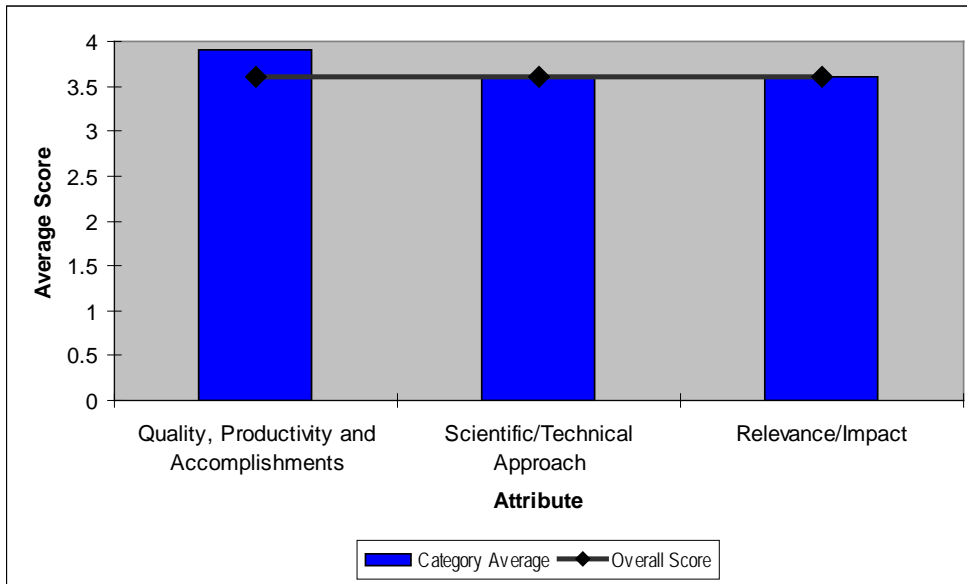


Advanced CSP Systems Analysis

Principal Investigator: Clifford Ho, Sandia National Laboratories



SNL’s research activities in advanced CSP systems analysis, which includes probabilistic modeling, review of CSP codes, solid particle receiver modeling, coupled processes and heliostat modeling, and glint and glare analyses.

Quality, Productivity and Accomplishments (Average Rating 3.9)

Rating Comments

- 4.0 The team carrying out this project has excellent credentials, and its productivity is impressive.
- 3.8 The PI has strong expertise in the subject areas. The other Sandia team members in the project also have extensive experience in CSP. Completed several component and process models that are very important input for the total system models. These are: review of CSP codes, probabilistic modeling, coupled processes/heliostat modeling, glint and glare analysis, solid particle receiver modeling. All of these are very important cross-cutting technologies, which are valuable for CSP. Probabilistic model provides much higher level of confidence in the values. Could be a very valuable tool, great futuristic work.
- 4.0 Really about the only presenter who focused on the three presentation assessment topics Nicely done over view – good speaker – brought in technical depth, but also brought in appropriate level of overview. Outstanding project, outstanding presentation. Keep up the great work. \$400k for advanced csp systems analysis. \$100k for solid particle receiver modeling
- 3.7 The resources have been used very well, The following tasks have provided outstanding results:
 1. CSP Codes
 2. Probabilistic Modeling - stochastic inputs
 3. Prioritize the factor that matter most
 4. Solid particle receiver model
 5. Glint and Glare Analyses
 - Published software

Scientific/Technical Approach (Average Rating 3.6)

Rating	Comments
3.0	The different technical approaches used to achieve the project goals seem appropriate.
3.8	Detailed, strong, well thought-out technical approach produced very good results.
4.0	Review of CSP codes
	SAND Report Improve rd to prioritize components that matter the most on LCOE RISK not necessarily on system performance – for example, are you saying that collector cost has the biggest impact on LCOE or are you saying the collector cost has the biggest impact on variability in LCOE? If you reduce variability in Glint – a momentary flash Glare – continuous source of brightness Promote Latin Hypercube sampling over Monte Carlo modeling approach
	Excellent architectural view of the approach to multi-level software integration from basic design to systems level overview.
3.6	The perfect example of the right technical approach: <ul style="list-style-type: none"> • Review of CSP codes and software • Identification of modeling and analysis gaps and needs • Positive use of integrating: <ul style="list-style-type: none"> • CAD-based software (Solidworks®), • computational fluid dynamics software (FLUENT® and Cosmos FloWorks®), • stress analysis (Cosmosworks®), and • advanced optical modeling software (ASAP®).

Relevance/Impact (Average Rating 3.6)

Rating	Comments
3.0	All of the project goals are of interest to the CSP industry. Especially relevant are the introduction of probabilistic modeling techniques in the analysis of the energy and economic performance of CSP parabolic trough plants, and the approach to heliostat analysis and design by coupling fluid dynamic and the finite element analysis.
3.7	Work very relevant to the industry needs.
4.0	This work has the potential for both NEAR and LONG term impact by focusing the development of the CSP roadmap on critical technology issues. I recommend that this type of analysis be incorporated as a central part of program planning for the overall CSP program.
3.8	There has been exceptionally excellent progress under this project. <ol style="list-style-type: none"> 1. Probabilistic Modeling 2. Solid particle receiver modeling 3. Coupled Processes/Heliostat modeling 4. Glint and Glare Analyses, and 5. Sensitivity analysis Will have a great impact on the success of the solar program CSP System Analysis: Probablistic Modeling has excellent project performance. Need to penetrate these ideas into industry. Very strong tool for laying the ground work for more sustainable work into the intermediate term.

Overall (Average Rating 3.6)

Rating	Comments
--------	----------

- | | |
|-----|--|
| 3.0 | All of the project goals are of interest to the CSP industry. The team carrying out this project its excellent. Its productivity is impressive and the technical approaches its uses are appropriate. Among the project goals the introduction of probabilistic modeling techniques in the analysis of the energy and economic performance of CSP parabolic trough plants, and the approach to heliostat analysis and design by coupling fluid dynamic and the finite element analysis are of particularly relevant. |
| 3.8 | The type of work done in this project provides the foundation for intermediate and long term studies that would be extremely valuable for the CSP industry. For example, the probabilistic model is very useful in providing a much stronger basis for decision making. It allows having broader perspective of the decisions. Instead of a single point deterministic decision, it allows the opportunity for probabilistic decision that allows the user to look at multiple decision points with varying levels of confidence. The solid particle receiver model would allow studying and developing that receiver, which is a good step towards extending the capability of the tower technology beyond the temperature limits of molten salt. Having a good simulation tool for this kind of development is absolutely necessary. Glint and Glare analysis is a very useful study for CSP development. The total system modeling approach is also a very useful tool. The work done during the performance period resulted in 4-5 technical publications, which indicates significant accomplishment. |
| 4.0 | Probably the best, broadest impact project of the session. Materials work by Kennedy, this project by Ho, collector optimization, and thermal storage clearly demanding attention. Excellent project. |
| 3.7 | <ul style="list-style-type: none">• Probabilistic modeling• Coupled-Processes Modeling• Solid Particle Receiver Modeling, and• Glint and Glare analysis are world-class accomplishments |

The lab staff is highly qualified and accomplished to perform necessary tasks even for the advanced CSP system analysis. The proposed work for the next fiscal year:

- Probabilistic modeling integration into existing tools (e.g., SOLERGY, SAM)
- Optimize design for next-generation solid particle receiver
- Integrate models to optimize system design and performance under normal and off-normal conditions (CAD/fluid/thermal/structural/optical) – such as wind and gravity loads on optical performance of heliostats
- Glint and glare analyses for solar thermal power plants