kc3059 - Kimberly Chia - Renewable Energy

In honor of April 22, 2020 — Earth Day in Unprecedented Times!

Due to this unforeseen worldly circumstances, my group was unable to complete the portion of Efficiency and Optimization: Solar Cell to Hydrogen Fuel Cell that involves developing our own experiments using a box set for wind power to fuel cell operation, a small fan to generate wind, and a meter to measure voltage, current, power, and rpm. Watching other groups having done it in weeks past, I was curious as to the experience had by my peers. I saw various individuals struggling with taping the fan exactly the right way, attempting to position and design turbine blades in an optimal manner to affect turbine speed and power generation. It was fascinating to see the finicky aspect of designing even one set-up; it gave me great appreciation for those who initially started examining wind as a source of incredible renewable energy.

Our experiment with the solar cell set up demonstrated light intensity to be maximized at a 0 degree incidence angle, solar cell efficiency to be 7%. Subsequent discoveries concluded an overall system efficiency of 3.0% when the energy efficiency of the electrolyzer with the solar cell/power source and the fuel cell were accounted for. Compared with other similar set-ups from literature that yielded total commercial efficiencies of about 7.2%, this was relatively low. Our group concluded that the angle/intensity of the sun and system resistances influence the efficiency of power generation/storage when electric modulation fails to maintain ideal operating conditions. Our results will help with commercialization by acknowledging and attempting to solve the issues posed to implement safe and economically efficient energy production and storage systems. This past summer I had the chance to work alongside an analyst that produced risk analyses on commodities, including alternative energy sources such as wind and solar. Frank worked on models that demonstrated how balancing the trades of solar stock with wind stock provided for a low-risk portfolio. Both technologies have to manage incidents of routine intermittency and locational/seasonal dependencies. It would be fascinating to conduct the second half of this experiment myself to understand the procedure in determining optimal wind energy performance.

Wind is cost-effective (costing $0.02-0.06/kWh), creates jobs, enables American industry growth and competitiveness (to compete in the clean energy economy space on a global scale), is a clean fuel source and domestic source of energy, and is sustainable! The most interesting outcome of my foray into sustainable energy was the understanding that wind is actually a form of solar energy. Combined with my visual knowledge of the models from the summer, it is reassuring to know that as long as the sun heats the atmosphere and the Earth rotates that there will be energy that can be harnessed. However, its weaknesses are still quite formidable at this point in time. Wind has to compete with conventional generation sources and the technology still requires higher initial capital investment than its fossil-fueled competitors. Sites for the bigger, land-based utility-scale wind projects are in remote locations that are overly distant from cities where the power is needed and building transmission lines is currently expensive. Aesthetic wise, they also cause noise, can be 'ugly' in beautiful natural landscapes, and damage local wildlife ecosystems.

In my lifetime, I would love to see communities that run purely on a combination of wind and solar energy as I firmly believe that the renewable energy future relies on them both as partners — transmission lines must be built to bring the energy where the demand is.