Advanced Low-Cost Receivers for Parabolic Troughs

Norwich Technologies Inc.

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SunShot U.S. Department of Energy

NORWICH TECHNOLOGIES

PROJECT OBJECTIVES

Goal: This project is directed at developing a **novel receiver for parabolic-trough concentrating solar powe**r (CSP) systems that will dramatically improve performance at higher temperatures while substantially reducing acquisition and operation & maintenance costs.

Innovation: State-of-the-art vacuum receivers are limited by high capital cost, vacuum related failures of 1–5% of tubes per year[1-3], and declining performance at high temperatures (*T*). Our advanced receiver will address all of these major challenges and has the potential to **(1) dramatically reduce radiation losses at high *T*, (2) significantly increase reliability by eliminating vacuum loses, (3) decrease acquisition costs due to simpler structure and manufacture, and (4) operate at higher *T*.**

Milestones: M1.1 Materials Matrix, M1.2 Optical Analysis, M1.3 Thermal Loss Analysis, 1.4 Materials Selection, 1.5 Testing Procedures, 1.6 Cost & Performance Estimates, 1.7 Finalized Prototype Design & Procurement

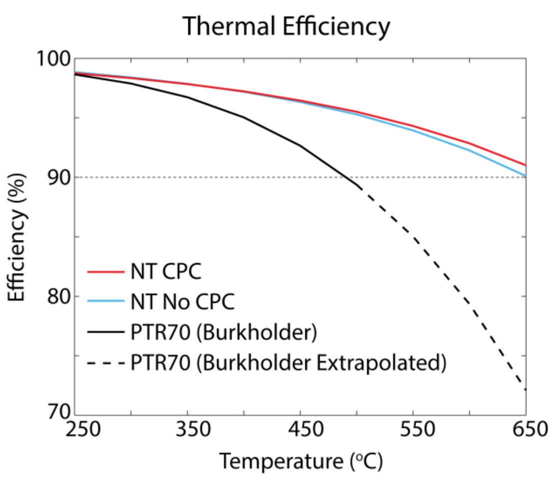
1. Burkholder F, Kutscher C. Heat Loss Testing of Schott's 2008 PTR70 Parabolic Trough Receiver (NREL/TP-550-45633): NREL, 2009.
2. Kutscher C, et al. Line-Focus Solar Power Plant Cost Reduction Plan: NREL Milestone Report, 2010.
3. Mahoney R. Trough Technology—Heat Collector Element (HCE) Solar Selective Absorbers (Trough Workshop, ASES 2000): Sandia National Laboratories, 2000.

APPROACH

•**Technical approach** includes extensive modeling, combined with materials research including development of a large matrix of material options and characteristics, to refine and exhaustively characterize our novel receiver designs. Modeling work is supported by experts in both the optical and thermal domain – Creare, Inc. for Zemax optical and ANSYS Consulting Group for ANSYS Fluent CFD thermal simulation tools.

•**Design approach** includes rigorous modeling of the state-of-the-art existing receiver technology, validation of those models with literature data, and parameter analyses based on selected modifications to the state-of-the-art to identify key design elements. The analysis of these results is used to generate design insight and improve candidate configurations. Rigorous modeling of candidate designs including parameter studies and co-optimization of their optical and thermal performance are then used to evaluate candidate configurations relative to the SOA.

KEY RESULTS AND OUTCOMES



- **Thermal efficiency** for 2 candidate designs >90% at 650C (FOA Target)
- **Optical efficiency** for 3 candidate designs near or exceed SOA
- **Thermal cost**: $75 to $90kW$_{th}$ << $150/kW$_{th}$ (FOA target)
- **Acquisition Cost:** Estimated materials and manufacturing more than 20% lower than SOA
- 4 US and 1 PCT patent applications filed

NEXT MILESTONES

Task 2.2: Build prototype; Commence build of test apparatus

- In this task, the receiver prototype will be built by subcontractor Creare under direction of Norwich Technologies.
- Begin procurement and assembly of optical and thermal performance test apparatus. Machining and fabrication techniques will be monitored to ensure maintenance of dimensional tolerances during build.
- Feedback from build process on receiver design and continued cost analysis to further minimize fabrication expenses

Task 2.1: Company and Marketing Development

- Norwich Technologies will continue developing partnerships to accelerate deployment of our receiver technology.
- Corporate partners will be approached for development of potential collaboration for next phase demonstration testing of our receiver technology.
- 3 pending grants for funding commercial scale demonstration