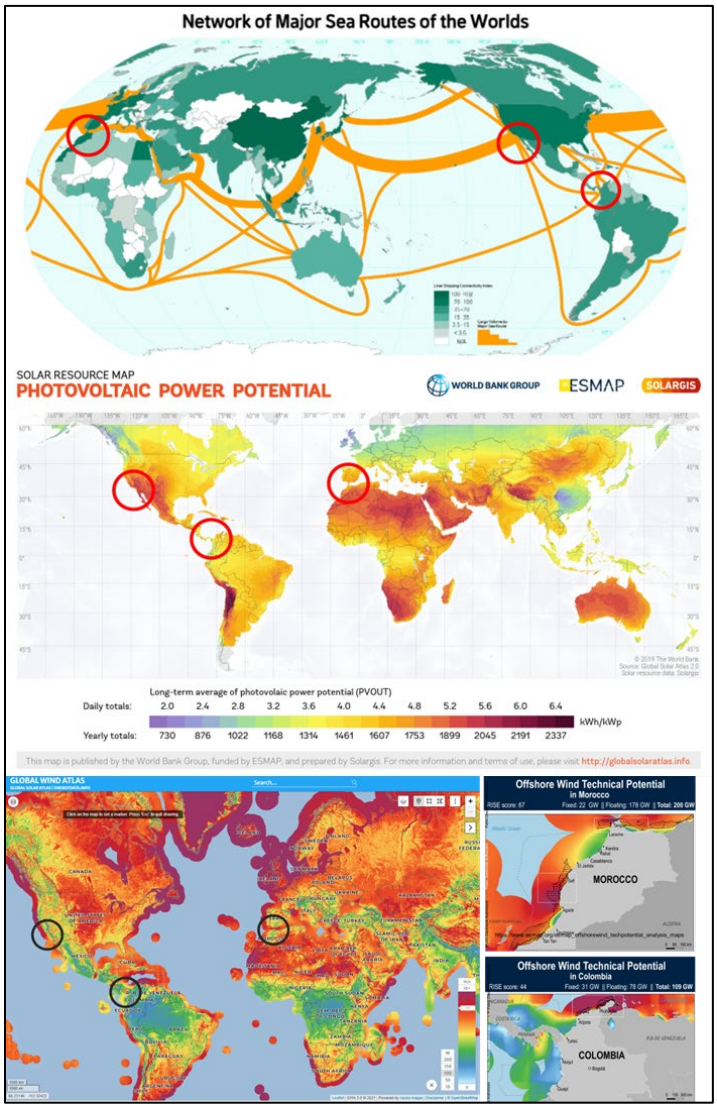
Green Ammonia Refueling Stations along Major Shipping Routes

Marc Schneider, May 2023

There is currently a great effort to decarbonize the shipping sector implementing the use of alternative fuels. Major fleet operators such as Maersk, Southern Devall, NYK, and GSC are either focusing on ammonia or methanol as the potential low carbon shipping fuel of the future. While maritime engines or other solutions for the use of these alternative fuels are far along in development, the greatest challenge for the decarbonization of the shipping industry is that nearly all of today's ammonia and methanol supplies are produced using fossil fuels in highly energy- and carbon-intensive processes. This capstone project focuses on an opportunity to support the maritime decarbonization goals by evaluating the installation of green ammonia refueling stations along major shipping routes. First, three ideal locations positioned along some of the busiest shipping routes and with significant access to renewable energy are selected in the project. The three locations considered in the capstone project are Southern California, a location along the Panama Channel (in Columbia or Panama), and a location along the Strait of Gibraltar (Southern Spain or Morocco). Then, the capstone project evaluates the business case of building a green ammonia facility with SOEC electrolyzers, which benefit from the excess steam of the ammonia process. A financial model calculates the minimum price of green ammonia that provides attractive economics for the project.



The capstone project assumes a 100MW, 300 MTPD green ammonia facility at each of the locations, with TIC of $230 MM each. It also assumes SOEC electrolyzers, with electricity consumption of 39.6kWh/kg of hydrogen, and a renewable electricity price of $0.04/kWh. This system could economically produce green ammonia at an over the fence price of $750/MT. While at times, $750/MT of green ammonia would require a premium for the low carbon ammonia produced by the capstone project, in recent years we have seen prices of conventional ammonia well above the determined $750/MT. Thus, the capstone project, in conjunction with the alternative fuel efforts of the shipping industry, signifies a great step to reduce carbon emissions while keeping in mind the economics of these efforts.