Renewables	1872.7
Invenery	1276.5
Babcock & Brown	1118.8
Edison Mission Group	959.9
AES	956.7
E.On Climate and Renewables	726.9
John Deere Wind	527.3
enXco	527.0
Shell Wind Energy	449.0
Puget Sound Energy	385.2
Terra-Gen Power	368.5
Duke Energy	321.5
AEP	310.5
Eurus	296.6
Noble Environmental Power	282.0
Orion Energy Group	280.5
Enel North America	249.3
Others	4167.1

## PTC Affect

In the following graph it is important to note when the first federal production tax credit PTC through the Energy Policy Act of 1992 it was scheduled to end in mid 1999. In the early 2000 the PTC was allowed to lapse and then be extended 3 times. Note the effects in Net capacity additions in 2000, 2002, and 2004.

## U.S. Wind Project Growth (National Capacity Growth)



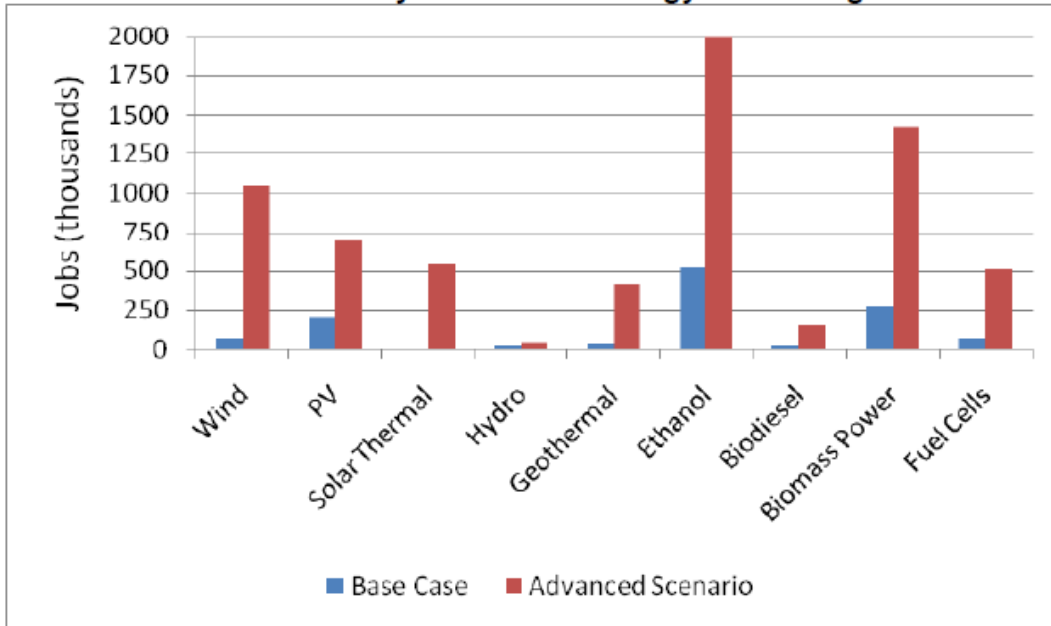
American Wind Energy Association – Annual statistics on Wind Energy

## JOBS

In 2008 there were 35,000 jobs created putting a total of 85,000 people to work in the wind energy industry by the end of 2008. Many in the manufacturing phase. Future projections are still optimistic although key issues have to be addressed if the cumulative growth curve is to continue. These issues will be covered in another part of this report.

In the following chart wind holds 3<sup>rd</sup> position behind Ethanol and Biomass for job growth. Ethanol growth needs to be revisited as an overall viable growth area going forth. The question needs to be answered as to whether it is the proper use of resources. With new developments taking place every day none of the renewable energy areas should be ruled out. There is a good case for utilization of the Wind and Sun becoming a major contributor.

### Total U.S. Jobs Created by Renewable Energy Technologies in 2030

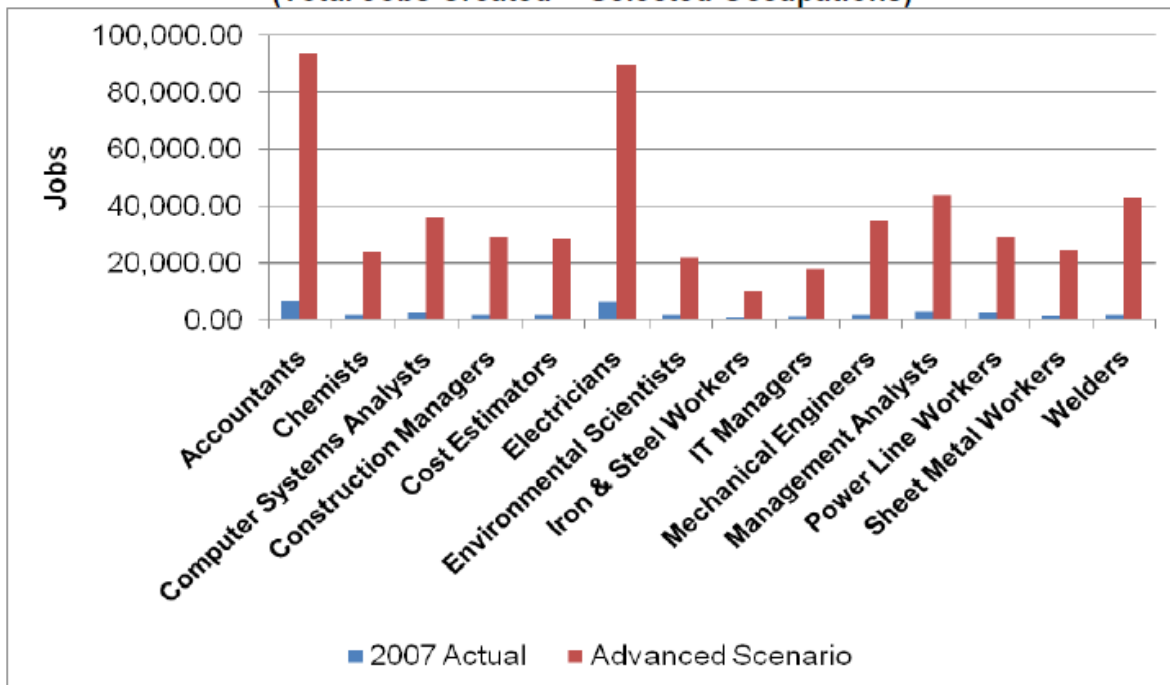


Source: Management Information Services, Inc. and American Solar Energy Society, 2008.

Defining, Estimating, and Forecasting The Renewable Energy and Energy Efficiency Industry – Colorado GEO

Electricians and accountants lead the list for areas of opportunity and the unnamed marketing and sales area should also be an area of employment opportunity.

### U.S. Jobs Created By Renewable Energy In 2030 Compared to 2007 (Total Jobs Created -- Selected Occupations)



Source: Management Information Services, Inc. and American Solar Energy Society, 2008.

Defining, Estimating, and Forecasting the Renewable Energy and Energy Efficiency Industry, - GEO

During the decade preceding 2030 the US wind industry could.

- Support roughly 500,000 jobs in the U.S., with annual average of more than 150,000 workers directly employed by the wind industry
- Support more than 100,000 jobs in associated industries (e.g., accountants, lawyers, steel workers, and electrical manufacturing)
- Support more than 200,000 jobs through economic expansion based on local spending;

(U.S. DOE, NREL, AWEA, Black & Vestech)

## **Wind & Solar**

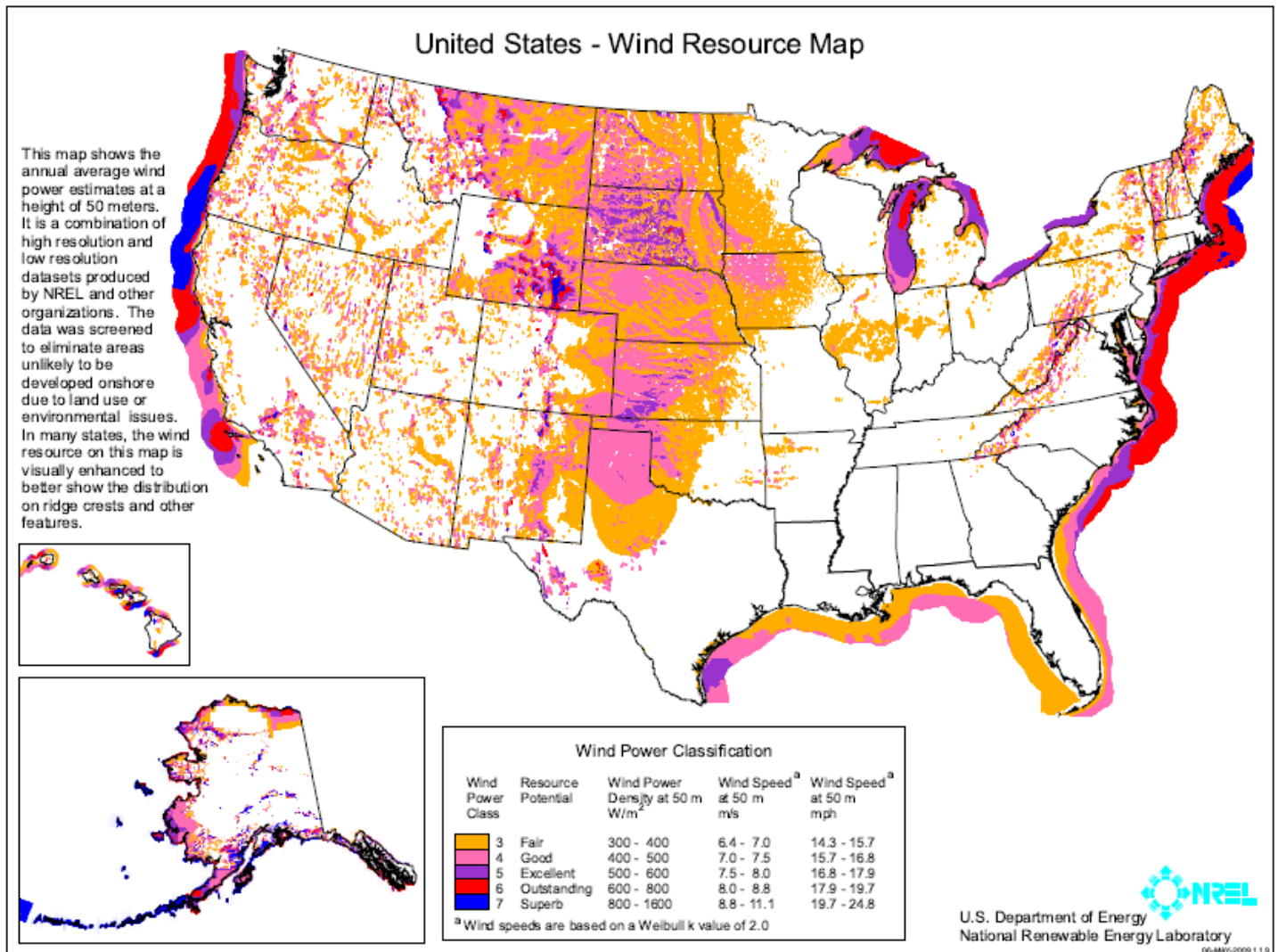
The combination of wind and solar is an ideal opportunity to utilize the power of wind and sun when they are in their generating cycles. The following chart shows the additional job opportunities going forth.

<b>Global Clean-Energy Jobs (Direct and Indirect): Solar and Wind</b>		
	<b>2008 (Current)</b>	<b>2018 (Projected)</b>
Solar Photovoltaics	190,819	1,341,968
Wind Power	413,522	1,315,324
<b>TOTAL</b>	<b>604,341</b>	<b>2,657,292</b>

*Source: Clean Edge, Inc., 2009*

## Energy of Wind & Sun

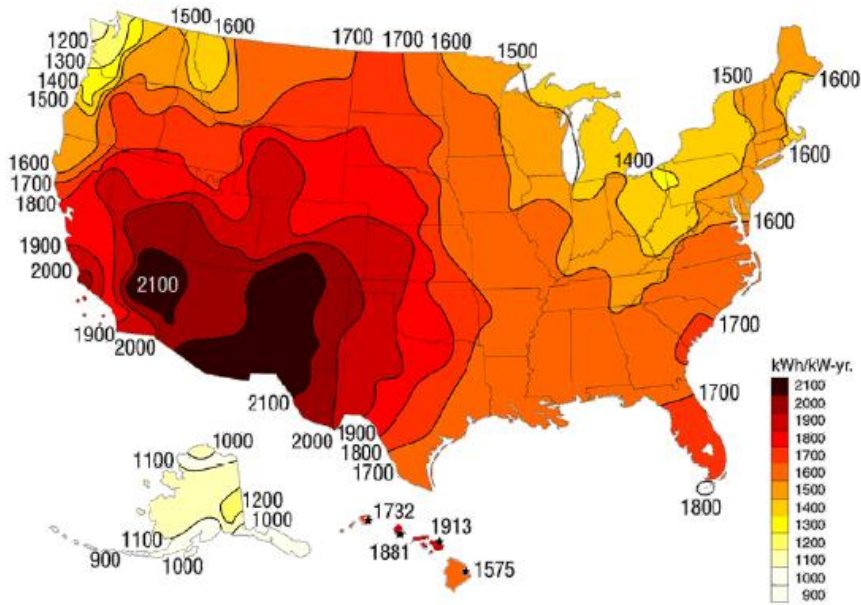
According to DOE US wind resources are vast enough to supply the electricity needs of the entire country several times over.



In any given hour, more energy from the sun reaches Earth than is used by the whole human population in any given year.

There are presently 3,594 sq. miles of federal land awaiting permits for solar energy development.

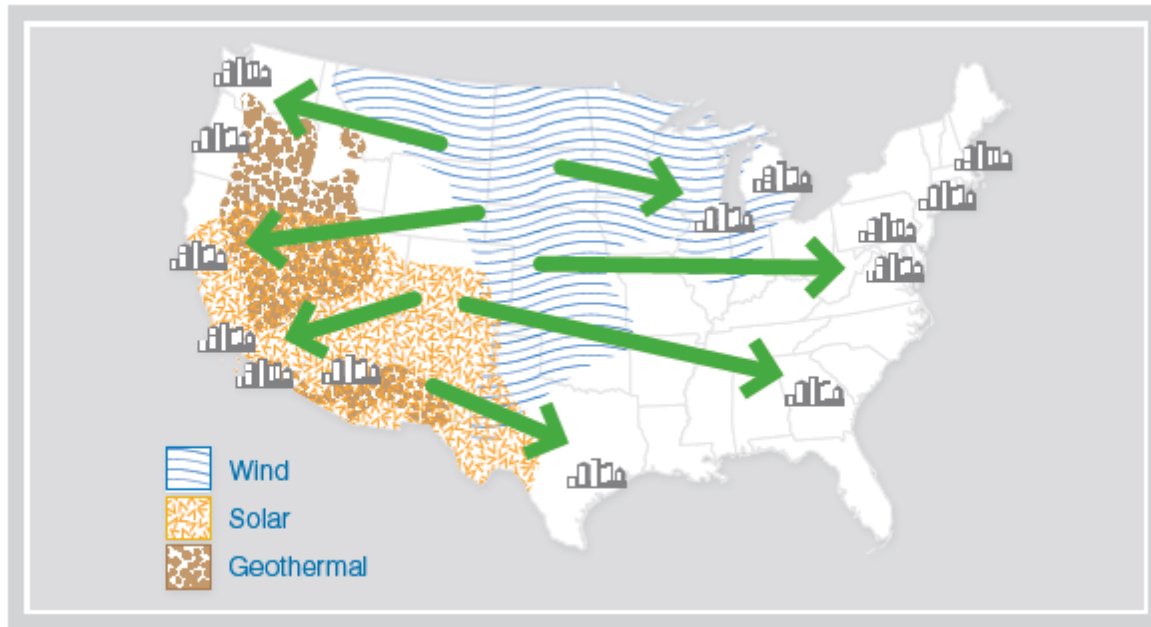
(National Geographic Collector Edition 2009)



[http://www.seia.org/cs/about\\_solar\\_energy/myths\\_and\\_facts](http://www.seia.org/cs/about_solar_energy/myths_and_facts)

We have a wealth of recognizable resources that can aid the entire country.

FIGURE 1: **Nationwide Green Power Superhighways: A Conceptual Vision**

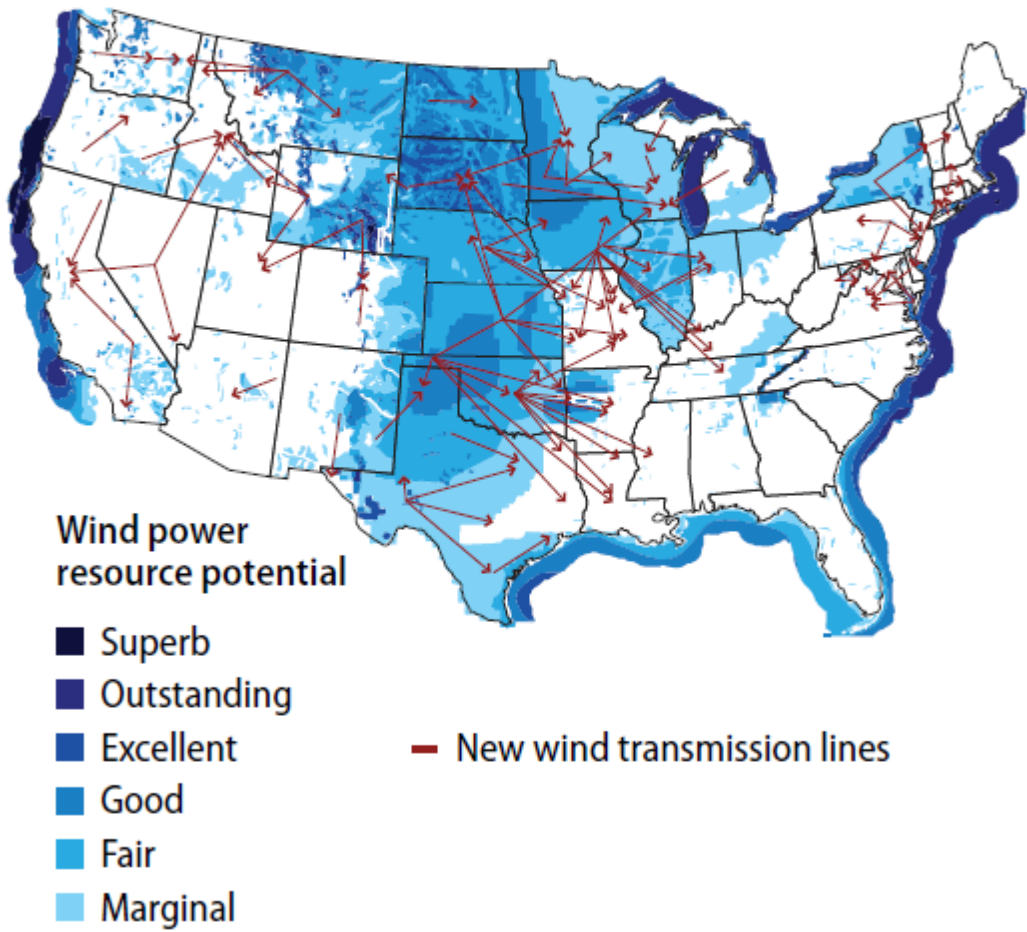


Source: AWEA and SEIA

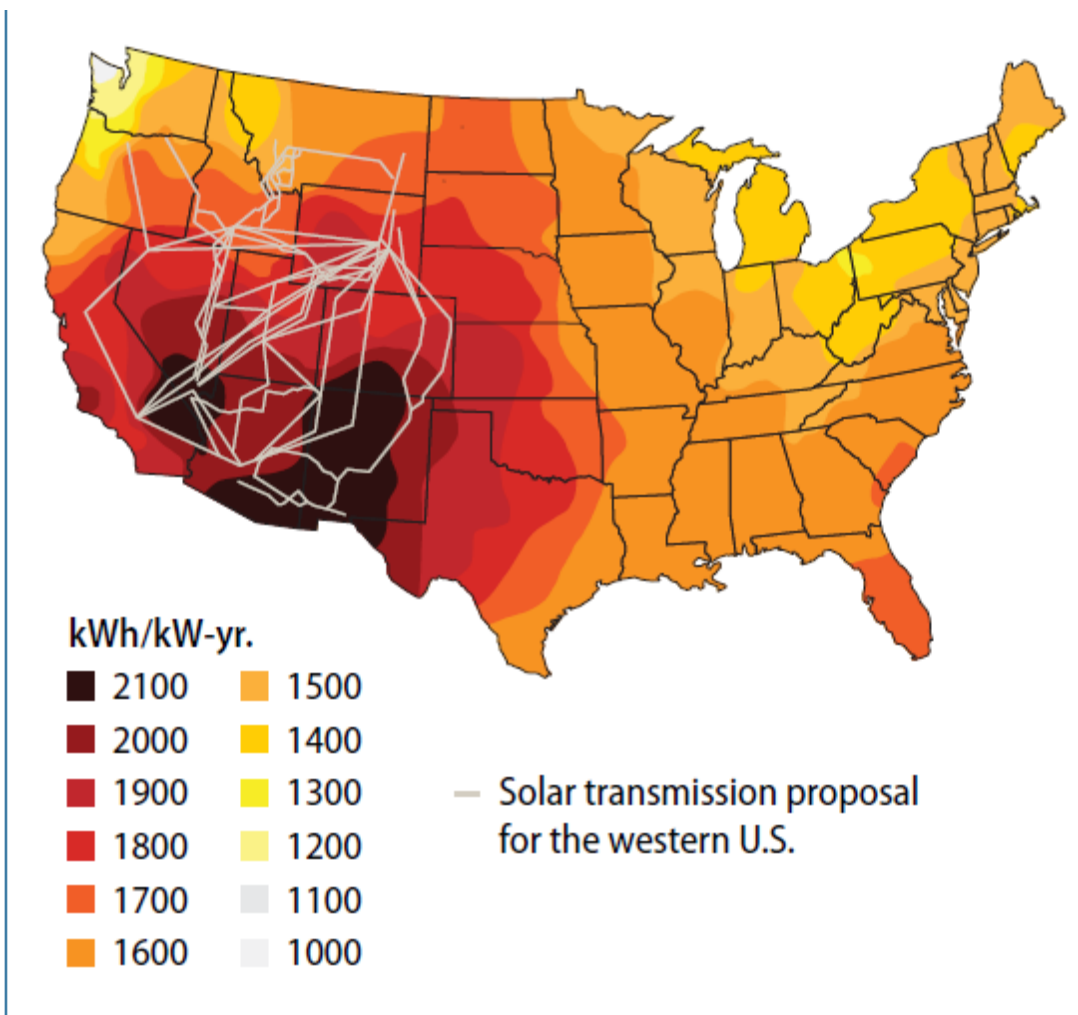
Studies have shown that aggregate output of wind and solar plants spread over a large geographic area is much less variable than output of plants clustered into a small area.

There are presently 300,000 MW of wind projects waiting in line to connect to the grid. Inadequate transmission concerns are also being expressed by the solar, geothermal, and hydropower industries.

## Transmission of the Wind Power Potential



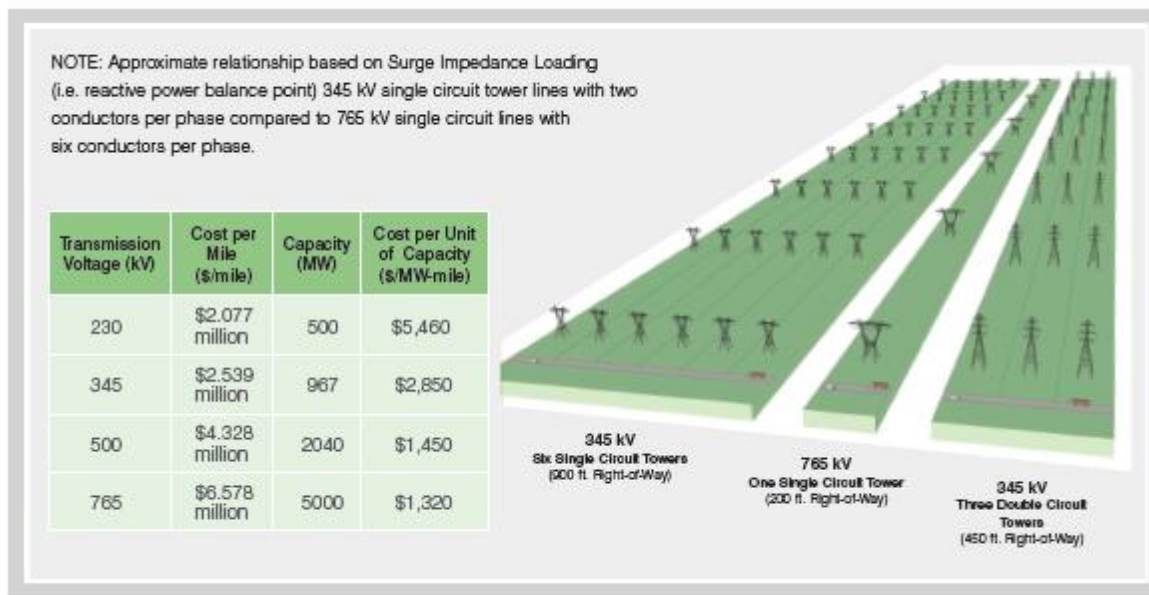
## Transmission of Renewable Solar Power Potential



Source: Wind map—National Renewable Energy Laboratory, POWERmap, powermap.platts.com; DOE, *20% Wind Energy by 2030: Increasing Wind Energy's Contribution to U.S. Electricity Supply*, page 160.

Solar map— <http://globalwarming.house.gov/tools/2q08materials/files/0157.gif>;  
WRA Smart Lines Report, 2008, page 2.

## High Voltage Transmission – Economic and Land Use Benefits



(Sources: Edison Foundation<sup>18</sup>, AEP<sup>19</sup>)

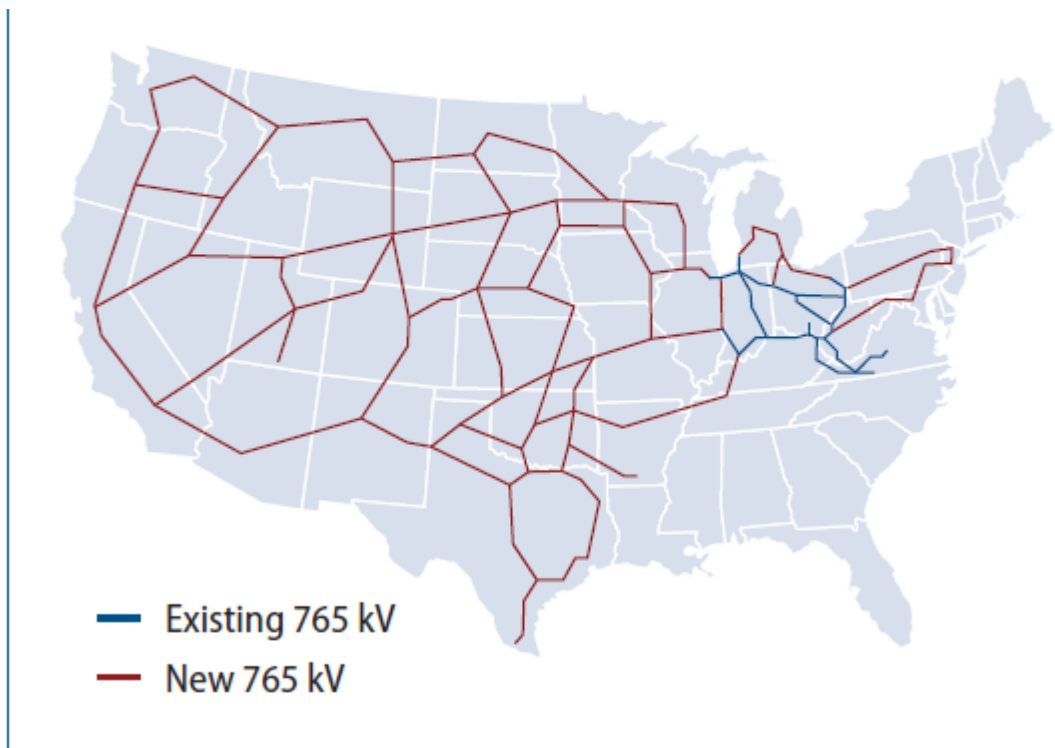
## New high-voltage transmission lines

President Obama stated in an interview on MSNBC just before the election, noting that:

“One of ... the most important infrastructure projects that we need is a whole new electricity grid. Because if we’re going to be serious about renewable energy, I want to be able to get wind power from North Dakota to population centers like Chicago.”

High voltage transmission has benefits:

- A \$50-60 billion investment with integration of 240 gigawatts (GW) of wind in the Eastern U.S. would reduce electric cost enough to offset the investment. (study by transmission grid operators in the Eastern U.S.)
- Investment in transmission for renewable would grow to larger than the costs of the investment in less than 3 years. (Electric Reliability Council of Texas )
- High-voltage transmission overlay to access wind resources in Kansas, Oklahoma, and Texas would provide savings of approximately \$1 billion/year, more than 2X the \$400-500 million annual cost of transmission investment. (Charles River Associates, International)

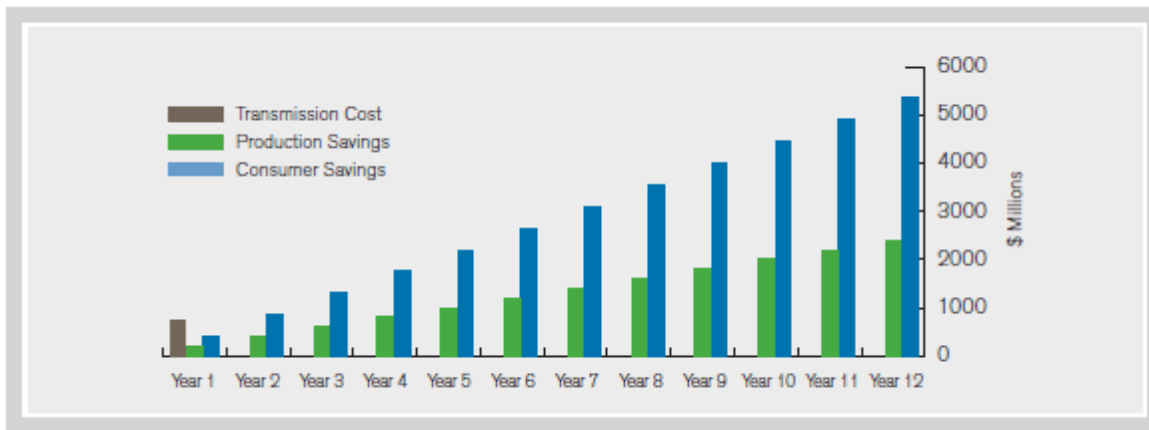


Source: American Electric Power.

Cost savings of high voltage lines outweighs the initial cost through production savings and consumer savings.

It has been found that the cost of transmission investments to bring wind power and other renewables are significantly outweighed by the consumer savings that those investments produce. The following example from a 2006 study by the Electric Reliability Council of Texas (ERCOT) found that over time an investment in new transmission infrastructure for renewable would have sizable savings over the initial investment.

### **Results from Texas Study Show that Benefits of Transmission for Wind Exceed Cost**



(Source: Electric Reliability Council of Texas)

## **Fossil Fuels**

Our dependence on fossil fuel supplies is not a practical approach for the future.

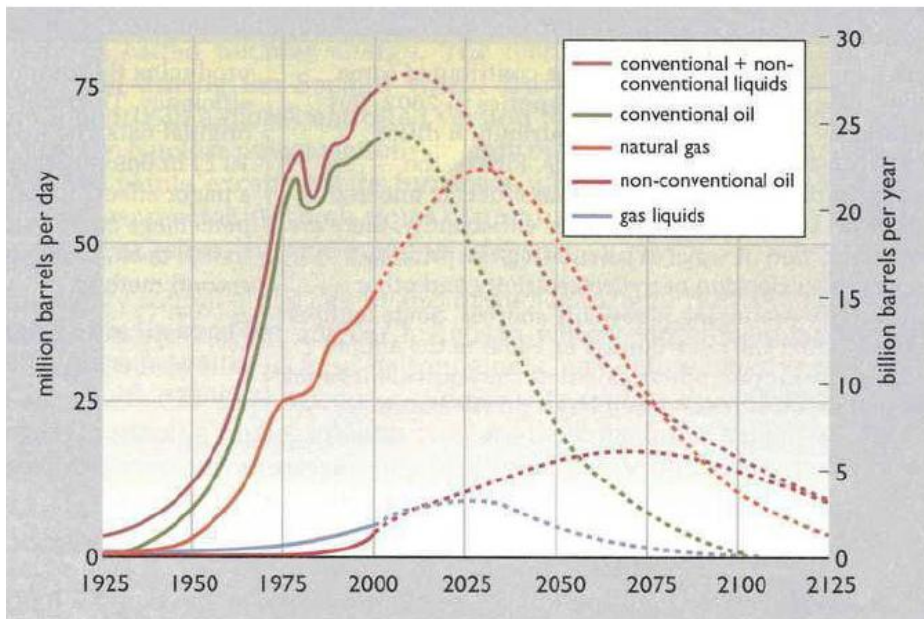
Rajendra Pachauri, the head of the Intergovernmental Panel on Climate Change, who accepted the Nobel Peace Prize in 2007, the alongside of Al Gore, said recently that unless fundamental shifts were underway by 2012, the feedback loop driving climate change would take on an irrevocable life of their own.

(National Geographic Collector Edition 2009)

### **Carbon Dioxide Reduced:**

1. Based on 20% wind power-reduces carbon dioxide emissions from electric. Gen. by 825 million metric tons (25% in 2030).
2. 140 million vehicles off the road
3. Avoid \$98 billion CO2 regulation cost.

## Declining Fossil Fuel Supplies



Boyle, *Renewable Energy*, Oxford University Press (2004)

## What needs to be done?

As President Obama has laid out, the federal gov't. needs to put forth long term policies that will address the following areas.

1. **Nat'l Renewable Electricity Standard (RES) to create a stable market investment**
2. **Interstate network of transmission lines**
3. **Strong climate legislation with early and aggressive emissions reduction targets.**

## National RES

Renewable energy protects consumers:

- A 2009 Union of Concerned Scientist (UCS) study estimates that under a 25% national RES, avg. consumer electricity prices would be 7.6% lower, with an annual avg. reduction of 4.3%. through 2030.
- A 2007 U.S. Energy Information Administration (EIA) study on 25% renewable by 2025 also shows a reduction in consumer expenditures.
- A 2007 study by global energy consulting firm Wood Mackenzie on a 15% national RES found electricity prices would decrease by 7% - 11%.

## **Transmission Lines**

The Joint Coordinated System Plan (JCSP) conducted by the major transmission operators in the Eastern U.S. shows that transmission would account for about 2% of total electric sector capital and operating cost between now and 2024. Other studies have found that the cost of transmission account for about 6% of consumers' electric bills on average. This appears to be a wise decision considering the benefits of the new transmission would be 50 years of longer.

A key point to note is that most state regulators have little authority or incentive to require ratepayers in their state to help pay for an interstate network with regional benefits.

Presently the battle takes place between building transmission lines and renewable power plants. A transmission line can take 5 years or more to be planned and built while a renewable power plant can be constructed in less than one year. Somehow it must be decided which comes first. The decision to build transmission is being driven by individual projects on a individual basis, vs. transmission being planned and built on a well thought out and planned basis.

Other major obstacles come from state and federal entities. Regulators in one state can veto a multi-state transmission network by refusing to grant permits for siting a transmission line if they are not going to get a share of the benefits. In the Western U.S. federal agencies control more than half of all land. These regulatory bodies have lengthy backlogs of applications to use their lands; projects can be held for years waiting for a permit.

Former Vice President Al Gore, speaking in Washington, DC, on July 17, 2008, also articulated the vision of a more robust grid:

“We do not have a unified national grid that is sufficiently advanced to link the areas where the sun shines and the wind blows to the cities in the East and the West that need the electricity. Our national electric grid is critical infrastructure, as vital to the health and security of our economy as our highways and telecommunication networks. Today, our grids are antiquated, fragile, and vulnerable to cascading failure. Power outages and defects in the current grid system cost U.S. businesses more than \$120 billion dollars a year. It has to be upgraded anyway.”

## **Climate Legislation with Emission Reductions**

- The DOE's estimated that 20% U.S. electricity from wind would reduce carbon dioxide (CO2) emissions by 7.6 billion tons between now and 2030. By 2030 this would be a reduction of 825 million tons, which is equal to 25% of all electric sector CO2 emissions or the equivalent of removing 140 million cars from the road.
- Per the American Lung Association, almost half of all Americans live in counties where unhealthy levels of smog place them at risk for decreasing lung function and aggravation of respiratory illness. With wind power there is no contribution to acid rain or smog.

- 82% of Americans support wind projects in their hometown, up from 76% a year ago, according to a 2009 Saint Index survey.
- Wind power does not contaminate water with pollutants like mercury, or require water for cooling of steam to drive turbines.

## **Conclusion**

The main points presented on National Electricity Standard; High Voltage Superhighway; and Climate Legislation with Emission Reduction, all need to be addressed and monitored as our elected representatives address each of them.

As a country we have to unite around the renewable energy sources in a realistic and aggressive manner while recognizing the steps along the way and the cost that will be incurred.

We have lived with fossil fuels for a long time and it is neither practical nor prudent to just say that we will turn off these sources and go totally with non-fossil power generation. There are a number of inventive ideas coming forth that will aid in making a transition with realistic outcomes.

## Information Sources

### Wind Power – Now and the Future

#### Ken Carlson

- American Wind Energy Association (AWEA)
  - Annual statistics on wind Energy
  - Annual Wind Energy Report 2008
  - Windpower Outlook 2009
  - Green Power Superhighways Feb 2009
- Department of Energy (DOE)-20% by 2030 Report
- United States Wind Energy – Annual Statistics
- BTM Consult ApS World Market Update 2008-March 2009
- Management Information Services
- American Solar Energy Society
- Colorado Governor’s Energy Office
- National Renewable Energy Lab (NREL)
- Black & Vestech
- Clean Edge, Inc. 2009
- United States Dept. of Energy
- National Geographic – Collector Edition 2009
- Solar Energy Industries Association (SEIA)
- Edison Foundation
- Transmission grid operators – Eastern U.S.
- Electric Reliability Council of Texas (ERCOT)
- Charles River Associates, International
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- Boyles Renewable Energy, Oxford University press
- Leads School of Bus. – Prof. Stephan Lawrence (Business Case for Renewable Energy Technologies)
- Union of Concerned Scientist (UCS) 2009 study
- Energy Information Administration (EIS) 2007 study
- Wood Mackenzie – Global Energy Study of 2007
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- North American Windpower July 2009
- Suzlon Energy limited – Investor Presentation June 2009