The $$ and Sense of Wind Energy

Larry Flowers
Team Leader, National Wind Technology Center

WEATS
Anchorage, AK
Wind energy is economically competitive
Capacity & Cost Trends

Increased Turbine Size - R&D Advances - Manufacturing Improvements

Cost of Energy and Cumulative Domestic Capacity

*Year 2000 dollars
Municipal Wind Power Pioneers

Austin Energy

“We at Austin Energy found that large wind energy projects are the least expensive new electric generation source. Not only is the price lower than other renewable sources, it's even lower than the fuel cost of our natural-gas-fired units.

- Mark Kapner, manager, Conservation and Renewable Energy, Austin Energy
Wind energy boosts economic development
Economic Development Impacts

- **Land Lease Payments**: 2-3% of gross revenue $2500-4000/MW/year
- **Local property tax** revenue: ranges widely - $300K-1700K/yr per 100MW
- 100-200 **jobs**/100MW during construction
- 10-30 permanent O&M **jobs** per 50-100 MW
- Local construction and service industry: concrete, towers usually done locally
Texas Wind Spurs New Jobs

- Texas developed 913 MW of wind and employed more than 2,500 people in the wind industry in 2001

Source: Virtus, 2003
Comparative Economic Development Impacts

Direct benefits to the *Colorado* economy from new power generation (over 20 years)

<table>
<thead>
<tr>
<th>Energy Source</th>
<th>Over 20 Years Benefit (Millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal</td>
<td>$100,000,000 - $200,000,000</td>
</tr>
<tr>
<td>Gas</td>
<td>$250,000,000 - $350,000,000</td>
</tr>
<tr>
<td>Wind</td>
<td>$300,000,000 - $400,000,000</td>
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</tbody>
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- **Taxes**
- **Landowner rev**
- **Fuel**
- **O&M**
- **Construction**
Case Study: Hyde County, South Dakota

- 40 MW wind project in South Dakota creates $400,000 - $450,000/yr for Hyde County, including:
  - More than $100,000/yr in annual lease payments to farmers ($3,000 - $4,000/turbine/yr)
  - $250,000/yr in property taxes (25% of Highmore’s education budget)
  - 75 -100 construction jobs for 6 months
  - 5 permanent O&M jobs
  - Sales taxes up more than 40%
  - Doesn’t include multiplier effect
“Converting the wind into a much-needed commodity while providing good jobs, the Colorado Green Wind Farm is a boost to our local economy and tax base.”

*John Stulp, county commissioner, Prowers County, Colorado*
Wind energy doesn’t consume water
Sustainable Withdrawal Of Freshwater Is National Issue

Source: EPRI 2003
Energy Requires Water

Water required to produce household electricity exceeds direct household water use

GALLONS PER PERSON PER DAY

- 510 for food production
  - includes irrigation and livestock
- 465 to produce household electricity
  - Range: 30 to 600 depending on technology
- 100 direct household use
  - includes bathing, laundry, lawn watering, etc.

In 2002, nationwide:

- Withdrawals of water at all thermoelectric power plants = 225 billion gallons/day
- = 252 million acre-feet
- ~ \( \frac{3}{4} \) size of Lake Erie

Source: Western Resource Advocates
Load Growth
Wind is a homegrown energy source
Figure 5: Growth in North American LNH regas projects
“Wind is a homegrown energy that we can harvest right along side our corn or soybeans or other crops. We can use the energy in our local communities or we can export it to other markets. We need to look carefully at wind energy as a source of economic growth for our region”

David Benson, Farmer and County Commissioner, Nobles County, Minnesota
Wind energy is inexhaustible and infinitely renewable.
U.S. OIL PRODUCTION 1900 TO 2050

PEAK 1970

GONE: 65% OF U.S. OIL HAS BEEN USED. IT'S HISTORY.

2001 DOWN THE OIL “OFF RAMP”

PRUDHOE BAY PRODUCTION

GONE

LEFT

Methane Madness

“In 1997, 600 rigs kept production flat.

In 2001, 1000 rigs were needed to keep production steady.

In 2002, production fell 3%.

US producers will find it very difficult to reverse these trends.”

Raymond James
Wind energy has many environmental benefits
Environmental Benefits

- No SOx or NOx
- No particulates
- No mercury
- No CO2
- No water
“The development of wind energy by Waverly Light and Power has been an important, environmentally correct step for our community, and continues to provide leadership for expansion of wind energy generation in the Midwest. We strongly believe that public power can play a significant role in the global reduction of greenhouse gasses by expanding and promoting wind energy and using programs like Iowa Energy Tags.”

- Glenn Cannon, general manager, Waverly Light and Power
Wind reduces risk associated with volatile fuel prices

($/MMBTU)


- Hurricane Andrew
- January 1994 Blizzard
- March 1993 Blizzard
- January 1996 Blizzard
- Massive Cold Front and Well Freeze Off
- Early Winter 1996/97
- Technical Factors
- Hurricane Georges
- Excess Storage and Mild Winter
- Coldest Nov/Dec on Record/S.T. Demand > S.T. Supply
- Declining production for six quarters

Source: NGW and EVA, Inc.
U.S. Natural Gas Spot Prices
(Base Case and 95% Confidence Interval*)

*The confidence intervals show +/- 2 standard errors based on the properties of the model. The ranges do not include the effects of major supply disruptions.

Sources: History: Natural Gas Week; Projections: Short-Term Energy Outlook, January 2005
The “Dash to Gas”

GAS CONSUMPTION: 1997-2017

Trillion Cubic Feet/Yr

INDUSTRIAL

ELECTRIC GENERATION

THE KEY DRIVER

RESIDENTIAL

COMMERCIAL

GAS CONSUMPTION: 1997-2017
EPRI CONCLUDES:

• Better technology alone is not enough, also need emission limits

• Carbon Dioxide Will Get a Value

• $3 to $10 per ton, Rising Over Time

• $10/MWH for Coal, $6 for Gas
“Wind energy adds diversity to our generation fleet and provides a hedge against fossil fuel price increases. In addition, the development of renewable energy resources is widely supported by the public and our customers.”

Rick Walker, director, Renewable Energy Business Development, AEP Energy Services, Inc., Dallas, TX
Wind energy can be used for a variety of applications
People want renewable energy
World Growth Market

Total Installed Wind Capacity

1. Germany: 16500 MW
2. United States: 6800 MW
3. Spain: 6202 MW
4. Denmark: 3121 MW
5. India: 2800 MW

World total 2004: 46048 MW

Source: WindPower Monthly
Utility Green Pricing Activities

Source: National Renewable Energy Laboratory (September 2004)
Renewable Electricity Standards

18 states + D.C.
9 states outside of restructuring
6 states increased standards

- WI: 2.2% by 2011
- IA: 2% by 1999
- MN: 19% by 2015*
- NV: 15% by 2013, solar 5% of total annually
- CO: 10% by 2015
- NM: 10% by 2011
- TX: 2.7% by 2009
- HI: 20% by 2020
- ME: 30% by 2000
- MA: 4% by 2009
- RI: 16% by 2019
- CT: 10% by 2010
- NY: 24% by 2013
- NJ: 6.5% by 2008
- PA: 8% by 2020
- MD: 7.5% by 2019
- DC: 11% by 2022

* MN has a minimum requirement for one utility, Xcel Energy
“Our customers wanted this wind program and it was our job to deliver it. It has turned out to be a huge source of community pride. The turbines are a visible landmark showing the Moorhead Community’s commitment to a better world for our children.”

Christopher Reed, Moorhead Public Service, Moorhead, Minnesota
“In my 44 years in the municipal utility business, no utility project has ever generated more customer support and interest than our wind turbine project.”

Nick Scholer, former manager of Algona Municipal Utilities, Algona, Iowa
Humanity’s Top Ten Problems for next 50 years

1. ENERGY
2. WATER
3. FOOD
4. ENVIRONMENT
5. POVERTY
6. TERRORISM & WAR
7. DISEASE
8. EDUCATION
9. DEMOCRACY
10. POPULATION

Source: Nobel laureate, Richard Smalley