Transitioning Coal-fired Power Plants into Combined Solar and Wind Energy Power Plants

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PURPOSE
The purpose of my research is to find a way to end the use of coal by devising a way a coal-fired power plant can be transformed into a combined solar and wind energy power plant without halting energy output. I am also going to examine certain financial aspects to determine if this conversion would be worthwhile to power companies.

METHODOLOGY
First, I will use an algorithm to simulate the long term effects of replacing coal with solar energy during the day and wind energy at night, specifically with respect to the energy output of the power plant and the cost of operation. I will then go to a coal-fired power plant and examine the specific design of the power plant as well as the weather conditions of the area so that I can determine which mechanical designs would work best after the new source of energy has been applied. I will also look for any mechanical parts within the power plant that would be diverse enough to incorporate into the new power plant designs. One specific mechanical part I would like to focus on is transmission lines that carry generated electricity to see if it would be possible to recycle them into the new power plant design. Once I have established a successful way of incorporating the variability of wind power plant into a combined solar and wind energy power plant without halting energy output during the conversion process. There are many engineers performing similar research, though no one has yet tried to completely eliminate coal from the energy equation.

Most research until now has been an attempt to make current coal power plants more efficient and/or environmentally friendly, and many of these ideas incorporate solar or wind energy alongside the boilers and combustion tanks to lessen carbon emissions and coal usage rather than replacing them completely. For example, Mokhtar et al. (1) proposed using solar energy to run a process called carbon capture. Carbon capture is a procedure where a solvent is used to separate carbon dioxide from cooled flue gas which is then compressed into tanks where it can be integrated back into the market and used for other purposes. It requires a great deal of energy, and until now it has not been very realistic for power companies to change over, as it would greatly reduce the efficiency of plants. It is for this reason that these scientists used solar energy to power the carbon capture. They performed their experiment by first developing equations that could calculate the difference in revenue from a regular Post-combustion Carbon Capture system compared to a solar power system, and then by conducting a case study based on a power plant in New South Wales, Australia (1). From both the case study and their calculations, they were able to determine that implementing a solar-powered carbon capture system would be cost-effective and increase the electrical output of the power plant.

Some engineers have also suggested combining coal-fired power plants with a form of solar energy. Nikita et al. (2) explored the unification of solar thermal energy with a fossil fuel based power plant to reduce the amount of fossil fuels used during power generation. Specifically, this group looked at a system with a new collector and boiler to see if it worked more efficiently. However, since this article talked about solar thermal energy rather than solar energy, which is a process where solar energy is used to create steam and run turbines using the steam, it is very different from harnessing energy directly from the sun and therefore somewhat different from my own research plans.

With regards to combining coal-fired power plants with wind energy, Hongyu et al. (3) mixed wind energy with electric heat pumps and coal-fired power plants in an attempt to generate more energy at a more efficient rate. Wind energy can be very inconsistent, so coal-combustion energy was needed to maintain a stable energy output (3). Hongyu et al. (3) used a numerical simulation to perform their experiment, and from it they learned that the irregularity of wind power can be lessened by combining it with coal combustion energy which leads one to wonder if the same results could be found by combining wind power with some other form of energy.

In addition to these scientists, there are other researchers who believe a combination of solar and wind energy power plants is the answer to the current energy crisis (4). Therefore, I believe it will be very possible to draw from past research to find a way to transition coal out of power plants and convert them into solar and wind energy power plants in a way that is beneficial to power companies as well as society.

REFERENCES

PICTURE REFERENCES
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