

WRAP-UP SOLAR PROCESS HEAT AND THERMAL DESALINATION

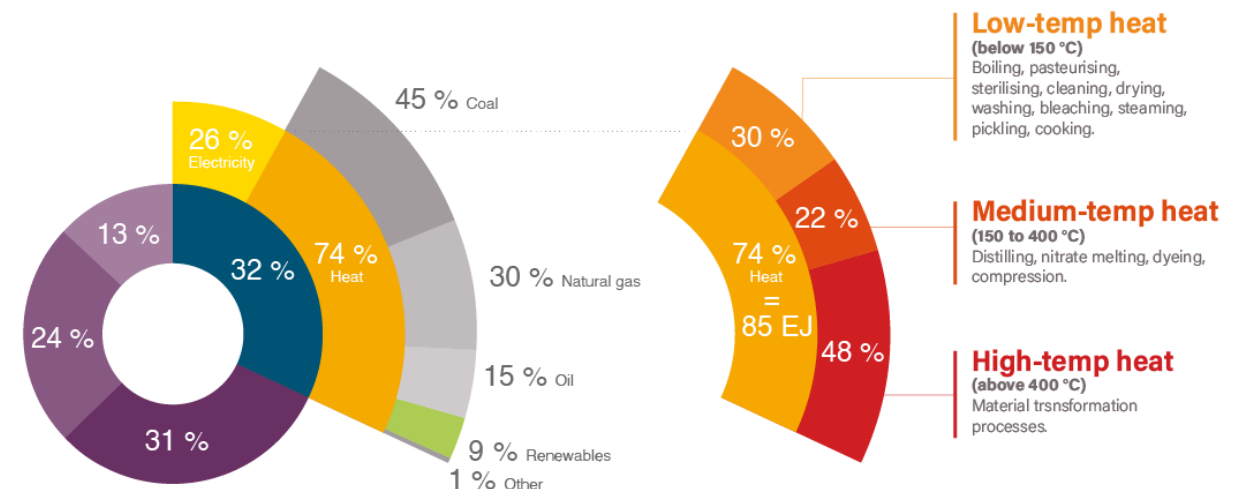
SolarPACES 2024 Conference, Rome, Oct. 8-11, 2024

Tobias Hirsch, DLR Institute of Solar Research

Solar Process Heat is in the focus

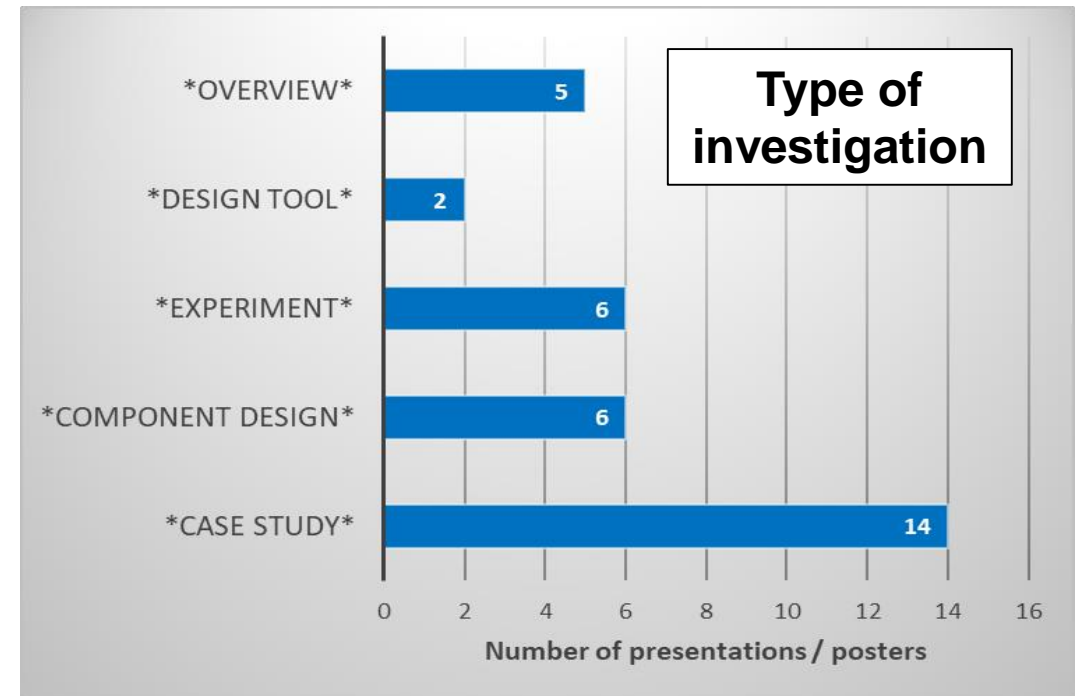
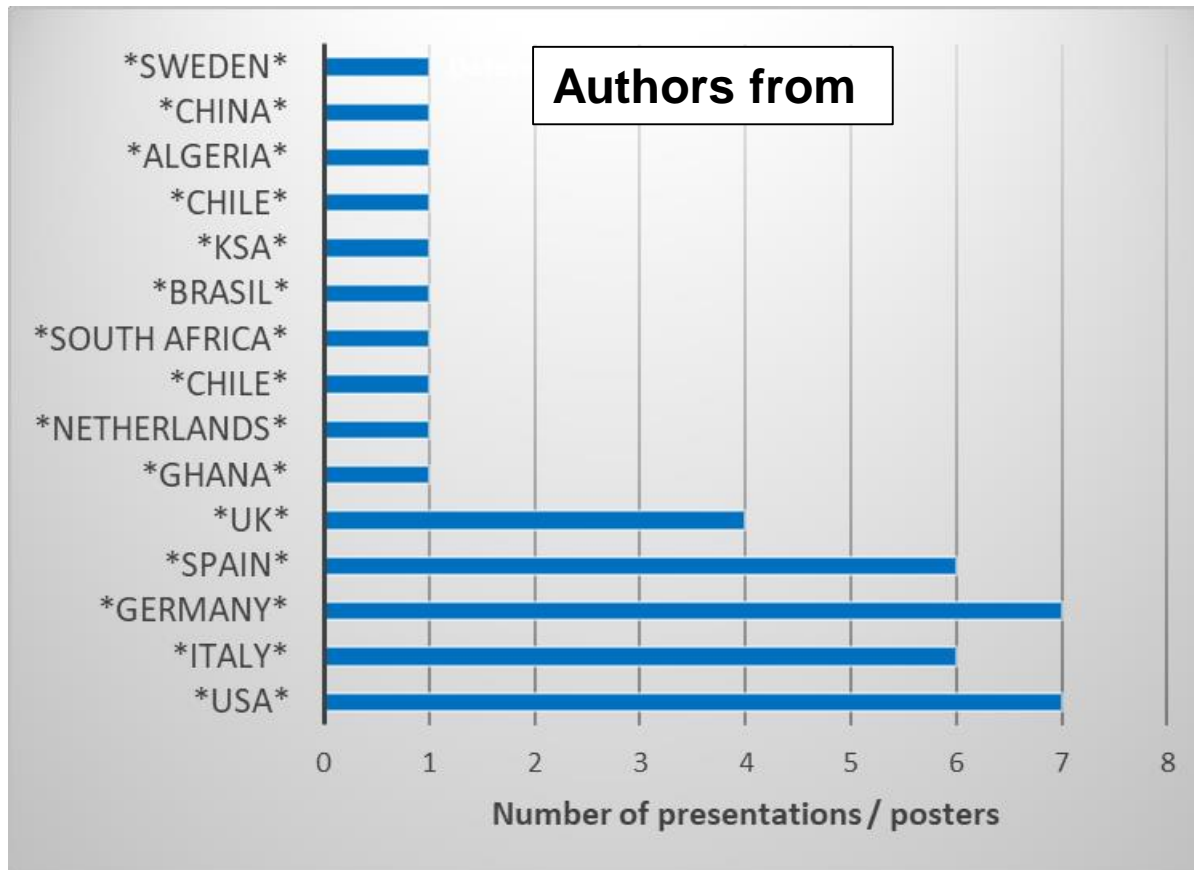


- Track “Solar Industrial Process Heat and Thermal Desalination”
- 43 submissions → 9% of all conference submissions
- Process heat also subject of presentations in other tracks
- 3 oral sessions with 15 presentations organized by the session chairs:
WED 8:30 Tobias Hirsch, DLR
THU 16:30 Fabienne Sallaberry, CENER
FRI 10:45 Navina Konz, DLR
- Poster session with 27 posters



The most used diagram in this session ...

Some statistics



Broad range of applications:

Food & beverages, gypsum, cement, textile, crude oil distillation, space heating&cooling, ...

Technologies:

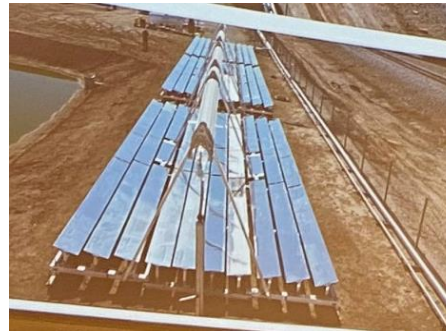
mainly parabolic trough and linear Fresnel.

Commercial plants

Solar Steam with Thermal Energy Storage for Renewable Fuel Production

Philip Gleckman¹, Brandon Hathaway¹

¹Sunvapor, Inc.



- California
- Linear Fresnel System
- DME distillation
- 34 bar/240 °C
- 7 hours storage
- 700 kW

Developments in Solar Heat Applications

Bärbel Epp¹, Dirk Krüger², Zimo Zippler³, Jakob Leicht⁴, Gregor Bern⁵, Martin Scheuerer⁶, Mark Schmitz³, Navina Konz², Stefan Mehnert⁵

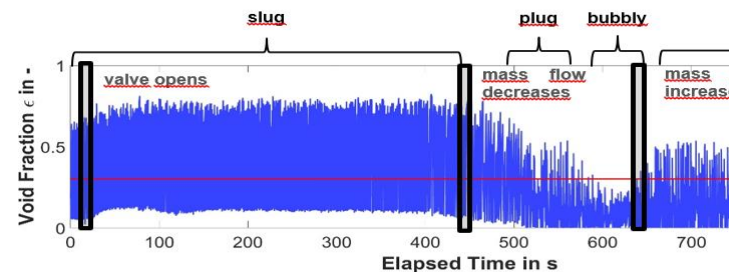


- Heineken, Seville, Spain
- Parabolic trough
- 210 °C pressurized water
- 43.000 m² aperture area
- ~50% solar share

Evaluation of Flow Patterns for Direct Steam Generation

Navina Konz¹, Eckhard Schleicher², Mohammed Smeirah³, Marwan Mokhtar³, Dirk Krüger¹

¹German Aerospace Center, ²Helmholtz-Zentrum Dresden-Rossendorf, ³Industrial Energies



- Flow patterns in a direct steam generation linear Fresnel plant

Component development - Collectors

Techno-economic Comparison Between the Parabolic Trough Collector and a Novel Rotatory Fresnel Collector

Magdalena Barnetche¹, Luis F. González-Portillo¹, Rubén Abbas¹

¹Universidad Politécnica de Madrid



- Rotary Linear Fresnel
- Single / dual axis tracking
- Techno-economic evaluation

Installation and start-up of two modular rotary collectors for SHIP: first experimental results

Ruben Abbas¹, Magdalena Barnetche¹, Julio San Millán², Juan José Roncal¹, Iman Golpour³, David J D Souza³

¹Universidad Politécnica de Madrid, ²Fundación para el Fomento de la Innovación Industrial, ³Universidad Nacional de Educación a Distancia

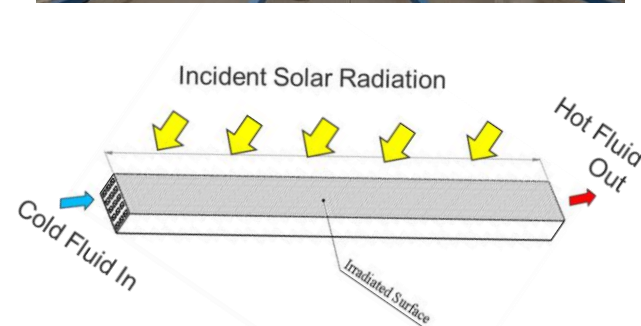


- Rotary Linear Fresnel
- Single / dual axis tracking
- Experimental results

Customising Linear Fresnel receivers to industrial processes

María José Montes¹, Rubén Barbero¹, Antonio Rovira¹

¹Universidad Nacional de Educación a Distancia (UNED)



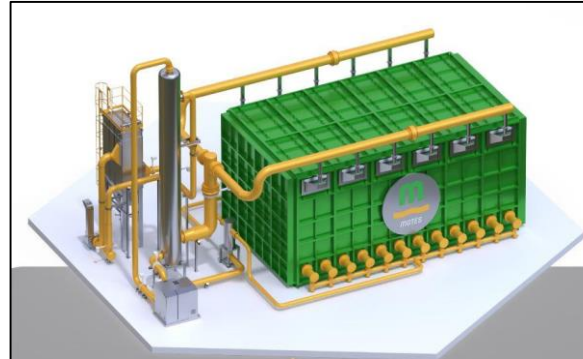
- Linear Fresnel collector with compact heat exchanger as absorber

Component development – Thermal storage

Power-to-Heat Thermal Energy Storage for Hybrid CST: Magaldi Solid Particles Fluidized-Bed System

Fulvio Bassetti¹, Carla Bevilacqua¹, Mario Cilentio¹, Daniele Coppola¹, Mario Magaldi¹, Raffaello Magaldi¹, Rocco Sorrenti¹, Piero Salatino², Maurizio Troiano², Roberto Solimene³

¹Magaldi Power, ²Univeristy of Naples, "Federico II", ³Istituto STEMS, CNR, Naples



- Fluidized bed sand storage
- Storing up to 1000 °C
- Charging by electricity or solar irradiation

Development of Sulfur Thermal Energy Storage for Solar Industrial Process Heat

Parker Wells¹, Hamarzar Aryafar¹, Karthik Nithyanandam¹

¹Element 16 Technologies, Inc.



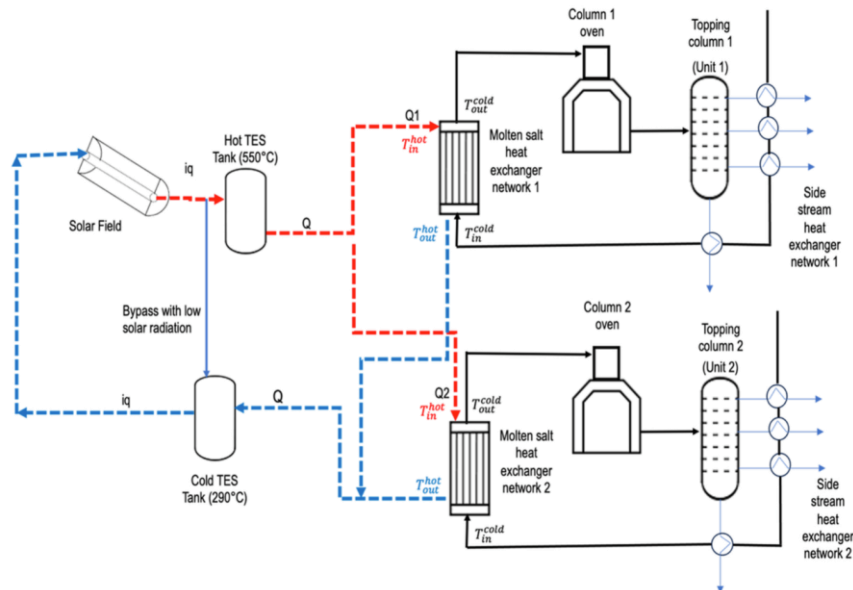
- Liquid sulfur based storage for applications up to 300 °C
- Charged by electricity or solar

Case studies

Concentrated solar heat to reduce carbon emissions of industrial chemical processes: the case of crude oil distillation

Claudia Prestigiacomo¹, Alberto Giaconia², Federica Proietto¹, Giampaolo Caputo², Irena Balog², Egnazio Ollà³, Chiara Freni Terranova³, Onofrio Scialdone¹, Alessandro Galia¹

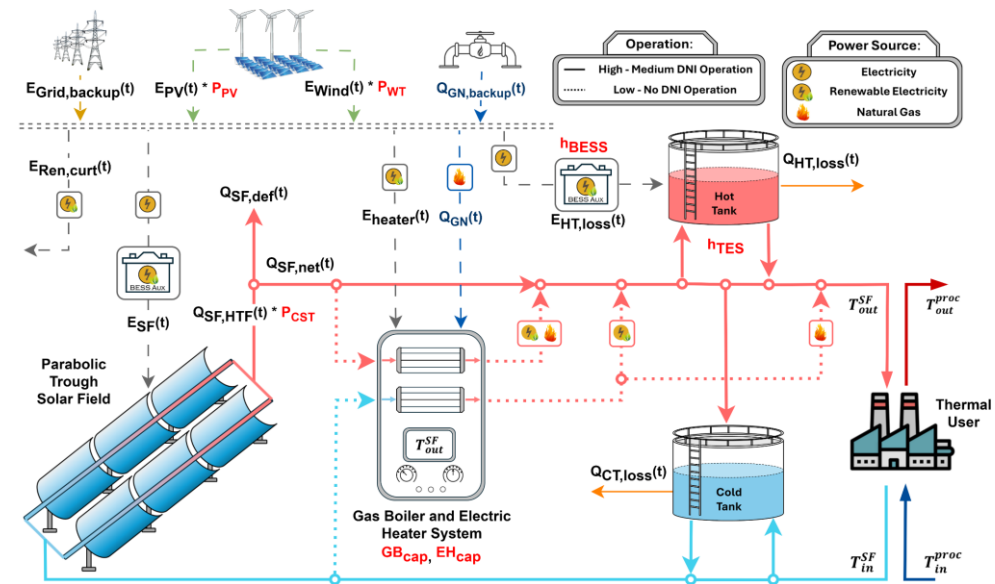
¹ Università degli Studi di Palermo, ² ENEA-Casaccia Research Center, via Anguillarese 301, 00123, Rome, Italy, ³ Raffineria di Milazzo SCPA (RAM) - Contrada Mangiavacca, Milazzo,



Hybrid Concentrated Solar Thermal and Wind Resistive Heating Systems as Key for Competitive Low Emission Industrial Process Heat Generation

Marco Colombi¹, Paolo Colbertaldo¹, Matteo Carmelo Romano¹, Marco Binotti¹

¹ Politecnico di Milano

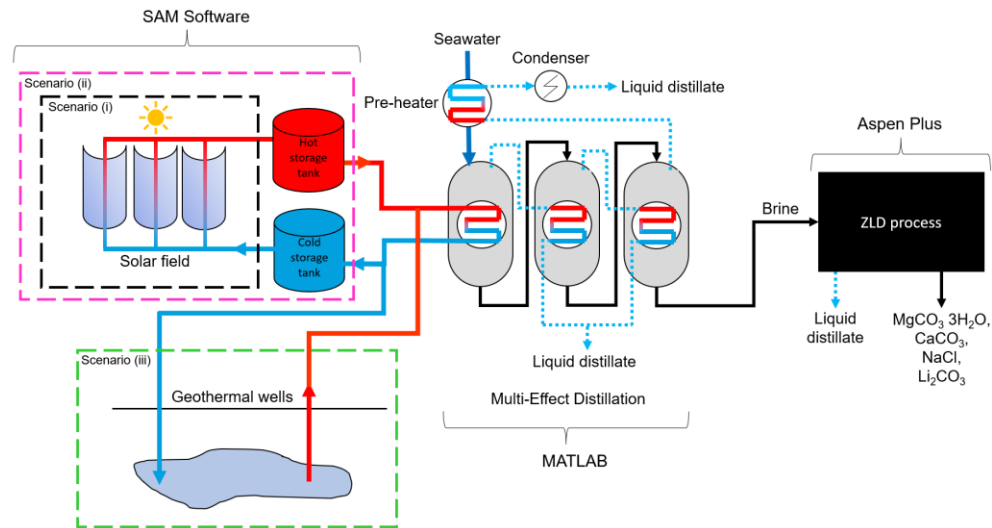


Thermal desalination & Standardization

Innovative ZLD desalination process for minerals recovery using solar and geothermal energy

Kristofer Poirier¹, Kumar Patchigolla¹, Liam Koh²

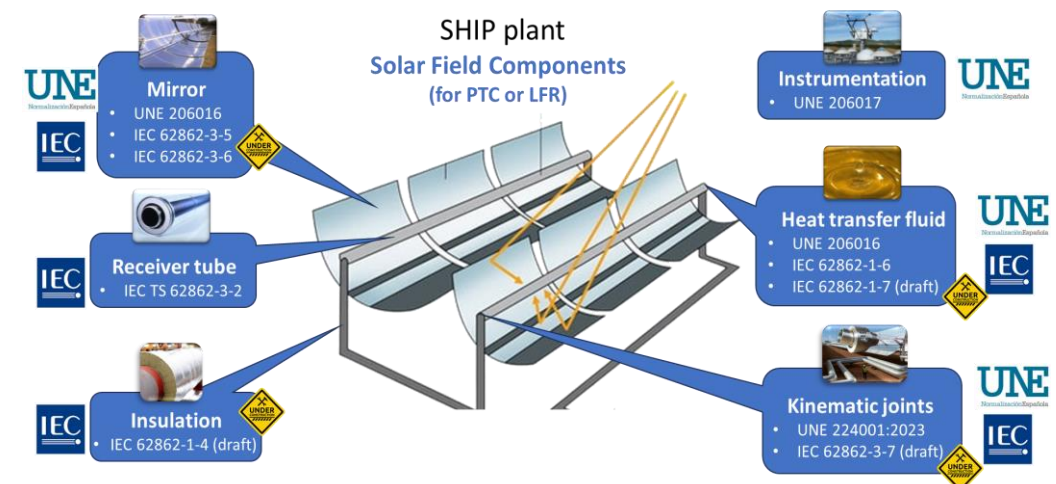
¹ Net Zero Industry Innovation Centre, Teesside University, Middlesbrough, Tees Valley TS1 3BX, UK, ² Solar Water Plc, 201 Great Portland Street, London W1W 5AB, UK



Road-map of Standardization for Concentrating Solar plants in Industrial Processes

Fabienne Sallaberry¹, Alberto García de Jalón¹, Egoitz San Miguel¹, Ana Maria Mariblanca², Sandra Cubero³, Loreto Valenzuela⁴

¹ CENER (National Renewable Energy Centre), ² UNE, ³ Protermosolar, ⁴ CIEMAT Plataforma Solar de Almería



General topics

First Solar Thermal Energy Planner (STEP 1) Overview: A new decision support tool for solar industrial process heat applications.

Jeffrey Gifford¹, Jaret Kadlec¹, Jeremy Sment², Kaden Plewe², Braden Smith², Luis Garcia Maldonado², William Hamilton¹, Janna Martinek¹, Alex Zolan¹, Zhiwen Ma¹

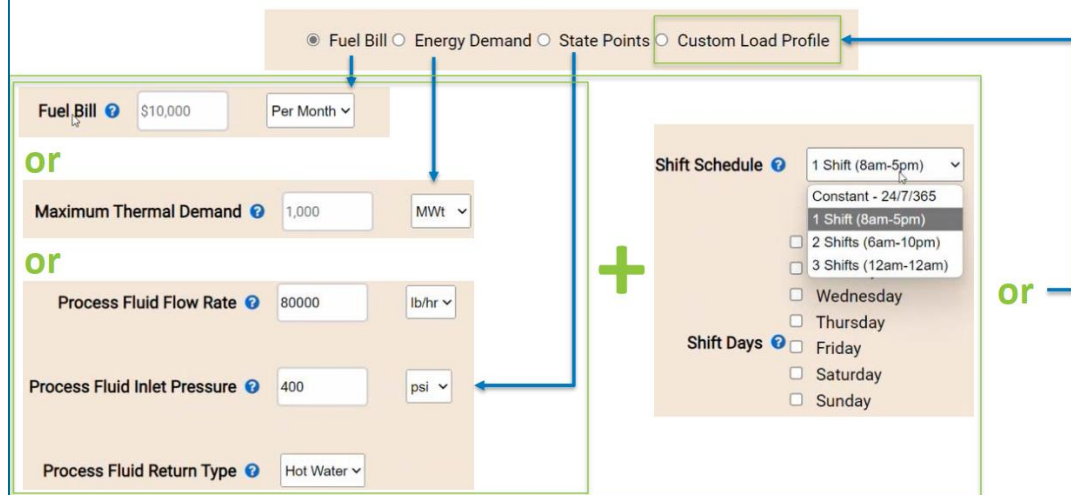
¹National Renewable Energy Laboratory, ²Sandia National Laboratory

Decarbonizing Industrial Heat - A Comparison of Embodied Carbon for PV and Enclosed Parabolic Trough Systems

Gerhard Weinrebe¹, Verena Göcke¹, Markus Balz¹

¹GlassPoint Technology Center GmbH

The user has four options to define their load profile.



Fuel Bill Energy Demand State Points Custom Load Profile

Fuel Bill Per Month

or

Maximum Thermal Demand MWt

or

Process Fluid Flow Rate lb/hr

Process Fluid Inlet Pressure psi

Process Fluid Return Type

+

Shift Schedule

Constant - 24/7/365

1 Shift (8am-5pm)

2 Shifts (6am-10pm)

3 Shifts (12am-12am)

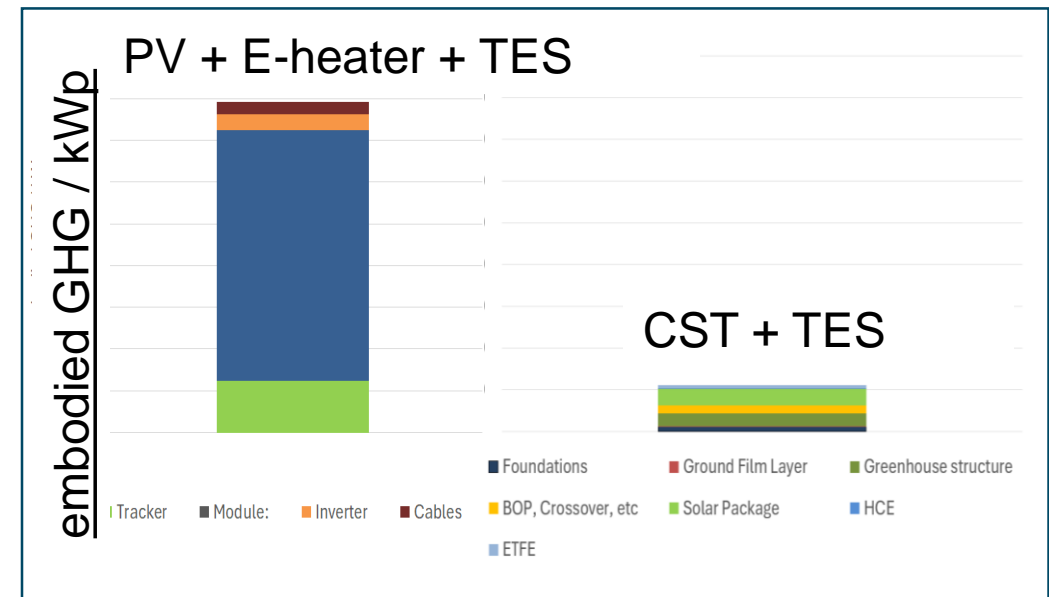
Shift Days Wednesday

Thursday

Friday

Saturday

Sunday



Take-away from all presentations



- Potential for decarbonization in industry is huge.
- Concentrating solar thermal can significantly contribute.
- Low gas/CO₂ price still hinders business cases in many regions
- Many authors compare their CST solution to a photovoltaic alternative (PV+e-heater+TES). General findings:
 - LCOH is lower for CST pathway compared to PV (especially when electricity is transported via public grid)
 - Areal energy density of CST is 2...3 times higher than for PV (especially true for higher temperatures where heat pumps cannot help)
 - CO₂ emissions of CST more than 50% lower than PV