



The Real Myths About Wind Turbines

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Myth

- noun

An unproved or false collective belief that is used to justify a social institution.

myth. (n.d.). *Dictionary.com Unabridged (v 1.1)*. Retrieved January 14, 2007, from Dictionary.com website:
<http://dictionary.reference.com/browse/myth>

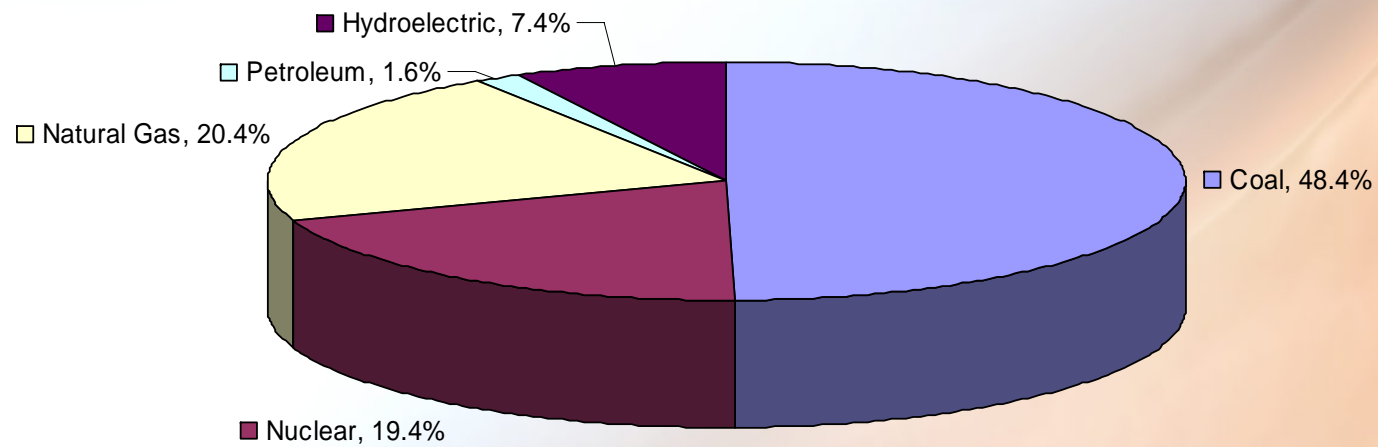


Myth #1

Wind will reduce our dependence on foreign energy.

Myth #1

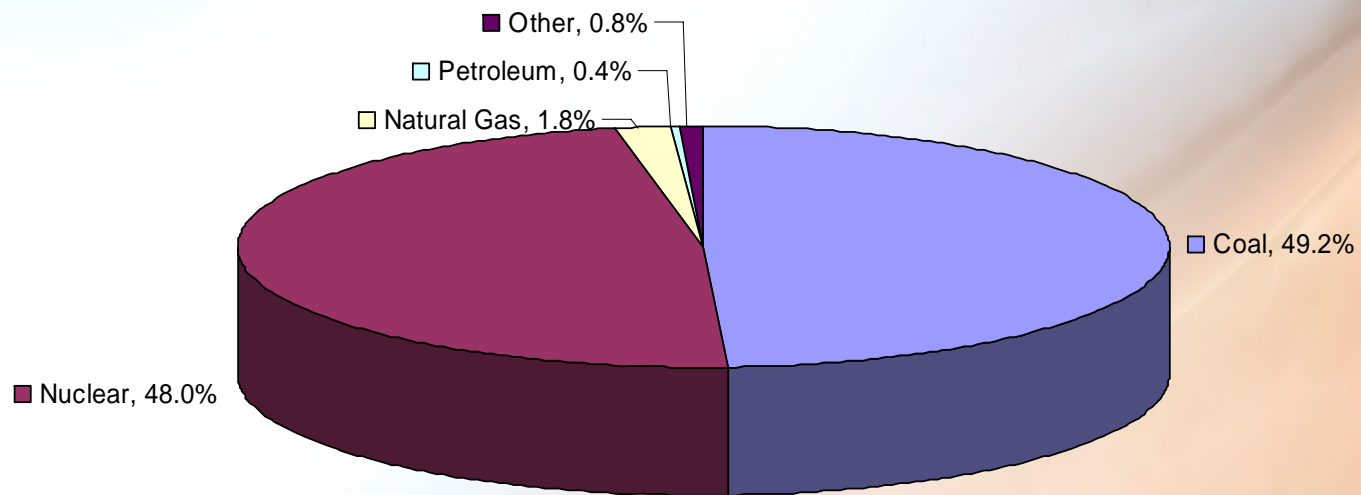
**Net Generation by Energy Source for the U.S.
(January - September 2006)**



Myth #1

Illinois

Net Generation Shares by Energy Source for the State of Illinois



Myth #1

Oil

- In the first 9 months of 2006 the United States generated 3,087,406,000 Megawatthours (MWh) of electricity.
 - Of that, 49,089,000 MWh came from burning petroleum (this includes waste oil).
 - This is 1.59% of the total.
 - It took 58,817,000 barrels to produce this electricity.
 - The U.S. used 5,613,075,000 barrels of oil during this period.
 - That means that 1.0% of U.S. oil consumption is used for generating electricity.
 - The U.S. uses more oil for gasoline in 6 days than we use to produce electricity the entire year.

Myth #1

Oil (Cont.)

- The state of Illinois generates even less electricity from oil than the U.S. as a whole.
 - In 2004 750,651 MWh of electricity were generated from burning oil. This is 0.4% of the total.
 - In the same year Illinois consumed 255,110,000 barrels of oil of which 1,518,000 were used for electricity production. This is 0.6% of our total consumption of oil and constitutes 2.17 days of average use in the state.
 - $1,518,000 \text{ barrels} / 191,957,778 \text{ MWh} = 0.0079 \text{ barrels/MWh}$.
 - Using Invenergy's claimed capacity factor of 0.32 this project would generate 420,480 MWh of electricity per year. (This is 0.2% of the total 2004 electricity production in Illinois).
 - So $420,480 \text{ MWh} \times 0.0079 \text{ barrels/MWh} = 3,322 \text{ barrels of oil saved}$.
 - This is about *7 minutes* worth of oil for the state.
 - This is about *18 seconds* worth of oil for the U.S.

Myth #1

Natural Gas

- Nationally, used to generate 20.4% of all electricity.
- In the first 10 months of 2006 the U.S. used 17.973 trillion cubic feet of natural gas.
- Of this 2.854 trillion cubic feet were imported. That is 15.9% of the total.
- In 2006 5.434 trillion cubic feet of natural gas was used to produce electricity.
- Approximately 0.863 trillion cubic feet was imported. 86% of this was from Canada.
- Recall that Illinois only generates 1.8% of its electricity from burning natural gas which amounted to 0.058 trillion cubic feet (2005).
- The state of Texas consumes this much natural gas in 6 days.

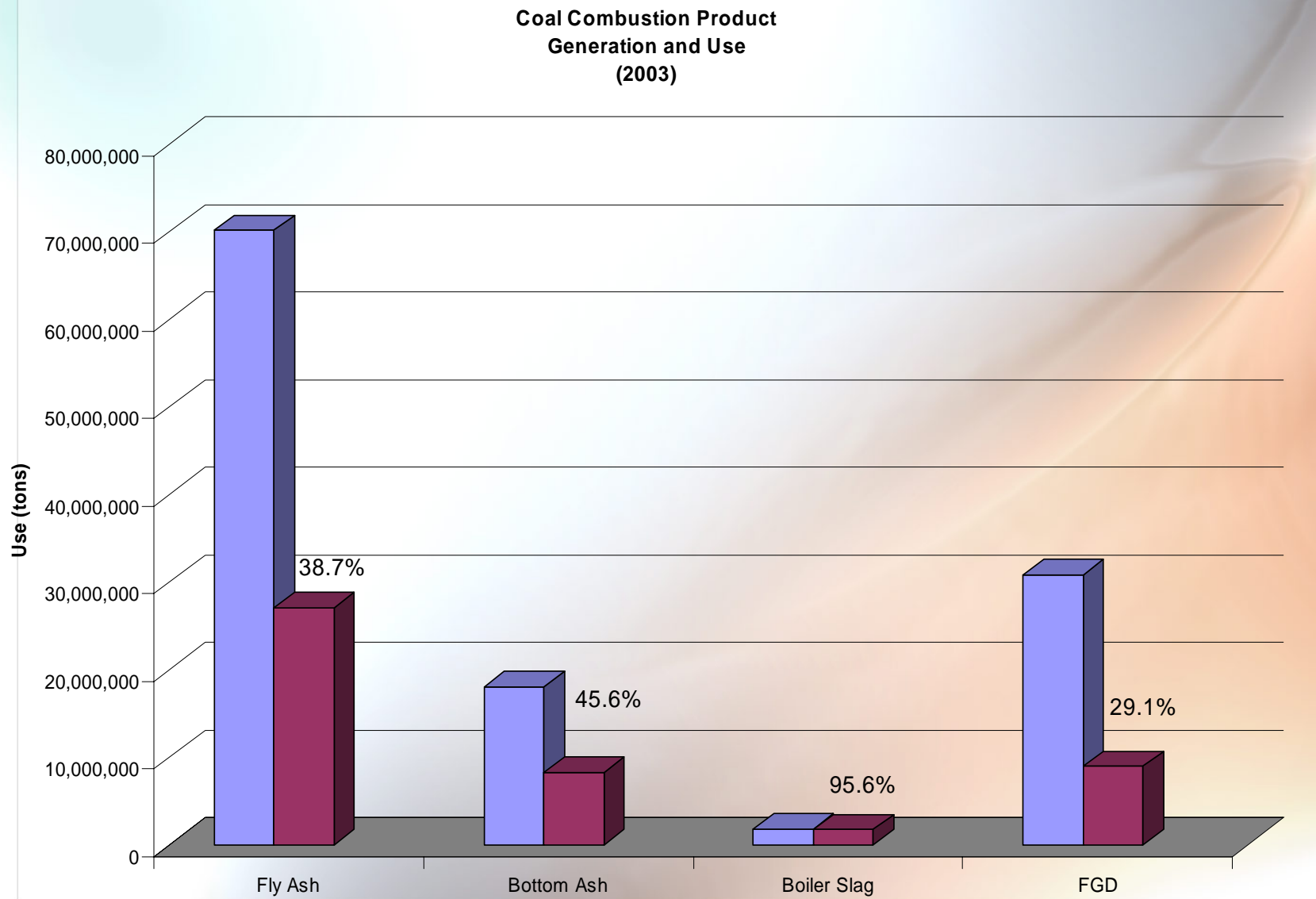
Myth #1

Coal

- 1,493,502,000 of 3,087,406,000 MWh of electricity is produced by burning coal (48.4% of total).
- In the first 9 months of 2006 770,738,000 tons were used to produce electricity. Total coal consumption for this period was 835,930,000 tons. 92.2% of all coal use in the U.S. is for electricity.
- During this same period the U.S. had *net exports* of 9,474,000 tons of coal.
- In 2005 the state of Illinois produced 32,014,000 tons of coal. This made Illinois the 9th largest producer of coal in the United States.
- At \$29.67/ton this generates approximately \$1 billion a year for the state.

Setting the Record Straight

- Contrary to previous testimony, fly ash from coal power plants *is* recycled.



Setting the Record Straight

- What is in fly ash?

<u>Weight %</u>	<u>Fly Ash</u>
SiO ₂	51.88
Al ₂ O ₃	21.05
Fe ₂ O ₃	10.33
SiO ₂ + Al ₂ O ₃ + Fe ₂ O ₃	83.26
CaO	3.17
MgO	0.99
Na ₂ O	1.41
K ₂ O	2.4
S	0.34

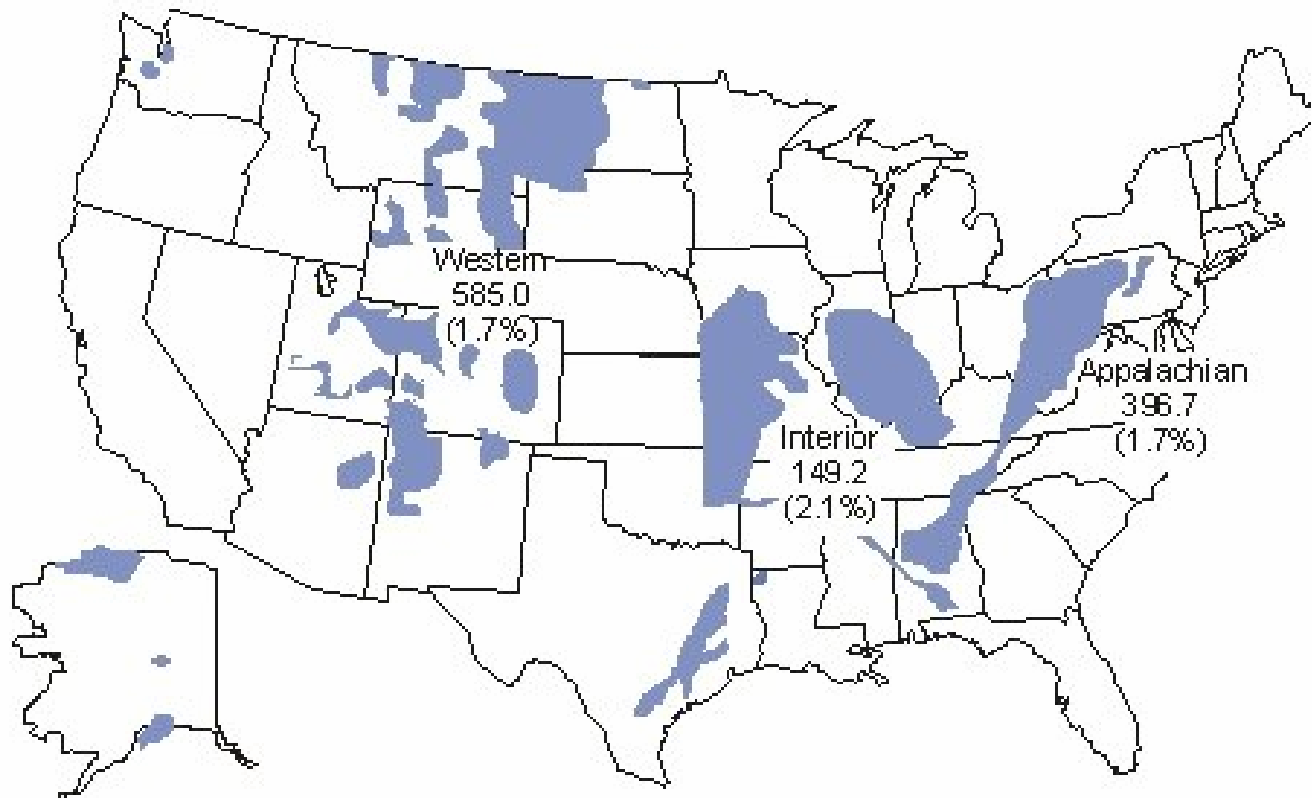
Setting the Record Straight

- What is in fly ash?

Weight %	Fly Ash	Clay
SiO ₂	51.88	57.69
Al ₂ O ₃	21.05	22.38
Fe ₂ O ₃	10.33	2.4
SiO ₂ + Al ₂ O ₃ + Fe ₂ O ₃	83.26	82.47
CaO	3.17	0.35
MgO	0.99	0.63
Na ₂ O	1.41	0.04
K ₂ O	2.4	1.64
S	0.34	0.67

Myth #1

- Adding hundreds of wind turbines will do *almost nothing* to help U.S. dependence on foreign energy.
- It could even *hurt* the state of Illinois economy.





Myth #2

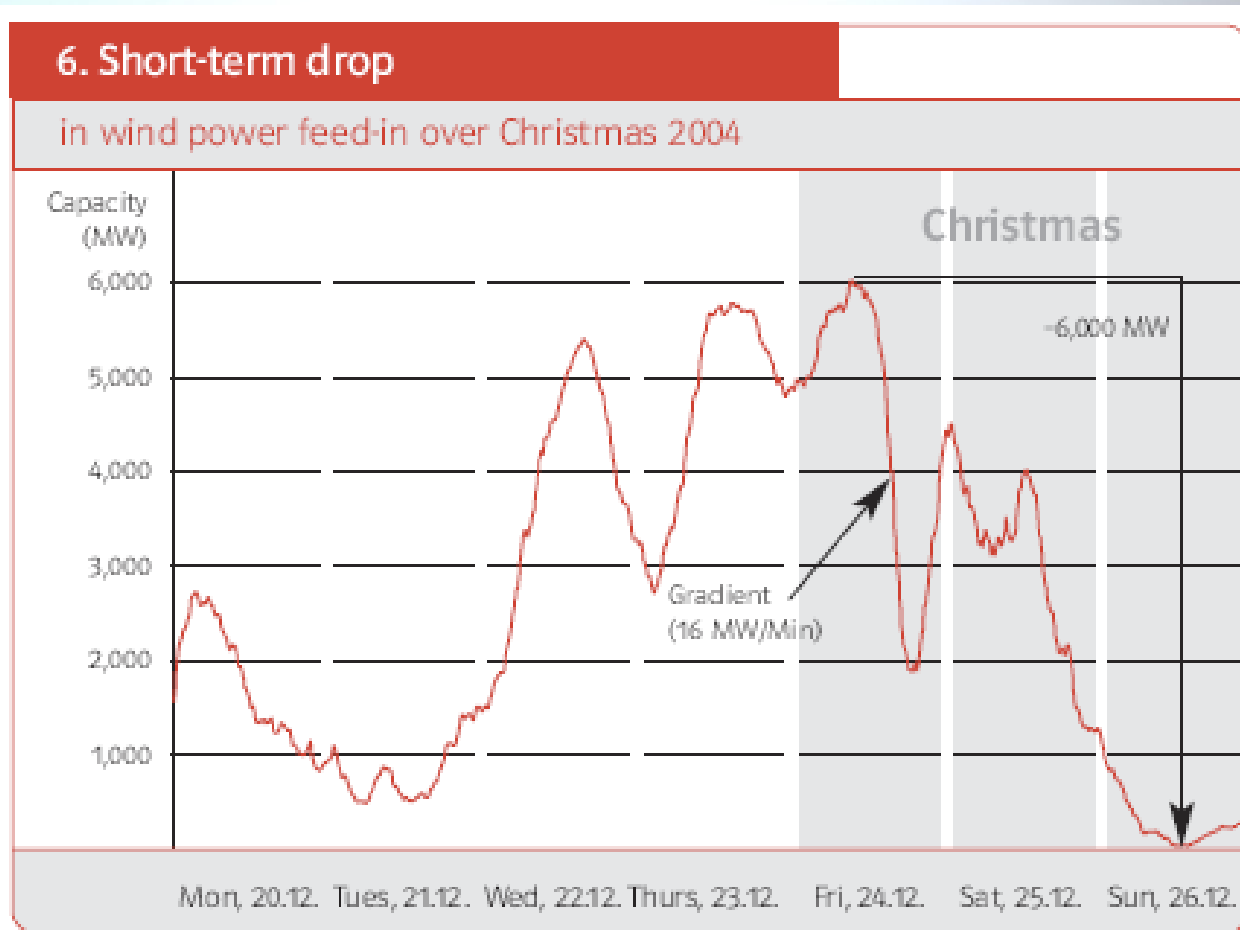
These turbines will provide enough electricity to power as many as 50,000 homes.

Myth #2

- The rule of thumb the energy industry uses is that producing 1 MW continuously could provide electricity for about 1000 homes.
- First (minor point), it assumes a “capacity factor” (CF) of 30%. That is, that the wind turbines will, on average, produce about 30% of their rated, or nameplate, capacity.
- The calculation is $\text{Power Produced} = \text{rated capacity} \times \text{CF} = \text{total MW}$. Thus the calculation used was $150 \text{ MW} \times 0.3 = 50 \text{ MW}$ or 50,000 homes.
 - This number is too large.
 - Denmark 2002 CF=16.8%
 - Denmark 2003 CF=19%
 - Germany 1998-2003 average CF was 14.7%
 - In 2004 Germany’s average CF was 18%
 - England 2003 CF was 24.1% (England is the windiest country in Europe)
 - Using a more realistic, but still generous, CF of 20% this project will “provide” electricity for about 30,000 homes.

Myth #2

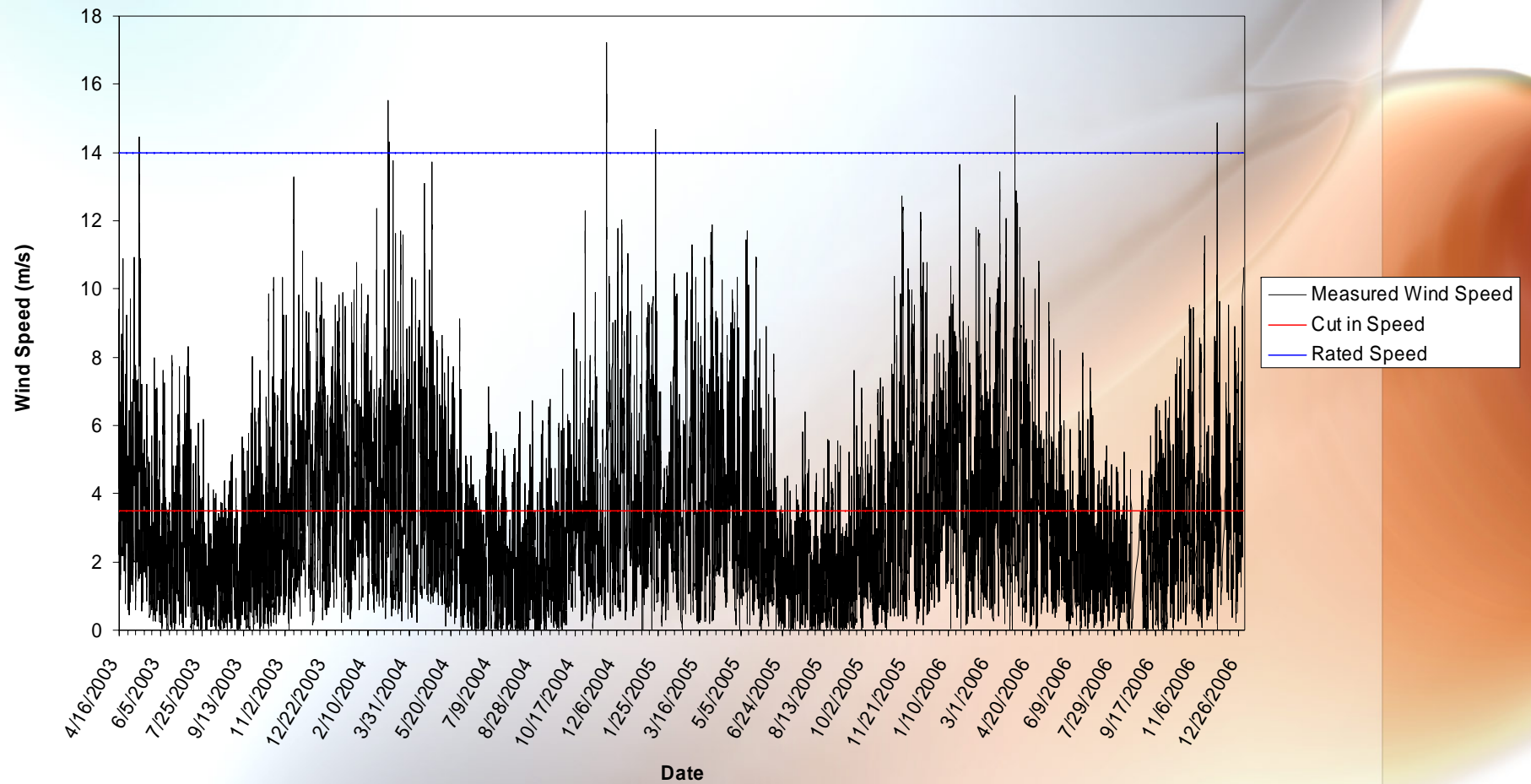
- The second (major) problem with this statement is that it assumes that all of the electricity produced will be used.
- Wind generated electricity is notoriously intermittent.



Myth #2

This is not unique to Germany

Hourly Wind Speed at Champaign Illinois
(Corrected to 80 m)



Myth #2

- These fluctuations are dangerous to the electrical grid.
- In 2004 the state of Illinois generated a total of 191,957,778 MWh.
- With a population of 12.8 million that equates to an average of 14.9 MWh/person/year.
- For McLean county with a population of $\approx 160,000$ this equates to 2,400,000 MWh/year. That is a average capacity of 274 MW (continuously).
- If approved, the two wind farms (Invenergy's and Horizon's) in McLean County would have a potential capacity of $150 + 396 = 546 \approx 550$ MW.
- That is over half of the Clinton Nuclear Plant (1043 MW) and about twice what B-N normally uses.
- What happens if a storm comes through and all of these turbines start producing at or near their capacity?
- What happens after the storm moves through and they drop back to about zero?

Myth #2

- Power outages.
 - In November 2006 there was a massive power outage over parts of Germany, Italy, France and Spain that left over 10 million people without power for up to several hours.
 - This outage was due to the high number of wind turbines in Germany.
 - These turbines had put too much stress on the electric grid.
 - Combined with high demand, this crashed the electric grid over 4 countries.

Myth #2

- Electricity is a unique commodity in that there is no real storage method. That is, electricity *must be used as soon as it is produced*.
- The problem is wind turbines produce the most electricity when demand is lowest, for example at night:

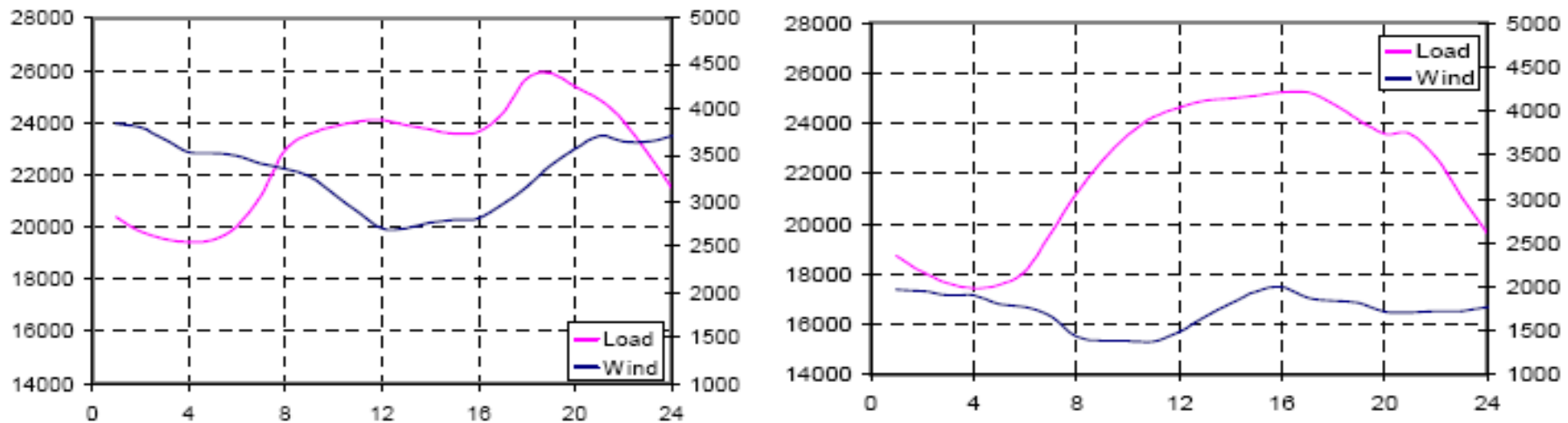
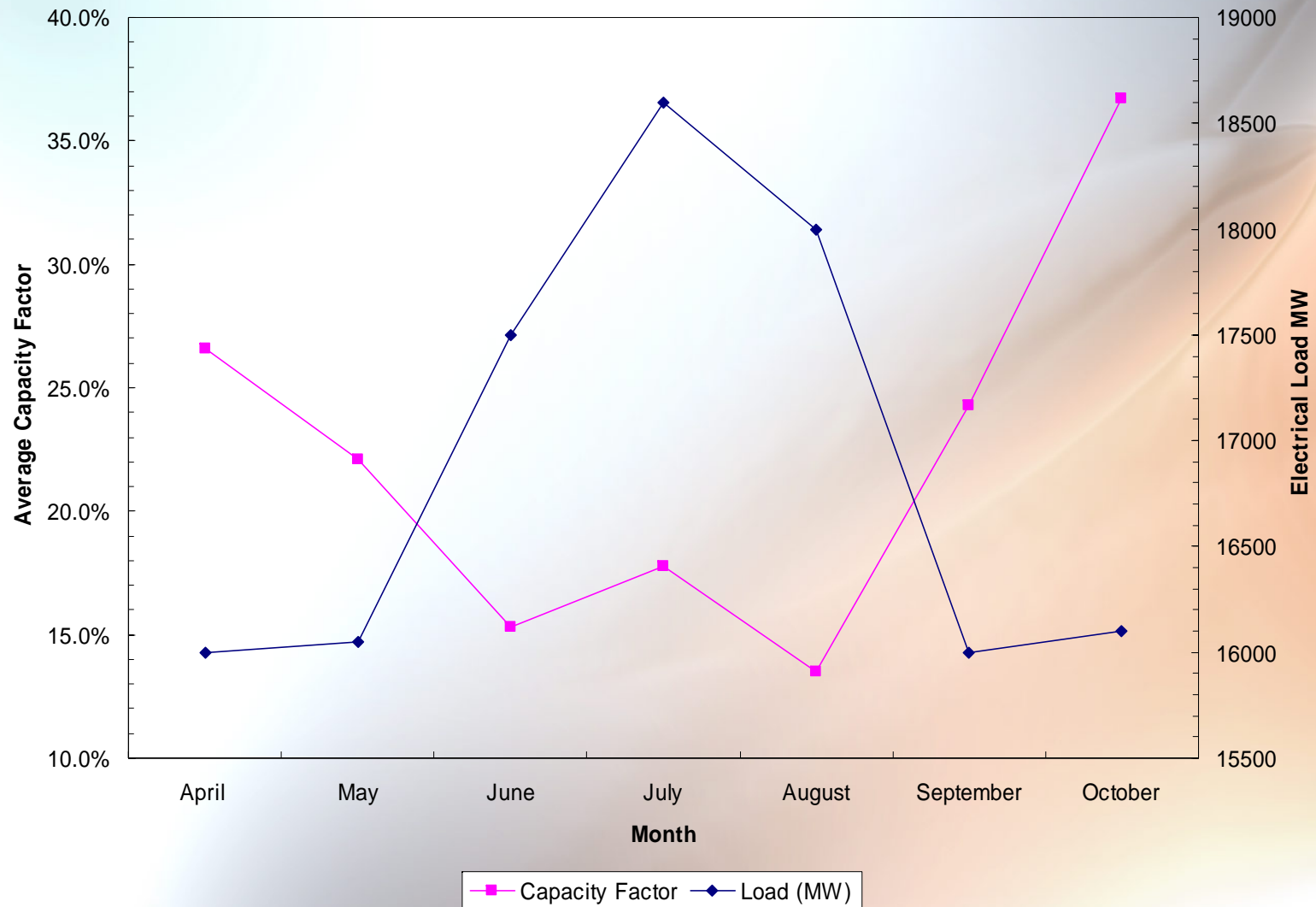


Figure 5.12 January and July Average Daily Profiles for 2020 Load and 10,000 MW of Wind

Myth #2

And in the winter
Capacity Factor and Electrical Demand



Myth #2

- **If you don't believe me, believe Invenergy!**

Fact #1: Natural Gas is the Cleanest Fuel for Region's Need.

- Cleanest fuel and technology to meet the region's need for electricity.
- Wind and hydroelectric are not options on the hottest and coldest days.
- Metropolitan Emissions Reduction Program to convert two coal plants in Minneapolis and St. Paul to natural gas.
- The Legislature has shortened the permit process for natural gas plants because they use the cleanest fuel.



Myth #2

- **This inverse relationship is so bad that in 2003 Denmark actually dumped 84% of the power that their turbines did generate into neighboring countries (they used 3.2% of the nameplate capacity (0.16×0.20)).**
- **In Germany currently only about 6% of the installed capacity is considered as reliable as traditional plants (that is expected to drop to 4%).**
- **In England 200MW/7300MW or 2.7% is considered reliable.**
- **Using a CF of 0.04 to represent the amount of useful electricity that this project will generate it will produce enough reliable electricity to power approximately 6,000 homes per year, not 50,000.**

Myth #3

These turbines will reduce carbon dioxide (CO₂) emissions by 480,000 tons annually.

Myth #3

- These types of numbers are notoriously hard to calculate.
- However, there are actual numbers for the state. According to the DOE each MWh of electricity produced in Illinois in 2004 generated 1,152 pounds of CO₂.

Table 1. 2004 Summary Statistics

Item	Value	U.S. Rank
Illinois		
NERC Region(s).....		MAIN/MAPP
Primary Energy Source		Coal
Net Summer Capability (megawatts).....	42,032	5
Electric Utilities	2,994	36
Independent Power Producers & Combined Heat and Power	39,037	3
Net Generation (megawatthours)	191,957,778	5
Electric Utilities	19,184,751	36
Independent Power Producers & Combined Heat and Power	172,773,027	3
Emissions (thousand metric tons)		
Sulfur Dioxide.....	385	11
Nitrogen Oxide.....	143	8
Carbon Dioxide.....	100,325	6
Sulfur Dioxide (lbs/MWh).....	4.4	27
Nitrogen Oxide (lbs/MWh).....	1.6	37
Carbon Dioxide (lbs/MWh).....	1,152	36
Total Retail Sales (megawatthours).....	139,253,956	7
Full Service Provider Sales (megawatthours).....	112,186,918	8
Deregulated Sales (megawatthours).....	27,067,038	4
Direct Use (megawatthours).....	4,280,370	10
Average Retail Price (cents/kWh).....	6.80	28

Myth #3

- Using this value and a CF of 0.20 these turbines would “reduce” CO₂ emissions by:

$$150 \text{ MW} \times 24 \text{ hours/day} \times 365 \text{ days/year} \times 0.20 = 262,800 \text{ MWh}$$

$$262,800 \text{ MWh} \times 1,152 \text{ pounds CO}_2/\text{MWh} = 302,745,600 \text{ pounds CO}_2$$

$$302,745,600 \text{ pounds CO}_2 \div 2000 \text{ pounds/ton} = 151,373 \text{ tons CO}_2$$

- While much lower than claimed (by a factor of ca. 3.2), these numbers are still too high.
- First, only about 4% of the nameplate capacity can reliably replace traditionally generated electricity. Using this number gives:

$$150 \text{ MW} \times 24 \text{ hours/day} \times 365 \text{ days/year} \times 0.04 = 52,560 \text{ MWh}$$

$$52,560 \text{ MWh} \times 1,152 \text{ pounds CO}_2/\text{MWh} = 60,549,120 \text{ pounds CO}_2$$

$$60,549,120 \text{ pounds CO}_2 \div 2000 \text{ pounds/ton} = 30,275 \text{ tons CO}_2$$

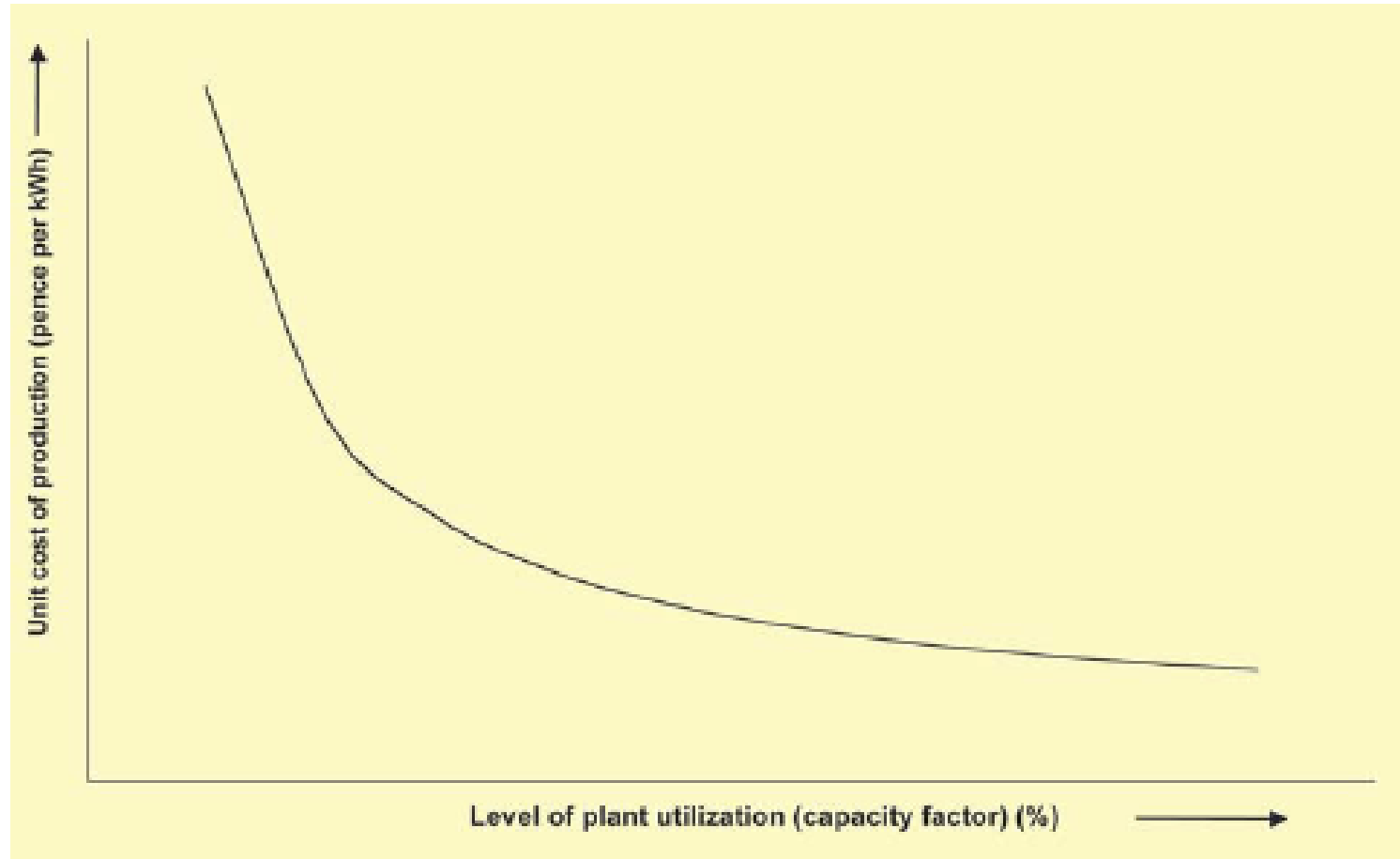
Myth #3

- This is less than the claimed value by a factor of ca. 15.85. However, even this number is too high.
- Why? Reserve power (spinning reserve). In order to maintain a constant supply of electricity, and to be prepared for spikes in demand, power plants run in two modes.
- Base load – plant is running all the time (except for repairs etc.)
- Spinning reserve – the plant is running, but not producing electricity. That is, fuel is being burned (with all of the associated pollution), the turbines are spinning, but no electricity is sent out.

Myth #3

- Obviously, this isn't very efficient.

Figure 2.1 – Effect of plant utilization on the unit cost of electricity production



Myth #3

- What does this have to do with wind energy?
- Everything. As shown earlier wind power is extremely unreliable. That means that an almost equal amount of fossil fuel power must be kept on spinning reserve to back up the turbines.

Installed Wind Capacity (MW)	Conventional Capacity (MW)	Reserve Capacity (MW)
500	59,000	9,500
7,500	57,000	14,500
25,000	55,000	30,000

- To insure that 50,000 MW is available you need 18,500 MW extra conventional and reserve (with 500 MW wind capacity)

Myth #3

- However, increase wind capacity to 25,000 MW and conventional capacity drops by only 4,000 MW but reserve capacity jumps to 30,000 MW. *So an increase in wind capacity of 24,500 MW must be accompanied by a net increase in conventional (fossil fuel) capacity of 16,500 MW which is operating in the inefficient spinning reserve mode.*
- *Since the CF for these turbines is 0.25 the 24,500 MW increase in wind capacity would only produce 6000 MW. Therefore, you actually need ca. 2.75 MW of extra conventional reserve for every 1 MW of actual wind energy produced.*
- Germany has had a similar experience. At least 90% of the nameplate capacity of their wind turbines is backed up by conventional electrical generation. So at any given time there is *at least 14,750 MW* in spinning reserve to back up the 16,400 MW of wind (nameplate) capacity.

Myth #3

This is expensive.

- Not only must new plants be built but the electrical companies must be paid for this spinning reserve (which is inefficient and therefore expensive).
- To maintain this scenario either prices must rise very high or else electricity consumers must become very responsive to short-term (i.e. half-hourly) “price spikes” with all of the consequences and problems posed by possible government or regulatory intervention in the market.
- Electrical prices could increase by 15% or more.
- The costs of upgrading the local electrical grid to handle wind power is unknown, however in Germany estimates have run as high as \$1.5 billion.
- *It also means that there is little to no net CO₂ reduction.*

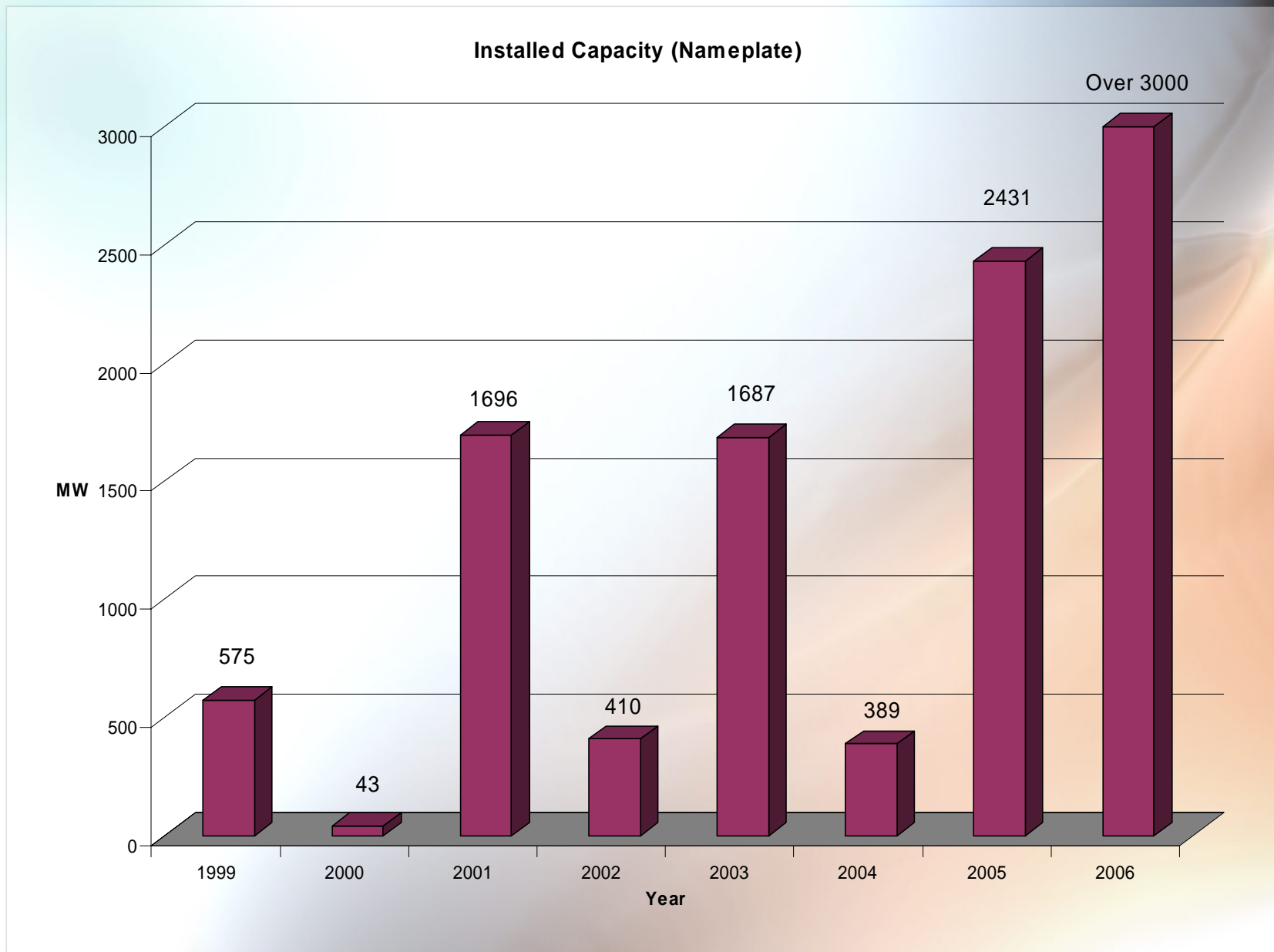
Why build?

- Recall that a myth is “*An unproved or false collective belief that is used to justify a social institution*”.
- Everything I have discussed up to this point begs a certain question.
- Namely, What social institution are these myths protecting? That is, if there are so few benefits why are these turbines being built in the first place?
- The answer is easy... Money.

Tax Breaks

- The Energy Policy Act of 2005 contained:
 - \$4.4 billion in tax breaks for coal energy
 - \$4.3 billion in tax breaks for nuclear energy
 - \$2.7 billion in tax breaks for renewable energy
- In 2005 the U.S. produced 4,054,688,000 MWh of electricity.
 - 2,015,179,936 MWh came from coal
 - 782,554,784 MWh came from Nuclear
 - 93,257,824 MWh from all renewables (excluding hydro).
- Dividing the tax breaks by MWh generated gives;
 - \$2.18/MWh for coal
 - \$5.49/MWh for nuclear
 - \$28.96/MWh for renewable energy. (13.28 times coal and 5.27 times nuclear for actual production).

Effect of PTC



Estimated Tax Breaks

- If you don't believe that these projects are for the tax breaks alone, then believe the developers.

Wind farm waits for testing, tax credit

- The wind-energy company will not move forward on the project unless a federal tax incentive is re-established.

BELVIDERE — Plans for a wind farm in Boone County are at a standstill because a federal tax incentive to help the wind energy industry expired last year.

“If we don't have a tax credit, there will be none (wind farms) developed this year or next year in Illinois,” said White.

Effect of PTC

- **Not all of these tax breaks go towards making the price of wind generated electricity competitive.**
- **These projects often use a “Flip Structure” where investors receive the cash and tax benefits of a project until they make a preset profit off the project.**
- **If the investors receive the tax benefits the company is not using them to keep their prices competitive with other forms of electric production.**
- **With a state Renewable Portfolio Standard (RPS) they don't have to. Utilities such as Ameren IP or Cornbelt Electric are forced to buy a percentage of their power from renewable sources. Those costs are passed on to the consumer.**

Abandoned Turbines

- What happens when the tax credits expire?
- The project is abandoned.
- There are an estimated 2,000 to 4,500 turbines abandoned in California alone.

Summary

- **Even if you believe Invenergy's numbers this project will (per year):**
 - **Increase Illinois electric generation by 0.2%**
 - **Reduce foreign oil use by 18 seconds (3,322 barrels).**
 - **Reduce anthropogenic SO₂ emissions by:**
 - **0.7% statewide (Should be 0.1%)**
 - **0.005% nationwide**
 - **Reduce anthropogenic NO_x emissions by:**
 - **0.5% statewide (Should be 0.1%)**
 - **0.006% nationwide**
 - **Reduce anthropogenic VOC emissions by:**
 - **0.01% statewide**
 - **0.00004% nationwide**
 - **Reduce anthropogenic CO emissions by:**
 - **0.06% statewide**
 - **0.00005% nationwide**

Summary

- **Even if you believe Invenergy's numbers this project will (per year):**
 - **Reduce anthropogenic particulate emissions by:**
 - **0.002% statewide**
 - **0.00003% nationwide**
 - **Reduce Mercury emissions by:**
 - **0.003% statewide (anthropogenic)**
 - **0.0001% nationwide (anthropogenic)**
 - **0.000004 % (total) (4 one millionths of one percent)**
 - **Reduce CO₂ emissions by:**
 - **0.2% statewide (anthropogenic)**
 - **0.006% nationwide (anthropogenic)**
 - **0.0018% worldwide (anthropogenic)**
 - **0.00005% worldwide (total)**

Summary

- **More realistic numbers are that this project will (per year):**
 - Increase Illinois electric generation by 0.03%
 - Reduce foreign oil use by 1.5 seconds (360 barrels).
 - Reduce anthropogenic SO₂ emissions by:
 - 0.012% statewide
 - 0.00006% nationwide
 - Reduce anthropogenic NO_x emissions by:
 - 0.011% statewide
 - 0.0007 nationwide
 - Reduce anthropogenic VOC emissions by:
 - 0.001% statewide
 - 0.000005% nationwide
 - Reduce anthropogenic CO emissions by:
 - 0.007% statewide
 - 0.000006% nationwide

Summary

- **More realistic numbers are that this project will (per year):**
 - **Reduce anthropogenic particulate emissions by:**
 - **0.00025% statewide**
 - **0.000004% nationwide**
 - **Reduce Mercury emissions by:**
 - **0.0004% statewide (anthropogenic)**
 - **0.00001% nationwide (anthropogenic)**
 - **0.0000005 % (total)**
 - **Will most likely not reduce CO₂ emissions, and may even increase them by over 100,000 tons (from emissions due to construction).**

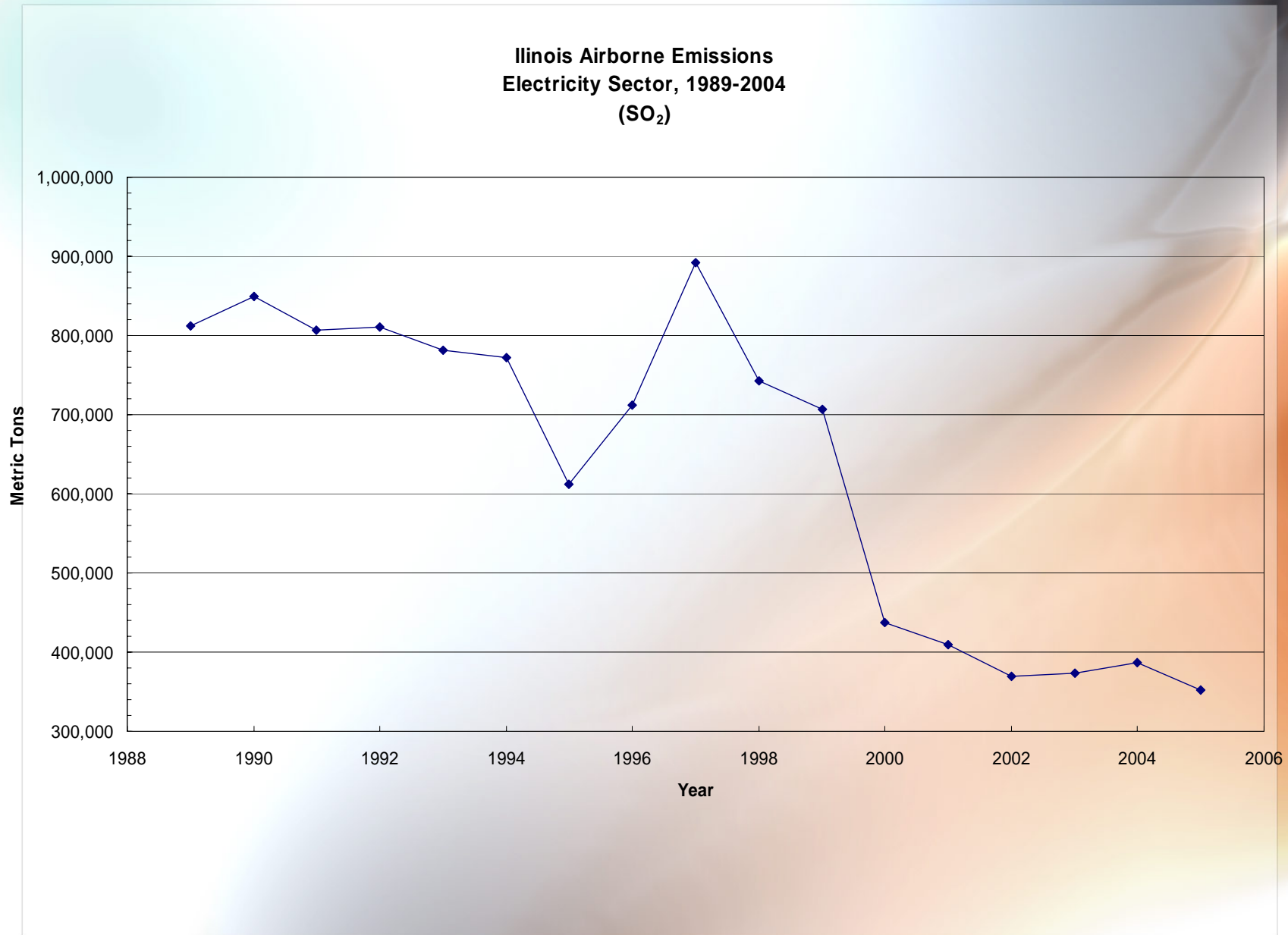
Summary

- **This project...**
 - **Will not produce significant amounts of electricity**
 - **Will not significantly reduce air pollutants of any kind**
 - **Will not reduce the United States dependence on foreign energy.**
 - **May destabilize the local electrical grid**
 - **May, in ten years, turn northwest McLean county into an industrial wasteland of 400 foot tall rusting turbines.**
 - **Will take almost 1000 times (15,700 vs. 16 acres) as much land to generate about 100 times less (reliable) electricity than Invenergy's own proposed 570 MW combined cycle gas fired plant in St. Clair Ontario.**
 - **Will make Invenergy millions of dollars.**

Myth #1 Supplemental

- Question; but doesn't burning coal pollute the atmosphere?
- Answer, yes but new technologies have significantly reduced this effect.
- From 1990 to 2004 SO₂ emissions from burning coal to generate electricity in Illinois have dropped by 221% (from 845 to 382 thousand metric tons).
- In the same time period NO emissions have dropped 239% (from 330 to 139 thousand metric tons).
- This decrease happened at the same time that the amount of electricity generated from coal increased by 173% (from 54,916,018 to 94,385,473 Megawatthours)

Myth #1 Supplemental



Myth #1 Supplemental

Illinois Airborne Emissions
Electricity Sector, 1989-2004
(NO_x)

