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To: Professors Bedrossian and Russo
From: Néhémie Guillomâitre
Subject: CHEN 3810, Chemical Engineering Lab

At 413 parts per million, the levels of carbon dioxide in the air are at their highest in 650,000 years, nineteen of the 20 warmest years on record have all occurred after 2001, satellite data shows that polar ice sheets are losing mass at a rate of 427 gigatonnes per year, and the global average sea level has risen almost 7 inches in the past 100 years, with an average of 3.3 millimeters per year.[1] As the effects on our environment due to climate change become more prevalent and impossible to ignore, more and more industries have begun to look towards viable and cost-efficient renewable energy sources, such as hydrogen fuel cells, solar cells, and electrolyzers. In the fuel cell lab, we explored the efficiencies of these methods and determined more technological development remains necessary before a switch can be made without risk of efficiency loss. In the United States, the implementation of solar energy has steadily been on the rise, with solar jobs increasing by nearly 160% in the last decade, nine times the national average job growth rate in the last five years.[2] The potential for solar energy is remarkable - if PV panels were installed on just 0.6% of the United States, it would supply enough electricity to power the country.[3] However, as important as it is to produce this energy in an efficient way, it becomes essential to develop a way to store said energy.

Although wind and solar power are abundant, they are discontinuous, and the current method of storing these energies - water splitting - is done using an expensive proton exchange membrane electrolyzer and relies on very expensive precious metals (like platinum and iridium) as catalysts.[4] However, in new research published in *Nature Energy* from scientists at Los Alamos National Laboratory and Washington State University, a new method of water splitting has been developed that utilizes a nickel-iron based catalyst, which is far less expensive and more abundant, to produce comparable results. Researchers at WSU first developed the nickel-iron catalyst, and then the Los Alamos team developed an electrode binder to be used with the catalyst. This product boosted the production rate of hydrogen to ten times that of preexisting anion exchange membrane electrolyzers, which puts it on par with proton exchange membrane electrolyzers.[5] With applications from power grid management and fuel cells to transportation and utilities, the potential for using stored hydrogen energy is endless and better yet, great for the environment.

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[1] Shaftel, H., Jackson, R., Callery, S. and Bailey, D., 2020. Climate Change: Vital Signs Of The Planet. [online] Climate Change: Vital Signs of the Planet. Available at: <https://climate.nasa.gov/>.

[2] Solar Energy in the United States. (n.d.). Retrieved from <https://www.energy.gov/eere/solarpoweringamerica/solar-energy-united-states>.

[3] National Renewable Energy Laboratory and U.S. Department of Energy. SunShot Vision Study. Feb. 2012. pp.4-5.

[4] Washington State University. "Water splitting advance holds promise for affordable renewable energy." ScienceDaily. ScienceDaily, 9 March 2020.

[5] Dongguo Li, Eun Joo Park, Wenlei Zhu, Qiurong Shi, Yang Zhou, Hangyu Tian, Yuehe Lin, Alexey Serov, Barr Zulevi, Ehren Donel Baca, Cy Fujimoto, Hoon T. Chung, Yu Seung Kim. Highly quaternized polystyrene ionomers for high performance anion exchange membrane water electrolysers. Nature Energy, 2020; DOI: 10.1038/s41560-020-0577-x