Candle in the Wind: Goodbye Fossil

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After food, shelter and clothing as basic needs for the survival of man, what would be the fourth pre-requisite for survival? How about electricity? Yes, electricity. Since its discovery and the development of its numerous applications, the demand for electricity has never ceased to grow. But with the increasing repercussions of the burning of fossil fuels on health, on the environment, and on the economy, scientists and world leaders are devoting more time in considering a shift from fossil fuel to renewable sources of energy to generate electricity. So far, wind energy has the characteristics qualifying it as the best alternative to fossil fuels. Unlike other renewable sources, wind energy does not consume a lot of water and has the least carbon footprint. Wind energy is also emerging as a powerful resource with its high energy capacity, which is responsible for the wide technological support that is strengthening its development.

One of the pronounced environmental advantages of wind energy is its overall very low water consumption. In fact, no water is required for the phases of electricity generation from the wind turbines. Is this not something, in a world which is facing worsening water crises? As noted by Alina-Florentina, "wind farms virtually require no cooling, as opposed to natural gas, coal and nuclear power plants that require a tremendous amount of water for cooling" (62). According to a study investigating "the usage of water for electricity generation in the US" (Fthenakis 2039), the percentage of water consumption for wind energy accounts only for the fabrication and assembling "of steel, iron, and glass fiber for wind turbines [which] are the most significant sources of indirect, upstream water withdrawal" (Fthenakis 2042). The study led to results on wind energy having a water "withdrawal factor" of "4 liters per megawatt-hour of power produced as compared to the 7570 liters per MWh withdrawal factor for geothermal" (Fthenakis 2044). This data proves that "wind energy conserves water resources" (Alina-Florentina 62). Hence, by consuming a relatively insignificant amount of water, wind energy ensures the protection of our water resources.

Wind energy not only preserves our water resources but it also maintains the sustainability of the environment simply because it is clean. Wind turbines do not release any toxic gas, or any hazardous or radioactive waste like "sulfur, methane, carbon monoxide, nitrogen oxides, ozone, volatile organic compounds, and other particulate matter [that] wreak havoc on human and natural habitats alike by causing things like acid rain, urban ozone (caused primarily by nitrous oxide emissions, resulting in respiratory problems in humans), and global climate change" (Shoock 1019). According to research "data from the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, approximately 67 million tonnes of CO_2 was avoided in 2006 by generating electricity through ... [renewable sources among which] wind energy [played] the most important role" (Solangi et al. 2425). Moreover, a comparative investigation was carried out to determine the extent of how much clean wind turbines are and Solangi et al. state that

> A typical turbine was installed ... with a rated capacity of 100kW and [it was] estimated that 168 tonnes of CO_2 [could] be reduced annually. According to ecological footprint, a forest absorbs approximately 3 tonnes of CO_2 per acre of trees per year. Hence, a 100kW wind turbine will prevent as much CO_2 from being emitted each year as could be absorbed by 24 acres of forest ... [thus] saving about 168 tonnes of CO_2 each year. (2426)

The investigation clearly evaluates the extent to which wind turbines are defined as clean, but one might argue that it assesses only the operation phase of the wind energy system. How about the setting up, the erection of the farms, and the implementation of the system? Ram tackles this argument in his article and states that

> The wind turbine life cycle (manufacturing, transportation, planning and construction, operations, monitoring, maintenance, and decommissioning) has fewer environmental risks than conventional energy generation because impacts are primarily temporal and localized. Life-cycle assessments show that the wind energy manufacturing and construction phase generates the largest risks owing to raw materials production and components assembly. This phase accounts for approximately 85% of [the total] emissions. (9-10)

But what is more interesting is that Ram cites a study done by Tester et al. which led to the conclusion that

> these processes take place only once during a turbines life, and so their impacts have been estimated to be relatively small. Because of these one-time life-cycle effects, wind energy appears to hold substantial promise for reducing carbon dioxide (CO_2) and other harmful emissions that pose ecological and health risks. (10)

Actually, what makes wind energy clean, is the mere fact that turbines do not use any fuel (Schiermeier et al 819). Sikri et al. explain how the power is simply and directly generated "from the kinetic energy of the mass of air moving in wind" (1). The kinetic energy trapped in the turning blades of the turbine then gets effectively converted to electrical energy when "the blades drive the shaft" which in turn "rotates the generator" of the turbine (Sikri et al.1).

In addition to their simplicity for the generation of electricity, wind turbines have a huge potential for energy capacity. Even though the electricity generation from wind farms are currently backed up by other sources of electricity generation, the prospect of it being a stand-alone source for transmitting electricity to a wide range of consumption type is not unrealistic and improbable. Oliver reports that "the amount of energy generated by the movement of Earths atmosphere is vast hundreds of terawatts" (4) and he further cites researchers from Stanford University who "calculated that at least 72 terawatts could be effectively generated using 2.5 million of todays larger turbines placed at the 13% of locations around the world that ... [are] practical sites" (4). This represents a very high efficiency of about 70% in harnessing wind for production of electricity. Similarly to the study carried out by the Stanford University researchers, a detailed investigation on wind farms was performed at the biggest wind resource in China which covers "an area of 83,000 km^2" (Lew 273). It was evaluated that the land is able to contain "nearly a million turbines with more than 500GW nameplate capacity" (Lew 273). But with intensive calculations and with assumptions of using the latest high-technology turbines which have the best features that ensure high efficiency operation, the study concludes that the "million turbines" can easily generate "an average annual wind electricity production of nearly 1800 terawatt-hour per year ... This represents 60% more energy than [what] is consumed currently in China" (Lew 273). It can hence be seen that wind farms have credible potential in generating electricity furthermore. The 60% overproduction of energy is more than satisfactory and it reflects again a very high efficiency in harnessing wind.

However, it cannot be denied that the existent potential of increasing the energy capacity of the turbines is challenged by the intrinsic characteristics of the wind. Wind is a variable and an unpredictable resource and turbines can only produce electricity when the wind blows, and it needs to blow within a specific range of speeds. Energy is generated when the wind speed reaches "16km per hour" but the turbines "shut down when the wind exceeds 90.00km per hour" (Costescu et al. 150). This is a real disadvantage that wind speeds cannot be predicted and that there is no certainty in the continuous supply of power output.

Wind does have somehow disheartening limitations in occurrence and speed, but it is alright. Thanks to technology, wind has already taken a great leap towards achievement. The wind energy industry is extensively growing with the support of new technologies specifically designed for wind farms. Turbines are getting more sophisticated to achieve a greater gain. "Computerized systems with integrated laser systems are proving effective ... [in sparing the turbine from destructive winds] while at the same time increasing efficiency" ("Contemporary Issues" 43). Modern turbine blades are carefully designed using specific type of materials. Costescu et al. mention that the blades are now made of "glass-reinforced epoxy ... and the turbines are equipped with asynchronous generators that do not create any electrical disturbance." (151). Costescu et al. discuss the "concrete foundations for the turbines" (151). Costescu et al. make a thorough analysis of "equilibrium conditions of the superstructure that transmits very large bending moments" (151) and consequently suggest detailed technological improvements to the foundations. Even the fluctuations in "wind velocity" can now be controlled by an "inverter technology" (Inoue 1313).

There is no doubt that experts and scientists are convinced that wind is the alternative to fossil fuel because the wind energy industry is undergoing mature technological developments in all its components thanks to the extraordinary on-going research and studies that are being carried out. Inoue and Miyazaki. believe that "control technology resolves a large number of problems in terms of safety and operation characteristics and is able to generate the largest possible percentage of wind power by optimizing the conversion from wind to wind power, which was previously reduced when prior technologies were used" (1308). Indeed, as Alina-Florentina states it, "wind energy has matured dramatically, making wind one of the fastest growing sources of electricity in the world today ... Wind Turbine Technology ... today are sleek and slender machines, a far cry from their bucolic wooden ancestors" (5).

Wind energy is unquestionably the alternative to fossil fuels. While being a frugal resource that saves a lot of water and a very shy polluter which has benign impacts on the environment, wind energy has outstanding and promising potential in its energy capacity. Having proven its benefits, it has attracted the attention of experts, engineers, scientists and researchers, so much so that these professionals are whole-heartedly investing their time and efforts to benefit and to further boost the wind energy industry through the medium of technology. Wind is believed to be the "cornerstone of [a] sustainable energy future" as stated by Alina-Florentina, but it is somehow too early for wind to completely take over fossil fuel because there is a need for wind-friendly policies and a need for more than just breezy funding from governments. But until the change happens, may the wind slowly blow all those candles that are sparking the burning of fossil fuel!

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