Powering P2X with Renewables

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Introduction

Green hydrogen has an important part to play in the decarbonization of a variety of hard-to-abate industries such as maritime transportation, the production of steel and cement, and long-haul road freight.

In North America there are well-defined incentives for green hydrogen production in the form of the Inflation Reduction Act in the US and the Canadian Clean Hydrogen Credit. Both frameworks provide financial incentives for green hydrogen production. Additionally, in Canada there is a further incentive in the form of an MOU called the Canada-Germany Hydrogen Alliance [1].

Methods

1. For this study, the solar Net Capacity Factor (NCF) was 20-23%, and the wind NCF was 36-39%.
2. Use time series energy modeling to combine 8760's of wind and solar resources for plants of different capacities for an off-grid facility.
3. Run a selection of cases combing wind and solar generation in different proportions to determine the Levelized Cost of Hydrogen (LCOH) for each mix.
4. Check the impact on LCOH of adding a Battery Energy Storage System.

Results

- **Figure 3** is the LCOH map which shows the best combination of wind and solar for this site without BESS
- **Figure 4** LCOH map **with** BESS

CONCLUSIONS

The **optimization** of an off-grid green hydrogen system involves numerous tradeoffs between hydrogen production and the site-specific energy resources, land and water constraints, capital costs, and the operating costs of the wind, solar, storage, and hydrogen production assets.

Resource selection plays a critical role in the optimization of the Levelized Cost of Hydrogen (LCOH). In this case study, the higher wind NCF, when combined with the expected wind CAPEX for the project when compared with the solar NCF and its CAPEX, resulted in a preference for a larger component of wind energy in the generation mix at this site. In other regions where the NCF of wind and solar are closer in value, Natural Power has seen an increased preference for solar. It is also worth considering that the optimization will be influenced by the site-specific relationship between wind and solar generation profiles. For these reasons, it is advised that a site-specific analysis should be completed even at the pre-feasibility stage.

The capital costs and the operating costs of the wind, solar, and energy storage portions of the green hydrogen project also influence the **LCOH optimization**.

Regional costs of construction and operation of each technology have a relatively small impact, but regional land costs can have a larger impact. For example, in areas where land costs are high or land is unavailable, there is a preference for a combination of solar and storage as opposed to wind, which requires more land.

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Figure 1: Combining Time Series Output of Wind and Solar Generation

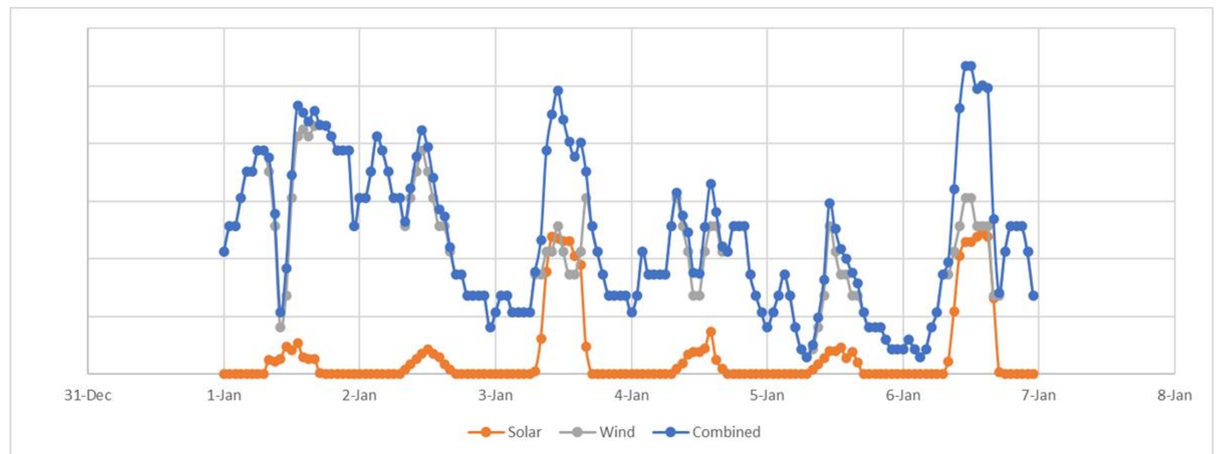
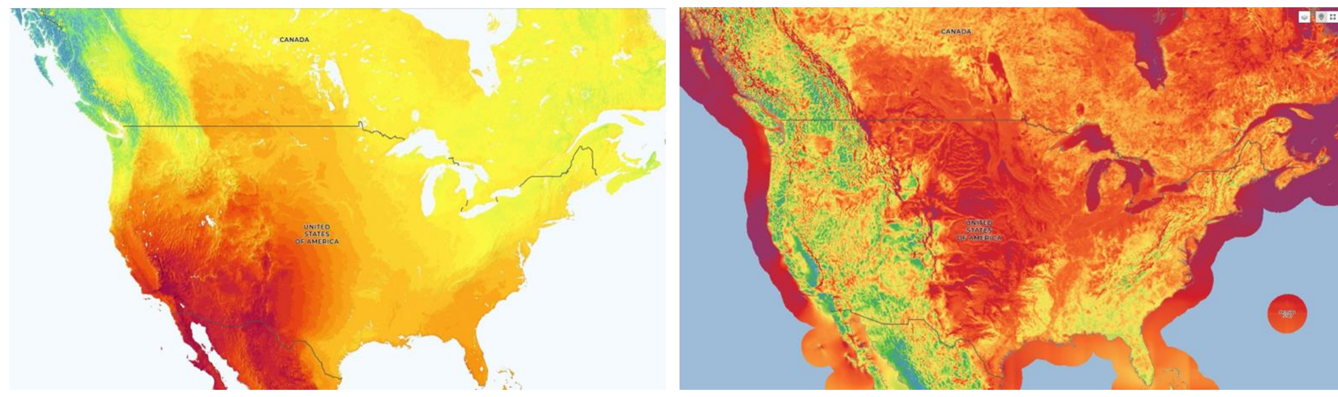


Figure 2: North American Solar and Wind Resource



Source: Global Solar Atlas and Global Wind Atlas

Figure 2A

Figure 2B

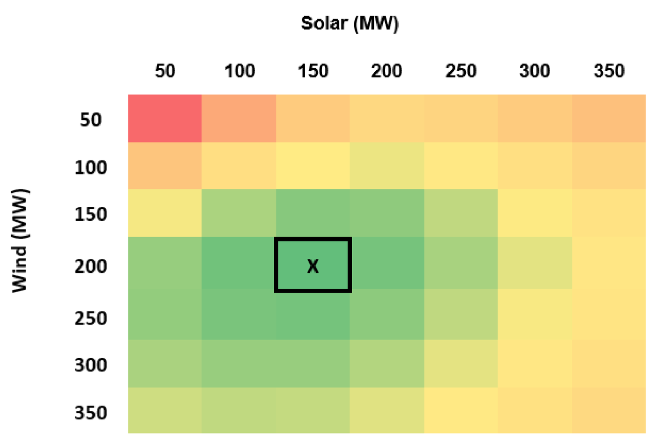


Figure 3: LCOH Heatmap Wind and Solar Only

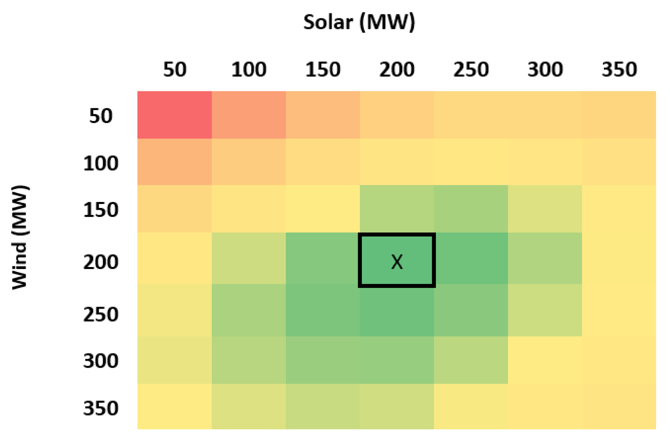


Figure 4: LCOH Heatmap Wind, Solar and BESS

References:

[1] "Joint declaration of intent between the Govt. of Canada and the Govt. of the Federal Republic of Germany on establishing a Canada-Germany Hydrogen Alliance". August 2022.

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