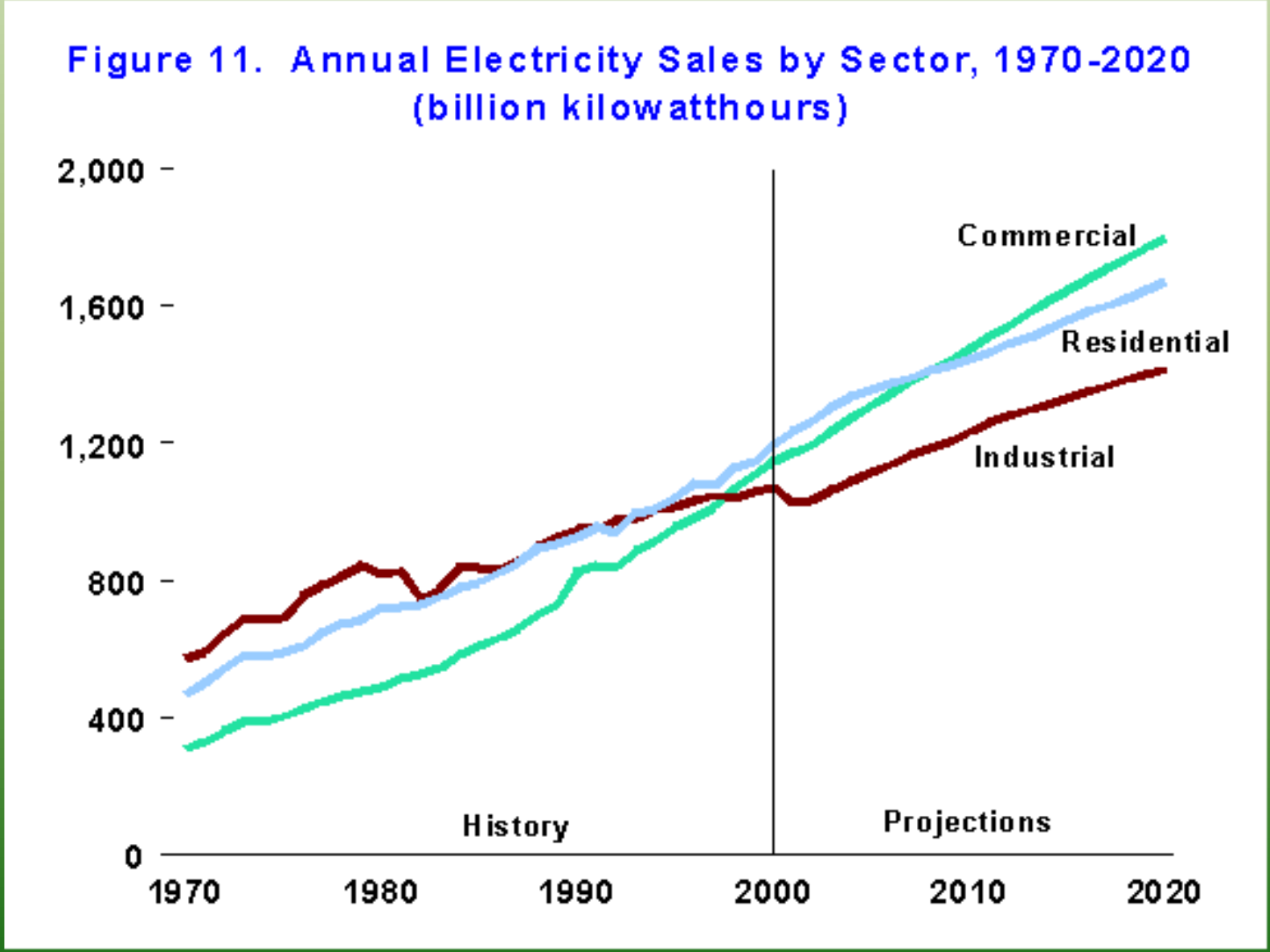
New York Wind Education Collaborative (NYWEC)

Why Are We Here?

New York is at an energy crossroads:

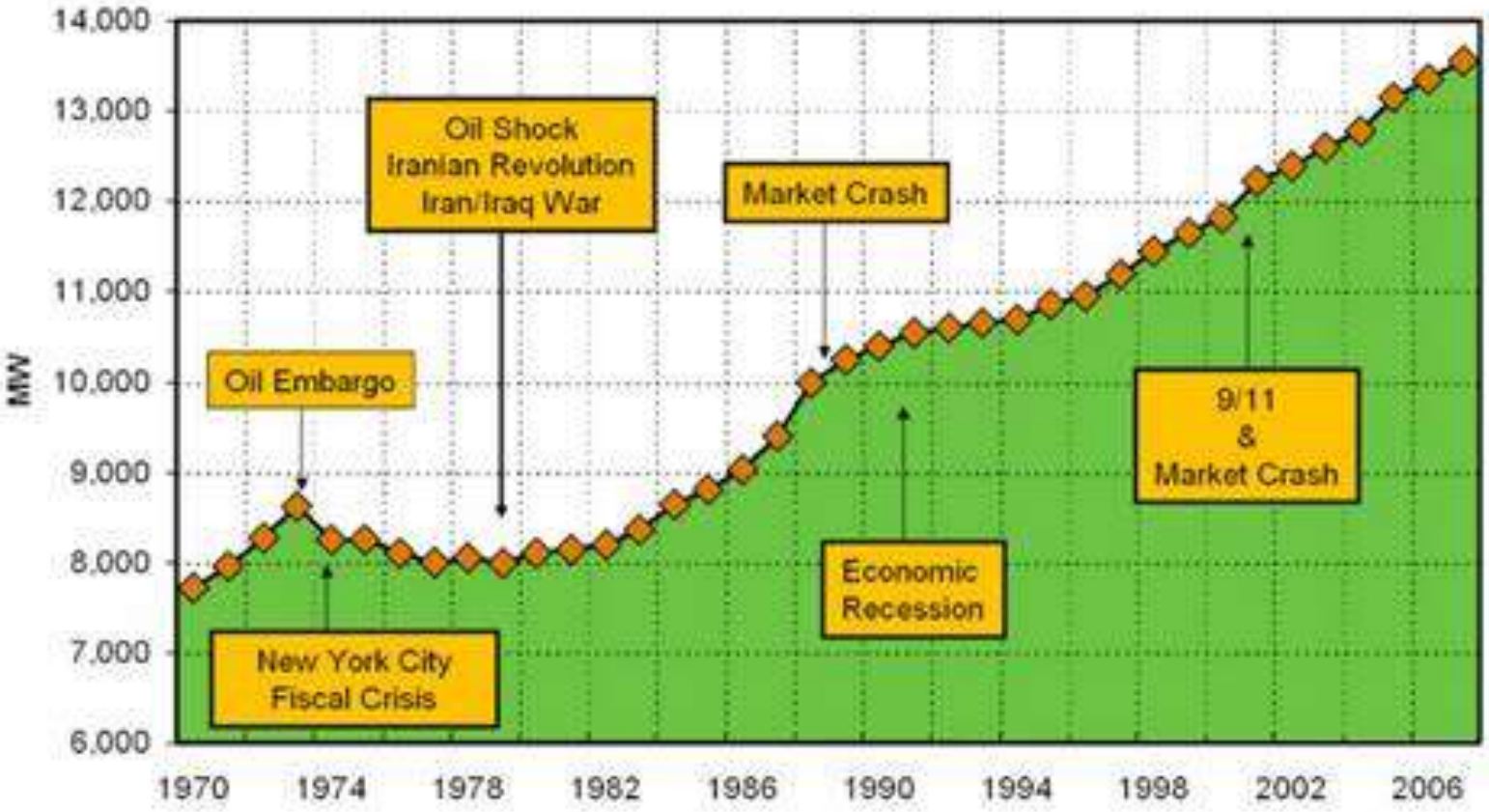
Electricity Demand Continues to Increase

…And projections show this trend continuing:



Source: U.S. Department of Energy

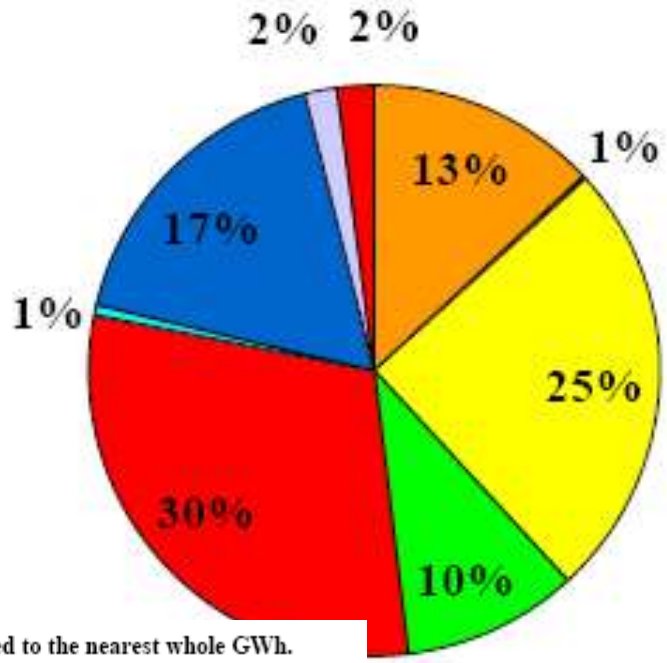
Peak Load Growth History 1970-2007



Source: ConEdison

New York State Generation by Fuel Type - 2010

Renewable Resources (3)	
Hydro	17%
Wind	2%
Other	2%
Total	21%



GWh (1)

- GAS - 18,223 (13%)
- OIL - 242 (1%)
- GAS & OIL - 34,705 (25%)
- COAL - 13,852 (10%)
- NUCLEAR - 41,870 (30%)
- HYDRO (PS) - 801 (1%)
- HYDRO - 24,214 (17%)
- WIND - 2,533 (2%)
- OTHER (2) - 2,917 (2%)

(1) - All values are rounded to the nearest whole GWh.
(2) - Includes Methane, Refuse, Solar & Wood
(3) – Renewable Resources do not necessarily match the NYS Renewable Portfolio Standard (RPS) Definition
(PS) – Pumped Storage

Total 2010 = 139,357 GWh

But Fossil Fuels Pollute – And New York State is Committed to Cleaner Air and Water, and Reduced Greenhouse Gas Emissions.

NYS Solutions: No Silver Bullet

1. Decrease demand
2. Reduce emissions from fossil fuel generators
3. Add non-polluting, renewable energy

Decrease Demand:
Efficiency and Conservation

- New York State invests about $175 million each year in energy efficiency, energy affordability, and the development of renewable and distributed energy, through the **New York Energy $mart**[SM] program

- New York has a 15 x 15 goal (to reduce electricity use by 15 percent from forecasted levels by 2015)

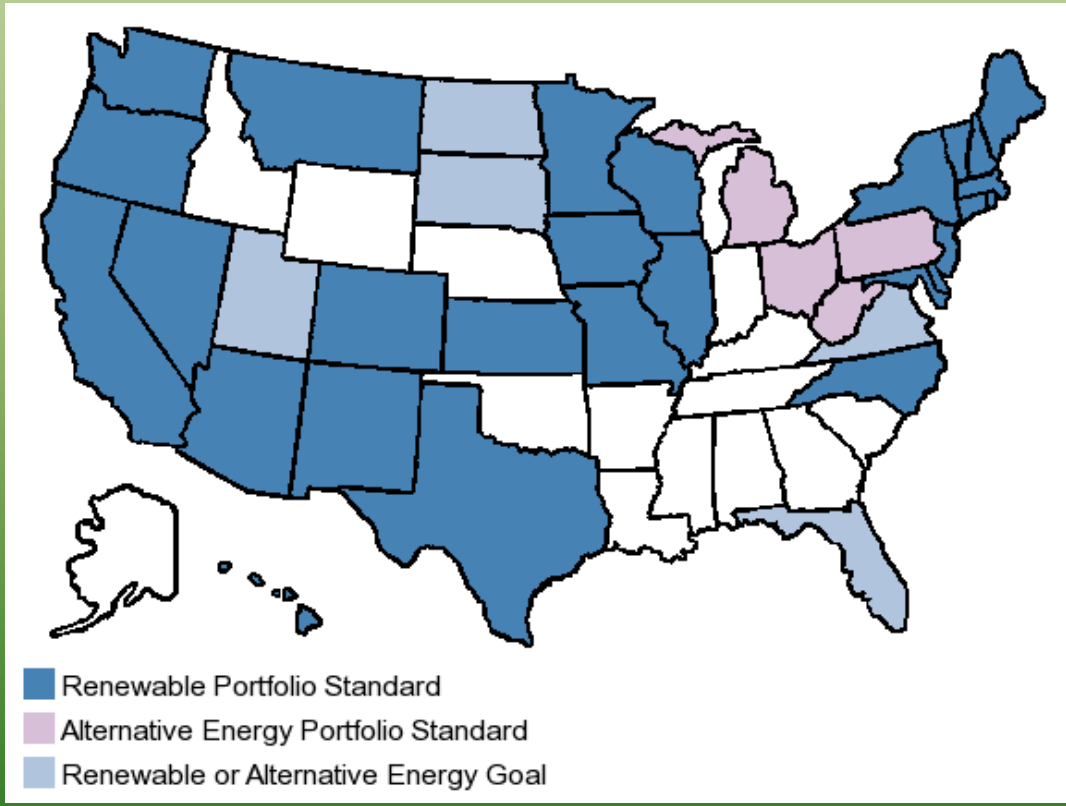
Reduce Emissions from Fossil Fuel Generators

New York has initiatives to reduce the emissions from fossil fuel power plants, including:

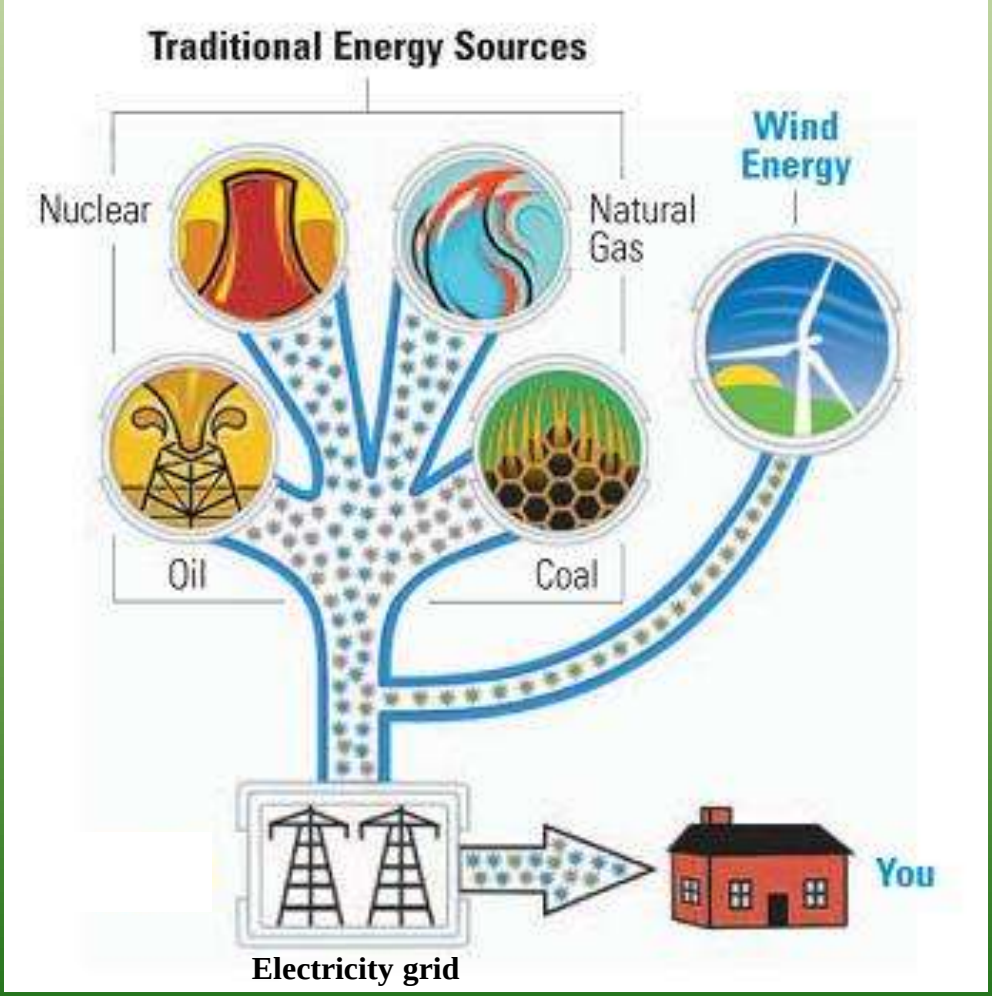
- Particulate matter
- Sulfur dioxide (SO_2)
- Nitrogen oxides (NO_x)
- Mercury
- Carbon dioxide (CO_2) and other greenhouse gases

Add Non-Polluting, Renewable Energy

- New York's Renewable Portfolio Standard (RPS) requires 30% of the electricity sold in NYS to come from a renewable source by 2015.
- Net Metering
- NYSERDA, NYPA and LIPA solar initiatives
- Federal Production Tax Credit (PTC)



Wind power can displace "traditional" energy sources such as coal, natural gas and nuclear power



- Homes and businesses use electricity from the power grid.
- The more clean wind energy goes into the power grid, the less need there is to use traditional energy sources.

Note: New York State uses little oil for electricity production, but does generate a significant amount of electricity from hydroelectric energy.

Source: NYSEG

Electricity Produced from Wind Turbines

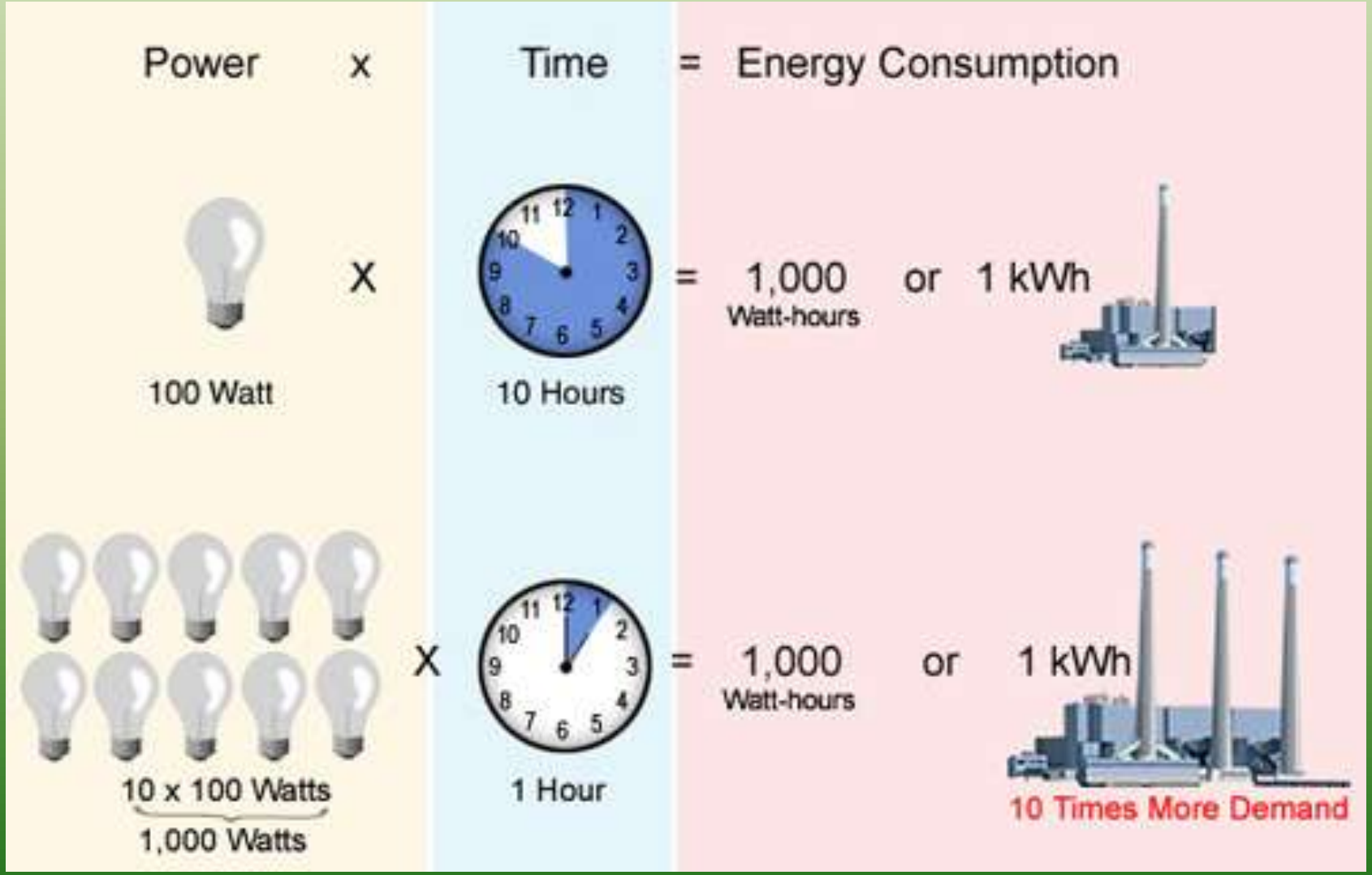
A single wind turbine rated at 1.5 megawatts can produce enough electricity to serve about 740 homes, depending on the wind resource ("capacity factor").

Source: NYSERDA

Terms:

- **Nameplate Capacity** is the full output rating of a wind turbine under ideal conditions.
- **Capacity Factor** is actual wind turbine power production, depending on wind resource. Average U.S. capacity factor is about 35% of the nameplate capacity (25%-30% in NYS).
- **Variable:** Wind is not "dispatchable" because electricity is only generated when the wind is blowing.
- **Spinning and non-spinning reserves** (on-line dispatchable generators ready to ramp up quickly to meet fluctuations in demand and supply) will be needed as larger amounts of wind are added to the system.

Kilowatts (kW) Versus Kilowatt-Hours (kWh)



(1,000 W = 1 kW)

Source: www.think-energy.net

State of Wind: Global

Source: World Wind Energy Association

How does the US compare?

(in MW, end of 2010)[1]

1) China (42, 287)
2) USA (40,180)
3) Germany (27,214)
4) Spain (20,676)
5) India (13,065)

1) Global Wind Energy Council (GWEC)

Comparison: China vs. USA

- China:
  - Installed 16,500 MW in 2010: 62% increase
  - Wind Capacity Goals:
    - 2020: 200,000 MW
    - National RPS
- USA:
  - Installed 5,115 MW in 2010
  - No National RPS

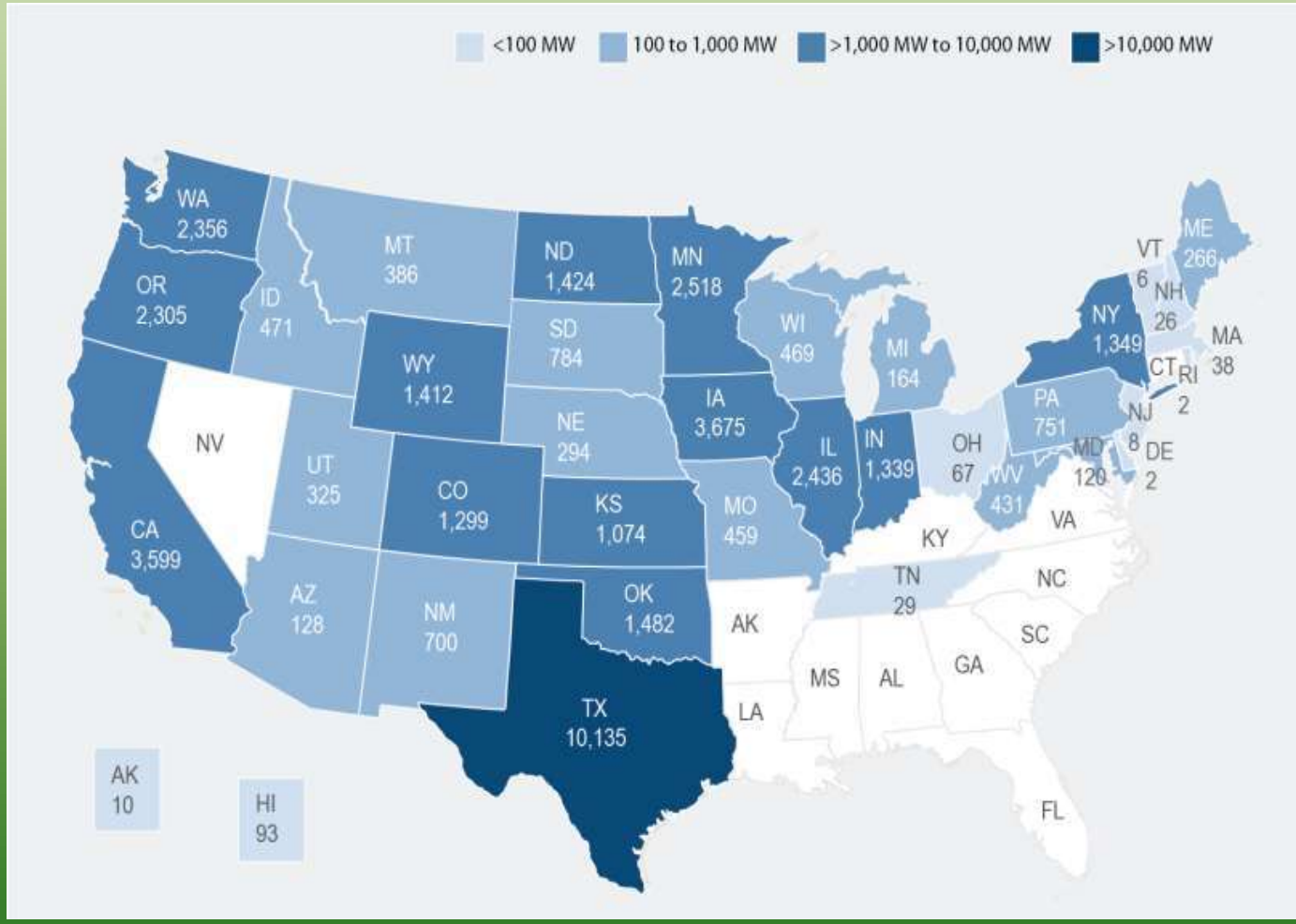
Source: GWEC

USA: By State

USA by State (MW) [1]

1. Texas (10,135)
2. Iowa (3,675)
3. California (3,599)
4. Minnesota (2,518)
5. Illinois (2,436)

11. New York (1,349)



Source: AWEA 2nd Quarter Market Report

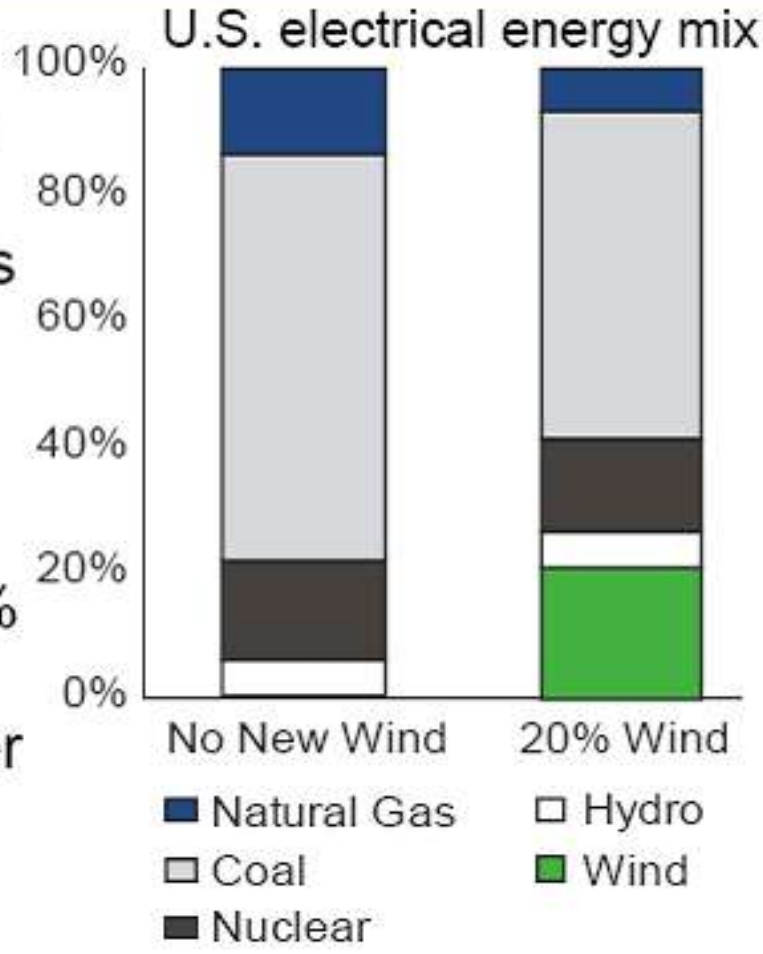
Wind Energy Potential

- **Globally,** there is enough wind energy potential to supply five times the world's total electricity needs.
- **In the U.S.,** there is enough wind energy potential off our coastlines alone to replace all the electric power plants in the United States.
- **U.S. Dept of Energy:** US could generate 20% of electricity with wind by 2030

1) Stanford, 2005
2) DOE, MTC, GE, 2005

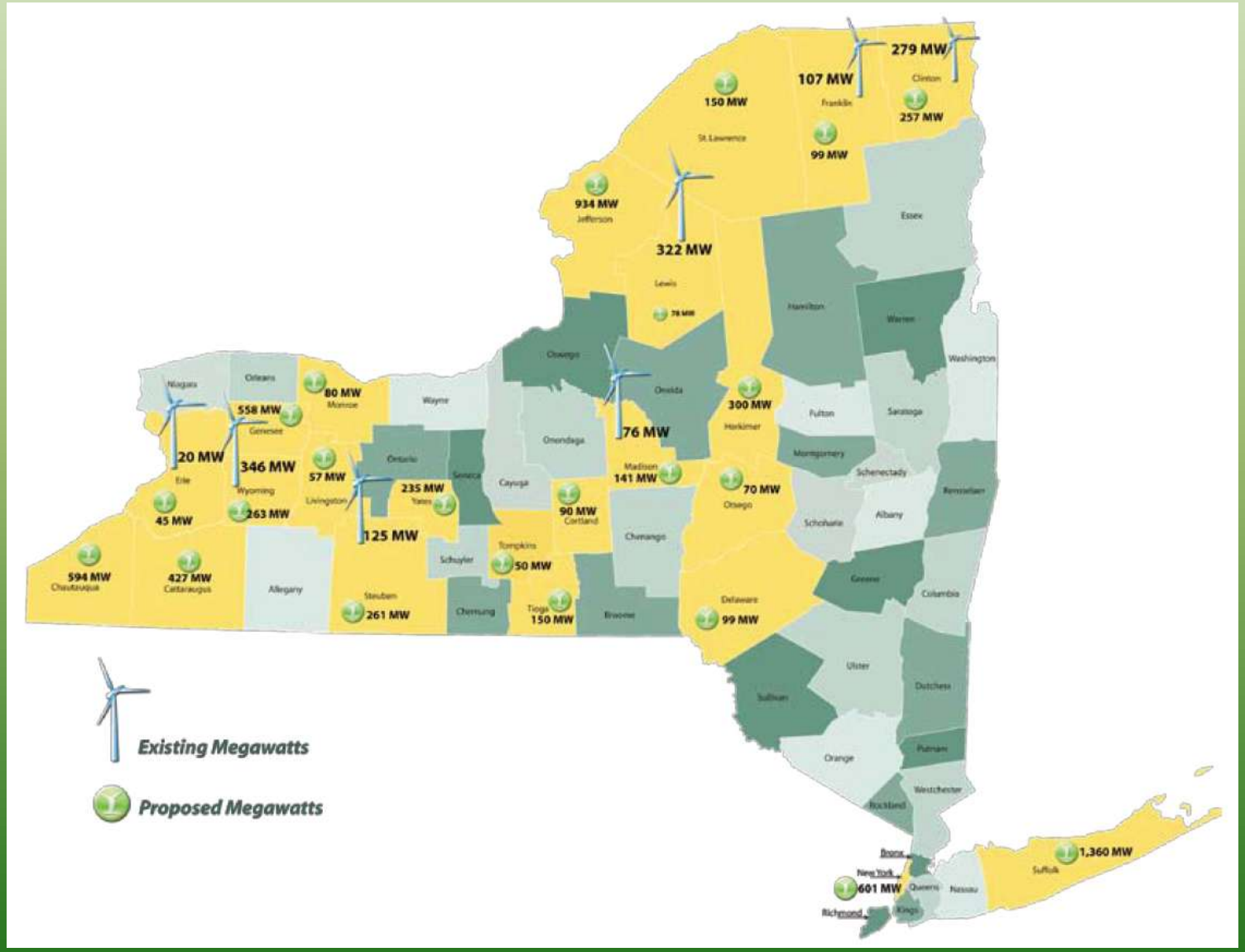
20% Wind Scenario Impact on Generation Mix in 2030

- Reduces electric utility natural gas consumption by 50%
- Reduces total natural gas consumption by 11%
- Natural gas consumer benefits: $86-214 billion*
- Reduces electric utility coal consumption by 18%
- Avoids construction of 80 GW of new coal power plants



Source *: Hand et al., 2008

New York: Existing and Proposed Wind Development



Source: NYISO

Example: Maple Ridge Wind Farm
Tug Hill, NY

- **Enough power for approximately:** 160,000 homes
- **Number of Turbines**: 195
- **Capacity**: 321 MW
- **1.65 MW per Turbine**
- **100 landowners receive approx $1.65 million in lease payments**

Example: Steel Winds
Lackawanna, NY

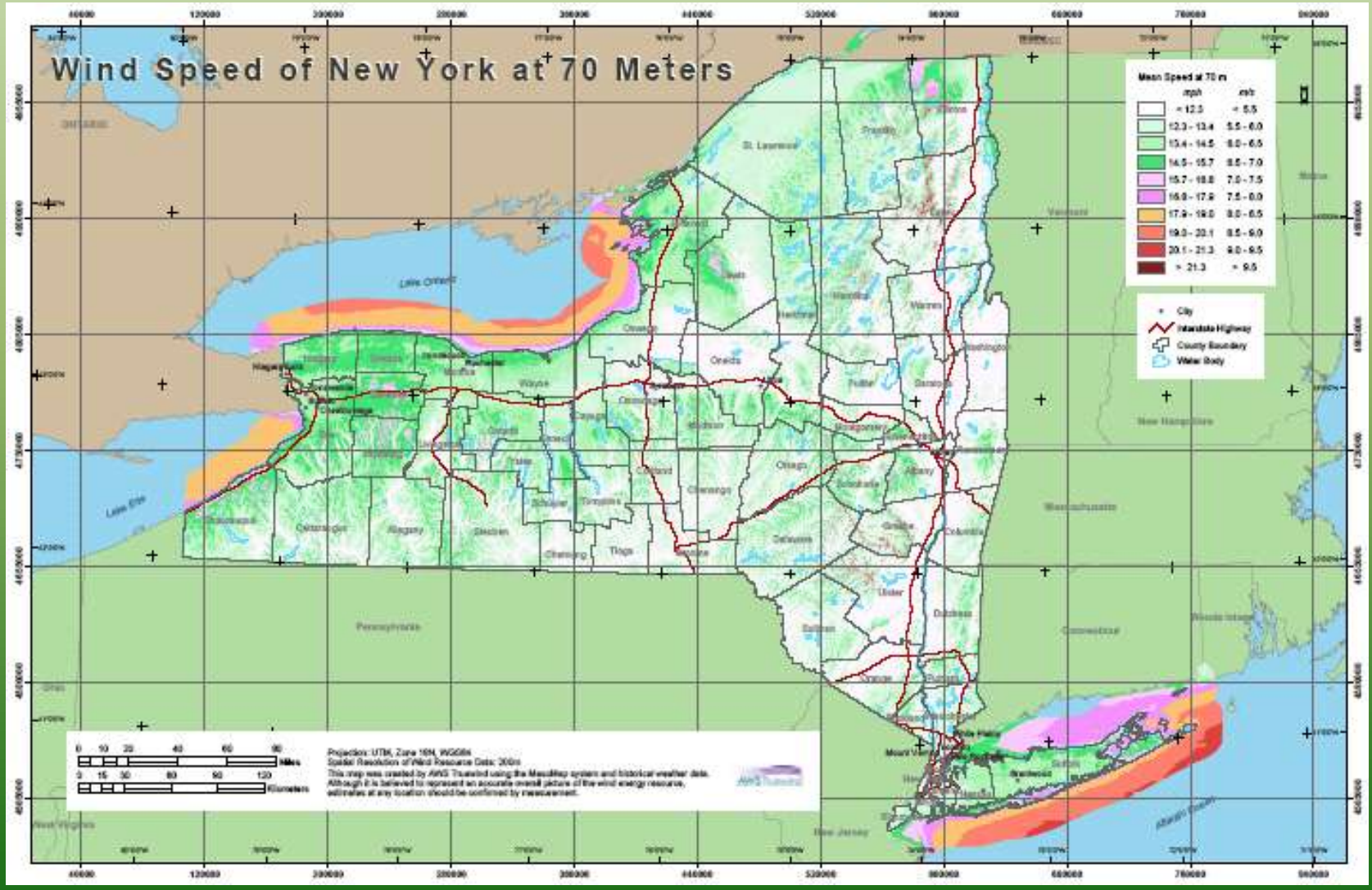
- Largest *urban* wind farm in US
- Brownfield reclamation
- 8 turbines, 20 MW
  2.5 MW per turbine
- Enough power for approximately 6,000 homes
- Proposal to expand

What do you need to build a wind farm?

1. Good winds
2. Available land
3. Sufficient electric transmission capacity
4. Community Participation

1. Good Winds

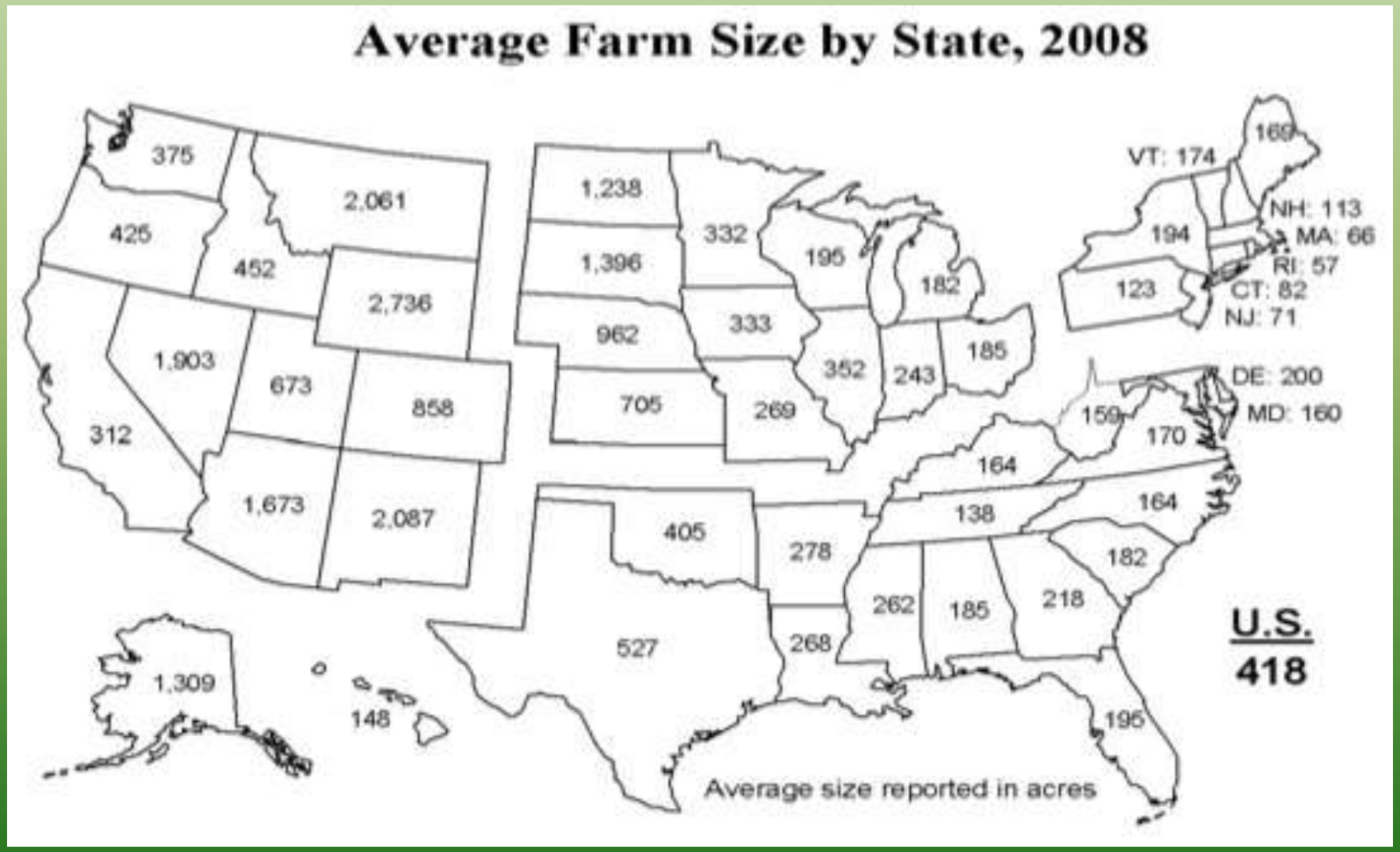
New York ranks 15th in wind energy potential--more than California or any state east of the Mississippi.



Source: AWS Truepower

2. Available Land

New York land parcels tend to be small.



Land in farms and livestock operations
Source: Agricultural Statistics Board, NASS, USDA

3. Electric Transmission Capacity

New York's electrical transmission network can add up to 8,000 MW of wind without affecting reliability.

Source: Growing Wind, Final Report of the NYISO 2010 Wind Generation Study, September, 2010

Transmission “Chicken & Egg” Problem

- Developers will not build wind farms where there is not sufficient transmission capacity
- Utilities unwilling to build additional transmission capacity until there is a proven “need” and state approval to recover costs from customers
- State reluctant to increase rates for transmission investments when there is no reliability need
- “Need” can be for reliability, economics or other policy goals such as increased renewable generation
- Example: Competitive Renewable Energy Zones (CREZ) created in Texas to facilitate investment in transmission to bring wind energy to load centers

4. Community Participation

- A statewide siting process (“Article X”) expired in 2002 but was reenacted in 2011.
  - In absence of Article X, wind projects were approved at the local level according to local zoning ordinances, with environmental review through the State Environmental Quality Review Act (SEQRA).
  - New Article X establishes statewide siting board for all electricity generating plants over 25 MW, including wind farms.

The New Article X

- Provides for a consistent state-wide approach to siting power plants:
  - “Fast-track” one-year timeline from application to decision
  - Siting board can overrule local requirements deemed unreasonably burdensome to applicants
  - Environmental review still required
- Provides for public participation:
  - Two ad-hoc members of the review board selected from the local community
  - Scoping process includes hearings
  - Intervener funds for local groups

Alternative Ownership/Development Model:

Community Wind Energy

- Locally owned/controlled
- Local players get larger share of profits
- Process is bottom-up, NOT top-down
- Wind development conforms to community, not the other way round

Wind Energy and the Environment

Pollution Offsets

Electricity Generation	Coal Fired	Gas Fired	Oil Fired	Wind
MWh produced	350,000	350,000	350,000	350,000
Fuel Consumed	180,000 Tons of Coal	2,500,000 Btu Nat. Gas	560,000 Barrels of Oil	None
Tons CO_2 Emitted	347,673	183,446	296,433	0
Tons NO_x Emitted	865	324	562	0
Tons SO_2 Emitted	1,973	1	2,292	0

Note: this is not a life cycle analysis

Pollution Offsets

Over 20 years, a 1 MW turbine produces 61,320,000 kWh of electricity and saves:

- **55 million lbs of CO_2**
- **198,360 lbs of SO_2**
- **73,580 lbs of NO_x**

(Based on the average fuel mix in New York State).

Source: NYSERDA

NOTE: The amount of electricity a 1 MW-rated turbine actually produces depends on the capacity factor… which depends on the wind resource.

Wildlife Impact Comparison

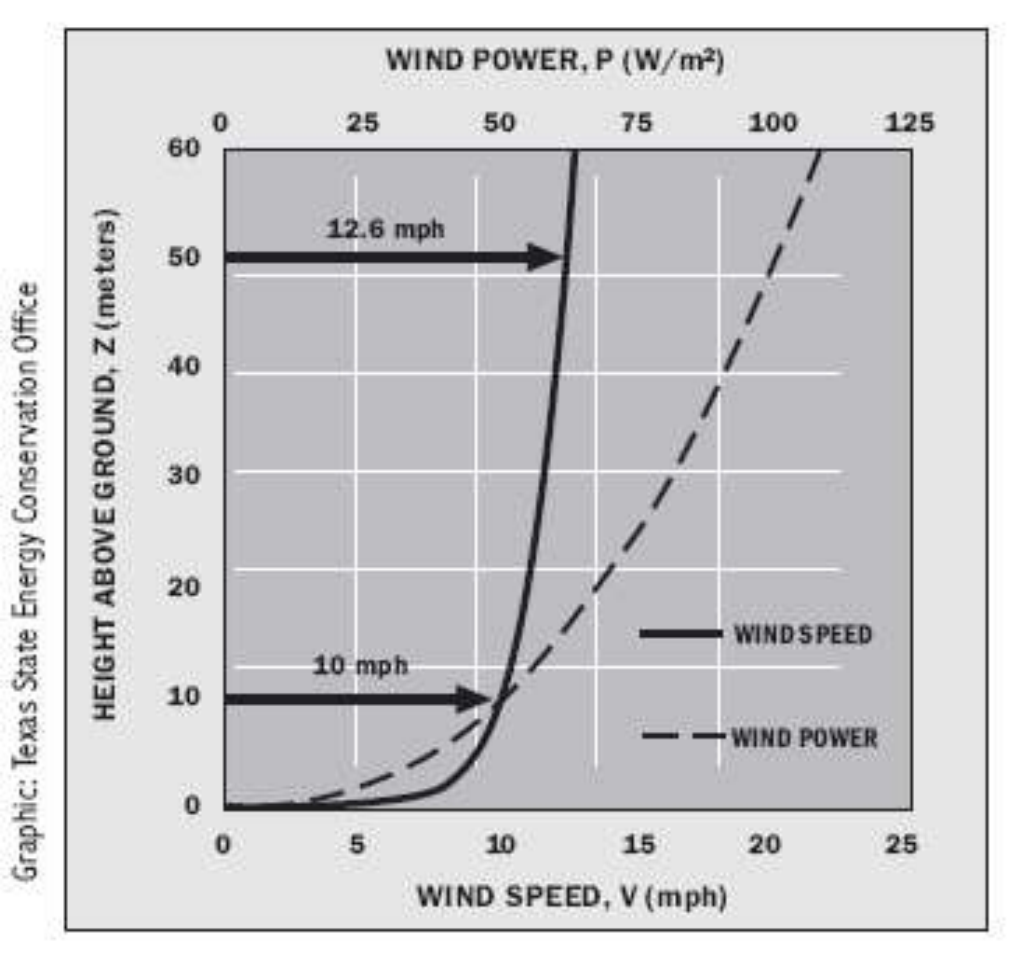
Table 3-1. The potential highest levels of relative wildlife risks for each life cycle stage of each electricity generation source.

Source	Relative Wildlife Risk Level for Potential Harm					
	Resource Extraction	Fuel Transportation	Construction of Facility	Power Generation	Transmission and Delivery	Decommissioning of Facility
Coal	Highest Potential	Lower Potential	Lower Potential	Highest Potential	Moderate Potential	Lower Potential
Oil	Higher Potential	Highest Potential	Lower Potential	Higher Potential	Moderate Potential	Lower Potential
Natural Gas	Higher Potential	Moderate Potential	Lowest Potential	Moderate Potential	Moderate Potential	Lowest Potential
Nuclear	Highest Potential	Lowest Potential	Lowest Potential	Moderate Potential	Moderate Potential	Lowest Potential
Hydro	None	None	Highest Potential	Moderate Potential	Moderate Potential	Higher Potential
Wind	None	None	Lowest Potential	Moderate Potential	Moderate Potential	Lowest Potential

"Coal is by far the largest contributor to risks to wildlife found in the New York and New England region." Source: NYSERDA

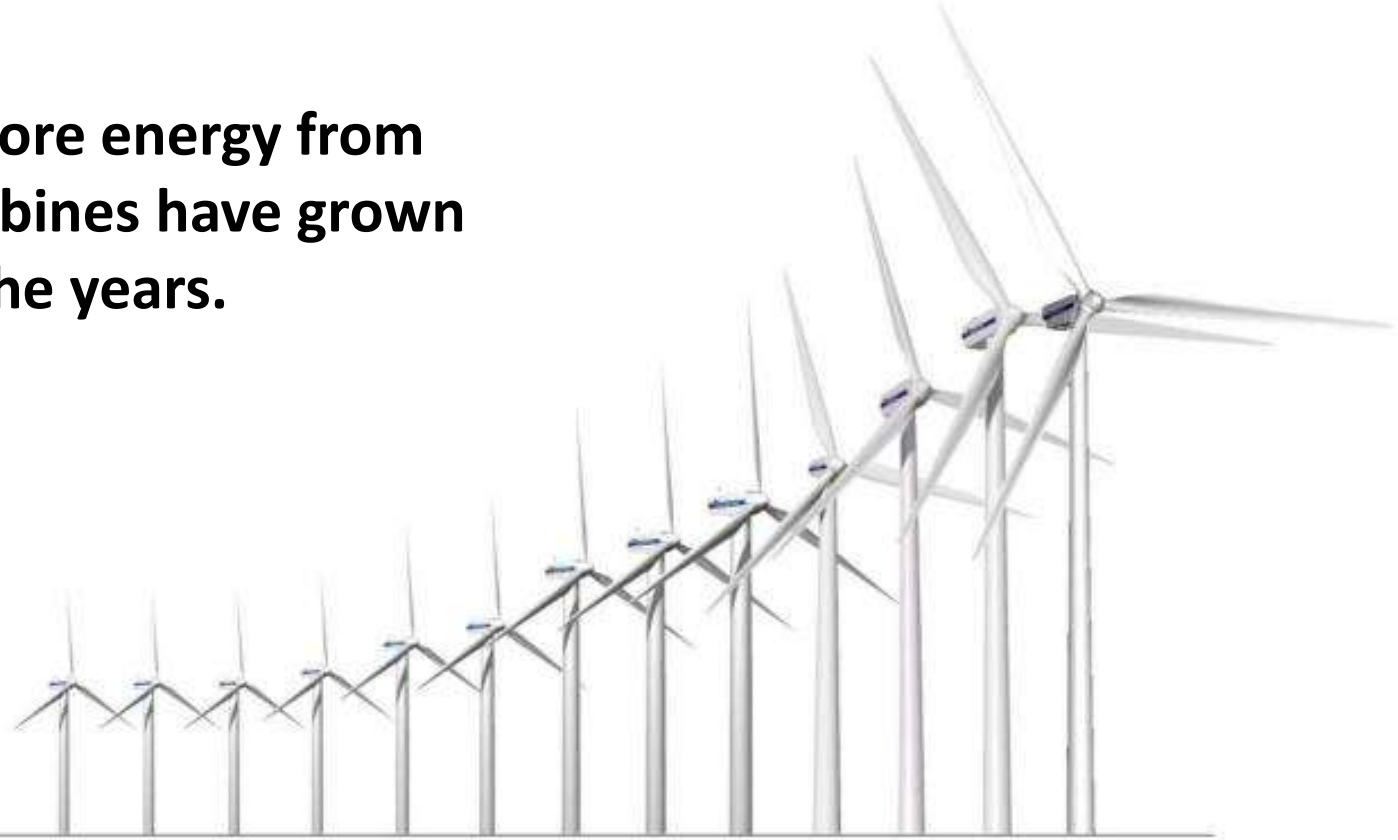
Visual Impacts

Wind power increases with wind speeds;
Wind speeds increase with height



Visual Impacts

To capture more energy from the wind, turbines have grown bigger over the years.



Product/Rotor diameter (m)	V15	V17	V19	V20	V25	V27	V39	V44	V47	V52	V66	V80	V90
Year of installation	1981	1984	1986	1987	1988	1989	1991	1995	1997	2000	1999	2000	2002
Capacity (kW)	55	75	90	100	200	225	500	600	660	850	1750	2000	3000
MWh/year	217	265	301	346	481	647	1304	1581	1947	2530	4705	6768	9152

Source: Vestas

Visual impacts:

Some people enjoy the sight of wind turbines.

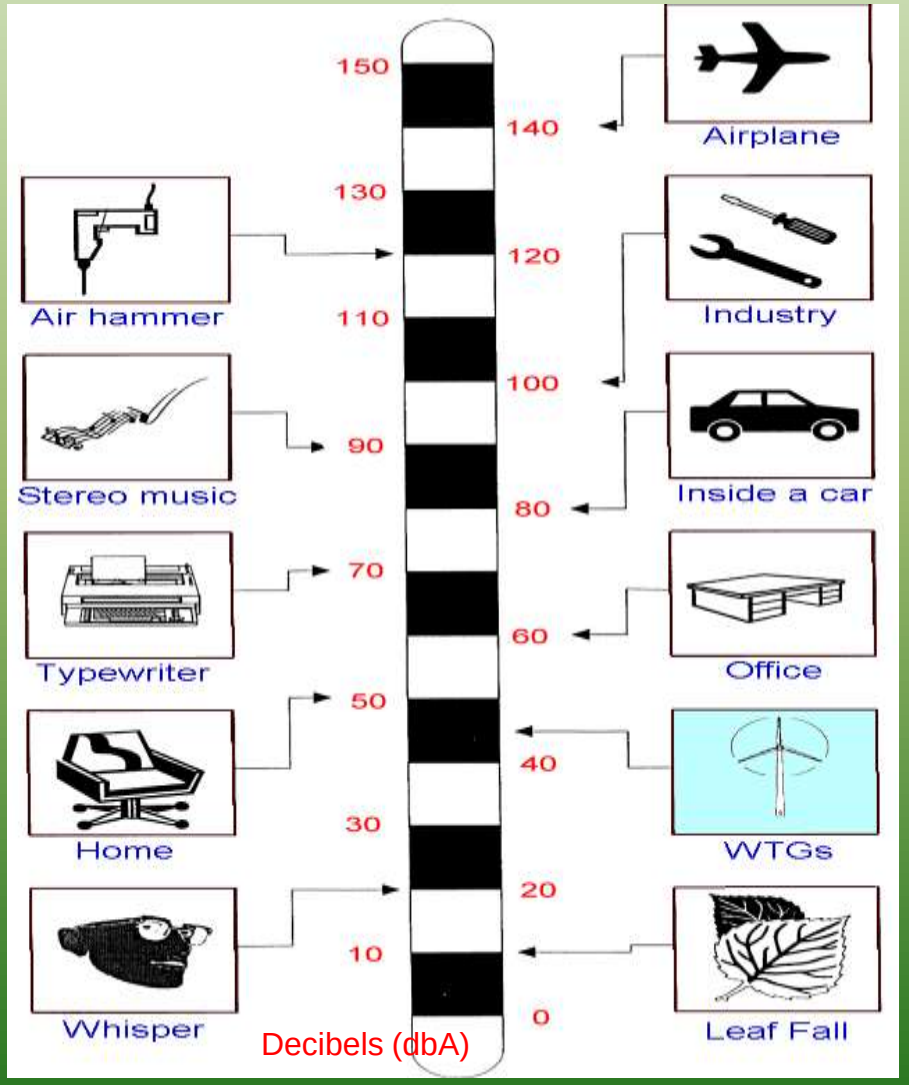
Some don’t.

Photo source: Glenn Cramer

Photo source: Glenn Cramer

Sound Impacts

- Studies have found no evidence that audible or sub-audible wind turbine sounds have any direct physiological effects.*
- Symptoms reported by some individuals may be indirect impacts associated with stress and sleep disturbance
- Some individuals are more sensitive to sound than others.
- Technological advances have decreased turbine sound levels. However, more study is needed on sound propagation from wind turbines.



*Source: 2010 report by Ontario Chief Medical Officer of Health

Bird Impacts

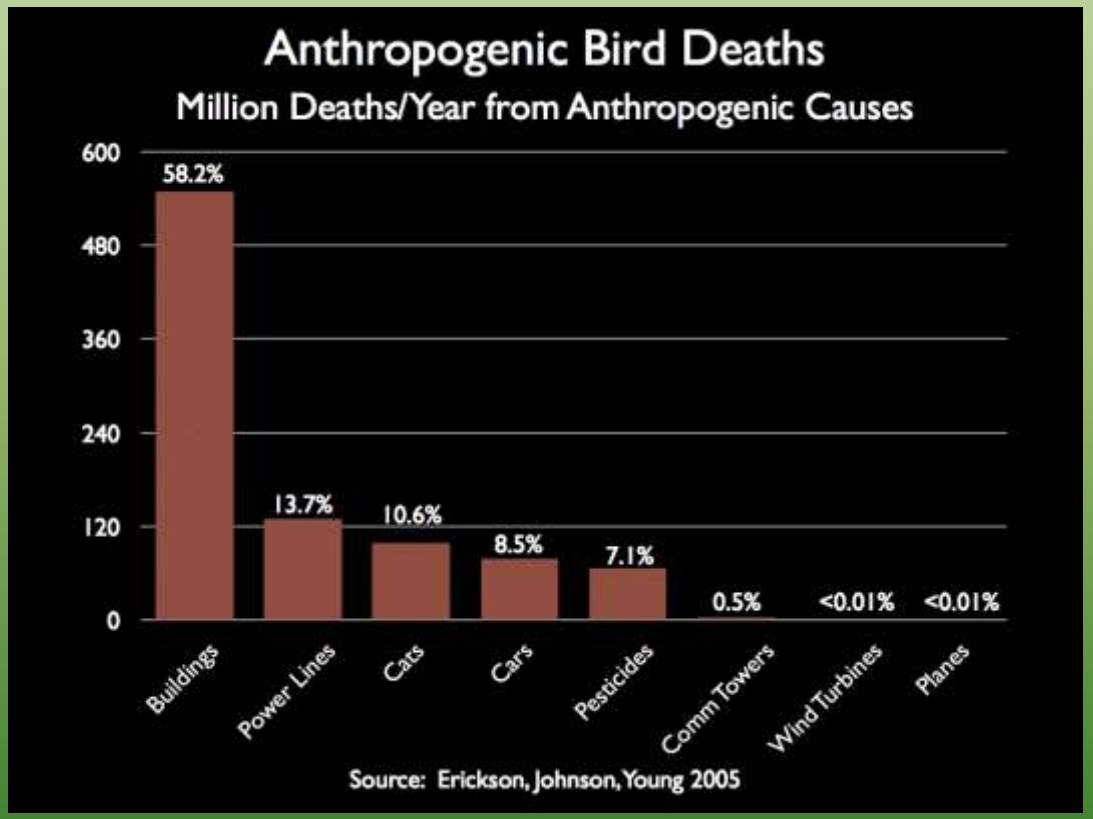
- Technological / Siting improvements:
  - Pre-construction migration studies
  - Monopole design
  - Larger blades/ slower rotations
  - Operational mitigation
- National Research Council: No evidence that existing wind farms are measurably impacting bird populations

Modern, monopole design discourages birds from perching or nesting.

Old lattice style towers encouraged birds to perch and nest. This type of tower is no longer used in utility scale wind installations.

Bird Impacts Put in Perspective

- **National Academy of Sciences:** Wind energy responsible for .003% of human and cat related bird deaths
- **US bird deaths in 2006[1]:**
  - Fossil fuel: 14.5 million
  - Nuclear: 327,000
  - Wind power: 7,000



1) Sovacool, Benjamin K. 2009. *Contextualizing avian mortality: A preliminary appraisal of bird and bat fatalities from wind, fossil-fuel, and nuclear electricity*. Energy Policy 37 (2009) 2241–2248

Bat Impacts

- Bat fatalities have been reported at nearly all wind farms in the U.S.
- Mortalities averaged 0 to 4.3 per turbine per year[1]
- Appalachian regions: mortality rates much higher[2]
- Mortality: higher in low wind, and during migration (summer to fall)[3]

Eastern Red Bat

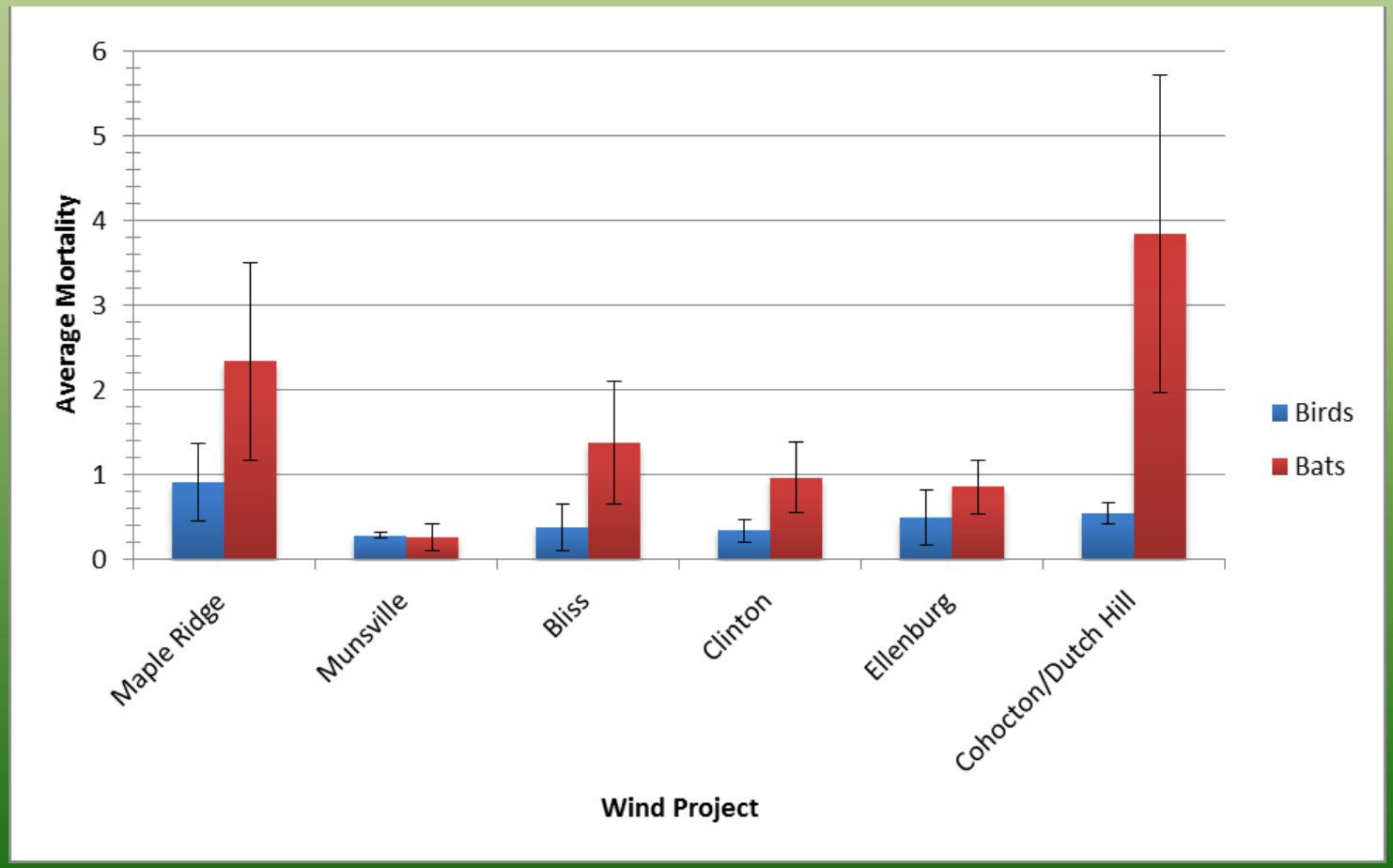
1) US Fish and Wildlife
2) US Fish and Wildlife
3) US Government Accountability Office

Options for Reducing Impacts on Bats

- Pre-construction bat migration studies
- Mitigation
  - Raise cut-in speed (so turbines don't spin at lower wind speeds, when bats tend to fly) – this has reduced fatalities by 83% - 95%
  - Post construction studies (to adopt management practices to reduce bat collisions with turbines)

Bird and Bat Impacts in New York State

Average bird and bat mortality per turbine per month at selected New York State wind farms:

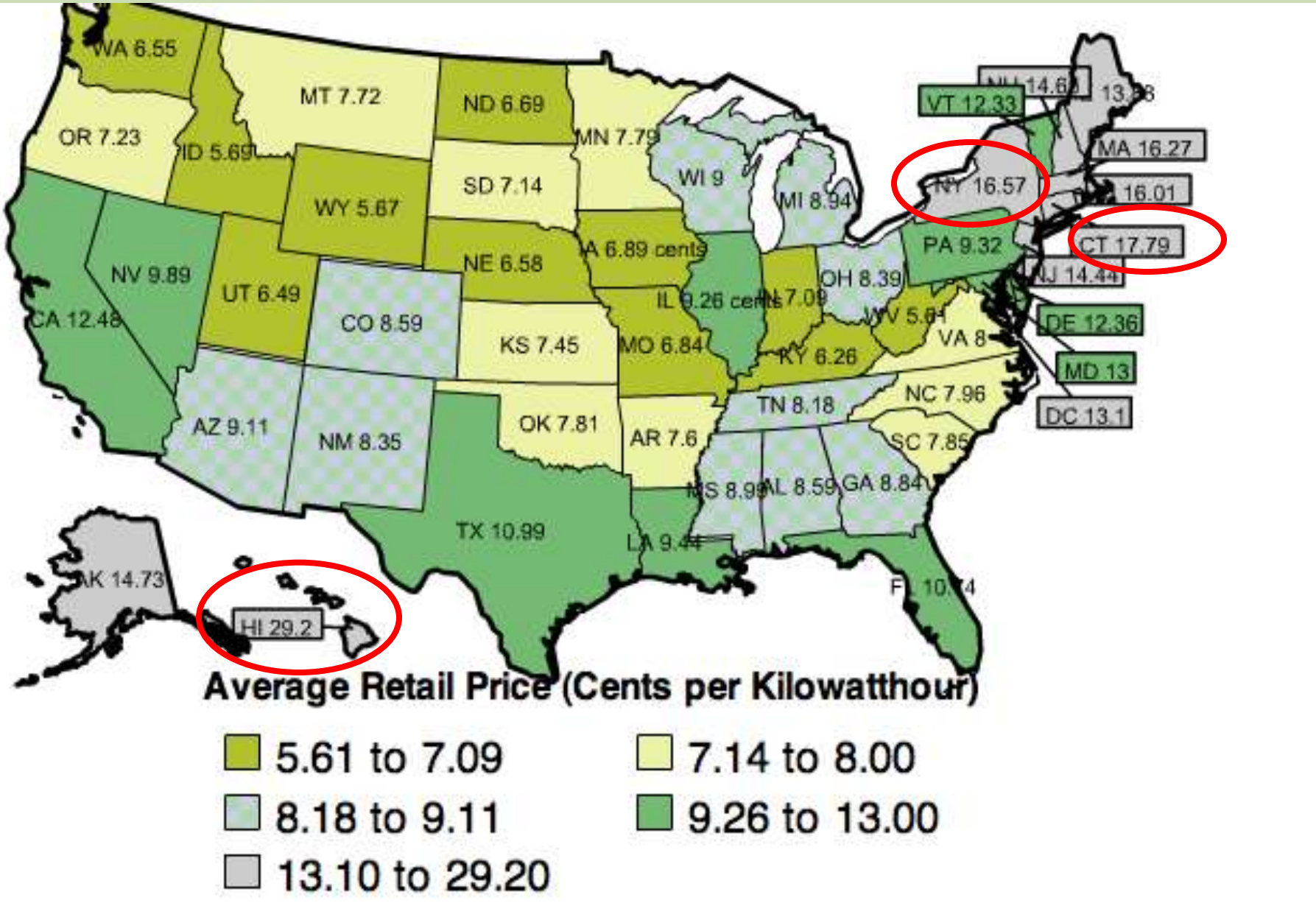


Source: New York State Department of Environmental Conservation (NYSDEC)

Wind Energy and Electricity Costs

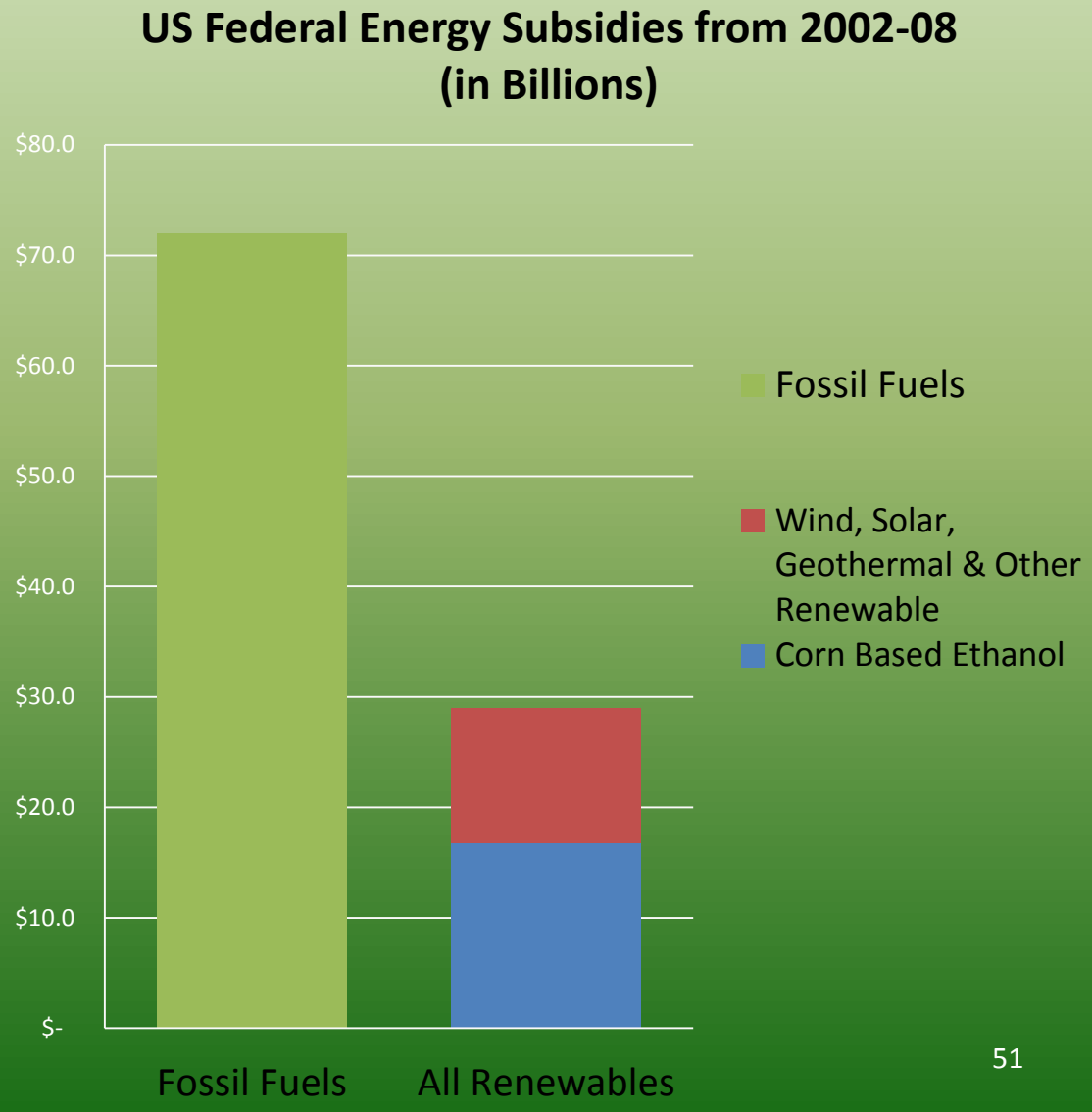
- U.S. Department of Energy: 25% from renewable sources would:
  - Decrease fuel prices across all sectors
  - Have a minimal impact on power prices
- NYISO (Independent System Operator): For every 1,000 MW of wind on New York's power grid, wholesale energy costs are reduced by about $300 million
- National Academy of Sciences (2009): Burning coal costs the U.S. $62 billion a year, primarily in health damages

2008 Average Retail Cost per Kilowatt Hour, by State



Subsidy Comparison

All energy sources are subsidized. However, fossil fuels receive more federal subsidies than renewables.



Source: Environmental Law Institute

Wind Energy and Farmland

Income to leaseholders can be $2,000-$4,000 per turbine, or 2-3% of gross income [1]

This amounts to roughly ten times the average amount of income per half-acre farmed land

Farmers can work around and between wind turbines

[1] U.S. Department of Energy, Electricity from Wind the New Cash Crop.

Wind Energy and Local Economics

PILOT Cases (Payments In Lieu Of Taxes)

Fenner Wind PILOT

- $5,000 per MW (30) = $150,000 per yr
- Residents' property tax went down 33%

Maple Ridge PILOT

- Phase 1 = ~$5.5million
- Phase 2 = $1million

Local Economics: Job Creation

- 85,000 jobs created in US wind industry*
  - Estimated 2,000-3,000 jobs created in NYS in 2009*
  - Construction, maintenance, operation, manufacturing, legal support, and marketing jobs.
- Increase in turbines/ turbine components made in the USA
  - US manufactured less than 25% in 2004, increasing to 50% in 2010*
  - A single turbine can consist of ~8,000 parts

* Source: AWEA

Energy Economics

- Wind helps keep electricity dollars in-state
  - NYS imports 13% of its electricity
- Meeting the 30% RPS goal:
  - More than $6 billion in direct macroeconomic benefits over 20 years
  - Economic “ripple” effects increase total projected benefits to approximately $12.5 billion.

Source: 2009 NYS Energy Plan

Wind Energy and Property Values

Several studies have found no impact on property values due to proximity to, or view of, wind turbines:

- U.S. Dept. of Energy (2009)
- REPP (2003)
- Bard College (2006)

A 2011 study conducted in three upstate New York counties by Clarkson University researchers found that wind turbines reduced property values in Clinton and Franklin Counties, but not in Lewis County. The data for Clinton and Franklin Counties were based largely on pre-operational sales, so the results may be temporary.

Wind Energy Reliability

Real world experience has shown that wind-generated electricity can be added to the grid reliably and without service interruption

- Wind speeds are thoroughly tested prior to siting to ensure adequate average wind speeds
- NYISO: Grid can support 8,000 additional megawatts of wind by 2018 without a problem
- New York has a state-of-the-art wind forecasting system

Wind Energy and Health and Safety: Shadow Flicker

- "Shadow Flicker" occurs when the rotating blades of a turbine come between the sun and an observer.
- Large wind turbines cannot rotate quickly enough to cause epileptic seizures.[1]
- A 2010 Ontario Chief Medical Officer of Health report found "No direct causal link between wind turbines and adverse health impacts."
- Symptoms reported by some individuals may be indirect impacts associated with stress
- Shadow Flicker can be mitigated through setbacks, tree planting, and window treatments

1. Epilepsy Foundation

Wind Energy and Health and Safety: Ice Shedding

- Automated turbine control systems sense icing and shut the turbine down.
- Turbine operators can also shut them down manually in icy conditions.
- The vast majority of turbine ice simply falls to the ground beneath the turbine. Although ice throw is possible in extremely unusual conditions, standard setbacks should be more than sufficient to protect public safety.

Wind Energy Construction

- Potential Impacts from construction
  - Agriculture
  - Roads
  - Environment
- Planning and communication to avoid adverse impacts
- Mitigation

Wind Energy Decommissioning

- Turbines have 20-30 year lifespan
- Responsibility for decommissioning determined before construction
- Developers often post decommissioning bond with the local municipality
- “Repowering” is likely (replacing old turbines with new ones)

Addressing Potential Impacts from Wind Energy Development

Most potential impacts from wind development can be addressed with:

- **Setbacks from buildings, roads, property lines**
- **Environmental impact studies**
- **Noise ordinances**
- **Mitigation**

CONTACT:

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