Techno-Economic Analysis of a Proposed Nuclear Renewable Hybrid Energy System in Nome, AK

Motivation

- Find cheaper energy options for Nome (Figure 1)
- Advanced nuclear needs to prove its economic competitiveness
- Replace existing diesel with advanced nuclear
  - Carbon dioxide emission goals
  - Nuclear-renewable hybrid energy systems (NRHESs)

Figure 1. Welcome to Nome

Design Objective

Determine if an NRHES deployed within an existing microgrid in Nome, Alaska by performing a techno-economic analysis (TEA) is economically competitive with current fossil fuel-based energy generation technologies.

- If not, determine how economic indicators must change in order for the NHRES to become viable.

Oregon State University

Nome, AK

- Isolated microgrid (Figure 2)
- Energy resources
  - 2.7 MW wind
  - 5.2 MW diesel
    - Potential 2 MW geothermal
    - Potential 5-10 MW nuclear
- Energy demand
  - 6 MW peak
  - 4 MW average

Figure 2. Nome Location

Methodology

To perform the TEA, a decision flowchart (Figure 3) was designed to facilitate the definition of the system and capital cost for each energy source. Depending on the desired market the TEA is for, it can be tailored to be power cost equalization (PCE) program eligible or not.

Once the inputs, load profile data (Figure 4 & 5), and discount rate have been obtained, the Renewable Energy Integration and Optimization (REopt) software is used to:

- Estimate of the size of the NRHES
- Propose the dispatch strategy of the chosen technologies

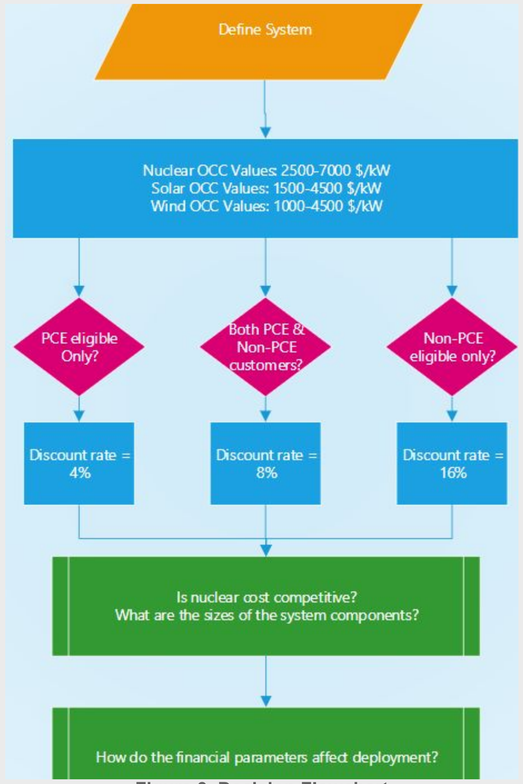

Figure 3. Decision Flowchart

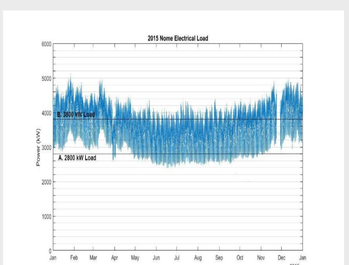

Figure 4. Nome Load Profile

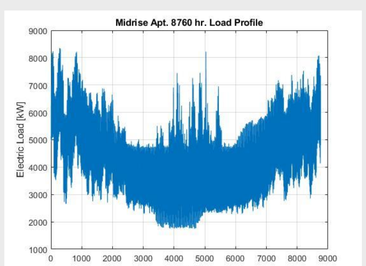

Figure 5. Midrise Apartment Load Profile

Results

- Both solar and wind energy sources show that the discount rate is important when looking at the type of NRHES that should be built for Nome, AK.
- Both solar and wind energy sources show a declining trend as the discount rate increases. With a lower discount rate, signifies life savings will be greater.
- Solar power showed a higher life savings and wind showed a greater load being met.

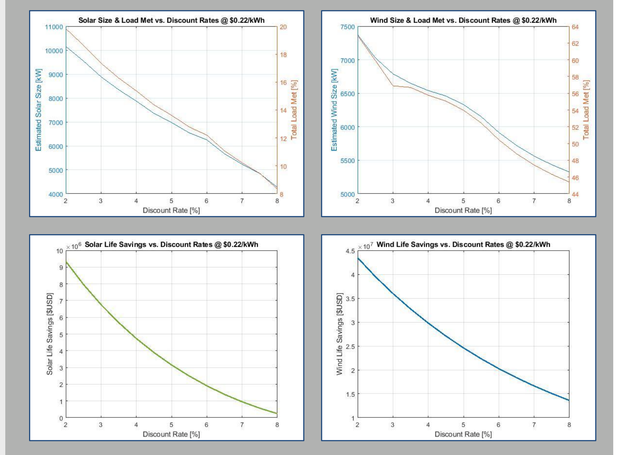

Figure 6-9. Solar and Wind REopt Results

Conclusion

Based on the gathered data and TEA simulation runs with REopt, noticeable trends with the discount rates and life savings was observed for both solar and wind energy sources. As expected, solar power is not efficient in Nome, AK due to its location; therefore, it opens the door for nuclear power to step in.

Future Work

With the use of the decision flowchart, future research of the economic feasibility of nuclear power can be done for other campuses. By showing that NRHESs can compete in the market with other energy sources, the nuclear field will be able to push towards the construction and deployment of advanced nuclear reactors.

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