March 26, 2015
Wind Energy Working Group, Meeting 2

Economic Implications for Land Owners and Surrounding Communities

<u>County Tax Base:</u>

Nameplate Capacity Tax – The owner of a wind energy generation facility must pay a nameplate capacity tax equal to the total nameplate capacity of the commissioned wind energy generation facility multiplied by a tax rate of $3,518 per megawatt. In Custer County, NE, a facility with 50 turbines, this amounted to $280,000 per year. Tax is collected by the state and distributed to the counties where the wind energy facilities exist. The state does not retain any of the proceeds for administration.

Property Tax – The National Renewable Energy Laboratory estimates $500,000 to $1,000,000 in new annual property tax payments generated per 100 MW installed. However, Nebraska Legislative Bill 1048 created the nameplate capacity tax to replace the central assessment and taxation of the depreciable tangible personal property associated with wind energy generation facilities. The tower, nacelle, blades and any other structure which is involved in the actual generation of electricity is not to be taxed as depreciable tangible property. Real property upon which wind generation facilities are based is not exempt from property tax (concrete pads, foundations, operations and maintenance buildings, road construction, leasehold value, and lease payments). The land itself will continue to be taxed as it was prior to construction of the tower.

<u>Land Owners:</u>

Fixed rent/Royalties – Property owners enter into private contracts or leases with the wind developer. Annual rent varies and is generally based on wind resource, capacity and number of turbines. In some cases, land owners form associations where there is an agreement to all receive the same payment and may be agreements for those who are part of the association, but who do not actually have turbines located on their property, to also receive payments.

Construction/Installation Fees – Due to impacts from the construction of the projects, the land owner may have further limitations on the use of their land during the construction period. Developers may agree on payments to offset those impacts during an agreed upon amount of time.

Neighbor Agreement Compensation – Neighboring properties which receive impacts from wind energy facilities may receive payments to compensate them for those impacts. Payments may be in the form of a one-time payment or annual payments.

<u>Jobs and Contracting</u>

Construction and Development – During the construction period there will be jobs created. However, construction may be completed by crews that are not from the area, or by subcontractors in the area. Opportunities to hire excavation, concrete, road construction and other general contracting workers, specialized workers are more likely to come from outside the area. However, these workers can bring a temporary boost to the economy when they purchase goods and services, rent hotel rooms, eat in restaurants, etc…

Ongoing Operations and Maintenance – Operation and maintenance jobs will be created and continue over the long term. There are local training programs for these jobs that could mean hires would be of local workers. Because of the proximity of Lincoln and other cities it is unknown whether these workers would end up living in the local small town communities.

Further reading:
The Economic and Tax Revenue Impact of the Nebraska Wind Energy Industry, December 30, 2014, Bureau of Business Research, Department of Economics, College of Business Administration, UNL, Dr. Eric Thompson, Director http://cba.unl.edu/outreach/bureau-of-business-research/research/documents/WindPowerReport.pdf

Environmental Implications of Wind Turbine Projects

Air – A primary benefit of wind energy is the lack of emission of greenhouse gases or other pollutants. In addition, greenhouse gases are not emitted in the transportation of fuel to the site, nor are there risks associated with fuel transported in pipelines. The manufacture and maintenance of wind turbines does produce some greenhouse gases.

Water – Wind energy requires no use of water resources for operation. Foundations are not usually any deeper than a standard basement foundation and do not interfere with water tables. No particulate or heavy metals are released into the atmosphere which can contaminate water supplies.

Land – The final footprint of a wind turbine is relatively small, approximately 15 feet in diameter, with some surrounding area needed for maintenance vehicles. Access roads do take up some land area and in environmentally sensitive areas can fragment habitat. During construction there is significant area disturbed for road construction, burying of transmission lines, construction of the foundation, and crane pad site. Erosion is a primary concern and must be addressed through the building permit process, as with other construction projects. Top soil should be sequestered during construction and replaced after construction is complete. During operation, agricultural use can be continued in the area surrounding the turbines.

Wildlife – Impacts can be direct and indirect. Direct impacts occur when birds and bats are struck by turbine blades or collide with towers and transmission lines. These impacts increase when the wind farm is located along a migratory fly way. In areas of the state where endangered species, such as the whooping crane, migrate, a loss of even a single individual could have a huge impact. Indirect impacts such as habitat loss and degradation, affect all species of plants and animals in the area when roads and turbine sites destroy habitat. Habitat loss may also occur when a species avoids the area of a wind farm, effectively fragmenting the habitat. Large tracts of intact grasslands may be effectively fragmented into smaller use areas and populations can become isolated.

The University of Nebraska and the Nebraska Game and Parks Commission have developed a Nebraska Wind and Wildlife map which identifies the relative sensitivity of biological populations in Nebraska. It should be acknowledged that even in low sensitivity areas there may be specific locations where siting of wind power could have significant impact to resources. Lancaster County is shown as an area of low sensitivity, however there are biologically unique areas within Lancaster associated with the Eastern Saline Wetlands. There are also guidelines developed for wind energy development in Nebraska. The Guidelines for Wind Energy and Wildlife Resource Management identify environmental concerns that should be considered during the wind energy development process. These guidelines are non-regulatory recommendations designed to help developers assess and minimize potential environmental impacts that could result from wind farm development. Not all recommendation apply to all wind projects, which are discussed on a project-by-project basis. The Avian Assessment Guidance for Wind Energy Facilities in Nebraska specifically to address the impacts to birds. This document provides technical guidance in conducting an avian assessment that meets standards and expectations developed by NGPC and the US Fish and Wildlife Service Nebraska Field Office.

Statistically, when looking at bird deaths nationally, Wind turbines have been calculated to cause between 200,000 and 400,000 bird deaths per year. Transmission lines cause about 25,000,000, automobiles about 200,000,000, building windows almost 600,000,000 and house cats about 2.4 billion deaths per year.

Further reading:
Wind and Wildlife map
http://outdoornebraska.ne.gov/wildlife/pdfs/wildlifewind.pdf

Guidelines for Wind Energy and Wildlife Resource Management in Nebraska
http://outdoornebraska.ne.gov/wildlife/pdfs/newwguidelines.pdf

Avian Assessment Guidance for Wind Energy Facilities
http://outdoornebraska.ne.gov/wildlife/pdfs/avianassessment3.pdf

Shadow Flicker and Ice Throw

Shadow Flicker – Shadow flicker is the phenomenon caused by the moving shadow of the wind turbine blades moving over a point. The area where flicker is experienced moves as the sun's position relative to the ground changes throughout the day and season to season. As with other shadows, the shaded area is larger but moves quickly in the early and late hours of the day and smaller but more slowly moving in the middle of the day. It should be noted that shadow flicker does not induce epileptic seizures as the number of cycles per second produced by commercial wind turbines (generally less than one per second) is well below the strobe effect that causes seizures (5 to 20 per second).

Shadow flicker can be modeled using data on topography and the latitude of the particular location. The prevailing wind direction can also effect the extent of shadow flicker because it determines the direction the blades face, and thus the width of the shadowed area during a period of time.

Shadow flicker can be mitigated through proper siting. There are modeling programs that can provide estimates on the number of hours per year that a given site will experience shadow flicker. It is also possible to estimate the effects of shadow flicker by reviewing the azimuth angles of the sun for a particular site and the prevailing wind conditions. Many wind energy regulations have maximum hours per year (most often 30) and minutes per day (most often 30) which are considered acceptable levels. If those hours or minutes are exceeded the turbine must be stopped during the time period effecting the site. In some cases shadow flicker can be mitigated through screening with coniferous trees or fences, although this is generally not desirable for most homeowners.

Further reading
http://windenergyfoundation.org/wind-at-work/public-health-safety/public-health/shadow-flicker
http://www.greenrhinoenergy.com/renewable/wind/wind_flicker.php
http://www.windvigilance.com/about-adverse-health-effects/visual-health-effects-and-wind-turbines

Ice throw - Ice throw is the phenomenon of ice, which builds up on turbine blades during particular meteorological conditions, being "thrown" from the blades as they turn or being blown from the blades as they are stationary. Most modern turbines are able to detect vibration of turbine blades that can be caused by a build-up of ice and are programmed to shut down in such conditions in order to address safety issues and to protect equipment from damage.

There are several ways of analyzing ice throw. From a purely mathematical calculation, where drag is ignored, an object released at the point in rotation where maximum horizontal distance could be achieved, on a turbine of 230' hub height and 100' blade length, that object could travel up to 1,750'[1]. However, several studies have shown that wind resistance is a significant factor and that in fact ice does not fall nearly that far from the turbine base. One study in the Swiss Alps, where icing events are frequent, even in summer, looked at a turbine near both a weather station and a ski run. Ice throw events were measured over the period of two years. The furthest an ice fragment was recorded from the base was 92 meters (about 302 feet). No ice was found beyond the calculated maximum distance of d = (D +H) x 1.5, where is D is the rotor diameter and H is the hub height, often cited in the literature. In the BOREAS IV Assessment of Safety Risks Arising from Wind Turbine Icing document[3] it was proposed that at a distance of 400 meters, 1,321 feet, the risk of an ice fragment reaching that point during the heaviest icing events was 1 in 1,000,000 or about the same risk as being hit by lightning. In that same document a survey of turbine ice throw events showed fragments being thrown from 15 to 100 meters from tower bases, although they acknowledge the level of care taken in searching for fragments was not known. Springfield and Sangamon County Regional Planning Commission of Illinois published a useful review of the literature on ice throw[4] which found no instances in the literature of ice being thrown further than 494 feet for any height tower.

Ice throw risk diminishes with increased distance and so the best method to mitigate this risk would appear to be through setbacks.

1. Professor Terry Matilsky, Rutgers University
   http://xray.rutgers.edu/~matilsky/windmills/throw.html
2. http://www.mi-group.ca/files/boreas_vi_seifert_02.pdf

3. http://www.renewwisconsin.org/wind/Toolbox-Fact%20Sheets/Assessment%20of%20risk%20due%20to%20ice.pdf
4. http://co.sangamon.il.us/Portals/0/Departments/Regional%20Planning%20Commission/Docs/InfoBrief%20WECS%20and%20Icing_doc.pdf

Examples of Regulations from Other Communities

The regulation of wind turbines varies widely across the Country. In some cases wind turbines have an entire chapter of the municipal code or a free-standing resolution that governs them. In Lancaster County Wind turbines, like other land uses, are handled in the Zoning Resolution. However, this is not the only set of rules that would govern wind turbines in our County. All State and federal entities with regulation responsibilities for these structures also have their own review processes, such as the Federal Aviation Administration, Fish and Wildlife Service, Nebraska Game and Parks Commission, Nebraska Department of Aeronautics. The structure and construction of the turbines is reviewed as part of the building permit review in Lancaster County, whereas some other jurisdictions include those requirements in their wind ordinance. The monitoring of the operations of the turbines would

In the Lancaster County Resolution, CWECS are included as a specially permitted use in the AG Agricultural District. All applications for specially permitted uses must include a site plan, documents showing the owner of the property is aware of and agreeing to the special permitted use, and supporting materials that are specific to the particular special permitted use. The resolution also defines a process for amending and revoking special permits. Again, in other jurisdictions these are sometimes defined in the wind energy ordinance. All special permits go through a public hearing process and approval or denial is made by the Planning Commission, and appealable to the County Board. Special permits are evaluated according to their impacts on surrounding land uses and the fact that an application meets all of the conditions of the special permit does not necessarily guarantee it to be approved. Circumstances particular to a special permitted use and the properties surrounding it are factors in the decision making process of the Planning Commission.

In the Lancaster County Special Permit Chapter 13 you will see the current conditions for Commercial Wind Energy Conversion Systems, summarized here:

1. No less than 1000 feet from any property line of a dwelling unit not associated with the project
2. Distance to boundary of SP area must be equal to height of tower plus rotor radius (blade length)
3. Noise standard of 35 dBA at property line of any dwelling unit within one mile. Noise study may be required.
4. Shall meet FAA requirements, only lighting required by FAA, unobtrusive color
5. Must follow all codes and regulations
6. Unrelated towers must be separated by 5 rotor diameters
7. Decommissioning plan and bond for removal required
8. Meet all Federal State and local requirements

In a review of wind ordinances nationwide, the following were conditions suggested:

Location	Setbacks to various uses	Maximum Noise Level	Shadow Flicker mitigation	Color and finish unobtrusive	Lighting to FAA standard	No Advertising	Vibration undetectable	Underground wiring	Signal interference minimized	Minimum Ground Clearance	Separation between Turbines	Access doors protected	Scenic view impacts minimized	Decommissioning plan and bond	Proof of Liability Insurance	Notification of ownership change	Complaint process outlined
Lancaster	X	X		X	X						X			X			
North Carolina	x	x	x	x	x	x						x		x			
Lake Township MI	x	x	x	x	x	x	x	x	x	x	x			x			
Ottawa Co. MI	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x
Plymouth Co. IA	x			x	x	x			x		x			x			
Minnesota	x	x		x	x	x		x	x	x		x		x			
Pennsylvania	x	x	x	x	x	x		x	x			x		x			x
Tennessee and Kentucky	x	x	x		x	x			x			x		x	x		
South Dakota	x	x			x			x	x	x	x			x			
Columbia University	x	x		x	x	x			x	x		x		x	x	x	
Better Plan Wisconsin	x	x		x	x	x		x		x		x					
New York	x	x		x	x	x		x	x	x		x	x		x		

North Carolina http://energy.gov/savings/model-wind-ordinance

Lake Township MI http://www.laketwp.org/PDF/Zoning_Ordinance/LTZO_article_III.pdf

Ottawa County, MI http://www.planningmi.org/downloads/ottawa_wind_energy_ordinance.pdf

Plymouth CO, IA p 92
http://www.co.plymouth.ia.us/Services/PDF/Plymouth%20Co%20Zone.pdf

MN model http://www.ecowerc.com/downloads/MN-model-ordinance-wind.pdf

PA Model http://www.pawindenergynow.org/pa/Model_Wind_Ordinance_Final_3_21_06.pdf

TN and KY Model
http://energy.ky.gov/renewable/Documents/TN%20KY%20Model%20Wind%20Ordinance.pdf

SD Model http://www.puc.sd.gov/commission/twg/WindEnergyOrdinance.pdf

Columbia law model http://web.law.columbia.edu/sites/default/files/microsites/climate-change/files/Resources/Model-Ordinances/Model-Municipal-Wind-Siting/Model_Municipal_Wind_Siting_Ordinance.pdf

Better Plan Wisconsin
http://betterplan.squarespace.com/display/Search?searchQuery=model+ordinance&moduleId=6671802&moduleFilter=&categoryFilter=&startAt=0

NY Model
http://www.ewashtenaw.org/government/departments/planning_environment/planning/wind_power/NYSERDA_Model_Ordinance_Options