Wind Energy and it's Benefits: An Interdisciplinary Study

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Wind Energy and What it can Provide

There's always been a big problem in terms of energy, and that's wondering if wind energy is better or worse than using fossil fuels. People believe that wind turbines are bad for the environment when it can actually benefit if made correctly. The question is, is it effective? Wind energy that gets used can have many great outcome, especially with farmers and nearby cities. Sure, it may start out expensive, but it can greatly benefit in the future and not pollute the air to help create a better and more livable environment as well. Energy can be refined in many ways, and the best way for it is by using turbines and getting rid of the air pollution. The energy is gathered by the amount of wind that's going through the day and it's stored within energy reservoirs, which can be used for powering up cities and many more different ways. It's considered one of the cleanest forms of energy and can also power lighthouses. Having wind energy to provide for the people in the empty lands can help create a better environment as well as create tons of jobs. The dimensions of the turbines also can reduce costs and create an efficient work-around to save money and use less than more.

There are many types of disciplines that can work around how effective it can be, but I've only chosen three to work with. The disciplines that I'm using show what can be done with the land, with jobs, and with money. Money can have differing effects based on how it's used. Jobs on the other hand can be brought upon for the new workforce members and allow them a place in the world that can provide food on the table. The ecosystem is a very delicate way of our lives that is already on the brink of exhaustion because of all of the pollution in the environment and with what I'll be giving information about it can give a better idea of how we

can reduce a lot of the pollution and start fixing up the air and land, giving the world another chance to live and have our ecosystem become what it used to be.

How it helps the Farmers

When it comes to wind energy, it works around farmers and their land in ways that leave them uninterrupted. The types of turbines are built with a multitude of dimensions and can benefit the farmers by providing them with clear skies and energy for their homes and tools. According to justenergy, less than 1.5% of contiguous US land is used by turbines and wind power plants. It can provide for extra turbine land if landowners and government land managers allow for it. The farmers can use some of their land to provide room for turbines and have people check on them from time to time to ensure they're working properly. When the turbines spin, they can provide a breeze for the crops if necessary as well as keeping them cooler and drier. While the turbines are moving, they can also fight off fungal infections and give the pants a better chance to extract CO2, according to ScienceDaily.

How it Helps the People

With the creation of wind turbines, they can provide for many jobs that can pay a good amount starting as low as $50k a year with 3 to 5 years of experience and a bachelor's degree according to Hamilton and Liming. When they start their jobs, they can start as interns under seniors and can branch off into working as different engineering fields. They can learn on the job or go through apprenticeships. The new employees could also start working as scientists or engineering technicians. When starting as a scientist, they can work with R&D to include

themselves as atmospheric scientists or material scientists to design components to generate the most power efficiently to withstand stress from the environment.

How the Turbines Can Be Made for Easy and Cost-Effective Use

When it comes to making the turbines, it all comes down to the sizes and shapes of them to reduce costs. According to Veers, there are three kinds of drivers that have reduced costs and they are increasing the hub's height, its power rating, and rotor diameter. When that's worked upon, the increased hub height reduces friction for higher quality resource regimes with high wind velocities. When giving the generator a larger capacity, it allows for variable speeds to get more power production and with more power per turbine allows for less of them to be built, lower costs for balance-of-systems, and fewer moving parts to enhance reliability. Making larger and more efficiently designed rotors captures more energy if the blades are longer and provide a substantial cost reduction. According to Tierny and Bird, when turbines were being used around 10 years ago, it was about $100/MWh for onshore wind turbines and now costs about $44/MWh. The US's levelized cost of energy is also less than almost all of fossil fuel related power production. Battery storage has also dropped from $600/MWh in 2015 to $150/MWh in 2020.

Searching within the Literature

While going on about how it can be improved economically, according to Hamilton and Liming, they state that as the wind energy industry continues to grow it will provide many opportunities for workers in search of new careers. The theory this is based upon is supply and demand and they found this out by handing out pamphlets and seeing who came along with

the key concept of researching and developing jobs. Also economically, according to Madrid-Vargas when explaining how well the work can work in rural areas, electricity provision in isolated rural communities can result in significant socio-economic outcomes based on supply and demand. She had performed data collections throughout Central America stating that rural areas are good for renewable energy farms and can create jobs. When working around in environmental sciences, according to Tierny and Bird, after collecting data they found out that a 35% generation of solar and wind power would reduce fuel costs by 40% and carbon emissions by 25-45% to equate a comparison of taking 22-36 million cars off of the roads by reducing the amounts of CO2 in the air with solar and wind power through environmental studies. Also, according to Tierny and Bird, renewable energy typically emits about 50g or less of CO2 emissions per kWh over their lifetime compared to 1000g of CO2 per kWh for coal usage and 475g for natural gases through data collection via environmental studies.

Finding the Adequacies

When searching for theories, there are a multitude of them that may work around wind energy. One of which being that it all relates to the supply and demand theory. When it comes to supply and demand especially in an economic standpoint, it comes down to how many jobs can be produced with all that can be done. If there are effective wind turbines in the process of being made, the demand for scientists, mathematicians, and engineers will be required and ample number of workers for the jobs will be needed to create a good enough supply of turbines to create them. If the supply is high, then the demand for engineers to keep the turbines in check will be demanded. When it comes to environmental science, it can go along with the model of human interaction with the environment. It relies on human interaction via

the turbines to filter out the CO2 in the air and help plants provide it while also keeping them try and cool during the warm days. With the wind and the turbines, they'll provide energy for homes, storing up extra energy if needed, and allow crops to grow without having to worry about fungal infections to that they may continue to provide food for the farmers to make money for their living. In terms of mathematics, the theory that best works with this is the control theory. Its relation deals with the control of dynamical systems in engineered processes and machines. It's based on the usage of feedback to influence the behavior of a system to achieve a desired goal. With this being used, the speed of the engine in the turbines is fed back to the rotors to achieve a specific speed for optimal power collection.

Problem Analyzation

According to David Bidwell, there may be a problem with the placement of where the machines are placed because there's a possibility that people may reject projects that threaten place-based identities. Conflicts may arise when different interpretations are given preference over others. This means that conflicts may come into play if the interpretation of offshore wind gets in the way of others saying that the waters should be left alone since there's a possibility that the oceans and the air may be affected by the machines used. According to Kunneke, the height of the near shore and on shore turbines might be limited by air traffic restrictions thus higher masts and longer blades are constructed to generate significantly more electricity at the higher winds at sea. Larger and heavier turbines need stronger foundations that stay at the bed of the sea though new types of floating and sinking foundations that are designed as constructions are easily dismantled and changed in the future. According to Kukreja, the

turbines would require about 10 kilowatts and $40K-$70K to become an energy producer and can break after 10 to 20 years.

Conflict Analyzation

According to Texas itself, wind energy ensures that business owners large and small can count on reliable power when they need it. In regard to the economical discipline and supply and demand, Texas will be able to provide jobs in response to gaining enough workers for the demand quota for turbine production to supply homes and businesses in Texas with electricity and energy for daily lives. With that, jobs in the field will continue growing and many more may become interested and make their way into the workforce to ensure people are given energy for as long as the world revolves. According to Tierny and Bird within environmental science, the size of turbines is more efficient the larger they are, and they can last around 20 years per turbine. That can provide energy for entire grids and give homes enough power for lifetimes and allow for constant jobs and provide futures for many. According to Veers, the three fundamental drivers that reduce the costs for wind energy rely on specifics that can result in proper and effective energy gain. With those specifics, the biggest reliability is the blade and with the styles of them it can provide a lot of energy storage and give great movement ability due to their shape and weight. Compared to turbines in the 1980s, their size and shape have changed considerably thus making for much cheaper production costs and far more energy gain.

Common Grounds

When searching through common ground, it can be reached in a way that works well among the disciplines. When relying on the economic standpoint and mathematics, it relies on how accurate the mathematics are from the scientists and engineers to provide energy for the economy, thus allowing the employees of the wind energy platform to be paid. With the mathematics and environmental science, the way they work with one another depends on the design and scale of the turbines to help the plants and the air stay clean and fresh. Upon looking into this, the size of the turbines will keep plants healthy from fungi and also give them a good breeze to keep them cool. The dimensions of the turbines as well as the power required to run them can reduce costs for energy compared to fossil fuels and the air around crops can be much cleaner compared to if there were coal and natural gas factories around polluting the air. Working economically and environmentally, it can provide jobs to create more of the turbines, thus making more energy storage and keeping the air cleaner for a safer climate.

Comprehensive Understanding

Reaching an understanding with wind energy can be completed, but it may take more time because of how much more energy we're still using via coals and natural gases. These states can be reached, but we need to have the right amount and kinds of people who are capable of performing the tasks necessary as well as being able to provide the energy necessary per grid and lifestyle. When moving about through supply and demand, the demand is high but the way to get there is a long road with some challenging roadblocks. Supplying scientists and engineers take at least 4 years of schooling and for engineers it requires possibly more because they have to reach out and get their certifications. When they get to the point of getting the job, there comes a time that you may need to deal with pay or time management because of

tight schedules and that could also cause problems in making sure things are correct. This all relies on the hope of the people and that starts with constructing ways to get their attention. The only way we can help the farmers and their crops in this kind of way also relies on the economic standpoint to help the environment. With this it can help change the environment in many ways that can possibly make the air clearer and provide for a cleaner environment in the skies.

Testing

When coming to the testing according Leigh University, with how the US produces energy, they can produce about 40 megawatts at the moment for 7 turbines per farm. If the industry for wind energy becomes bigger in the future, they could increase production to about 30 gigawatts by 2030 and 110 gigawatts by 2050. Each of the projects that are being conducted within the wind energy and have interactions from the soil foundation and they expect wind turbines to be in service for a few decades.

Conclusion

This topic was a rather hard one to look through because I had to find lots of places that I wouldn't think to look to find the information that I did find, making many hard choices of what to use for my paper and trying my best to get a grasp of what each section was to hold. While using IDS, it's made me realize that problem solving can be very complex and can allow for great discoveries on what you looked upon that you had no idea would relate to your questions and insights. While energy is still thriving, the need for wind energy may be just what

we need for extra jobs and creating a better environment. I found this process to be very challenging and it helped me find out a new way to solve complex problems that can help out the future for those who are looking for a place to go when they're thinking of the next step in their life. Wind energy feels like a great way for us to clean up the air and provide for better futures.

References

Bergen, Molly. "How Wind Turbines Are Providing a Safety Net for Rural Farmers." World Resources Institute, 13 Oct. 2020, https://www.wri.org/insights/how-wind-turbines-are-providing-safety-net-rural-farmers.

DOE/Ames Laboratory. (2010, December 18). Wind turbines help crops by channelling beneficial breezes over nearby plants. ScienceDaily. Retrieved April 14, 2022 from www.sciencedaily.com/releases/2010/12/101216122014.htm

"Theories and Concepts for Human Behavior in Environmental Preservation." Journal of Environmental Science and Public Health, Fortune Journals, 30 Aug. 2017, https://www.fortunejournals.com/articles/theories-and-concepts-for-human-behavior-in-environmental-

preservation.html#:~:text=Models%20and%20theories%20to%20be,The%20Value%2DBelief%2DNorm%20Theory.

“11 Types of Economic Theories Aspiring Economists Should Know.” Indeed Career Guide, https://www.indeed.com/career-advice/career-development/economic-theory-types.

“Control Theory.” Applied Mathematics, 19 Jan. 2015, https://uwaterloo.ca/applied-mathematics/future-undergraduates/what-you-can-learn-applied-mathematics/control-theory.

Hamilton, James, and Drew Liming. “Overview of a Wind-Farm Project.” U.S. Bureau of Labor Statistics, U.S. Bureau of Labor Statistics, 10 Sept. 2010, https://www.bls.gov/green/wind_energy/.

Madriz-Vargas, Rolando, et al. “The Future of Community Renewable Energy for Electricity Access in Rural Central America.” Energy Research & Social Science, Elsevier, 25 Oct. 2017, https://www.sciencedirect.com/science/article/abs/pii/S2214629617303432.

Tierney, Susan, and Lori Bird. “Setting the Record Straight about Renewable Energy.” World Resources Institute, 12 May 2020, https://www.wri.org/insights/setting-record-straight-about-renewable-energy.

Veers, Paul, et al. “Grand Challenges in the Science of Wind Energy.” Grand Challenges in the Science of Wind Energy, Science.org, 25 Oct. 2019, https://www.science.org/doi/epdf/10.1126/science.aau2027.

“Texas America’s Leader in Wind Energy - Powering Texas.” Powering Texas, Feb. 2019, https://poweringtexas.com/wp-content/uploads/2019/02/Powering-Texas-R15.pdf.

“Wind Energy: The Pros and Cons.” Just Energy, 3 Dec. 2021, https://justenergy.com/blog/wind-energy-pros-and-cons/.

“Wind Energy's Economic Impacts to Communities.” WINDExchange, https://windexchange.energy.gov/projects/economic-impacts.

“Interdisciplinary Team Tackles Challenges of Offshore Wind Energy 'from the Ground up'.” P.C. Rossin College of Engineering & Applied Science, 12 Apr. 2022,

https://engineering.lehigh.edu/news/article/interdisciplinary-team-tackles-challenges-offshore-wind-energy-ground.

Bidwell, David. “Ocean Beliefs and Support for an Offshore Wind Energy Project.” Ocean & Coastal Management, Elsevier, 3 July 2017, https://www.sciencedirect.com/science/article/abs/pii/S0964569117302478.

Künneke, Rolf, et al. “Understanding Values Embedded in Offshore Wind Energy Systems: Toward a Purposeful Institutional and Technological Design.” Environmental Science & Policy, Elsevier, 17 July 2015, https://www.sciencedirect.com/science/article/pii/S1462901115300162.

Kukreja, Rinkesh. “7 Pros and Cons of Wind Energy (Wind Power).” Conserve Energy Future, 4 Aug. 2020, https://www.conserve-energy-future.com/pros-and-cons-of-wind-energy.php.