A Sustainable Environment: Our Obligation to Protect God's Gift

by

George P. Nassos

Can We Afford Water for Energy Producing Technologies?

Although 75% of the earth is covered with water, only 3% is fresh water and less than 1% of that is actually available for consumption by agriculture, industry or humans. According to UN research, by 2025, two-thirds of the global population will face water shortage to some degree. Because of global warming and a continually growing world population, we need to be more cognizant in the efficient use of water. The Chicago Mercantile Exchange (Merc) believes that California's dwindling water supply is in such a state that as of December 2020, water has joined gold, oil, wheat and bitcoin on the Merc as a traded commodity. Fortunately, it only applies to California's water supply. This is just one example of our dwindling water availability.

In 2018, the U.S. became the top producer of oil and natural gas in the world. This was primarily due to the use of hydraulic fracturing, commonly known as fracking. In the period between 2011 and 2014, about 25,000 – 30,000 new wells were drilled and fractured each year. This process now accounts for 69% of all oil and natural gas wells in the U.S. The fracking process uses a combination of chemicals and large amounts of water and sand at high rates of pressure to open up the underground rock formations and release the oil or gas. This process consumes billions of gallons of water and only a small portion is reused for additional fracking.

While the total amount of water consumed by U.S. fracking is about 50 billion gallons per year, it probably represents less than 1% of the total water consumption. However, much of this fracking takes place in areas where the water supply is not plentiful. Any of the wastewater that is collected from the fracking process must be treated before it can be used again as it contains many chemicals, some of which are dangerous for human consumption. Another potential problem that needs to be considered is if any of water used for fracking leaks into the drinking water supply of the nearby community.

Another new technology that is being developed for the energy sector is green hydrogen. This is hydrogen that is produced from the electrolysis of water which separates the hydrogen and oxygen molecules, thus producing the hydrogen gas for consumption while releasing the oxygen to the atmosphere. Upon combustion of the hydrogen, the only output is water – no carbon emissions. There are several other methods of producing hydrogen such as steam methane reforming, nuclear thermochemical splitting, gasification of coal or biomass, but the primary method of interest today is by electrolysis which yields "green hydrogen". This hydrogen can be used both for combustion and for the feed stock of fuel cells, a very efficient type of battery.

The big question is how much green hydrogen will be produced and how much water will be needed. Based on the chemical process, one ton of hydrogen would require nine tons of water. However, this water must be purified and that could require as much as 18 tons of water.

One of the first reports to estimate the size of this market indicated that there would be an annual production of 15 million tons of hydrogen when the transitional hydrogen economy would occur around 2035. The report estimated that 20-70 trillion gallons of water would be needed as a feedstock for hydrogen production and as a coolant for thermoelectric power. When this report was written in 2004, the thermoelectric power sector was already consuming 72 trillion gallons of water per year to generate about 90% of the electricity in the U.S.

This isn't the entire story. Don't forget that the electrolytic process to separate the hydrogen from the water requires more electricity. The amount of electricity depends on the electrolysis efficiency and could range from 1.2 to 2.8 trillion kWh per year. Again, in 2004 the annual electricity generation in the U.S. was about 4 trillion kWh. So we are talking about a 50% increase in power generation just to produce the hydrogen.

With the UN research projecting that by 2025 about two-thirds of the global population will face water shortage to some degree and 1.8 billion people will be living in "absolute water scarcity", we should be more careful on the development of new technology. We need to project the consumption of our critical resources before we invest huge capital for our future. This is not to suggest that we should cease the development of green hydrogen, but we should be cognizant of the applications where it makes most sense. The financial cost of large scale green hydrogen is another story and should also be looked at carefully.