

Introduction and Summary of Recommendations

For counties interested in the benefits of utility-scale wind projects, a well-drafted wind ordinance will protect the health and safety of the county and its residents while still enabling developers to build workable, cost-effective wind projects. Under Iowa's home rule policy, counties have adopted a wide range of ordinance provisions related to wind development. These county ordinances allow wind development but impose a variety of restrictions or requirements for wind development and a variety of processes for wind project approval.

By the end of 2017, Iowa had utility-scale wind in operation or in active development in approximately half of Iowa's 99 counties. Our research indicates that well more than half of Iowa counties have also adopted some type of ordinance to guide wind development. Counties have used a wide variety of approaches in these ordinances during adoption over the past 15-20 years. We have reviewed many of these ordinances and identified specific provisions that can be viewed as successful practices.

We encourage counties that have not adopted an ordinance, or that are updating an ordinance, to use this document as a reference to support the development and adoption of a well-designed ordinance rooted in existing successful practices.

A summary of our recommendations for wind ordinances to enable wind development – and the benefits that come with it – includes the following:

- **Setbacks.** Counties should ensure that setbacks balance multiple interests and support cost-effective wind development. We recommend setbacks from residential dwellings of between 1,000 feet and 1,250 feet at the most. Setbacks for property lines and other rights of way should be approximately 1.1 times the turbine height, or about 600 feet. Counties can consider longer setbacks for a small number of other areas, such as natural resource areas. Counties should provide for waivers for voluntary reductions in setbacks.

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- **Application and approval process.** We recommend that counties establish a clear and well-defined application process and a set of known application requirements. Wind turbines should be treated as a conditional use in established zoning districts. If the application and associated wind development meet the clearly identified conditions, the Board of Supervisors should approve the application and the project.
- **Decommissioning.** Counties may require a decommissioning plan to support potential decommissioning as part of the application and approval process.
- **Infrastructure.** Counties may require a pre-construction plan for handling potential impacts to roads and other infrastructure from wind project construction as well as a post-construction review to identify impacts and provide for repairs.
- **Safety.** There is a basic set of minimal safety standards regarding wind projects, which make sense for counties to include in an ordinance.
- **Optional additional standards on shadow flicker and noise.** We do not recommend adding standards for handling shadow flicker or noise. We discuss the provisions that some counties have adopted and why setbacks and other requirements should sufficiently address these issues without adding specific, separate provisions for noise or shadow flicker.

Context for Iowa and at the County Level:

Benefits from Wind Development and Future Potential

Iowa is a national leader in wind energy, ranking first among states in the percentage of electricity from wind and third in total installed wind capacity. Iowa has significant potential for additional wind development, with studies providing a range of 276,000 MW to 570,000 MW of technical potential for wind.

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With about 7,300 MW installed at the end of 2017, Iowa has just begun to tap the potential for wind development. While parts of Iowa have some of the best wind resources in the U.S., technology improvements in wind turbines are leading to successful wind development in less windy parts of the state. This means that most Iowa counties could benefit from utility-scale wind development.

In recent years, wind energy in windier states like Iowa has also become the lowest cost new source of electricity – even without considering tax incentives like the federal production tax credit. These positive economics, combined with significant opportunities for more wind projects, means Iowa can and should see significant wind development for years to come.

Counties play an important role by reviewing and approving specific wind projects at the local level. County policies that guide review and approval need to strike a balance between the needs of the county and its residents and successful, cost-effective wind development. We believe that this balance is being achieved in parts of Iowa already and can be achieved in every Iowa county. The ordinance that a county adopts to guide wind siting and approval is a critical part of achieving that balance and seeing maximum local benefits from wind generation.

Wind development offers a number of benefits to county residents and the county itself. These benefits include:

- **Lease or easement payments to landowners.** In 2016 alone, wind turbines in Iowa resulted in payments to landowners of between \$20M and \$25M.¹ That annual amount is expected to grow as more wind projects come on-line, with Iowans estimated to receive \$43M annually by 2020.²
- **Property tax revenue to counties.** Wind turbines generate property tax revenue paid to counties that can support a range of public benefits, including roads and bridges, health services, schools, debt service and reduced need for revenue from other sources. In Iowa counties that have had significant wind development, property tax revenue from wind projects is one of the largest sources of such revenue.
- **Clean energy resources.** Unlike fossil fuel-fired power plants, wind turbines do not produce air pollutants such as sulfur dioxide, nitrogen oxide, greenhouse gases, particulates or mercury and thus do not contribute to acid rain, smog, or public health impacts such as asthma where they

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are located. Wind turbines also do not use water or produce water pollution in the process of generating electricity (e.g., for cooling or steam production), unlike fossil and nuclear power plants.

- **Local economic development.** In 2016, Iowa had between 8,000 and 9,000 jobs supported by the wind industry. These jobs are located across the state in a range of sectors, including manufacturing, installation, operations and maintenance. Wind farm construction brings significant local construction jobs as well as some permanent operations jobs. Iowa's wind development has also attracted significant employment in wind manufacturing and businesses in the wind supply chain to communities across the state. Iowa's supply of low-cost wind energy also attracts companies with renewable energy goals to locate new facilities or expand operations in Iowa.

Full Discussion of Major Provisions for County Wind Ordinances

A. Establishing Setbacks from Neighboring Properties

Nearly all counties that have adopted a wind ordinance have included provisions that set minimum distances between wind turbines and residential dwellings.³ Most counties have also adopted such setbacks for certain types of occupied buildings or public buildings, such as schools and hospitals. Many ordinances also specify setbacks for a range of other categories such as property lines, roads and other rights of way, municipal town limits, and natural areas. A range of required setback distances in these various categories across Iowa and industry best practices are discussed below.

Appropriate setbacks should strike a balance between enabling cost-effective wind development and the additional interests of the county and its residents, including non-participating landowners (landowners who do not have a turbine on their property). Very large setbacks from homes, property lines, and other categories of properties or areas will restrict the number of sites available for wind development. This can raise the cost of wind development by eliminating the windiest sites and limit the total investment in wind that a county can attract. Setbacks that are particularly restrictive can go so far as eliminating any opportunity for wind development. Conversely, setbacks that are too small may not successfully minimize sound or visual impacts to nearby properties. Setbacks are a primary regulatory tool that counties use both for safety considerations and for sound or visual impacts, which we also discuss later in this paper.

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Our review of existing ordinances indicates that this balance is possible and has been struck in many county ordinances. As discussed in more detail below, it is important for counties to provide flexibility in setbacks by allowing voluntary waiver or negotiation below the setbacks included in an ordinance.

Residential properties and occupied structures

Counties require the largest setback distances for turbines from residential dwellings and human-occupied buildings (e.g., schools and hospitals). Most ordinances' required setbacks from these structures are in the range of 1,000 to 1,250 feet, although a few fall outside of this typical range—either smaller (e.g., Boone) or larger (Kossuth and Palo Alto). Most counties' setbacks for this category are expressed in feet rather than a percentage of the total height of the turbine. Some ordinances do include a setback related to the total height of the turbine, such as two times the height.

It is crucial that counties establish setbacks for such structures that will protect occupants from unlikely but hazardous events such as the collapse of a turbine tower or the “throwing” of a turbine blade. As explained by the American Planning Association (APA):

There is now enough operating history in enough locations around the world that reasonable probabilities can be established for these events. The probability of injury or property damage from any of these events is extremely small, but the residual risk can be minimized with reasonable setbacks. The 1,000-foot setback became a standard in part because it creates a substantial margin of safety.⁴

Therefore, a minimum setback of 1,000 feet from occupied structures is recommended for safety purposes. Wind developers have indicated that a setback of 1,500 feet represents the upper limit of what is typically workable for designing a utility-scale wind project; most counties have considerably smaller minimum setbacks for occupied structures.

Recommendation: We recommend setbacks from residential dwellings of between 1,000 to 1,250 feet, which is within the typical range of most county ordinances in Iowa. Setbacks within this range protect public safety and the quality of life of rural residents while allowing workable project footprints and minimizing impacts to productive agricultural land.

Property Lines

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In addition to mandating minimum setbacks distances from residential dwellings, most counties also specify minimum setbacks from neighboring property lines. Unlike the requirements for dwellings, these required setback distances are usually expressed in terms of the height of the wind turbine: for example, in Clay County, where the required distance is 110% or 1.1 times the turbine's "total height." A turbine's total height is generally defined as the vertical distance from the ground to the tip of the turbine blade when at its highest point.

Utility-scale wind turbines of the type currently being installed in Iowa have tower heights of between 80 and 100 meters, measured at the hub. As technology improves, it is possible that taller towers will be installed in the near future, such as 125 meters. The blade length of newer Vestas and GE turbines installed in Iowa is in the range of 54 to 64 meters. The total height of such turbines, using a tower height of 100 meters, results in a total height of 154 to 164 meters, or approximately 510 to 540 feet. Most counties require setbacks from property lines of 1.1 times to 1.25 times the turbine's total height.

Using the dimensions described, the resulting setbacks would range from approximately 560 to 675 feet. Kossuth County's mandated setback from property lines of 600 feet (one of the only counties to specify a distance in feet for this type of setback) is also within this range.

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Summary Table of Setbacks in Counties – Most With Operational Wind Farms

County	Residential Dwelling Setback	Property Line Setback
Black Hawk	n/a	1.5x total height of turbine (about 600-800 feet)
Boone	750 feet	1.25x total height of turbine
Cass	1,200 feet	1x total height of turbine
Clay	1,200 feet	1.1x total height of turbine
Carroll	1,000 feet	Not less than the rotor radius from non-participating properties
Dickinson	Greater distance of 1,200 feet or 2x total height of turbine	Turbines may not overhang adjacent property lines without securing appropriate easements
Emmet	1,250 feet	1.1 x total height of turbine
Greene	1,000 feet	Not less than the rotor radius from non-participating properties
Grundy	1,200 feet	1.25x total height of turbine
Ida	1,250 feet	1.1x total height of turbine
Madison	Greater distance of 1,000 feet or 2x total height of turbine	No overhang of adjoining property line without an easement
O'Brien	1,200 feet (includes accessory structures)	[None specified]
Osceola	1,250 feet	1.1x total height of turbine
Pottawattamie	100% of tower height	Manufacturer's fall distance
Poweshiek	Greater distance of 1,000 feet or 2x total height of turbine	1.1x total height of turbine
Story	Greater distance of 1,000 feet or 2x total height of turbine	No overhang of adjoining property line without easement
Webster	1,000 feet	150 feet

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Unoccupied Structures and ROWs

Most counties also have specified minimum setbacks for unoccupied structures (such as animal confinement buildings); for roads and other public rights of way; and for utility lines. Mandated setbacks for these categories of property are generally either identical or comparable to the setbacks described above for property lines.

Natural areas

Some counties require minimum setback distances from specified natural resources and/or public lands, which vary widely. For example, Kossuth County requires that a turbine be sited at least 600 feet from any public conservation area, while Palo Alto County mandates setbacks of 1,500 feet from all public lands and public waterways. Boone County requires a setback of 1,320 feet from river bluffs; 600 feet from public conservation areas; and 600 feet from certain types of wetlands, specified in its county zoning ordinance.

Adequate setback distances for protecting a county's natural resources will necessarily vary depending on local site-specific factors such as the type of resource being protected and the ecological sensitivity of the area and its wildlife.

Some counties, rather than mandating setback distances by type of resource, approach the issue of protecting natural areas on a project-by-project basis by requiring applicants to consult with the Iowa Department of Natural Resources before applying for a permit. The developer must then include the Department's siting recommendations with its submitted site plan and other application materials. The ordinances of Dickinson and Ida Counties provide examples of this approach. (Palo Alto County requires both a preliminary pre-application review by IDNR and the minimum setbacks distances described above.)

Waivers or Negotiated Setbacks

Many county ordinances include waiver provisions allowing either the property owner or the controlling governmental authority to waive the mandated setback distance for that property type. Written waiver agreements must be executed pursuant to the specific requirements set forth in the ordinance. A few

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counties require waiver agreements to be approved by the county permitting authority. Some ordinances only allow waivers in certain setback categories, while others (such as Kossuth and Palo Alto counties) allow setbacks for any property type to be waived.

Waivers are an important tool to improve flexibility and allow for the potential for additional land area to become available for wind development. However, providing a waiver is not a substitute for a strong setback policy that can enable cost-effective wind development.

Recommendation: We recommend that counties adopt recommended setback distances above of 1,000-1,250 feet from residential dwellings, and also include waiver provisions to reduce such setbacks when appropriate.

Height restrictions

Few of the county ordinances we reviewed include a limit for a specified number of feet for the total height of turbines. Many counties do require that wind developers ensure that turbine heights do not extend into approach zones and other restricted air space, and/or that the project complies with any applicable Federal Aviation Administration (FAA) requirements. (Several ordinances specify that a copy of any FAA permit or approval must be included in the list of application materials submitted to the county's permitting authority.) Such a requirement, along with appropriate setback distances from residences and other structures at ground level, addresses any potential concerns posed by the height of a commercial wind turbine.

Recommendation: We do not recommend establishing a separate, distinct height restriction.

B. Application and Approval Process

Conditional Use with Clear Application Process

The procedural requirements for owners and developers seeking county approval to build a commercial wind project vary significantly across Iowa. Some counties require a lengthy and detailed application process (or even pre-application process) while others have few requirements beyond submitting a site plan and application materials for review. Most counties require a public hearing before the permitting authority decides whether to approve the project.

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Recommendations:

- First, we recommend that county officials prioritize creating a clear application and review process with well-defined steps and conditions for approval. This allows a wind developer to clearly identify the application requirements for a wind project which, if met, will result in county approval of the application. The setback provisions above would be one of the clear application requirements, while the additional provisions discussed below can comprise the balance of those requirements (e.g., decommissioning, road impact plan, etc.).
- Second, we recommend treating utility-scale wind projects as conditional uses in existing zoning districts, which provides for an efficient but flexible process. This is the approach followed by a majority of the counties that provide for the permitting of utility-scale wind developments in their zoning ordinances. We suggest this approach instead of treating wind developments as either allowable uses or special exceptions.

Both conditional uses and special exceptions can only be permitted subject to review and approval by a discretionary board, usually after a public hearing. Uses permitted on this basis are those that a county considers not generally adverse to the public interest, but requiring some special review and precautions as well as an opportunity for public input.

Conditional uses and special exceptions have similarities and there can be some overlap in how these terms are used in zoning ordinances. The term “conditional use” in a zoning code usually means that the use is expressly allowed or permitted in a specified district (or districts), but *only* on condition that certain requirements will be met, hence the term. Conditional use permitting decisions depend on the applicant’s compliance with the standards specified in the zoning code as conditions for permit approval. If the conditions and standards are met, the permit will be issued.

In contrast, the process for permitting special exceptions often relies more heavily on the Board of Adjustment to impose the conditions, which may not be listed or included in the ordinance. The Board of Adjustment may impose conditions it deems necessary to ensure that public health and safety are protected and that the use is compatible with others in the neighborhood.⁵

Kossuth County has recently adopted a zoning ordinance that provide a useful model for a comprehensive yet streamlined permitting process for commercial wind. Like most other counties in Iowa, Kossuth decided to permit commercial wind projects as conditional uses in specified districts. The

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county created a set of uniform standards after soliciting input from citizens, municipalities, local and state agencies and others for all wind projects that must be met as conditions for approval. After all required application materials have been filed with the County Zoning Administrator for review, final approval authority rests with the Board of Supervisors. The relevant portion of the ordinance states:

Approval by Board of Supervisors. Within thirty (30) days following the submission of the FDP [Final Development Plan] by the Applicant, the Board of Supervisors shall review it for completeness and compliance with this Ordinance; and, if same is in compliance, approve the Application by Resolution. The Resolution shall direct the Zoning Administrator to issue a WECS [Wind Energy Conversion System] Construction Permit.⁶

Such a review and approval process provides more predictability to both applicants and local residents than requiring approval of a special exception from a county's Board of Adjustment, which is a more discretionary process with less clearly-defined standards for approval.

If a county does decide to vest final approval authority in its Board of Adjustment, we recommend that the county provide applicants the opportunity for a preliminary review as described in a provision recently adopted by Poweshiek County in its revised ordinance.⁷

Boards of Adjustment typically have broad discretion in deciding whether to approve or deny permits and in setting the conditions required for approval, and once denied, an applicant's only recourse is to seek judicial review in district court. A pre-application review process helps provide applicants with a more predictable process by allowing them to become better informed about a county's criteria for project approval.

Overall Policy Statements

Counties adopting "wind ordinances" into their zoning provisions often include prefatory language explaining why the county determined it was necessary to establish standards and procedures for permitting wind projects. For example, the article of Osceola County's zoning ordinance regulating wind installations begins with the statement below. Other counties have adopted the same or similar language, including O'Brien County:

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Section 13.1. INTENT. The intent of this article is to provide for the regulation of owners/developers engaged in the construction, erection, placement, location and maintenance of wind energy devices in Osceola County; and to preserve and protect public health and safety without significantly increasing the cost or decreasing the efficiency of wind energy devices and associated structures.

C. Decommissioning

Wind ordinances often include a provision requiring the project owner to take responsibility for and bear the costs of decommissioning at the end of a wind project's useful life. These provisions ensure safety for turbines that are no longer operational and ensure the county and landowner do not bear the cost of removing the turbines. Wind project life for early wind projects in Iowa (e.g., built in 2000 or 2005) was typically twenty or twenty-five years. New wind projects being built now are projected to have a forty year useful life. In addition, many of Iowa's early wind projects are now being repowered, which extends the operating life by up to twenty years. As a result of longer lives and repowering, few wind turbines in Iowa have been decommissioned in practice. Planning for the responsibility and cost of decommissioning, however, is a prudent step for a county ordinance.

Ordinance provisions related to decommissioning tend to be substantively similar across most counties. The following recent example is from Poweshiek County's ordinance, updated in March of 2017:

Discontinuation and Decommissioning. A C-WECS shall be considered a discontinued use after one (1) year without energy production, unless a plan is developed and submitted to the Zoning Administrator outlining the steps and schedule for returning the C-WECS to service. Discontinued use does not apply to the pre-construction or construction period and shall be measured from the initial commercial energy production and operation of the C-WECS project. All C-WECS and accessory facilities shall be removed to a depth of four (4) feet below ground level within one year of discontinuation of use.

1. Decommissioning Plan. Each C-WECS shall have a Decommissioning Plan outlining the anticipated means and cost of removing the C-WECS at the end of their serviceable life or upon becoming a discontinued use. The cost estimates shall be made by a professional engineer licensed in the State of Iowa. The plan shall also identify the financial resources that will be available to pay for the decommissioning and removal of the C-WECS and accessory facilities. The County reserves the right to verify that adequate decommissioning terms are contained in the landowner's lease or easement.

2. Decommissioning Fund. Commencing on the fifteenth (15th) year after commencement of commercial operations, and annually thereafter, the operator shall continuously maintain a

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financial assurance mechanism(s) in the form of performance bond, letter of credit, and/or other security approved by the County Attorney, for the remaining life of the facility. The amount of the security shall be equal to the total decommissioning cost, net of reasonable residual value of the C-WECS, as determined by a professional engineer licensed in the State of Iowa. If a bond is posted to meet this requirement, or if a letter of credit is issued to meet this requirement, the issuing entity must be agreed upon by both the operator and the County. This requirement can be waived by the Board of Adjustment.⁸

D. Impacts to Roads and other Public Infrastructure

The transportation of turbine components and heavy equipment during the construction phase of a wind development project can cause impacts to county roads and other infrastructure. To address these potential impacts, several counties have adopted requirements similar to the following example, also from Poweshiek County's recently revised ordinance. While the language below is similar to provisions in other ordinances, the following provision requires both a pre-construction and post-construction survey of roads used, and a post-construction meeting to address impacts.

Putting such a process in place before construction begins helps clarify for all parties what specific impacts a developer will be held responsible for and what steps must be taken to mitigate damages to roads and other infrastructure.

Public Infrastructure Protection Provisions

From Poweshiek County Ordinance:

1. Roads. Applicants shall identify all roads to be used for the purpose of transporting C-WECS, substation parts, cement, and /or equipment for construction, operation or maintenance of the C-WECS and obtain applicable weight and size permits from the impacted road authority(ies) prior to construction.
2. Existing Road Conditions. Applicant shall conduct a pre-construction survey, in coordination with the impacted local road authority(ies), to determine existing conditions of roads identified pursuant to subparagraph 1, above. The survey shall include photographs or video and written documentation of the condition of the identified road facilities. The applicant is responsible for on-going road maintenance and dust control measures identified by the Poweshiek County Engineer during all phases of construction.

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3. Drainage System. The applicant shall be responsible for immediate repair of damage to public drainage systems stemming from construction, operation or maintenance of CWECS.

4. Post Completion Survey. Applicant and the Poweshiek County Engineer will meet upon completion of the project and agree as to the necessary action needed to return roads to the existing road conditions as identified in subparagraphs 1 and 2, above.

Required Financial Security. The applicant shall be responsible for restoring or paying damages as agreed to by the applicable road authority(ies) sufficient to restore the identified road(s), bridge(s), and associated infrastructure to preconstruction conditions. Financial security in a manner approved by the County Attorney shall be submitted covering 130% of the costs of all required improvements. This requirement may be waived or modified by the Board of Adjustment upon recommendation from the Poweshiek County Engineer.⁹

E. Safety Issues

Standard Safety Requirements

While setbacks and other provisions above are intended to improve safety, utility-scale wind projects present county officials with an additional and unique set of safety concerns not typically encountered with more traditional types of building structures. A commonly recommended list of safety precautions has emerged to address these issues.¹⁰ These include:

- Posting of emergency contact information at various locations throughout the project;
- Posting warning signs about falling ice during winter;
- Locking turbine doors to prevent unauthorized access;
- Preventive measures such as avoiding structures near turbines that would allow unauthorized people to climb them.

Many of the counties in Iowa with wind ordinances have similarly-worded provisions addressing such common safety concerns. The following section from Story County's ordinance is representative of these provisions:

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Safety.

- (1) All wiring between wind turbines and the C-WECS substation shall be underground. If the developer can demonstrate the need for an overhead line and the acceptance of landowners for this line, such option may be approved conditionally by the Board of Adjustment
- (2) Wind turbines and meteorological towers shall not be climbable up to 15 feet above ground level.
- (3) All access doors to wind turbines and meteorological towers and electrical equipment shall be locked when not being serviced.
- (4) Appropriate warning signage shall be placed on wind turbine towers, electrical equipment, and C-WECS entrances.
- (5) For all C-WECS, the manufacturer's engineer or another qualified engineer shall certify that the turbine, foundation and tower design of the C-WECS is within accepted professional standards, given local soil and climate conditions.

Meteorological Towers

An additional safety concern that is also addressed by several counties' safety requirements is the potential hazard posed to pilots of low-flying crop-dusting planes by temporary meteorological towers, or "METs." These towers, used to gather data that helps wind developers site turbines, are typically just under 200 feet high, and so are not currently subject to Federal Aviation Administration (FAA) regulations. The thin metal towers and their guy-wires are difficult for pilots to spot and fatal collisions have occurred in the U.S., prompting the National Transportation Safety Board to recommend that the FAA adopt new regulations requiring markings to improve safety.¹¹

As of this writing, no such federal regulations have been adopted, although in 2015 the FAA issued new voluntary guidelines for met tower markings.¹² In the absence of state- or federally-mandated markings for met towers, we recommend that counties include a requirement similar to the one below, adopted by Poweshiek County and some others. This ordinance is consistent with practices adopted by some wind developers who use large plastic orange balls on the guy-wires:

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6. For all guyed towers, visible and reflective objects, such as plastic sleeves, reflectors or tape, shall be placed on the guy wire anchor points and along the outer and innermost guy wires up to a height of eight (8) feet above the ground. Visible fencing shall be installed around anchor points of guy wires.¹³

Emergency Conditions

The APA also recommends the development of a written emergency plan covering all reasonable scenarios, as local emergency response crews will likely not have plans in place for dealing with emergencies at wind turbines, or tall structures generally.¹⁴ Kossuth County's ordinance requires such a plan as one the "ancillary agreements" that are a condition of approval:

Issuance of a WECS Construction Permit is strictly conditioned on the Applicant executing the following: ...3. An Emergency Response Plan provided by Applicant and approved by the Board of Supervisors. Said Plan shall contain response procedures to be followed in the event of a fire, collapse, personal injury, or other emergency at a Project. The Plan shall contain 24 hour emergency contact information for the Project.¹⁵

F. Additional Siting Standards

Shadow Flicker

Shadow flicker is an effect that can appear on neighboring properties due to the movement of wind turbine blades between the sun and the property. Minimum setbacks can minimize such undesirable aesthetic impacts. According to the American Planning Association, "With reasonable setbacks, shadow flicker occurs only when the sun is low in the sky and for relatively few hours a year—typically a tiny fraction of daylight hours."¹⁶

In addition to requiring minimum setbacks from occupied structures, a few counties have incorporated specific standards for shadow flicker into their ordinances by adopting planning and/or operational requirements that set a minimum allowable threshold of shadow flicker caused at neighboring residences. As a planning requirement, at least two counties (Kossuth and Palo Alto) require applicants to submit computer modeling that demonstrates that shadow flicker impacts will be below the specified limit.

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For example, Kossuth County’s wind ordinance requires the owner or developer to submit the following with its application:

A report prepared by a qualified third party using the most current modeling software available establishing that no Occupied Residence will experience more than thirty (30) hours per year, or more than thirty (30) minutes per day, of shadow flicker at the nearest external wall based on real world or adjusted case assessment modeling. The report must show the locations and estimated amount of shadow flicker to be experienced at all Occupied Residences as a result of the individual Turbines in the Project.¹⁷

Such a requirement has the advantage of including a specified limit and method of demonstrating compliance with that limit – the requirement is clear and does not allow for subjective discretion of the permitting authority. This approach is preferable over less-precisely worded provisions requiring owners to “minimize” shadow flicker for those counties seeking to reduce such impacts to acceptable levels.

Recommendation: We do not recommend that counties adopt a separate shadow flicker requirement as a standard practice, which is consistent with the approach in the vast majority of county ordinances that we have reviewed. However, if a county does adopt such a requirement, the requirement should enable wind development and provide a clear condition that wind developers can meet in the application process, such as the approach in Kossuth County.

Sound

Adequate setbacks can protect property owners from experiencing nuisance level noise from turbines. The APA recommends a setback of at least 1,000 feet to address sound issues, which is within the range of residential setback distances common in Iowa counties with successful wind projects.

Some Iowa counties have also included sound level limits in their standards for wind turbines aimed at keeping sound from turbines at nearby properties within acceptable levels. These limits, based on specific sound pressure levels measured in decibels, range from 50 dBA to 60 dBA when measured from the affected property.

Wind developers can perform a sound impact analysis for wind turbines using computer-based mapping and modeling and sound level data provided by turbine manufacturers. These models are

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useful in helping to ensure that turbine placement will comply with local sound level limits. However, while such models often reflect conservative assumptions, they may not always be able to take all of the nuances of a particular situation into account, particularly in project locations with complex terrain.¹⁸

Furthermore, while sound can be scientifically measured, “human perception of sound is substantially subjective,”¹⁹ again underscoring the prudence of requiring adequate residential setbacks from turbines.

Recommendation: We recommend that minimum setbacks from residential properties fall within the range of 1,000 to 1,250 feet (see “Setbacks” above). As the American Planning Association explains in its planning guidelines for commercial wind, the options for effectively mitigating sound levels after the fact (once a project has been built) are limited, so addressing sound impacts upfront with appropriate setbacks is prudent. If a decibel limit for turbine sound levels is also included in an ordinance, we recommend a standard no lower than 50 dBA, in keeping with the 50 dBA to 60 dBA range that has proven workable in counties that have successfully developed wind projects.

Conclusion

For counties interested in attracting all of the local benefits that come with wind generation, a well-drafted and balanced wind siting ordinance is an important initial step. Our review of county ordinances across Iowa shows that many counties have adopted workable ordinances resulting in successful local wind development. We have not identified a single model ordinance in any particular county that we recommend in total. Instead, we have identified the strongest parts of different ordinances to include in this paper. Most county ordinances have additional provisions in the adopted ordinances. We have focused on the major provisions critical to the success of an ordinance.

We do note that several Iowa counties have attracted wind development without adopting a specific ordinance. Those include Howard, Mitchell, and Adair counties. While this approach has worked in these counties, we believe the clarity and predictability that comes from adopting a wind ordinance is beneficial for the county, its residents, and wind developers.

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About

The primary authors for this paper are Nathaniel Baer, Clare Kernek, and Kerri Johannsen with the [Iowa Environmental Council](#). We appreciate the input and guidance provided by wind developers, county officials, and others as we researched and drafted this paper.

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Appendix A: Main County Ordinances Reviewed

County	Residential Dwelling Setback	Property Line Setback	Type of Permitting Process/Use	Permitting Authority	Date adopted or amended	Link to County Ordinance
Black Hawk	n/a	1.5x total height of turbine	Special exception	Board of Adjustment	2011	http://www.co.black-hawk.ia.us/227/Zoning-Ordinance
Boone	750 feet	1.25x total height of turbine	Conditional Use	Board of Adjustment	2009	http://www.co.boone.ia.us/index.aspx?page=256
Cass	1,200 feet	1x total height of turbine	Special exception	Board of Adjustment	2015	http://www.atlanticiowa.com/county/county-government/county-ordinances/
Clay	1,200 feet	1.1x total height of turbine	Special exception	Board of Adjustment	2011	http://www.co.clay.ia.us/offices/auditor/policies.htm
Carroll	1,000 feet	Not less than the rotor radius from non-participating properties	Conditional Use	County Zoning Administrator	2016	http://www.co.carroll.ia.us/Attorney/ordinances.htm
Dickinson	Greater distance of 1,200 feet or 2x total height of turbine	Turbines may not overhang adjacent property lines without securing appropriate easements	Conditional Use	Board of Adjustment	2008	http://dickinsoncountyiowa.org/wp-content/uploads/2013/03/ZONING-ORDINANCE-102-ORIGINAL4.pdf
Greene	1,000 feet	Not less than the rotor radius from non-participating properties	Conditional Use	Board of Adjustment	2011	http://www.co.greene.ia.us/pView.aspx?id=15466&catid=659
Grundy	1,200 feet	1.25x total height of turbine	Principle Use	County Zoning Administrator	2009	https://www.grundycounty.org/departments/zoning/development-ordinance

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Ida	1,250 feet	1.1x total height of turbine	Conditional Use	Board of Adjustment	2016	n/a
Kossuth	1,600 feet	600 feet	Conditional Use	Board of Supervisors	2017	http://www.co.kossuth.ia.us/windfarms.php
Madison	Greater distance of 1,000 feet or 2x total height of turbine	No overhang of adjoining property line without an easement	Conditional Use	Board of Adjustment	Pending	n/a
O'Brien	1,200 feet (includes accessory structures)	[None specified]	n/a	Board of Supervisors	2015	http://www.obriencounty.org/board-of-supervisors/ordinances/
Osceola	1,250 feet	1.1x total height of turbine	Conditional use	Board of Adjustment	2013	http://www.osceolacountyia.org/county/of/fice/9
Palo Alto	1,500 feet	1.2x total height of turbine		Board of Supervisors	2016	https://www.paloaltocountyiowa.com/board-of-supervisors/wind-energy-ordinance/
Pottawattamie	100% of tower height	Manufacturer's fall distance	Principle Use	Director of Planning and Development	2008(?)	https://pottcounty-ia.gov/resources/county-code/
Poweshiek	Greater distance of 1,000 feet or 2x total height of turbine	1.1x total height of turbine	Conditional Use	Board of Adjustment	2017	http://poweshiekcounty.org/sanitarian-zoning/
Story	Greater distance of 1,000 feet or 2x total height of turbine	No overhang of adjoining property line without easement	Conditional use	Board of Adjustment		http://www.storycountyiowa.gov/index.aspx?nid=115
Webster	1,000 feet	150 feet	Conditional use	Board of Adjustment		http://www.webstercountyia.org/

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¹ American Wind Energy Association, *Iowa Wind Facts* (2017) available at <https://www.awea.org/state-fact-sheets>.

² Navigant Consulting/AWEA, *Economic Development Impacts of Wind Projects* (2017) at https://www.navigant.com/-/media/www/site/insights/energy/2017/awea-study-1-031017_v2.pdf.

³ The only exception we have found is Black Hawk County, which does not require a minimum setback from residential properties but does include a setback requirement for all non-participant property lines.

⁴ American Planning Association. (2011). *Planning for Wind Energy* (Planning Advisory Service Report No. 566). Chicago, IL: American Planning Association, at 98.

⁵ See e.g., Black Hawk County Zoning Ordinance No. 36, Section XXIV—Administration and Enforcement, G.1.(f)-(g) (providing in part, “Prior to the granting of any special use, the Board of Adjustment shall stipulate such conditions and restrictions upon the establishment, location, construction, maintenance, and operation of the special exception as is deemed necessary for the protection of the public interest and to secure compliance with the standards and requirements specified in Subsection (f) above.”), at 104.

⁶ Kossuth County Ordinance #310, Section II—Permit Application and Review, No. 8.

⁷ Poweshiek County Zoning Ordinance, Article XX, “Conditional Use Permits,” Sec. 5.1 (q).

⁸ Poweshiek County Zoning Ordinance, Article XX, “Conditional Use Permits,” Sec. 5.1 (n).

⁹ Poweshiek County Zoning Ordinance, Article XX, “Conditional Use Permits,” Sec. 5.1 (o)-(p).

¹⁰ American Planning Association. (2011). *Planning for Wind Energy* (Planning Advisory Service Report No. 566). Chicago, IL: American Planning Association, at 98.

¹¹ Brent McDonald, *For crop-dusters, towers pose a hidden and growing danger*, N.Y. Times, Oct. 3, 2014, at A19. Electronic version retrieved from <https://www.nytimes.com/2014/10/03/us/for-crop-dusters-a-hidden-danger-in-the-fields.html?mcubz=0> (last visited Sept. 12, 2017).

¹² FAA’s recommended markings for met towers are in Sec. 2.7 of Advisory Circular 70/7460-1L (originally published on Dec. 4, 2015, updated Oct. 8, 2016.) To obtain a pdf of the circular, go to www.faa.gov. Once at the home page, click on the Regulations & Policies tab. In the search bar, type in “70/7460-1L.” Click on “Obstruction Marking and Lighting with Change 1.”

¹³ Poweshiek County Zoning Ordinance, Article XX, “Conditional Use Permits,” Sec. 5.1 (m)(6).

¹⁴ American Planning Association. (2011). *Planning for Wind Energy* (Planning Advisory Service Report No. 566). Chicago, IL: American Planning Association, at 99.

¹⁵ Kossuth County Ordinance #310, Section V—Ancillary Agreements.

¹⁶ *Id.*

¹⁷ Kossuth County Ordinance #310, Section II—Permit Application and Review, No. 2(J).

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¹⁸ American Wind Energy Association. *The Wind Energy Siting Handbook* (Feb. 2008) at 5-35, available online at <https://www.awea.org/Issues/Content.aspx?ItemNumber=5726>; Kenneth Kaliski et al. 2011. "Improving predictions of wind turbine noise using PE modeling," paper presented to NOISE-CON 2011, Portland, Oregon, July 25-27, 2011.

¹⁹ American Wind Energy Association. *The Wind Energy Siting Handbook* (Feb. 2008) at 5-37