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