**Theme: Wind Energy Production**
**ID Letter: EE**

**Questions:**

1. Can electrical transmission lines be buried underground from the wind turbine to the substation? See response below.
2. Can the electrical transmission lines be buried from the substation to the high voltage transmission lines? See response to question EE1.
3. Do the turbines take electricity to operate? See response below.
4. Where will the transmission lines that will connect these turbines and existing transfer stations be placed? Will the transmission lines be underground or overhead? How wide will they be if they go overhead? Will they cross non-participating properties? Will the property be condemned or seized by eminent domain? Will there be a map that shows the placement of transmission lines before erected? See response below.
5. Will the transmission lines for the grid be underground? See response to question EE1.
6. Can the township require transmission lines to be buried? Can the township do anything to limit the impact of substations on a non-participating land owner? See response below.
7. What is the total distance the new power lines will run? Project specific.
8. Who will benefit from the generation of power by the windmills? Is it used locally? See response below.
9. Will the power generated locally be used locally? Can it be? See response to question EE8.
10. Does the majority of the population that is leasing their property to Duke realize that this power they generate does not "benefit" our area? Do they know it's for Detroit Edison? Project specific.
11. Does the public realize that Duke is supplying to Detroit Edison? Project specific.
12. Is there any guarantee that we can require that the electricity generated in our community stays in our community? See response to question EE8.
13. How much land would be cleared for power lines and other utilities? See response below.
14. What infrastructure improvements will be necessary to support and connect the proposed turbines and who will pay for this? See response below.
15. Will Duke be sharing roads, power lines, etc. with already established companies? Project specific.
16. At what speed does the tip of a blade on a wind turbine rotating at its maximum go? How fast before the breaking system kicks in? See response to question C12.
17. Are the turbines speed limited, and if so, why? Is there an RPM limit at which the current output does not increase appreciably? See response below.
18. Since it can only supplement energy under the right circumstances, why is it worth it? See response to question EE20.
19. How would wind projects in Benzie and Manistee Counties fit into and help maximize the $800 million upgrade investment planned by Consumers Energy and DTE for the Ludington Pumped Storage Facility? See response below.
20. What happens to the energy produced by a wind turbine if it's not being required? Is it stored? See response below.
21. Can we limit the amount of energy generated by a project in our township ordinance? Say, 2.5 times what our township used last year? See response to question D1.
22. Since Michigan has lost 1,000,000 million people and many manufacturing companies, we actually have a surplus of electricity. Why do we need any industrial wind turbines in our area? Where will the energy actually go? See response below.
23. Can a community/township develop a renewable energy program that only allows community wind or limits the amount of MWH produced by the community, like 1.5 times what the community uses, or restrict it to the communities' benefit only? See response to question D1.

24. For each tower's total carbon footprint, which includes road building, transportation of materials, and transmission lines, how long does it take to "work off" the negative of carbon footprint versus the positive of "pollution-free" energy generation? See response below.
25. Can radio-active wind produce energy for a windmill? See response below.
26. We have always been very supportive of wind energy, but, not too long ago, we were coming through an area in northern Indiana (I believe this is where it was) and over half the windmills were turned off! Why would this be? Needs further clarification.
27. Would wind energy be considered an essential service? Needs further clarification.
28. Can a community/township say that only point of use wind or solar would be allowed, i.e. at home or business and not large grid-tied units? See response to question EE21.

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**Questions and Responses**

*These questions may have been recategorized and reorganized. Some may have been sent to another "theme" area (this will have been explained in red under the "Original Questions" section). In other cases two or more questions will be answered with one response.*

EE1. Can electrical transmission lines be buried underground from the wind turbine to the substation? Can the electrical transmission lines be buried from the substation to the high voltage transmission lines?

**Response:** Transmission lines can be buried underground from a wind turbine to a substation, but this is significantly more expensive – both to install and to maintain – than traditional overhead transmission lines. Generally, underground transmission lines are 5 to 6 times more expensive to install than above ground transmission lines. As transmission costs typically account for roughly 7% of a consumer's electricity bill, higher transmission costs can mean more expensive electricity for individuals. Transmission lines are usually only buried in particularly sensitive areas where there are overhead restrictions. The technical feasibility and environmental impact of underground vs. overhead transmission must also be considered when transmission lines are being sited and constructed. For more information, see: http://www.modernizethegrid.com/index.html and http://www.nationalwind.org/assets/transmission/TM_Planning_Principles_-_Feb_2004.pdf.

EE3. Do the turbines take electricity to operate?

**Response:** Wind turbines generate electricity by working like the inverse of a common household fan. As the wind blows past the blades, the movement turns an internal shaft which is connected to a generator creating electricity. Wind turbines do require some energy to operate control systems, such as lights, controllers, communication, sensors, metering, data collection and brake mechanisms.

EE4. Where will the transmission lines that will connect these turbines and existing transfer stations be placed? Will the transmission lines be underground or overhead? How wide will they be if they go overhead? Will they cross non-participating properties? Will the property be condemned or seized by eminent domain? Will there be a map that shows the placement of transmission lines before erected?

**Response:** While questions about the specific details about possible future transmission line construction in Manistee and Benzie Counties is project specific and beyond the scope of this report, we can provide some basic information about how federal, regional, and state policy can shape electricity transmission in the area. At the federal level, the Federal Energy Regulatory Commission and the Departments of Energy, Agriculture, and the Interior regulate rights of way and land use management. At the regional level, the MISO conducts regional planning and can help provide access to transmission. State and local governments are primarily responsible for regulating the siting and placement of transmission lines. These three levels of regulation, along with an environmental review statement, answer more specific questions about siting, placement, and mapping of transmission lines. For more information, see the Department of Energy's Primer on Transmission http://energy.gov/sites/prod/files/oeprod/DocumentsandMedia/primer.pdf.

EE 6: Can the township require transmission lines to be buried? Can the township do anything to limit the impact of substations on a non-participating land owner?

**Response**: Under most circumstances, a township cannot require transmission lines to be buried. The Electric Transmission Line Certification Act requires electric utilities to apply to the Michigan Public Service Commission for a certificate of public convenience and necessity for any transmission line that is at least 5 miles long and carries a voltage of at least 345 kV. The Act allows the utility to seek a certificate for transmission lines with voltages lower than 345 kV as well. If the utility applies for and is granted such a certificate, any local ordinance in conflict with the certificate is preempted.

The Michigan Supreme Court has held that the MPSC's rules governing underground electric lines trump any local ordinances related to undergrounding. More generally, the Michigan Court of Appeals invalidated a local zoning ordinance that specified minimum corridor width, minimum distance from dwellings, and maximum noise levels for transmission lines. The Court of Appeals held that these requirements conflicted with the Transmission of Electricity Act, which authorizes the MPSC to regulate the safety, capacity, need, and service requirements of transmission lines. The Michigan Supreme Court has held that there is some zoning authority over the location through which a transmission line runs, but that opinion precedes the other opinions discussed in this answer and its current status is unclear.

A local unit of government's zoning authority over substations is very limited, as well. The Electric Transmission Line Certification Act mentioned previously also applies to substations. It defines a transmission line as "all structures, equipment, and real property necessary to transfer electricity at system bulk supply voltage of 100 kilovolts or more." The Michigan Public Service Commission has found on at least one occasion that this definition of transmission lines includes substations. Therefore, a certificate of public convenience and necessity will preempt local zoning related to substations, as well.

Townships do have the right to grant franchises for the use of rights-of-way for electric lines and other utilities, subject to those reasonable regulations as the township may prescribe from time to time. However, a township may not unreasonably withhold consent to a utility that requests a franchise.

EE8. Who will benefit from the generation of power by the windmills? Is it used locally? Will the power generated locally be used locally? Can it be? Is there any guarantee that we can require that the electricity generated in our community stays in our community?

**Response:** While residential and small wind systems can supply energy directly to a home or location, utility scale wind farms are connected to the electricity grid. Once the wind energy enters the grid it is mixed with all other electricity generated by other sources. The MISO grid distributes energy across the Midwest and parts of Canada depending on demand levels. Therefore, it is difficult to tell from exactly what source and location a community is receiving their energy at a given time. However, utilities often have programs where for a premium, consumers can purchase wind energy ensuring that at least part of their electricity supply is being generated through these sources. For example, by enrolling in Detriot Edison's "Greencurrents" program, consumers can purchase a 100 kH of renewable energy for an additional $2.50 per month.

EE13. How much land would be cleared for power lines and other utilities?

**Response:** While much of this information is site specific and could be answered by an environmental impact statement, we can provide general information regarding land clearance for wind energy development. In terms of transmission lines, the amount of land required depends upon the design and site for the system. Generally, the width of a strip of land cleared for a transmission line ranges between 80-140 feet. To read more about types of transmission lines and rights of way, see this document from the Public Service Commission of Wisconsin: http://psc.wi.gov/thelibrary/publications/electric/electric09.pdf.

In terms of access roads for wind development, developers often try to use previously constructed roads for operation and maintenance instead of clearing land for new roads. If new roads need to be developed, the average width of land that needs to be cleared for temporary access for large equipment is 40 feet, while the average width of land that needs to be cleared for permanent access is 16 feet. For wind turbines themselves, their average land footprint is 0.25 acres. To read more information, see: http://www.nrel.gov/analysis/power_databook/calc_wind.php. Additional land may need clearance to allow for large construction equipment.

EE 14. What infrastructure improvements will be necessary to support and connect the proposed turbines and who will pay for this?

**Response**: Based on depreciation filings by Consumers Energy and Detroit Edison, typical infrastructure improvements for wind energy generating facilities include roads, drainage, foundations, FAA lighting, a collection system, a collection substation, a transformer, a HV distribution line, and transmission. All of these improvements except transmission are paid for by the customers of the utility purchasing or generating the energy. Transmission is paid for separately. How it is paid depends on who owns the system - an independent transmission company or a system operator.

EE17. At what speed does the tip of a blade on a wind turbine rotating at its maximum go? How fast before the breaking system kicks in? Are the turbines speed limited, and if so, why? Is there an RPM limit at which the current output does not increase appreciably?

**Response:** The specifics about the speed of blade tip rotation and braking systems vary across turbine models. However, the Tip Speed Ratio (TSR) is an important factor which influences a turbine's energy output. If the blade turns too slowly for the amount of wind that is passing through, then the turbine can't harness optimal energy. Conversely, if the blades turn too quickly, the blades actually block wind from passing through and don't generate optimal energy. Therefore, the TSR and braking systems on turbines are important as they influence energy production. See question C21 for more information.

EE19. How would wind projects in Benzie and Manistee Counties fit into and help maximize the $800 million upgrade investment planned by Consumers Energy and DTE for the Ludington Pumped Storage Facility?

**Response**: It is possible that the upgrades to the Ludington Pumped Storage Facility could increase the capacity of wind facilities that are either owned by Consumers Energy or Detroit Edison, or whose energy will be purchased by one of those two utilities. Increasing the capacity will in turn increase the energy these facilities can produce, and lower the cost of that energy.

The Ludington plant has a capacity of 1,872 MW. Consumers Energy owns 51% of the facility, and Detroit Edison owns the remaining 49%. The plant uses electricity during off-peak hours to pump water uphill from Lake Michigan into a reservoir. Then, during peak hours, the water is released, flows through turbines and generators in a powerhouse, and makes electricity.

Consumers Energy is beginning a major overhaul of the plant, which will be completed by 2019. The upgrade will increase the plant's total capacity by 300 MW. Consumers Energy states that the purpose of the upgrade is to maintain safety and operating condition, as well as to re-license the plant with the Federal Energy Regulatory Commission.

The primary purpose of the plant is to supply electricity during peak hours so as to avoid purchasing from the spot market. However, there is significant added value in the ability to convert off-peak energy from an intermittent generation source like wind into capacity that can be used to supply energy during times when the wind facilities are not generating due to weather conditions.

EE20. What happens to the energy produced by a wind turbine if it's not being required? Is it stored?

**Response:** Wind energy can be stored by different methods. The most popular method is pumped hydro storage. During low-cost off-peak times, water is pumped from a lower elevation reservoir to a higher elevation. During high electricity demand periods, the stored water can be released to generate hydro power. See response above to question EE19. Pumped storage can be an expensive option depending on the landscape and comparative costs of energy.

Compressed air energy storage systems can also use off-peak electricity from wind farms by pumping air underground. The high pressure air acts like a huge battery that can be released on demand to turn a gas turbine and make electricity.

Though storing wind energy is possible, storage is not always necessary when wind energy is integrated on the electricity grid. Using smart grid technologies, wind forecasts, interconnected markets and farms, and predictions of demand, excess energy produced in one area can be dispatched to an area of need instead of stored. For more information about wind energy flexibility and reliability see Section L: Alternative Forms of Energy, specifically question L 12.

EE22. Since Michigan has lost 1,000,000 million people and many manufacturing companies, we actually have a surplus of electricity. Why do we need any industrial wind turbines in our area? Where will the energy actually go?

**Response:** Michigan is a part of a much larger, interconnected electricity grid connecting the Midwest and parts of Canada. Additionally, Michigan is investing in wind energy in part because of its Renewable Portfolio Standard, which requires that 10% of Michigan's electricity be produced by renewable sources by 2015. To read more information about MISO, see question EE 8,9,12. For more information about Michigan's Renewable Portfolio Standard see theme Z.

EE24. For each tower's total carbon footprint, which includes road building, transportation of materials, and transmission lines, how long does it take to "work off" the negative of carbon footprint versus the positive of "pollution-free" energy generation?

**Response:** Of all energy technologies, wind energy has one of the smallest carbon footprints. Wind energy emits no carbon dioxide as it generates electricity. The majority of its footprint is generated during the manufacturing of the turbines and the construction of the wind farm. A very small portion of a wind farm's carbon footprint is derived from maintenance trips and inspection. The total carbon footprint for onshore wind during its entire lifecycle is estimated at 4.64 g $CO_2$ eq/kWh. Comparatively, coal's total carbon footprint, Michigan's largest energy source, is 1,000 g $CO_2$ eq/kWh. To read a comparison of carbon footprints by electricity generating technologies, see this report from the UK Parliament http://www.parliament.uk/documents/post/postpn268.pdf

EE25. Can radio-active wind produce energy for a windmill?

**Response:** If this question refers to wind that is carrying radioactive fallout, the response is that radioactive wind still functions like wind and can produce electricity. For more information about how turbines generate electricity, see response to question EE3.