System Advisor Model (SAM) Improvements for Emerging Solar Thermal Applications

Ty Neises, William Hamilton, Taylor Brown, Janna Martinek, Alexander Zolan

ty.neises@nrel.gov

Poster ID 470

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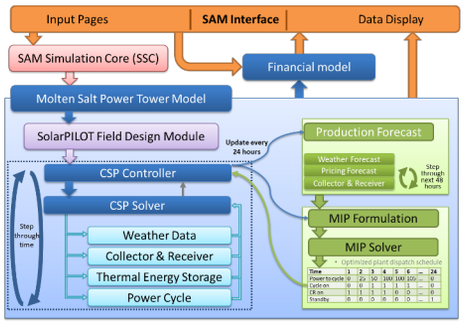
System Advisor Model

SAM is a free software for modeling renewable energy projects

- Developed by NREL with funding from DOE
- Accessible through user-friendly GUI and Python API (PySAM)
- Facilitates technology comparison by handling performance, costs and financing consistently across technologies
- Used for feasibility studies, benchmarking, research projects, plant acceptance testing, and evaluation of grant proposals

Solar thermal and TES models in SAM

Physics based approach shows how design and operation influence techno-economic performance



Solar Thermal Power & Heat

- Parabolic Trough
- Power Tower
- Linear Fresnel (salt and steam)
- Generic Solar (power only)

Energy Storage

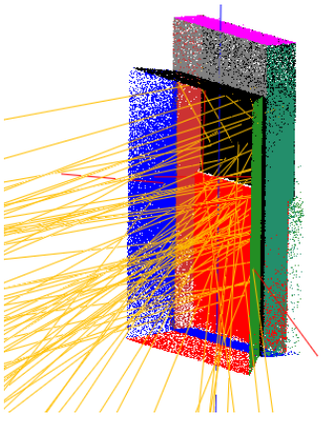
- Electric Thermal Energy Storage
- Pumped Thermal Energy Storage

Improvements for Upcoming Fall Release

SolarPILOT field layout and optimization for multi-receiver towers and tunneled aperture designs

SAM uses SolarPILOT for heliostat field design and generate receiver flux maps

- SolTrace's Monte Carlo ray tracing enables detailed optical properties for tunneled aperture, cavity, and receiver surfaces
- A model-to-model comparison validated SolarPILOT's Hermite method for the SNOUT receiver
- Multi-receiver layout optimizes receiver azimuth angle and can accept different design thermal power for each receiver.
- SolarPILOT release with these capabilities planned this fall



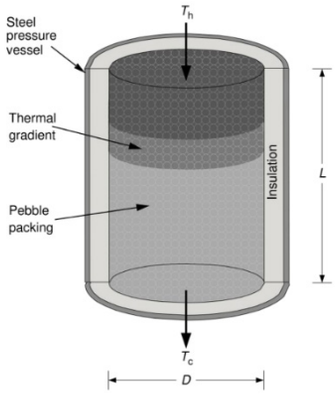
Process heat improvements and new TES models

Process heat technology models replace the power cycle component model with a heat sink model. We are developing:

- Detailed heat sink model to represent user-defined temperature constraints
- Heat-specific metrics and labels

SAM models two-tank liquid TES for electricity generation technologies. We are adding models for TES designs of potential interest for linear systems at smaller scales:

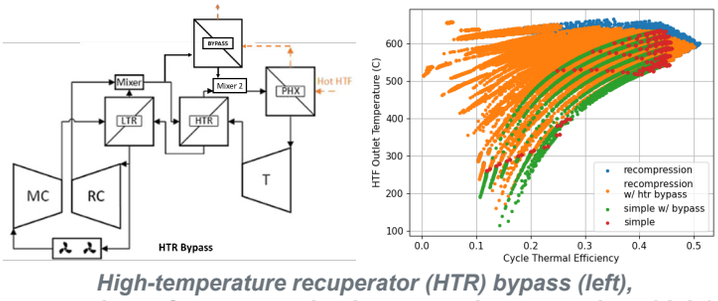
- Packed bed thermocline
- Piston-cylinder pressurized water



McTigue et al. Journal of Energy Storage, 2018. https://doi.org/10.1016/j.est.2018.08.016. This image is licensed under a CC-BY license. No modifications made.

Supercritical carbon dioxide (sCO_2) cycle configurations for heat input over large temperature differences

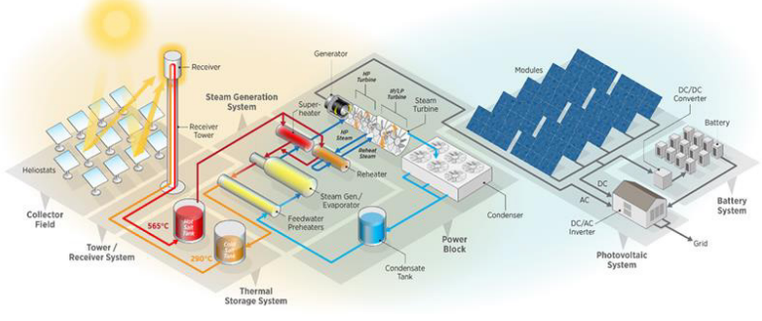
Particles can span a large temperature range. While cycle efficiency decreases, a larger temperature difference of heat input may reduce TES cost, lifting parasitics, and receiver losses. We developed design-point models for the recompression-bypass and turbine split flow configurations and validated against literature. These models are available in SAM's code base, and analysis results using these models is shown in Poster 314.



High-temperature recuperator (HTR) bypass (left), comparison of recompression-bypass cycle permutations (right)

Planned Improvements

- CSP-PV-TES-battery hybrid model
- SolTrace modernization to enable GPU parallelization
- Reduced order sCO_2 off-design to facilitate parametric simulations
- Desktop application with user interface for sCO_2 models
- Technology defaults updates



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