Wind Turbines: Killing the market or just a few deals?

29th Annual Outlook for Texas Land Markets

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Overview

• Market overview: what does wind production look like in the U.S. and Texas?

• Future of wind production: should we expect wind turbine graveyards?

• Contract structures: what to look for?

• Land values: killing the market or just killing a couple deals?

• Separating wind rights from surface rights: does it make sense?
What is wind energy and what is expected from landowners?

• Wind energy developers want to access landowner’s wind, convert it to electricity and send the electricity offsite.

• Wind companies want to minimize their already massive footprints hence their preference for leasing.

• Power (watts) = $\frac{1}{2} \times \text{Density of Air} \times \text{Swept Area} \times \text{Speed of Air}^3$

• Turbines are usually 1.5 to 2 MW wind towers
  • 1.5 MW model
    • Blades: 116 feet
    • Tower: 212 feet
    • Total Height: 328 feet
Comparable to the Statue of Liberty

Figure 1. Expected Growth in Land-Based Turbine Size in North America
Bigger turbines, more power, same land footprint

Past & Present Wind Turbine sizes

1,000 KW = 1 MW

1.5 MW

10 MW

20 MW

5 MW

3 MW

100 m
5,000 Kw

125 m
10,000 Kw

250 m
20,000 Kw

17 m
75 Kw

30 m
300 Kw

50 m
750 Kw

70 m
1,500 Kw

80 m
1,800 Kw

100 m
3,000 Kw

Future Wind Turbines
Wind energy struggles

Power (watts) = \( \frac{1}{2} \times \text{Density of Air} \times \text{Swept Area} \times \text{Speed of Air}^3 \)

Wind availability & variability

1. Need wind to blow
2. Need it to blow at the right speed

Cut – in: 8 mph
Max generation: 22 – 34 mph
Cut – out: 56 mph
Wind energy struggles

• Inputs to wind energy production are geographically fixed.

• Wind energy and transmission lines are inherently related to deliver electricity to demand sites
  • Two costs: transmission line development + energy lost during transmission
Wind production in the U.S.

- 80/20 mix: hydrocarbons/renewable + nuclear
- Renewable energy provided 18% of the electricity generation in the U.S. in 2018
  - 90% from wind and solar
- 6.3% of the nation’s electricity generation comes from wind
Installed wind power capacity

> 50% of the U.S.' wind production comes from:
1. Texas, 25%
2. Iowa
3. Oklahoma
4. California
5. Kansas

8 of the world’s 10 largest wind turbines reside in the U.S. 5 of those are in Texas.

Greater wind capacity than Texas:
1. China
2. United States
3. Germany
4. India
5. Spain

Source: American Wind Energy Association Market Report
Wind production of top 5 states

- Texas became number 1 in wind energy production in 2006 and has since produced about a quarter of the wind production in the U.S.
How the energy production portfolio is changing

• In 2017, wind and solar represented almost half of the new electricity generation capacity and wind surpassed coal in installed generating capacity in Texas.
Wind production capacity—plenty of room to grow

- Installed:
  - Texas: 25K MW (2%)
  - U.S.: 96.5K MW (<1%)

- 25% of the total land area of the U.S. has winds powerful enough to generate electricity as cheaply as natural gas or coal at today’s prices.
2017 wind portfolio

- 23K MW of energy produced from wind (90% of capacity).
- Accounts for 15% of all in-state electricity production
  - Equivalent to powering 6.2M homes
Texas’ wind portfolio

Texas’ Wind Portfolio:

- Installed wind capacity: 24,899 MW
- No. of wind turbines: 12,793
- Wind capacity under construction: 6,148 MW
- No. of jobs supported (direct and indirect): 24,000
- No. of active manufacturing facilities: 46
- Total capital investment through 2017: $42 billion
Declining capital costs

- Declining costs due to improvements in technology and manufacturing capabilities.
- Concentrating construction in regions with the lowest installation costs.
- Increase 2005 – 2010:
  - Increases in labor costs.
  - Increases in the cost of key manufacturing and construction commodities.
  - International currency exchange fluctuations affected key equipment imports.
Average construction cost per kilowatt

Capacity-weighted average construction cost by installation year (2013-2015)
dollars per kilowatt of installed capacity

<table>
<thead>
<tr>
<th>Year</th>
<th>Solar</th>
<th>Wind</th>
<th>Biomass</th>
<th>Petroleum Liquids</th>
<th>Natural Gas</th>
<th>Hydro</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>4,000</td>
<td>3,000</td>
<td>1,000</td>
<td>1,000</td>
<td>2,000</td>
<td>1,000</td>
</tr>
<tr>
<td>2015</td>
<td>2,000</td>
<td>2,000</td>
<td>2,000</td>
<td>1,000</td>
<td>1,000</td>
<td>1,000</td>
</tr>
</tbody>
</table>
Subsidies

- In 2016, the U.S. spent $18.4 billion on energy subsidies
  - Renewable energy: $11 billion
  - Energy efficiency: $3 billion

- 2019 U.S. energy subsidies (per megawatt hour):
  - Coal: $0.5
  - Oil and Natural Gas: $1- $2
  - Wind: $15- $57
  - Solar: $43- $320

- **Production Tax Credit (PTC)**
  - 2.3 cents per kilowatt hour
  - PTC is currently set to phase out by 2024
Contract Structures

Various Easements

- Access
- Construction
- Transmission
- Non-obstruction
- Overhead
- Noise

Overlying Lease

- Compensation structure
- Time frame
- Required land
- Post construction restoration
- Damage management
- Other obligations
### 3 stages of wind project development

<table>
<thead>
<tr>
<th>Development</th>
<th>Construction</th>
<th>Production/ COD</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Data collection</td>
<td>• Lay-down yard</td>
<td>• The moment the turbines are connected to the grid, they are making money and therefore the landowner is making money</td>
</tr>
<tr>
<td>• MET Towers: test wind parameters such as speed</td>
<td>• Delivery of equipment</td>
<td></td>
</tr>
<tr>
<td>• Test soil for structural integrity—ability to support the structures</td>
<td>• Build out of turbines</td>
<td></td>
</tr>
</tbody>
</table>
Easements

Access

- Roads
- The developer needs to travel across the property to reach the turbine area.
- Blanket easement - the landowners need to specify where roads can be built to minimize disruption on the property or in certain areas.
Easements

Construction

- Tied to the access easement
- Areas used for construction and delivery of equipment ("lay-down yards").
- Construction takes up the most space compared to any other step.
Easements

Transmission

• Building underground and overhead transmission lines between turbines and substations.

• Underground lines should be below plow depth.

• Erosion can cause the lines to move above plow depth. Include a provision that insures continual maintenance of that depth.
Easements

Non-obstruction

• The landowner agrees not to build structures—trees, grain or feed towers, etc.—that interfere with the speed and direction of the wind.

• Maximum heights and minimum distances from turbines are specified.

• This may include an approval process for the landowner to build on the land.
Easements

Overhang

- Agreement with neighboring properties—all parties must sign.
- Turbine blades are allowed to overhang on to adjoining properties.
Easements

Noise

- Noise, up to a certain level and within a certain radius, is allowed

- At 10 mph, 1K feet away a turbine registers at about 45 to 55 decibels.
## Standard lease features– rate structure

<table>
<thead>
<tr>
<th>Timing</th>
<th>Units</th>
<th>Accuracy</th>
</tr>
</thead>
</table>
| • Periodic– monthly, six-months, annual | • Per megawatt production  
  • Deductions for energy lost in transmission  
  • Per turbine  
  • As a royalty | • How are records provided for proof of accuracy? |
| • Stages: development and production |                                            |                                              |
| • One time– upfront or at time of completion |                                            |                                              |
| • Stage: construction       |                                            |                                              |
### Standard lease features—rates structures for each stage

<table>
<thead>
<tr>
<th>Development</th>
<th>Construction</th>
<th>Production, COD</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Paid an annual rent</td>
<td>• Road, transmission lines, and collection lines easements are paid per linear foot</td>
<td>• Paid per turbine</td>
</tr>
<tr>
<td>• MET tower</td>
<td>• Lay-down yard is paid per acre</td>
<td>• Paid based on the capacity of the turbines</td>
</tr>
<tr>
<td>• Annual payment if tower is permanent.</td>
<td>• There may be several of these for a single property</td>
<td>• Paid per energy produced</td>
</tr>
<tr>
<td>• Lease rate is substantially lower than construction and production stages so may not make significant money for a while.</td>
<td>• Turbine pad</td>
<td>• Steady payments aren’t promised</td>
</tr>
<tr>
<td></td>
<td>• Turbine</td>
<td>• Amount isn’t always the same</td>
</tr>
<tr>
<td></td>
<td>• 1 time payment for installation</td>
<td>• Minimum annual rate paid per turbine</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Standard lease features—rates: two markets pricing wind energy

<table>
<thead>
<tr>
<th>Wholesale Electricity Market—ERCOT</th>
<th>Power Purchase Agreement</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Competing with the low production costs of natural gas</td>
<td>• Energy sold specifically to a power provider</td>
</tr>
<tr>
<td>• Relatively low kilowatt prices</td>
<td>• Usually built to satisfy a portfolio</td>
</tr>
<tr>
<td>• Higher price risk</td>
<td>• Less risk in these scenarios because price is set</td>
</tr>
</tbody>
</table>
Standard lease features - timing

**Development**
- Need at least 1 year of data.

**Construction**
- Won’t necessarily begin after the data is collected.
- Can take 3 to 5 years or longer to complete the development and construction phases.
- The developer may also initially estimate a larger number of turbines than they ultimately decide to build on the property.

**Production**
- 30 to 150 year leases
- Commonly, 30 year lease with 2, 10 year lease options owned by the company.
Standard lease features – footprint
Standard lease features—“return the land to its previous use and quality”

Development ➔ Construction ➔ Production

The construction stage has the largest footprint and puts the soil under considerable stress due to size and weight of the equipment.

*Restore soil to conditions prior to construction:*

De-compact and restore topsoil, reconstruct terraces or conservation structures, restore native vegetation
## Standard lease features – damages

<table>
<thead>
<tr>
<th>Land and farm</th>
<th>Turbine and operational equipment</th>
<th>Additional insurance requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Damages or impediments to growing crops and grazing livestock.</td>
<td>• If damage is caused by landowner or anyone in their party or on the land with their permission due to negligence – the landowner is responsible for paying the damages.</td>
<td>• Additional insurance may be a required on the property with the addition of the turbines</td>
</tr>
<tr>
<td>• Prices paid (per acre or head) should be predetermined.</td>
<td>• Hunting leases</td>
<td>• Commercial general liability insurance</td>
</tr>
<tr>
<td>• Local market price in the week following the incident.</td>
<td>• Prudent to have an agreement signed by all parties that if damage is caused by the holder of the hunting lease, they are responsible for paying the cost.</td>
<td></td>
</tr>
<tr>
<td>• Yield</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• The average yield/acre for the last 3-5 growing seasons</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• County averages</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Standard lease features—other obligations

<table>
<thead>
<tr>
<th>Property Taxes</th>
<th>Government Programs</th>
<th>Mineral Lease Holders</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Property taxes may increase due to the addition of the turbines on the property.</td>
<td>• The developer will cover the cost (penalties or back taxes) of all land taken out of CRP or other similar government programs.</td>
<td>• <strong>Accommodation agreement</strong> of the surface rights with the mineral owner of usually 300 feet around turbines.</td>
</tr>
<tr>
<td>• The tenant is responsible for obligations related to their real estate structures.</td>
<td>• Payments will be made on the effective date that the land is taken out of that program.</td>
<td>• Does not usually impede mineral income.</td>
</tr>
<tr>
<td>• The tenant is not responsible for increases in taxes due to the development of the land by the landowner—i.e. a house or barn.</td>
<td>• Tenant will not reimburse the landowner for forgone future payments from that program.</td>
<td></td>
</tr>
</tbody>
</table>
### Standard lease features—project completion

<table>
<thead>
<tr>
<th>What is needed?</th>
<th>How to enforce?</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Disassembly and removal of equipment</td>
<td>• What assurances are included to make sure it happens?</td>
</tr>
<tr>
<td>• Restore soil grades</td>
<td>• Many leases require the company to bond the removal costs.</td>
</tr>
<tr>
<td>• Restore vegetation</td>
<td>• Oklahoma has made it state law and mandate restoration following a project’s completion.</td>
</tr>
</tbody>
</table>
## 2 Major Caveats

<table>
<thead>
<tr>
<th>Installed but not producing</th>
<th>Asset Transferability</th>
</tr>
</thead>
<tbody>
<tr>
<td>• No warranty of energy production</td>
<td>• The company you sign your lease with may not be the company you work with through the entirety of the life of the lease.</td>
</tr>
<tr>
<td>• Turbines break, wind is not always blowing.</td>
<td>• Developers maintain the right to transfer the assets to another company.</td>
</tr>
<tr>
<td>• If paid on a per MW basis, you may have payment periods of low or no income.</td>
<td>• Flipping occurs in wind turbine construction.</td>
</tr>
<tr>
<td>• Create a minimum annual rent provision</td>
<td></td>
</tr>
<tr>
<td>• Compensation on a pro-rata structure</td>
<td></td>
</tr>
<tr>
<td>• 100 MW project, you have 10, 1 MW turbines on your land. You are paid for 10% of the energy production from the entire project vs. only for what the turbines on your land produce.</td>
<td></td>
</tr>
</tbody>
</table>
“If I can see a turbine, I don’t even want to look at the land”
What do the academics say?

• Academic literature has shown **no statistical evidence** of adverse property value effects due to views of or proximity to wind turbines.

• Various statistical methodologies, datasets and regions have been considered.

• “Neither the view of wind energy facilities nor the distance of the home to those facilities was found to have any consistent, measurable, and significant effect on the selling prices of nearby homes.”

• Fear of the unknown
  • “Anticipation stigma” effect- lower community support for proposed wind facilities before construction but support increases once facilities are operational.

  • Similarly another article found those who live closer to turbines support turbines more than respondents who live further away.

• Showed homes’ property values increased due to the facilities driving economic investment and tax revenue which benefited all surrounding property owners.
What about appraisers?

• Consider the income capitalization and highest and best use.

**Income Capitalization**
• Land receiving income from wind energy production will receive a higher price, *ceteris paribus*, than similar land not receiving income from wind turbines.

**Highest & Best Use**
• High ag production areas
  • Pan Handle, South Texas, etc.
  • Will not see declines in prices as the use of the land has largely been unchanged but instead the land now has an added income source.

• Residential land
  • Hill country, proximity to metro areas
  • Land selling at a premium for residential and view shed use are more likely to be affected by the addition of wind turbines.
  • Market data has not shown to support any diminution in value from wind turbines.
### Texas’ largest wind farms

<table>
<thead>
<tr>
<th>Nolan County (1,743)</th>
<th>Pecos County (217)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roscoe</td>
<td>Sherbino</td>
</tr>
<tr>
<td>• 634 wind turbines</td>
<td>• 110 wind turbines</td>
</tr>
<tr>
<td>• Completed in 2009</td>
<td>• Completed in 2011</td>
</tr>
<tr>
<td>Horse Hollow</td>
<td>Desert Sky</td>
</tr>
<tr>
<td>• 421 wind turbines</td>
<td>• 107 wind turbines</td>
</tr>
<tr>
<td>• Completed in 2006</td>
<td>• Completed in 2001</td>
</tr>
<tr>
<td>Sweetwater</td>
<td></td>
</tr>
<tr>
<td>• 392 wind turbines</td>
<td></td>
</tr>
<tr>
<td>• Completed in 2007</td>
<td></td>
</tr>
<tr>
<td>Buffalo Gap</td>
<td></td>
</tr>
<tr>
<td>• 296 wind turbines</td>
<td></td>
</tr>
<tr>
<td>• Completed in 2008</td>
<td></td>
</tr>
</tbody>
</table>
Nolan County Price per Acre
Pecos County Price per Acre

Pecos County Historical Price Per Acre

PricePerAcre_Median
Pecos County Total Dollar Volume

Pecos County Historical Total Dollar Volume

TotalDollarVolume
Separating wind rights, the future?

• “Seller reserves the oil and gas and minerals lying in, on or under the property wind rights lying on or above the property.”

• Properties with wind turbines:
  • Some portion of the income from the turbines, and for the most part all, will be transferred with the sale of the land.
  • If the seller wants to maintain some of the rights, they create a royalty for the life of contract.

• Properties without wind turbines:
  • Wind is not the dominant estate so you may have rights to the wind but no ability to access it.
  • Overhead for developer is too high.
    • Margins are already low. If there is a lot of additional management costs to find and organize who to pay, the land becomes less desirable.
  • Several states have made it illegal to sever wind rights from surface rights.

• Valuing wind rights
  • Wind production is currently too speculative to place a value on.
Wind wrap up

• Market overview and future of wind production: what does wind production look like in the U.S. and Texas and should we expect wind turbine graveyards? Wind production in U.S. and Texas is growing, construction costs and technology are improving and there remains significant capacity for continued growth.

• Contract structures: what to look for? Contracts for wind lease have become much more standardized and protect land owners.

• Land values: killing the market or just killing a couple deals? Currently, it looks like wind turbines are only killing a couple deals and haven’t adversely affected land markets. Research also shows that as people are exposed to wind turbines, they are more supportive of them. A positive outlook for future.

• Separating wind rights from surface rights: does it make sense? Has been done but doesn’t prove efficient yet.
Thank you

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