Theme: Alternative Forms of Energy
ID Letter: L

Original Questions:

1. Can you provide a comparison matrix of energy sources including but not limited to coal, wind, solar, nuclear, and natural gas that addresses cost, carbon footprint, subsidies, health risks, historical costs associated with health and environmental impacts, etc.? See response below.
2. How does wind compare with other green energy options based on cost, energy efficiency, and environmental impacts? See response below.
3. What forms of renewable energy might respect the independence and pride of small rural, agricultural communities such as Frankfort, allowing the residents and landowners to take the lead in energy development that would benefit them? The current process in which huge corporations such as Duke Energy use state-of-the-art methods to market their product and project, and the massive size of the turbines themselves, dominates the local people and leaves them dependent on the corporation to make good on its claims. This is not the way of Benzie County's people. See response below.
4. Gas looks better than coal, but rock fracturing is hard on the ecosystem 3. Hydro also destroys lots of ecosystems 4. Nuclear - Safety problems could be solved, but we need to deal with waste and the mining of the uranium ore 5. Solar - a long way from economical 6. Geothermal, fuel cells, biofuels 7. Wind - compared to above, maybe we should give it a chance. Comment not question.
5. Coal is not yet clean, and the mining of it is destroying vast land areas ("mountain top removal') in the east. Comment not question.
6. Can wind compete with coal or nuclear without subsidy? See response below.
7. Compare and constant wind energy to coal (emissions). See response to question L6.
8. If we don't go with this form of wind energy, what else is being discussed for the area? Offshore wind farms? Solar? See response below.
9. Is there something out there that is more expensive for Duke Energy but would affect taxpayers/residents less? Project specific.
10. Recommendations made in the *Final Report of the Michigan Wind Energy Resource Zone Board*, October 15, 2009, are being cited as reason to support extensive utility wind turbine development in 4 of Michigan's prime natural areas: Allegan County, Charlevoix County, Huron County ("The tip of the thumb") and Benzie/Leelanau Counties ("The little finger"). What form of renewable energy might be more compatible than utility turbines with the longstanding statewide priority to protect and promote "Pure Michigan" (See: michigan.org)? What form of renewable energy will assure that these lands remain free of industrial development, that their beauty is preserved and that the ecosystems are supported? Value judgment.
11. Are there any permits being considered to drill the deep well fractoring sites in our area? Are there any Q and A meetings proposed on this technology? What footprint will these facilities leave to drill, fracture, and produce? How many are being considered? See response below.
12. Does wind power in Michigan have real potential to reduce or eliminate the current base load power supplied by more consistent sources of power, like coal, natural gas, and nuclear? Has wind power been verifiably credited with reducing traditionally reliable base load sources of power anywhere in the world? See response below.
13. How is power currently generated for Benzie and Manistee Counties? Does the existing infrastructure use the newest technology to protect the environment or are they grandfathered under older laws that are less restrictive? What is their carbon footprint and what are their plans to reduce it? See response below.
14. What happens when other alternative energies are more viable than wind turbines? Beyond scope of this project.
15. Are there other fuel sources that are more consistent than wind energy? See response below.
16. What are the comparisons of traditional energy sources and wind energy based on cost, energy efficiency, and environmental impacts? See responses to questions L1, L2, L16, and AA1.
17. How does a cap and trade, a tax on carbon or a clean energy standard impact the economics of a wind generator relative to the economics of a coal, oil or natural gas plant? What is the likelihood that a cap and trade, tax on carbon, or clean energy standard will be enacted in the next 25 years? See response below.

18. Why would we move forward with any utility turbine projects that will spoil our extraordinary natural heritage when there are new renewable energy products/processes rapidly emerging that are less invasive, sized to be more manageable, more versatile, and comparably or more efficient? (See: flat panel wind generators, accioenergy.com; solar shingles, dowsolar.com). Value judgment.
19. Could we find common ground for serious dialogue that leads to a good plan, and implementation of that plan through community action, by agreeing that we will strengthen the renewable energies that guarantee we will never develop nuclear power in the Benzie or Leelanau areas? Surely, this will require compromise on all sides. Those who are enthused about utility wind turbine development will need to listen to and accept higher setbacks from residences, lakes/rivers/creeks, shorelines, park/forest preserves. Those who are grieving the loss of pristine panoramas, unspoiled natural acreage and loss of a peaceful, undisturbed environment will need to listen to and accept the mandate to support reasonable local development of clean energy. There will be losses for everyone, but greater gains for all are a hope worth striving for. Comment not question.

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.

L1. Can you provide a comparison matrix of energy sources including but not limited to coal, wind, solar, nuclear, and natural gas that addresses cost, carbon footprint, subsidies, health risks, historical costs associated with health and environmental impacts, etc.? What are the comparisons of traditional energy sources and wind energy based on cost, energy efficiency, and environmental impacts? What is the actual net production output as a percentage of the rated capacity of other sources of energy such as solar, coal, natural gas, and nuclear?

Response: A comprehensive response to these questions is beyond the scope of this project. However, this question has been answered by other scholars and experts. For example, a 2002 report titled "A Life Cycle Analysis of Electricity Generation Technologies" was written by staff at the Carnegie Mellon Electricity Industry Center to provide comparative analysis of coal, natural gas, oil, nuclear, hydro, biomass, wind, and solar energy. It is available at https://wpweb2.tepper.cmu.edu/ceic/pdfs/CEIC_03_05.pdf.
For a more simplified version, the Union of Concerned Scientists also provides a brief summary of different energy sources. See http://www.ucsusa.org/clean_energy/clean_energy_101/the-sources-of-energy.html.

L2. How does wind compare with other green energy options based on cost, energy efficiency, and environmental impacts?

Response: All renewable energy resources, like wind, solar, and geothermal energy, are considered "sustainable" because their energy/fuel source can be replenished over a short period of time. Additionally, because renewable energy sources are not extractive like fossil fuel sources are, and because they don't produce harmful emissions (like carbon dioxide or mercury) or generate toxic waste like traditional energy sources, they pose a significantly less risk to overall human and ecological health.

Despite the fact that all renewable sources have similar environmental and health benefits, not all renewable resources are currently cost competitive with more traditional fossil fuels. Due to a number of economic and technological factors, wind energy tends to be the most cost efficient renewable resource for generating utility-scale electricity generation. There are also life cycle environmental impacts associated with all energy resources. For more information on comparing renewable energy options, see the Union of Concerned Scientists Clean Energy 101 page at http://www.ucsusa.org/clean_energy/clean_energy_101/ .
To read about lifecycle analysis of wind, biomass, and solar energy, see the Carnegie Mellon University study at https://wpweb2.tepper.cmu.edu/ceic/pdfs/CEIC_03_05.pdf.

L3. What forms of renewable energy might respect the independence and pride of small rural, agricultural communities such as Frankfort, allowing the residents and landowners to take the lead in energy development that would benefit them? The current process in which huge corporations such as Duke Energy use state-of-the-art methods to market their product and project, and the massive size of the turbines themselves, dominates the local people and leaves them dependent on the corporation to make good on its claims. This is not the way of Benzie County's people.

Response: This research team is unqualified to comment on the Duke project. However, we can address the more general question about the legal power that landowners and citizens have over energy development in Benzie and Manistee Counties. Concerning wind energy development, the state of Michigan leaves all zoning, siting, and review processes up to township governments. Therefore, the scale and attributes of renewable energy development can be incentivized and regulated through local zoning ordinances. See section D for more information about ordinance creation.

L6. Can wind compete with coal or nuclear without subsidy? Compare and constant wind energy to coal (emissions).

Response: A comprehensive response to this question is beyond the scope of this project. In general terms, Michigan derives 60% of its energy from coal, and as coal is not found in large quantities within Michigan, the state spends $2.6 billion dollars annually securing coal energy from other states and countries. Similarly, Michigan derives 26% of its energy from nuclear sources and exports $696 million annually to secure nuclear energy. Wind, on the other hand, is found in abundance within Michigan's borders, but only currently supplies .3% of electricity in Michigan.

In terms of environmental impacts, coal emits mercury, carbon dioxide, and other gasses which, as they accumulate, can have negative consequences for human health, ecosystem health, and can alter the composition of the atmosphere. Though nuclear energy doesn't pose the same emissions problems, it does generate toxic radioactive waste, which poses long term safety hazards to workers, nearby residents and the environment. In comparison, wind energy does not emit any harmful gasses, does not produce toxic waste, and is renewable instead of extractive. Wind energy does have environmental impacts and life cycle impacts. See the responses to questions L1,L2, L16, AA1 for these details.

The federal government subsidizes all major energy markets through direct expenditures, tax credits, and investments in the research and development of energy technologies. Wind, nuclear, and coal are also subsidized through these three avenues. For example, wind energy receives federal tax credits based on the kWh of energy produced, the upfront cost of wind energy development, or the property values of development sites. Coal is subsidized through coal royalty payments, tax credits for nonconventional fuels, and handful of other tax credits, development subsidies, and research and development grants for coal capture technology. Nuclear energy development also receives tax credits, capital subsidies, and liability limitations from the federal government.

To quantify these subsidies, the Energy Information Administration reported that in 2007 the coal industry received $3.3 billion dollars in subsidies, the nuclear industry received $1.26 billion in subsidies, and the wind industry received $724 million dollars in subsidies. While coal and nuclear received more total subsidies than wind, it is important to remember that they receive fewer subsidies per unit of electricity because coal and nuclear constitute a greater portion of the nation's energy production.

The EIA data for 2010 reports shifts in subsidies. For example, renewable energy technologies received 55% of total subsidies, of which wind accounted for 42%. This information is available in the "Direct Federal Financial Interventions and Subsidies in Energy in Fiscal Year 2010", accessible at http://www.eia.gov/analysis/requests/subsidy/pdf/subsidy.pdf The EIA 2010 report cautions that focusing on a single year's data does not capture the imbedded effects of subsidies that may have occurred over many years across all energy fuels and technologies. There was also a significant increase in overall subsidies of energy between 2007 and 2010 ($17.9 billion in 2007 to $37.2 billion in 2010).

For more information about federal energy subsidies, read the 2009 Environmental Law Institute's study on government subsidies: http://www.elistore.org/Data/products/d19_07.pdf. For more information about subsidies for different energy sources, visit the Energy Information Administration's 2007 study on Federal Financial Interventions into energy markets: http://www.eia.gov/oiaf/servicerpt/subsidy2/pdf/execsum.pdf. For more information on the technologies behind coal, nuclear, and wind energy, visit the Union of Concerned Scientists: http://www.ucsusa.org/clean_energy/coalvswind/brief_coal.html ; http://www.ucsusa.org/clean_energy/technology_and_impacts/energy_technologies/how-wind-energy-works.html ; http://www.ucsusa.org/nuclear_power/nuclear_power_101/

L8. If we don't go with this form of wind energy, what else is being discussed for the area? Offshore wind farms? Solar?

Response: Michigan's two large investor-owned utilities, Detroit Edison and Consumers Energy, have proposed to the Michigan Public Service Commission to invest $1 million each in the collaborative research and development of offshore wind energy. The MPSC also made a $1.3 million grant to Grand Valley State University to conduct research on offshore wind technology. We are not aware of any pending applications for governmental approvals for offshore wind development in Michigan at this time.

With one or two exceptions, most solar development in Michigan is being done on a pilot program basis and is limited to small installations on residential and commercial buildings. The residential systems are typically no more than 20 kW and the commercial no more than 150 kW of capacity. There are net metering and some small feed-in-tariff programs to support these installations. Consumers Energy recently agreed to continue its feed-in-tariff program up to an additional 3 MW of capacity that will be allocated in cycles using a lottery system between now and 2015.

L11. Are there any permits being considered to drill the deep well fractoring sites in our area? Are there any Q and A meetings proposed on this technology? What footprint will these facilities leave to drill, fracture, and produce? How many are being considered?

Response: Deep well hydraulic fracturing typically refers to the emerging use of this technology to develop natural gas wells in the Utica/Collingwood Shale. As of September 2011, the Michigan Department of Environmental Quality ("MDEQ") lists no permits or permit applications for drilling in the Utica-Collingwood Shale in Benzie or Manistee County. Hydraulic fracturing is used at a much smaller scale in shallower Antrim formation wells, which have been around for a long time and in numerous locations. Several environmental organizations are negotiating with the MDEQ for protective regulatory standards or a moratorium on deep shale fracking until such standards are in place.

L12. Does wind power in Michigan have real potential to reduce or eliminate the current base load power supplied by more consistent sources of power, like coal, natural gas, and nuclear? Has wind power been verifiably credited with reducing traditionally reliable base load sources of power anywhere in the world?

Response: While we were unable to locate studies that have focused on Michigan, studies have been conducted in the Midwest about wind's potential to supply base load power and potentially decrease our dependence upon fossil fuels or nuclear sources for a consistent supply of energy. One such study, conducted by Christina Archer and Mark Jacobson from Stanford University's Department of Civil and Environmental Engineering, looked at the ability of interconnected wind farms in areas with high wind potential to generate base load power for the grid. In this study, Archer and Jacobson compared base load power potential between integrated systems of 3, 7, 11, 15, and 19 wind farms located in an area spanning the southeast corner of Colorado, eastern New Mexico, the northern tip of Texas, the western half of Ohio, and southwest Kansas. As the interconnected system borrowed extra energy produced by one farm to compensate for lulls in energy production at other farms, Archer and Jacobson found that a system of 19 interconnected wind farms across diverse terrain had the potential to produce base load power for 79% of

the year. That is just slightly less than the average coal plant, which supplies base load power for 79-92% of the year. Further, Archer and Jacobson found that at a large enough scale, a wind farm system could devote 1/3 of the energy it produced to supply base load power while it used the rest to provide some flexibility to the system and generate energy for transportation. According to their results, wind has the potential to supply base load electricity and energy to other energy sectors, though this would require investment in electricity transmission and the integration of wind farms. To read the 2007 Stanford University study on interconnected wind farms and base load power, see: http://www.stanford.edu/group/efmh/winds/aj07_jamc.pdf

L13. How is power currently generated for Benzie and Manistee Counties? Does the existing infrastructure use the newest technology to protect the environment or are they grandfathered under older laws that are less restrictive? What is their carbon footprint and what are their plans to reduce it?

Response: Michigan operates under a deregulated energy market, meaning that homeowners and businesses can choose their electricity provider and providers have to compete for their business. Thus, electricity in Manistee and Benzie Counties is not generated uniformly. Technologies, sources, emissions, and rates all vary by provider. There are two main providers for Manistee and Benzie, and by looking at their production practices, it is possible to understand how electricity is generated and impacts in Manistee and Benzie.

Consumers Energy, the main subsidiary of CMS Energy, provides electricity to much of Michigan, including some parts of Manistee and Benzie Counties. The below table describes the fuel sources for 2011. Coal is the single largest source of energy, and in total it generates 59% of the electricity Consumers Energy supplies. In 2009, Consumers Energy emitted 18 million metric tons of carbon dioxide for every megawatt hour of electricity it supplied, an amount that has varied little in the last two years. This data was accessed at http://www.consumersenergy.com/uploadedFiles/CEWEB/OUR_ENVIRONMENT/Electric-Sources.pdf

Coal	59.2%
Nuclear	20.6%
Gas	14.4%
Wood	2.6%
Hydroelectric	1.2%
Solid Waste Incineration	1.0%
Wind	0.7%
Oil	0.1%
Biomass	< 0.1%
Biofuel	< 0.1%
Solar	< 0.1%

Cherryland Electric Cooperative is the other main electricity provider in Manistee and Benzie Counties, and it buys all of its electricity from Wolverine Power Cooperative. Similar to Consumers, of the electricity that Cherryland supplies, 80% is derived from coal, 12% from nuclear, and 4% from renewable sources. Of those renewable sources, 3.3% is generated from wind. In 2009, Cherryland emitted 1,814 lbs of carbon dioxide for every megawatt hour of electricity it supplied.

Both Cherryland Electric Cooperative and Consumers Energy have programs in place to increase their energy derived from renewable sources, clean up old power plants, and reduce their emissions of carbon dioxide. To read more information about these providers, go to http://www.cecelec.com/ and http://www.consumersenergy.com/.

L15. Are there other fuel sources that are more consistent than wind energy?

Response: Consistency is based on both short term reliability and long term sustainability. In the short term, wind is less consistent than other energy sources, but over the long term it is significantly more consistent because it is a renewable resource. For example, as wind speeds fluctuate during the day, the amount of energy a turbine can produce fluctuates as well. It is possible to compensate for this variability, though, through interconnected wind farms. For more information about reducing the variability of wind resources, see L12. There are other energy sources, such as coal, oil, and natural gas, which have less short term variability than wind, as they can be extracted and converted to energy at a steady rate. Yet the long term sustainability of fossil fuels is limited as deposits of coal, oil, and natural gas are being depleted and take billions of years to replenish. On the other hand, wind energy has significant long term reliability as wind is an infinite resource. Therefore, though some sources of energy are more consistent than wind in the short term, these same sources are generally less consistent in the long term.

L17. How does a cap and trade, a tax on carbon or a clean energy standard impact the economics of a wind generator relative to the economics of a coal, oil or natural gas plant?

Response: A comprehensive response to this question is beyond the scope of this project. In general, there are two major market mechanisms for lowering emissions: a carbon tax and cap and trade systems. In comparison, a renewable energy standard is a regulation that requires the increased production of energy from renewable sources.

A carbon tax refers to a tax imposed on CO2 emissions, and has been implemented by many nations including South Africa, India and the Netherlands. A carbon tax could be calculated as follows: According to the US Energy Information Administration, emissions from petroleum are about 20 pounds of CO2 per gallon (2.4 kilograms per litre, 2.4 kg/L), so a tax of $100 per ton of CO2 would translate to a tax of about $1.00 per gallon ($0.26 per litre). In comparison, under a cap and trade program, an overall emission tonnage cap is set for an affected sector or set of plants. The nation's first cap and trade program was initiated under the Clean Air Act in 1990 and applied to sulfur dioxide (SO_2) for electric utility generators to address acid rain.

There are also voluntary regional cap and trade programs in place in the US, including the Chicago Climate Exchange. A carbon tax would not apply to wind energy generation because it is only implemented on the burning of fossil fuels in proportion to their carbon content. A carbon tax, however, would increase the cost of producing electricity from fossil fuels and would make the production of wind energy more attractive.

Under a cap and trade system, wind energy producers could receive an allocation of emission allowances and then sell them to emitting generators. They could also receive allowances and retire them on behalf of customers when they participate in voluntary markets.