Wind Power: We’re big fans of it

Team Dynamics
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History

Michael Penny
Ancient History

• Sailing ships
  – Transportation
  – Trade

• Vertical windmills
  – Grain Processing
  – Pump water

1. http://www.barewalls.com/i/f/d01700-9950_1_5_1____96.0_38.0_507666_Ancient-Egyptian-Sailing-Boat.jpg
Middle Ages/Renaissance

- Development of horizontal windmills
  - Grain processing
  - Wine production
  - Water pumping

1. http://wallpaperstock.net/campo-de-cRIPTana_wallpapers_13991_1280x800_1.html
Modern Era

- Further development of horizontal wind turbines
  - Water pumping
  - Electricity production

Turbine Design

Tiffany Hargett
Turbine Design

• 2 Main Categories
  – Horizontal-Axis Wind Turbine (HAWT)
    • Modern
  – Vertical-Axis Wind Turbine (VAWT)
    • Savonius
    • Giromill/Darrieus

**HAWT**

**Size**
- Blades typically 66 to 130 feet
- Towers typically 200 to 300 feet

**Motion**
- Can rotate at 10-22 rpm
- Must face into the wind

**Energy Production Average**
- Land-Based: 1.67 MW
- Offshore: 4 MW
## Mechanics

### Rotor Size and Maximum Power Output

<table>
<thead>
<tr>
<th>Rotor Diameter (meters)</th>
<th>Power Output (kW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>25</td>
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<tr>
<td>17</td>
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<tr>
<td>72</td>
<td>2000</td>
</tr>
<tr>
<td>80</td>
<td>2500</td>
</tr>
</tbody>
</table>

Sources: Danish Wind Industry Association, American Wind Energy Association

Current Usage

Will McGinness
U.S. Usage

- 43,461 MW (2.3% of energy generated)
- Texas produces 10,223 MW
- DOE – 20% by 2030
- 8,432 MW under construction in the 3rd quarter of 2011
U.S. Usage and Costs

- National Renewable Energy Lab reports there is 10,459 GW available onshore.
- U.S. Energy Information Administration (EIA) states the cost is similar to coal.
- Costs decrease considerably after initial investment.
- Farmer’s receive around $3,000 to $5,000 in royalties per year.
- Wind energy accounts for 35% of new power capacity built in the past 5 years.
Future Uses

Bryan Castillo
Buoyant Future

• Floating platforms attached to the seabed by mooring lines
• 3 main types
  – Ballast stabilized
  – Tension Leg Platforms
  – Buoyancy Stabilized
Airborne wind turbines

• Produce energy more consistently
• Require lower capital costs
• Deliver the most cost-effective renewable energy
Advantages & Disadvantages

Daniel Records
Advantages

• Wind energy is “free”
  – Aside from maintenance and start-up costs, the actual power source doesn’t cost any money.
    • Compared to NatGas generation
• Wind power is clean energy
• No emissions
Disadvantages

• Wind is not Constant
  – Constant winds found off-shore, which is the most expensive place to erect wind turbines

• Unsightly
  – Dead Birds
  – Clusters of turbines for power generation

• Need a lot of them to account for one fossil fuel generation source
Disadvantages

• Maintenance/Repair is difficult above ground
• Turbine overhaul costs (Every 5 years)
• Net total costs work out to $935/kWh installed cost
• NatGas generation costs $.085/kWh vs $.145/kWh for wind
Where they can make sense

- Places where there is no “power grid”
- Several wind turbines can be erected as well as a backup generator to provide a cost-effective and environmentally friendly power source.
So why do we have them here?

- Federal Tax Credits and Grants to power producers for installing renewable energy sources
  - Helps to offset cost of land, turbine construction, and lost opportunity while wind isn’t blowing
  - Long history of government grants and contracts to provide electricity from wind
  - In the 80’s, government subsidies pay 50% of turbine installation cost
  - EPAct

"If wind power made sense, why would it need a government subsidy in the first place? It's a bubble which bursts as soon as the government subsidies end." – Ben Lieberman
Questions?
Sources

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