ETES and CSP-ETES Hybrids Models in SAM (37870)

Operations optimization, annual timeseries performance, and financial return of ETES in open-source software

1. Impact

Electric-thermal energy storage (ETES) is a promising mid-to-long-duration grid storage technology. Robust technoeconomic evaluation of ETES designs requires knowledge of charge and discharge profiles for different grid-pricing scenarios.

2. Project Goal

Develop operations optimization and annual timeseries performance models for stand-alone ETES and CSP-ETES hybrid models. Models will be available in NREL's System Advisor Model (SAM) and use SAM's financial models to perform technoeconomic analysis.

3. Method(s)

Develop a mixed-integer linear program of the ETES system and optimize operations to maximize gross profit over a look-ahead period. Send operations solution to detailed engineering model and solve for portion of look-ahead window to ensure accurate component performance and feasible plant behavior.

4. Outcome(s)

Figure 1 shows preliminary optimized operation of a stand-alone ETES plant. Optimization maximizes gross profit by leveraging largest price differentials while minimizing startup and ramping costs. The stand-alone model will be available in the SAM 2021 fall release.

5. Conclusion/Risks

Next step develops hybrid ETES-power tower CSP system. Trade-off between solution speed and optimality worth exploring. Results highly dependent on grid-pricing assumptions.

6. Team

Ty Neises (PI), Dr. William Hamilton, Dr. Janna Martinek, Dr. Joshua McTigue

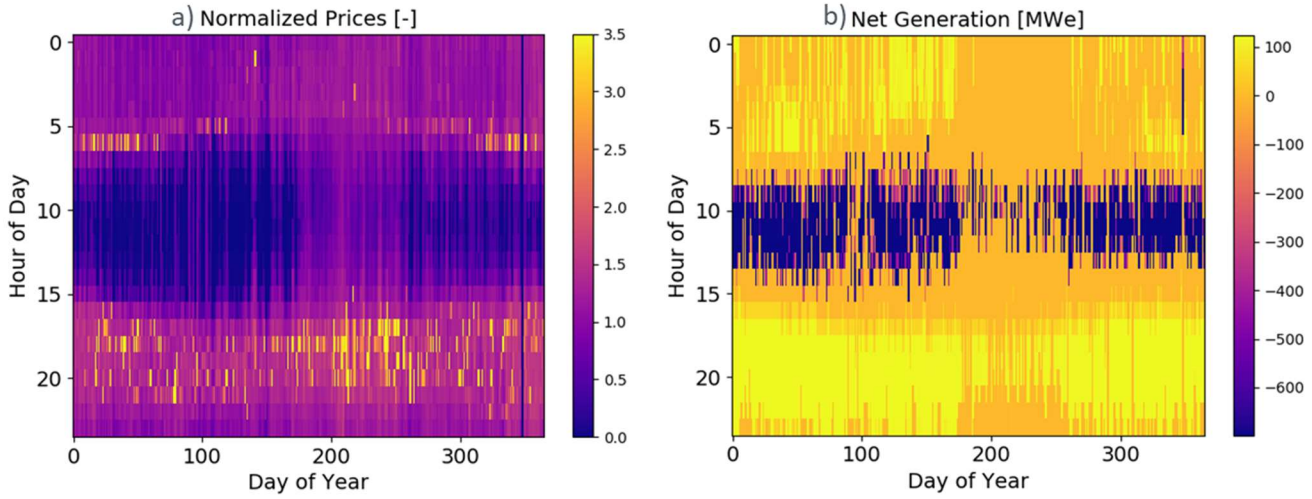

Figure 1. a) Normalized electricity prices from PLEXOS analysis of the "target high solar" scenario in Low Carbon Grid Study: Analysis of a 50% Emission Reduction in California (Brinkman et al., 2016). b) Preliminary optimized operation of stand-alone ETES plant using pricing in a).