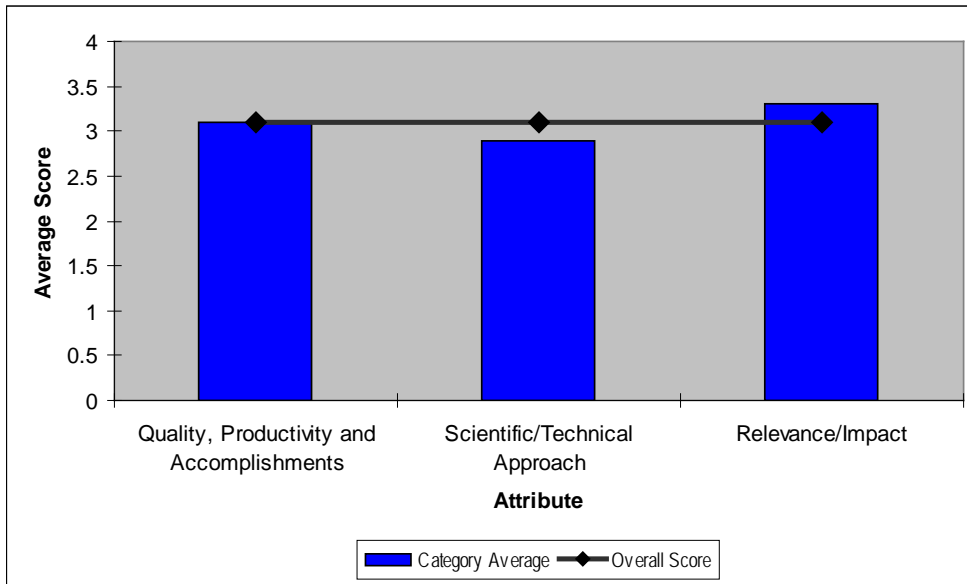


TECHNICAL TRACK: CONCENTRATING SOLAR POWER

Funding Opportunity Announcement (FOA) / Industry Support

Principal Investigator: *Charles Kutscher, National Renewable Energy Laboratory*



Review of NREL’s FOA-supported technical assistance to industry, designed to advance development of parabolic trough technology for central station power generation. Activities include optical measurement techniques and optical modeling, advanced absorber coating, receiver heat loss measurement, and hydrogen mitigation.

Quality, Productivity and Accomplishments (Average Rating 3.8)

Rating Comments

4.0 The project achievements seem to be balanced with the allocated resources. The results obtained have helped targeted industrial partners to improve their technological capabilities. The information provided indicates an effective management of the project.

4.0 Very strong team, equipment, resources, and facilities from NREL and SNL providing the industry support. Much of the work is reported in the other presentations. The VSHOT technology support provided to the industry (Abengoa, SkyFuel, Glasstech, Inc. and Guardian industries, SES and Solar Systems) appears very extensive. It seems to be very successful and beneficial for the solar trough development. Receiver development support provided to Corning, Solel (heat loss from receiver), and Schott/SkyFuel (heat loss), ReflecTech (abrasion resistant coating). It would have been nice to know where Corning is in their development. Are they still going ahead full steam with their work? Performance evaluation for SEGS VIII and IX was a good demonstration of the technologies developed.

- Strong team of solar, optical, and materials experts working with industry
- Milestones all met on time and within budget
- Results are of immediate benefit to industry: improved mirror design, overall optical design, total field, and receivers

3.0 An appropriate number of people, with well recognized technical credentials have been engaged in this project. The members of the team and collaborators clearly demonstrate their ability to contribute to the project. The facilities deployed on the project appear to be adequate, but limited, for the task at hand. The work under way is producing an appropriate level of accomplishment relative to the costs incurred. The project team appears to be on schedule, but

the project is clearly still in progress and not yet complete.

- 4.0 Technical advising to DOE
Alcoa is most mature project
Providing direct industry support
Provided optical test support – good cooperative relations
Abengoa Solar:
Near term trough module
Guardian Glass:
Development of mirror technology for trough industry
Stirling Energy:
Solar System CRADA: Heliostat mirror QC testing

Scientific/Technical Approach (Average Rating 3.8)

Rating	Comments
4.0	The technical approaches used in the execution of the different tasks are appropriate. They also seem well executed. The collaboration with the industrial partners seems to be very valuable to them.
4.0	Good technical approach: <ul style="list-style-type: none">• Very close collaboration with industry to work on issues that are of immediate importance for the industry. Worked with real systems which are either deployed or close to being deployed in the field.• Optical testing, materials development, and analysis provided significant near-term improvement in parabolic trough collectors• Very good technology transfer efforts
3.0	The project team applied an appropriate technical approach in pursuit of project objectives. The design and execution of the approach are good.
4.0	The lab has assisted industry in the development, deployment and maintenance of CSP technology. This support will lead to the development of CSP technology for central station power generation. The support has been provided to the following companies: Alcoa, Inc., Abengoa Solar, Inc., SkyFuel, Inc., and Solar Millennium. The project teams have leveraged resources, including funds and capabilities, by teaming with private organizations. The projects adequately address specific technical and market identified need. Good collaboration with industry. Strong team of solar, material and optical experts.

Relevance/Impact (Average Rating 3.7)

Rating	Comments
4.0	The support provided to FOA awardees within the framework of this project seem to be of high value to those awardees, and to address some of the most important short-term technological needs.
4.0	Work performed is very relevant to the needs of the CSP industry. Worked with some of the major CSP Trough technology developers, who are also the leaders of the CSP technologies. Results and successful completion of future work would lead to useful technologies that would significantly help the specific industry partners and the CSP industry in general.

Specific accomplishments include:

- Optical mirror measurements of immediate benefit to SkyFuel, Abengoa, Guardian, etc.
- Transfer of VSHOT to industry
- Measuring and documenting receiver performance important to trough industry
- Field IR measurements of receivers and plant analysis led to significant increase in revenue for FPL Energy
- Partnered with industry to develop advanced optical materials to improve performance and lower cost of current designs.

Direct quantification of the benefits and the progress towards achieving DOE goals and objectives is difficult, and has not been done by the project team. However, the work will directly benefit the industry.

- 3.0 Near term focus on industry support is good, and reasonable given the current climate and need to respond rapidly. We understand that most of the work done for specific companies cannot be published in certain forms, however, the more data you can put in public domain, the better for advancement of the field. Is there some way to share performance data or performance envelopes without disclosing proprietary information? The semi-conductor industry accomplishes this through roadmapping in their highly competitive field – can some similar technology roadmapping be done for CSP?
- 3.8 Documented receiver performance for the trough industry. One of the items that needs to be addressed by the program is to identify for the project reviewers the structural relationship between different projects.

Overall (Average Rating 3.7)

Rating	Comments
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| 4.0 | The results obtained have helped FOA awardees to improve their technological capabilities within the CSP domain. The project has been effectively managed and executed. The support provided to FOA awardees is of high value to them, and addresses some of the most important short-term technological needs. |
| 4.0 | It seems a lot of the industry support work has not been documented in the form of reports, for genuine reasons. It would be useful make an effort to aggregate findings and publish as much as possible without disclosing company confidential and proprietary information. More documentation and public domain information will be helpful. |
| 3.0 | FY08 \$312K
FY09 \$652k , \$843K enhanced |

FOA Awardees: Alcoa Inc, Abengoa Solar Inc, SkyFuel Inc, Solar Millenium
VSHOT Optical Test support, VSHOT tech transfer, Receiver thermal loss testing
Solar trough perf eval, Guardian – glass mfg looking to get into the mirror market
Glasstech – make the forming equipment for mirrors
Stirling Energy Systems, Abrasion resistant coating CRADA with skyfuel

How many design cycle turns have you collaborated on with Guardian over the past year?
VSHOT system equipment costs about \$15k; one person can operate the VSHOT system. Was originally designed to do point focused optics, but then was refined to do line focus optics.
How many of the field survey tools / drive bys have you implemented? I/R camera in the area of \$50 - \$100k cost element. A single system developed at this time, loaned out to FPL for example on a baseline evaluation basis. Anticipate trending analysis over time at larger installations.
Needs to be better integrated with other optical tools and technologies, as part of a comprehensive suite. Concerns about labor intensive nature shared among the technologies.

- 3.9 The work performed under this project is appropriately relevant to the program's goal and mission. The scientific and technical advances from this research will translate into cost and real energy savings. Most of the work was performed for specific companies and could not be published. It is highly recommended that higher the amount of results available in public domain, the better for advancement of the solar field.