2/ Integration & Control of Solar Heat with HTL [GUNAM]

ODTÜ GÜNAM
CENTER FOR SOLAR ENERGY RESEARCH AND APPLICATIONS

The Challenge

One of the main industrial barriers in solar-aided hydrothermal liquefaction (HTL) systems is achieving smooth and reliable control between **solar heat supply**, **thermal energy storage (TES)**, and **HTL reactor operation**. The HTL process requires stable conditions of around 300–350 °C and 20–30 bar for several hours — but solar input fluctuates with irradiance and weather. These variations can cause thermal instability, affecting process performance and fuel yield.

This challenge focuses on developing **a smart, automated control system** that can dynamically balance and coordinate the energy flow from **parabolic trough collectors**, **storage units**, and the **HTL reactor**. Predictive control algorithms, automated valves, and real-time decision systems are needed to decide when to store, bypass, or release heat.

Although identified by the research team at **GÜNAM**, this challenge directly responds to **industrial requirements** for scalable, cost-effective solar-aided HTL operation in the biofuels and waste valorization sectors.

Current Status

The system has been validated at laboratory scale with partial integration of solar thermal and HTL components. Advanced control logic and automation integration are under development.

Technology Readiness Level (TRL)

4 – Validated in laboratory environment; next steps involve pilot-scale integration and control testing.

Expected Outcomes

- Stable and continuous HTL operation using variable solar heat
- Reduced dependency on fossil-based backup heat sources
- Higher overall system efficiency and process reliability
- Pathway toward industrial-scale solar-fueled biocrude production

Impact on Operations

Solving this challenge will enable continuous, low-emission production of renewable fuels using solar heat. For industry, it means **lower operating costs**, **greater energy autonomy**, and **enhanced sustainability credentials**.

Previous Actions

Key technologies have been validated. Next actions include: Pilot and demonstration projects, and joint R&D proposals for EU, national, or bilateral funding calls.

About GÜNAM (ODTÜ-GÜNEŞ Energy Research Center)

GÜNAM — the Center for Solar Energy Research and Applications at Middle East Technical University (METU) in Ankara, Turkey — is the country's leading solar energy research institute and one of the most advanced in the region. Its integrated research infrastructure covers the full solar value chain, from photovoltaics (PV) and solar thermal technologies to energy storage, hydrogen production, and hybrid energy systems. GÜNAM actively collaborates with industrial partners to bridge the gap between research and large-scale applications, providing pilot-scale facilities and technical expertise for technology validation and upscaling. Its work on solar-aided hydrothermal liquefaction (HTL) directly supports the development of **solar-driven, low-carbon fuel production technologies**, addressing real industrial needs for energy efficiency and process stability.

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