Project Proposal: THERMOGEN

Advancing Next Generation Thermal Batteries

- **Topic:** HORIZON-CL5-2026-04-Two-Stage-D3-02: Next generation of renewable energy technologies.
- **Action Type:** Research and Innovation Action (RIA)
- **Target budget:** EUR 4.00 million.
- **Project Status:** Consortium under formation led by Hydrogen Valley DK.

Project Concept & Objective

THERMOGEN aims to address the challenges of European energy independence and security of supply by eliminating reliance on fossil imports through the stabilization of a 100% renewable electricity grid. Where current storage solutions struggle with low efficiency, our project delivers a critical breakthrough in supply security via innovative High-Temperature (HT) Thermal Batteries. By utilizing advanced Thermophotovoltaic (TPV) emitters, we convert stored heat into electricity with the efficiency required for true sovereign power balancing. This enables a cost-competitive infrastructure that allows Europe to independently manage supply-demand fluctuations without external energy reliance. The primary goal is to validate the technological feasibility of a novel **TPV-based HT thermal battery** to enable efficient grid balancing for a resilient, self-sufficient future. The specific objectives are:

1. **Establish TPS-based Thermal Battery Process:** Validate HT components and integrated thermal battery process setup.
2. **Efficiency Validation (TRL 5):** Demonstrate that the integrated system can achieve RTEs of 40% (max RTE of current High-Temperature Energy Storage (HTES) solutions).
3. **Cost Pathway:** Establish a clear technological pathway that can deliver a significant reduction in LCOS compared to existing HT Thermal Battery solutions at TRL 9 scalability.
4. **Technological Integration:** Progress the Technology Readiness Level (TRL) from TRL 2 (Concept formulation) to TRL 4/5 (Technology validation in lab/relevant environment).

Technological Scope

THERMOGEN exploits the thermodynamic advantages of extremely high temperatures (>1000°C). The process is visualized in Figure 1 and involves:

- **Charging:** Using renewable electricity to heat a HT storage medium (e.g., slag/ceramics) at >1000°C.
- **Energy Conversion:** A selective TPV crystal emitter converts stored heat into Infrared Radiation (IR).

- **Power Generation:** A specialized PV cell converts the IR back into electric power, avoiding the mechanical losses of conventional heat engines.
- **HT component interface and integration** for decreased energy losses.

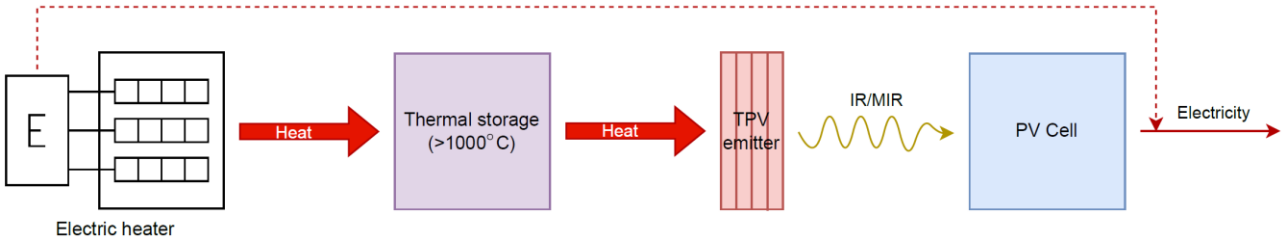

Figure 1: Simplified HT Thermal Battery Process using TPV Crystal Emitter Technology

Expected Impact

- **Grid Stability:** Enabling the integration of large-scale variable renewables.
- **Cost Competitiveness:** Making HTES competitive with conventional peaking power.
- **Resource Security:** Utilizing low-cost, non-critical raw materials for storage.
- **Sector Coupling:** Transferring HT technology into hard-to-abate industrial sectors and district heating.

Partner Profiles Sought

We are looking for European partners to complete our consortium, currently consisting of *Hydrogen Valley DK, AAU Materials and Production,* and *Aalborg CSP*. We seek experts in:

- **Software and control systems** for developing **Energy Management Systems, Predictive Maintenance**, and **Interface-software**,
- **HT Materials Specialists** for storage media design and encapsulation and **PV Specialist** for optimizing HT IR-to-electric conversion,
- **Impact Assessment Specialists** and **LCA Modelers** for techno-economic pathways and Life Cycle Assessment to validate LCOS reductions.

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