WEEKLY STATUS REPORT

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| Name: | Julian Florez |
| Week Ending Date: | July 28th 2022 |
| Self-Assessment: | Green, ~~Yellow~~, ~~Red~~ |

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| ACTIVITIES COMPLETED THIS WEEK |
| The following activities were completed this week:   * After exploring further cost details and ship processes for the downstream handling. I decided to reformulate the transportation model to take the perspective of chartering ships and thus not having to build and own ships. Inspired from [Optimization of green ammonia distribution systems for intercontinental energy transport - ScienceDirect](https://www.sciencedirect.com/science/article/pii/S2589004221008713#tblfn1). * Ideated and decided for simplicity in transportation model to pursue the following route for demand scenarios as introducing the chartering aspect exponentially increased runtime. * Saudi Arabia can export to two regions: Europe (Germany) and Asia (Japan) * Since green hydrogen/ammonia will be a sellers’ market for the near term (i.e., there will be much more demand than supply), the model will assume that there is always going to be enough demand at the two locations. * As an input to the model, we will provide a percentage that dictates how much of each month’s fuel should go to Europe (and therefore indirectly Asia). * The model will then find the optimal fleet size and respective costs associated with that export focus. * In effort to reduce runtime length, I explored simplification in the production models. I decided to shift to a [google colab format](https://colab.research.google.com/) as well which has increased runtime speed (runs on the cloud) and has aided in model development. * I have also implemented multi-threading (runs models at the same time) to enable greater model testing and eventually lays the foundation for sensitivity analysis * Reviewing literature I came across this great thesis which is similar to my project: [Costs competitive large-scale green hydrogen production in North-Africa in 2030. | TU Delft Repositories](https://repository.tudelft.nl/islandora/object/uuid%3A72588491-ddd7-469c-98c0-e3ada0b19a78) * He found that increasing the model simulation timespan has marginal effects on the levelized cost after ~8-9 months (see image below from paper) * Now developing outline for a paper structure, here is my current idea as of now:   The story we are trying to tell:  Decarbonized fuels are critical to meeting decarbonization targets. So far, other researchers have explored green hydrogen and ammonia production and subsequent transportation under varying conditions and methodologies.  The novelty of the research-why is this work unique:   1. No research has directly focused on Saudi Arabia’s value chain cost projections for islanded green hydrogen/ammonia with subsequent transportation to demand in Europe and Asia. 2. Little research has incorporated the temporal variability of islanded green fuel production at an hourly resolution. 3. Few research has taken a grey box model\* approach to analyze cost projections and compare analysis with greater detailed models.   \*Explanation of three different box modeling approaches  White box-full knowledge of the whole structure down to thermodynamic relationships (e.g. Aspen)  Grey box- know some of the working structure (on a subunit basis-wind,solar,electroyzer) but not at the physics level (my current model)  Black box- don’t know the working structure and instead make predications based on statistical trends (e.g. this would be using Full Load Hours as an indicator for the eventual LCOH)  **Paper structure format**  **Introduction**  problem facing humanity, importance of decarbonized fuels in solution to problem, past work done on hydrogen and ammonia cost analysis, novelty of this research  **Methodology**   1. Geographic assessment on three chosen sites (Northwest, Central West, Northeast)    1. Outline of solar and wind resources in Saudi Arabia    2. Outline requirements for electrolysis plant (access to water, port infrastructure presence nearby, available land for renewable plants) 2. Optimization model of islanded green ammonia and hydrogen at three sites    1. Outline flow chart of production plants    2. Outline mathematical formulations for both plants    3. Cost details and assumptions for the plants 3. Optimization model of transportation of hydrogen and ammonia to two regions (Asia-Japan and Europe-Germany)    1. Outline transportation model flow diagram    2. Outline mathematical formulation    3. Outline demand scenarios       1. Europe oriented-100% goes to Europe       2. Even split 50% to Europe and 50% to Asia       3. Asia oriented-100% goes to Asia   **Results**   1. PLCOA and PLCOH for the two production optimization models 2. Sensitivity tests to the PLCOA and PLCOH 3. Optimal transport routes (can include a video or at least a screenshot of the flow diagram) and therefore DLCOA and DLCOH 4. Sensitivity analysis for transport model   **Discussion**  Biggest drivers of total production cost (broken down by components-i.e. wind,solar,electroyzer, so forth)  Compare calculated prices to other studies (grey box model comparison vs white and black box models)  Analysis of the daily operations of islanded production and what security implications can be derived from the hourly production and operation of a green ammonia/hydrogen economy  \*I can incorporate cracking discussion in this section if necessary. Decided not to dedicate an entire section for cracking as in my grey box model approach it would just be treated as a single final cost (i.e. there isn’t that much work to do on it). Instead I can say in order for the ammonia to be cracked back to hydrogen for a DLCOH of x $/kg, the cracker must add no more than y $/kg to DLCOH.  **Conclusion**  High level summary and key findings   1. TBD (to be discovered)   Weaknesses in model   1. Grey box approach obfuscates the true physical concepts going on. 2. Assumptions inherent in data (linear cost scaling, no learning rate, ex..)   Next steps   1. Further geographic diversity (in production and delivery) (more locations than 3 in KSA) 2. Further temporal analysis (more years than just 2017-2019) 3. Greater technical development in model components (accounting for power flows and actual physical siting of renewable plants) |
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| ACTIVITIES IN PROCESS | NEXT ACTIONS | DUE DATE |
| 1. **Running initial analysis on preliminary results** | * **Review results and explore further visualizations** * **Start initial sketch up of draft** |  |

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| ACTIVITIES TO BE STARTED NEXT WEEK |
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| LONG TERM PROJECTS |
| * Analyzing optimal economic analysis of green ammonia from production to transportation * Increasing useability of model for non-developer use. |

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| ISSUES FOR IMMEDIATE ATTENTION |
| * N/A |

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| KEY TEAM INTER DEPENDENCIES |
| * N/A |