SUSTAINABLE PLACES 2023

ASTEP

FRIEND SHIP

Solar Energy in Industrial Processes: how to meet the expectations of the European Commission

June 15, 2023 - Madrid, Spain
14:00 – 15:30 CEST

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R2M SOLUTION
RESEARCH TO MARKET

POLITÉCNICA

AGENDA

- Introduction of the workshop and expectations
- "*Development of industrial solutions with limited installation, maintenance, and operation requirements*" – **Magdalena Barnetche Orensanz and Mercedes Ibarra Molla (ASTEP)**
- Q&A
- "*Creation of significant visibility to the potential of applying solar thermal energy in industrial processes*" – **Pierre Dury and Puneet Saini (FRIENDSHIP)**
- Q&A
- Panel discussion

INTRODUCTION

Call H2020 LC-SC3-RES-7-2019
Solar Energy in Industrial Processes

- Development of industrial solutions with limited installation, maintenance, and operation requirements.
- Roadmap of the SPIRE cPPP.
- Creation of significant visibility to the potential of applying solar thermal energy in industrial processes.

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Development of industrial solutions with limited installation, maintenance, and operation requirements.

Magdalena Barnetche Orensanz and Mercedes Ibarra (ASTEP)

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RTM RESEARCH TO MARKET SOLUTION

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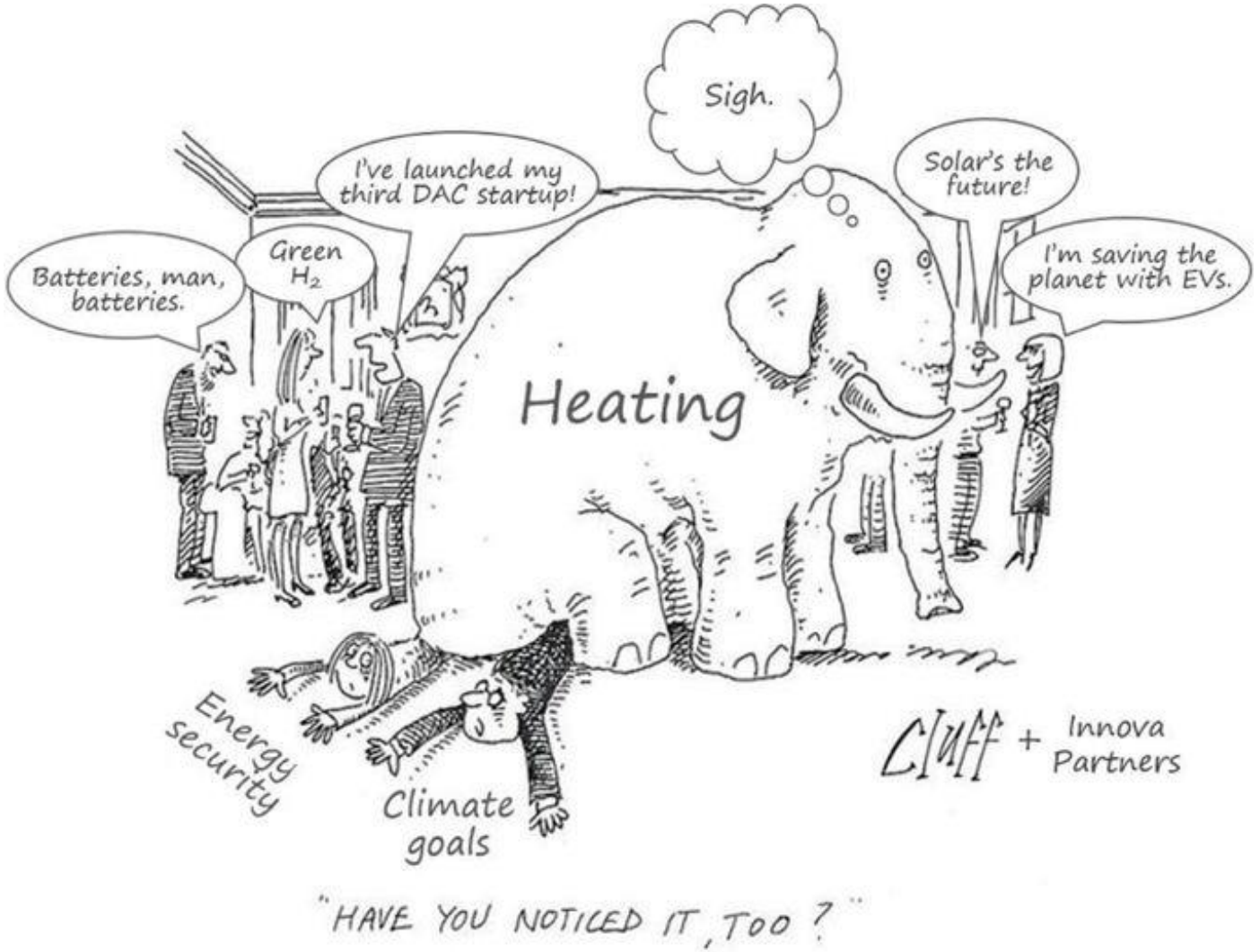
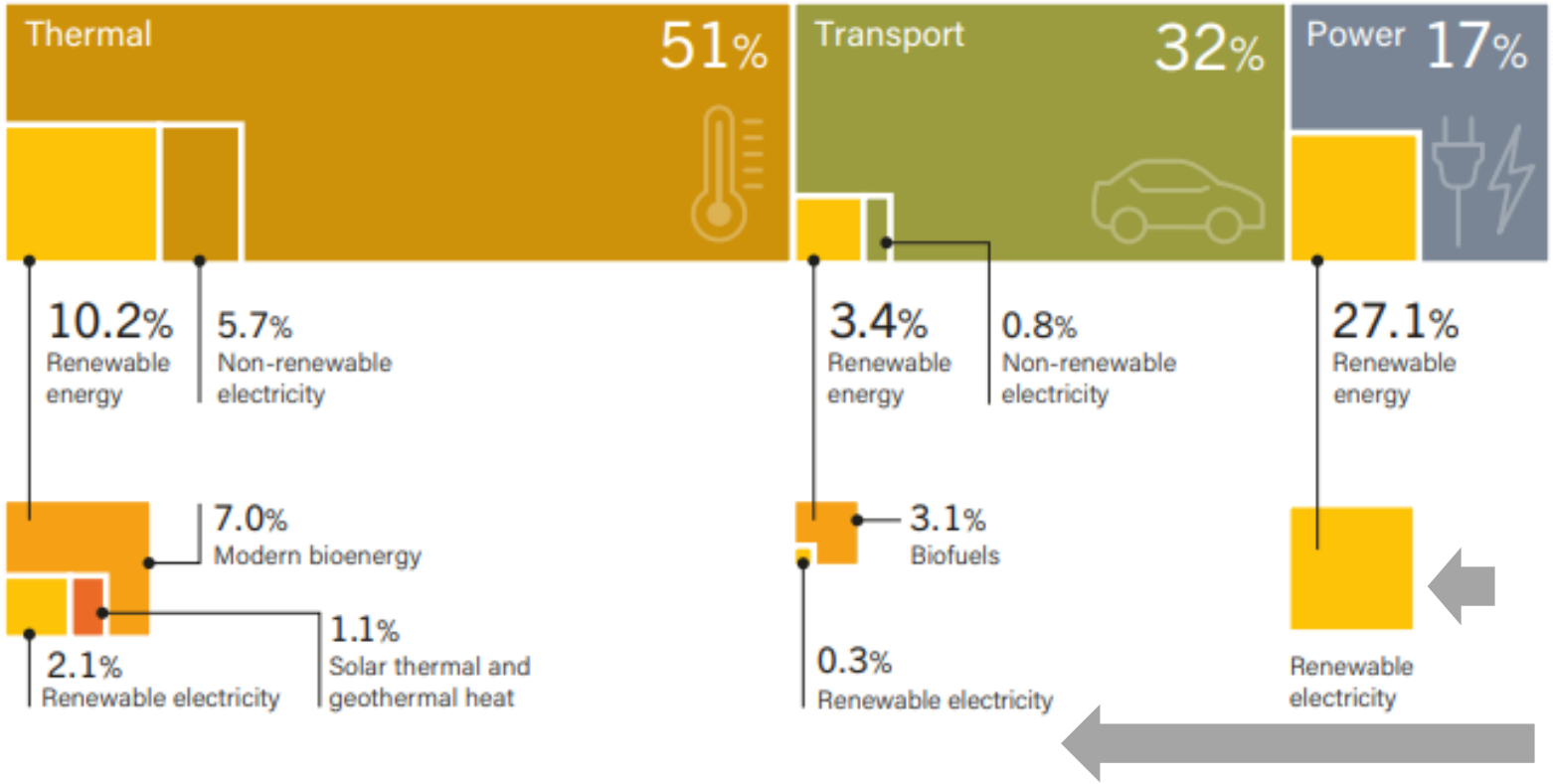
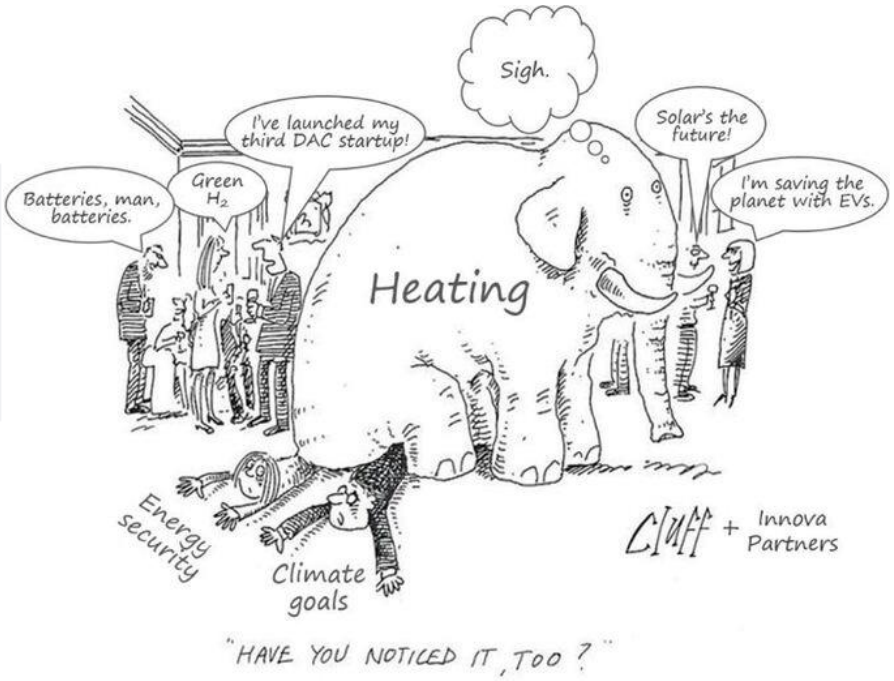
Decarbonization challenges



Decarbonization challenges



REN21 RENEWABLES NOW RENEWABLES 2021 GLOBAL STATUS REPORT

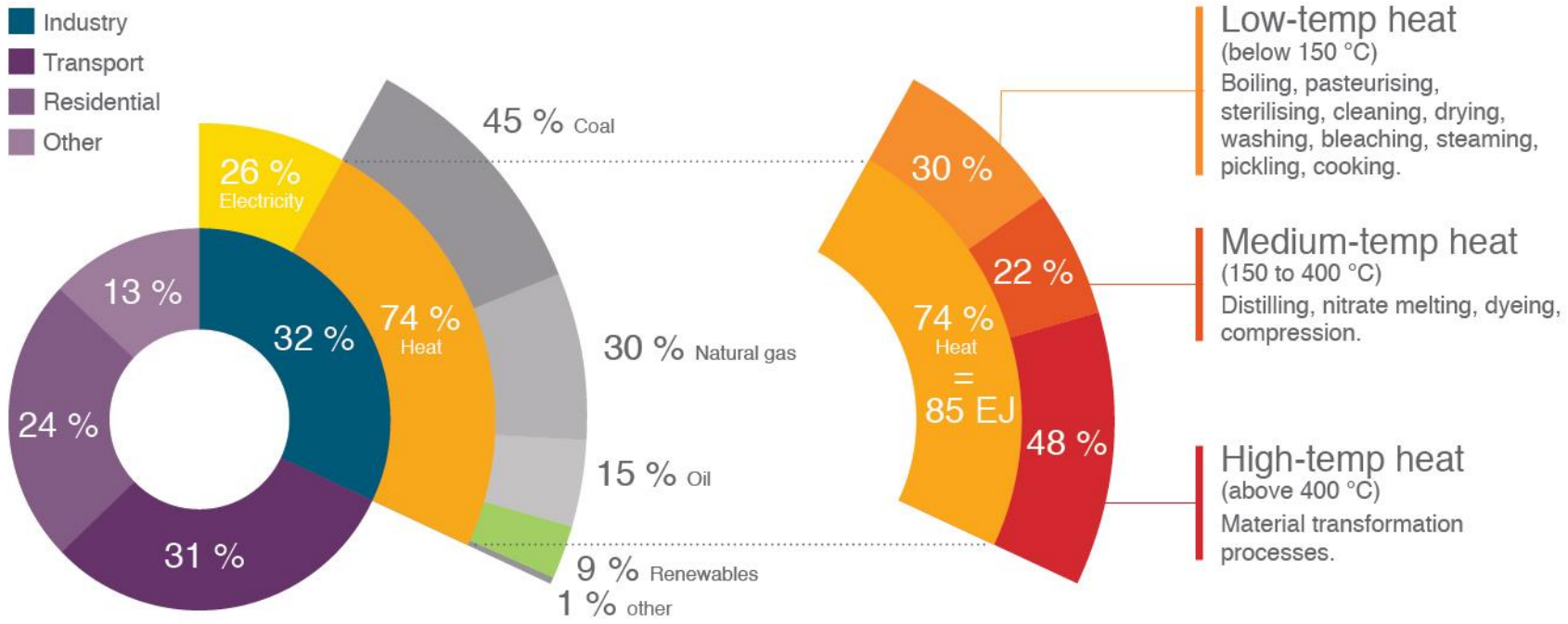


The priority strategy at the moment is not enough:

- The decarbonization of the power matrix
- Electrification
- Energy efficiency

Decarbonization challenges

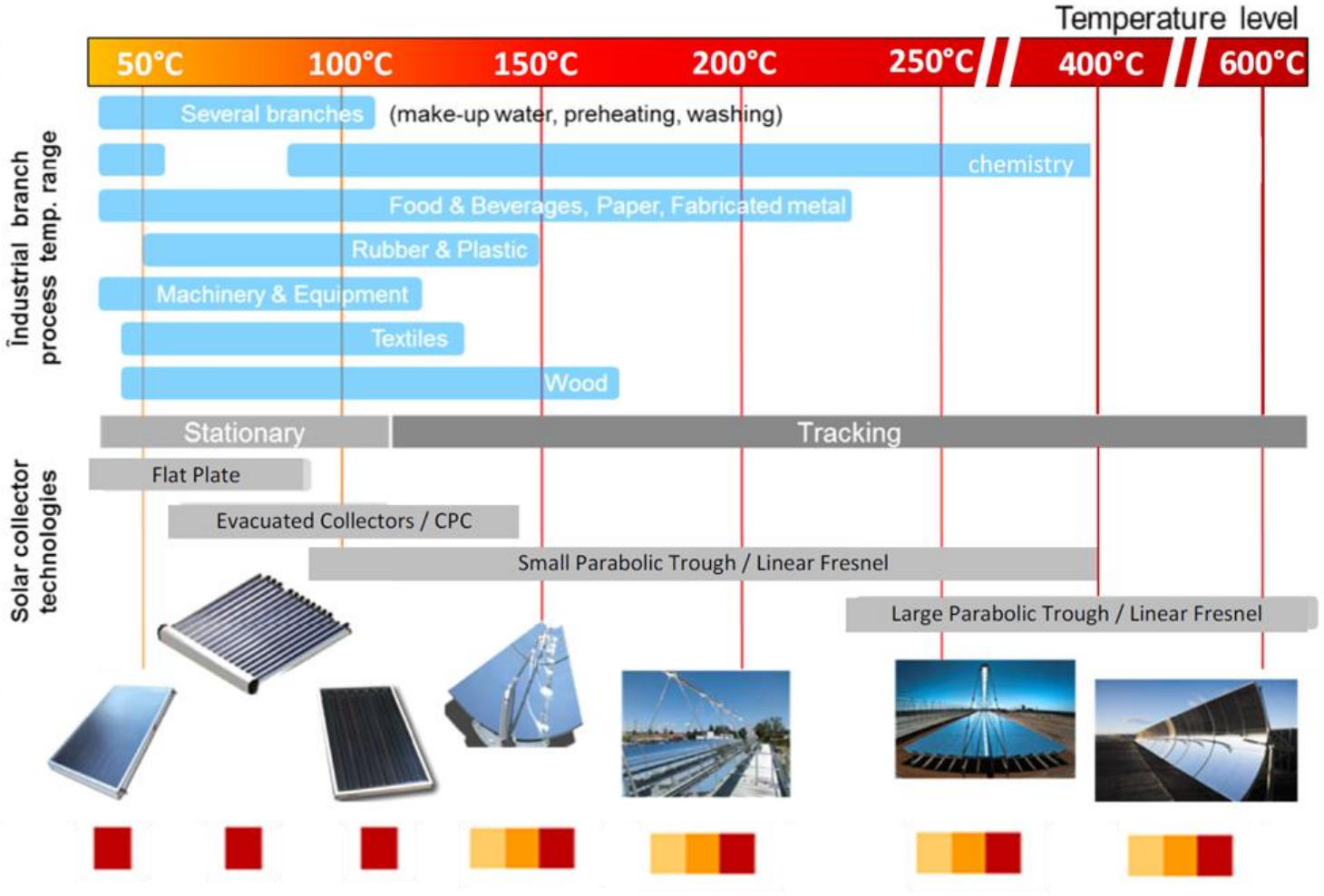
- Industry energy demand is the 32% of the total energy consumed
- 74% of that energy is used by thermal processes, and 90% of that is supplied with fossil fuels
- 1,7% annual increase of the energy consumption in the industry



Solar thermal technologies for industrial processes

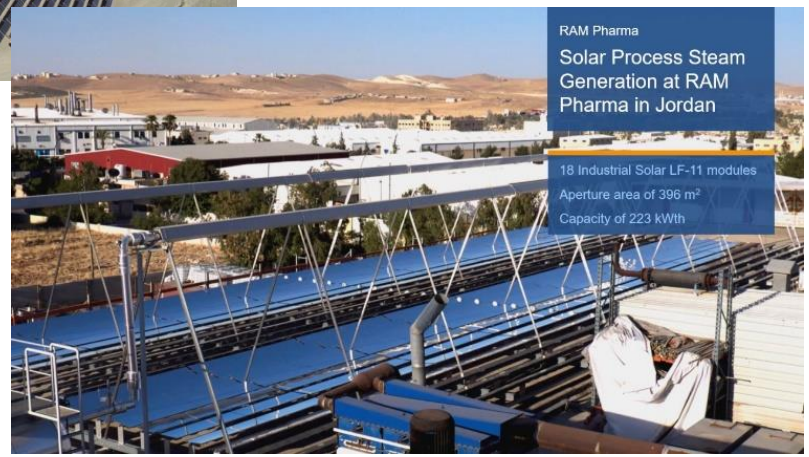
TRL level* (in SHIP applications)

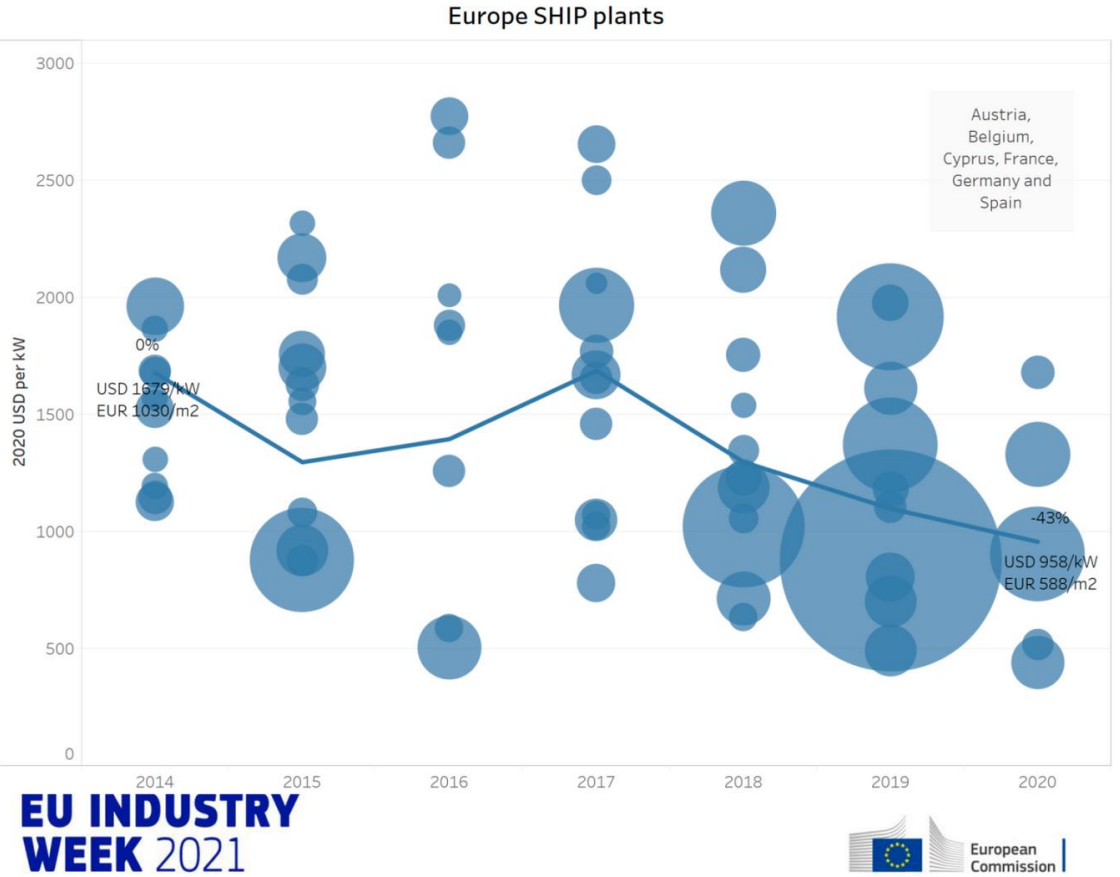
9. System operation
8. System Qualif.
7. Oper. demo
6. Relev. Envir. demo
5. Relev. Envir. Val.
4. Lab. validation
3. Exp. Proof
2. Tech. Concept
1. Basic principles



Cost in Europe:

- Cost reduction of 43% between 2014 and 2020
- Economies of scale





Parabolic Through collector

Linear Fresnel collector

Challenges

- High capital investment
- Reliability and durability
- Solar energy variation
- Availability of land
- High latitudes performance
- Integration with the process
- Storage requirements

Application of Solar Thermal Energy to Processes

15 partners including universities, research centers, SMEs, and big companies from 9 countries.

Objetive

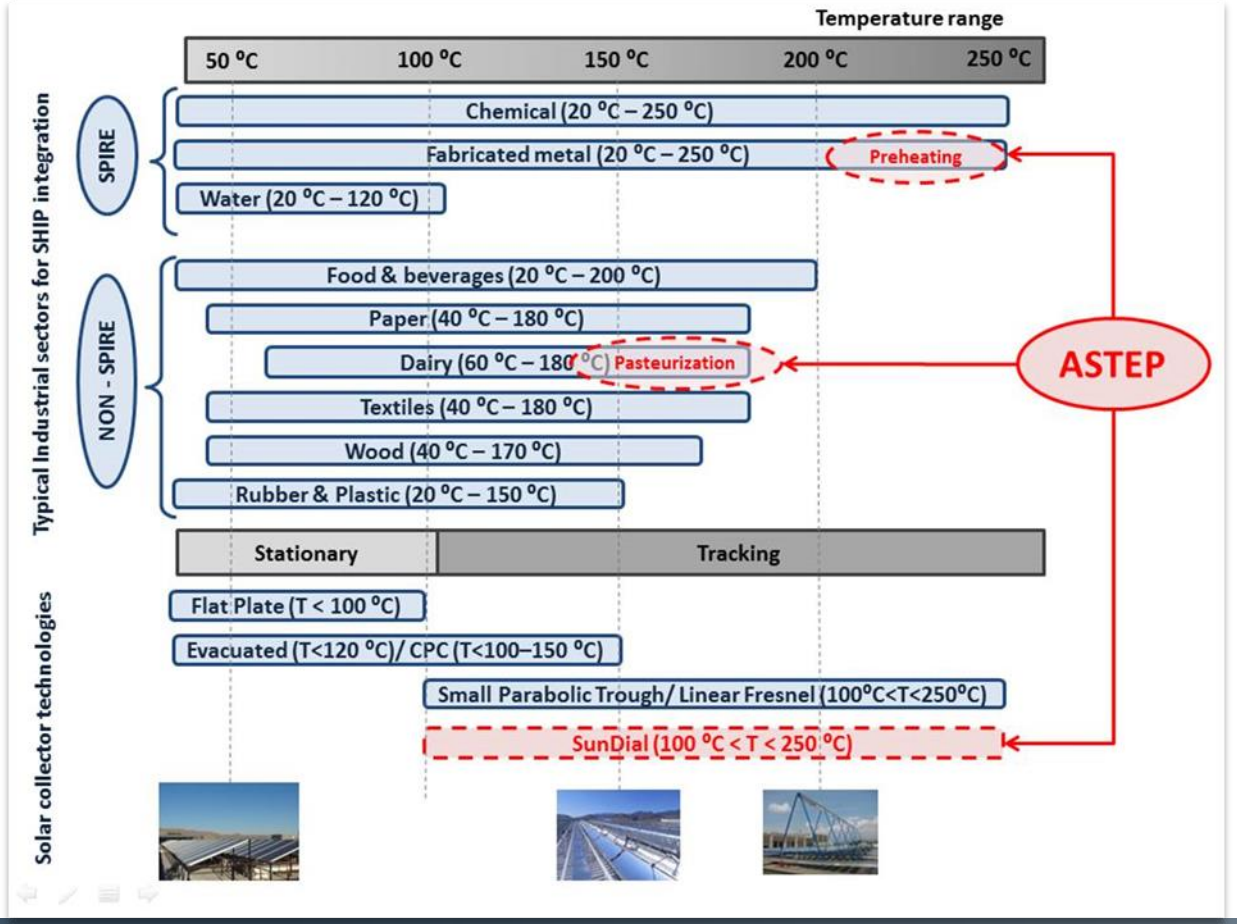
The main objective of ASTEP project is to successfully demonstrate the viability of applying solar thermal energy to partially cover heating, and heating and cooling demands on two different relevant industrial demo sites located on two different climate regions, and to further develop the implementation of solar thermal energy in industrial processes up to 400 ºC.

The project will:

Demonstrate its capability to cover a considerable part of the heat demand of the process industry at temperatures above 150 ºC and for latitudes where current designs are not able to supply it.

Allow full compatibility with the existing systems of potential end-users of Solar Heating for Industrial Processes (SHIP). → very competitive solution to substitute fossil fuel consumption.

The developed solar concept will be tested at two industrial sites to prove the objective's target of TRL5.



Features

- Heat supply at T > 150 ºC and latitudes where current designs are not able to supply it.
- Modularity and compactness: easy installation and repair, reduced space requirements, full compatibility with the existing systems of end-users -> competitive solution (LCA analysis).
- Validation of the concept in two industrial case studies:
  - 1 module of 17 kWth (peak): 50 kWh (Winter) – 135 kWh (Summer) daily
  - 25 MWh yearly, avoiding 5.7 tCO2 (KPI 6), 2 tNG (KPI 7), 5 kg NOx (KPI 8)

1

Dairy industry

- Corinth (37.93N)
- Steam: 8 bar – 175 ºC (pasteurization) and 5 ºC (storing products)
- Fixed mirrors
- Tilted mirrors field

2

Steel industry

- Iasi (47.1N)
- 220 ºC (pre-heating for coating)
- 2-axes tracking system
- Non-tilted mirrors field

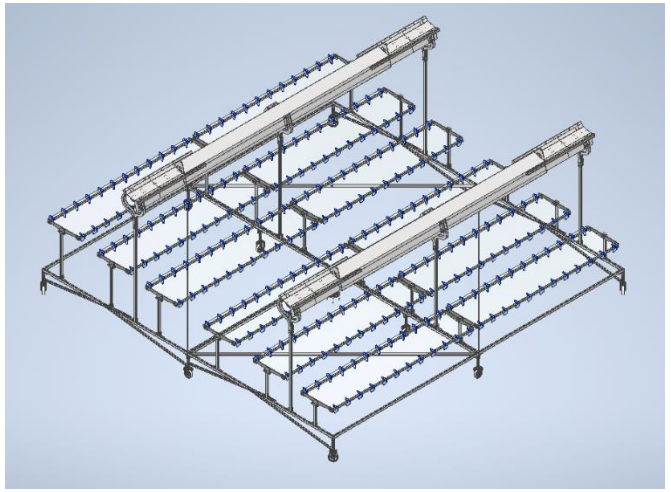
SunDial Prototypes Objectives

Low cost

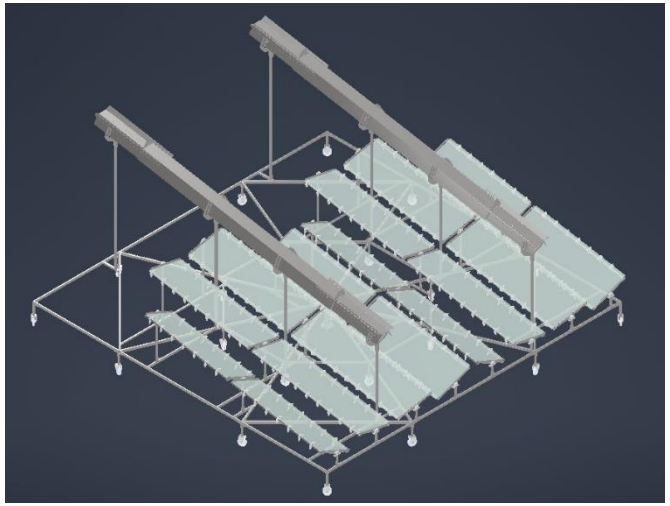
Easy to installed

Low maintenance

Easy to operated

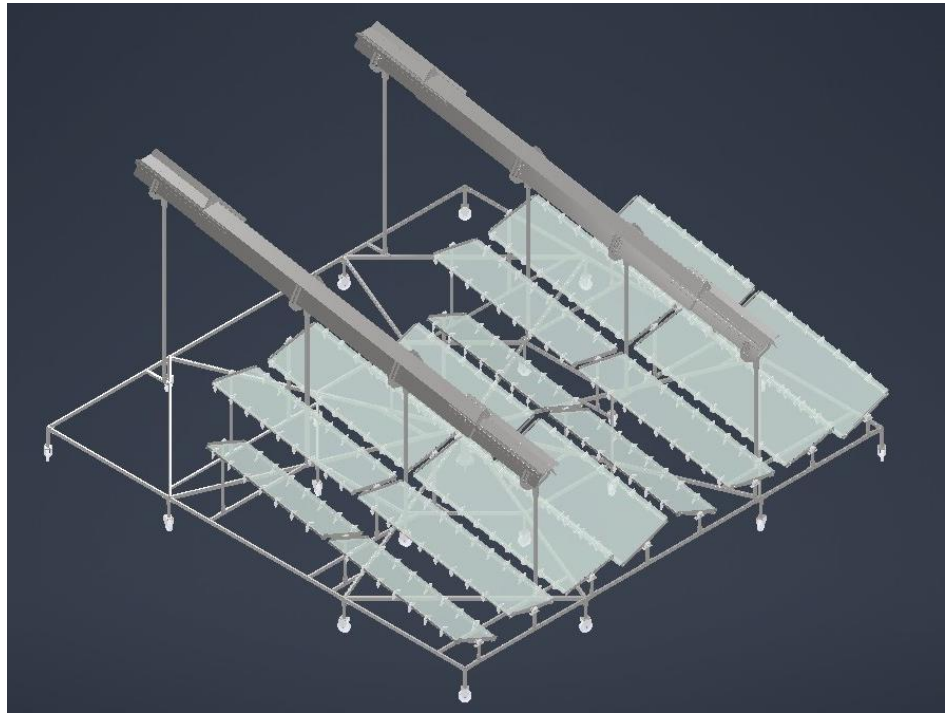


High latitude prototype



Low latitude prototype

SunDial Low latitude prototype features



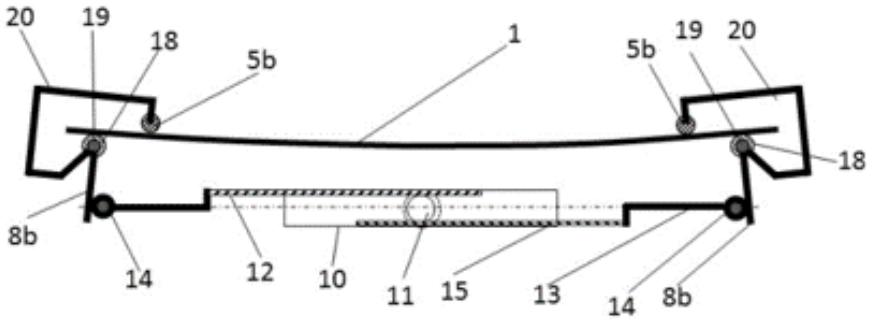
Low cost achieved by:

- 3 mm-thick non-solar mirrors are easily installed and bend
- Mirrors fixed in a different position: less tracking motors
- Modular collector
- Compactness

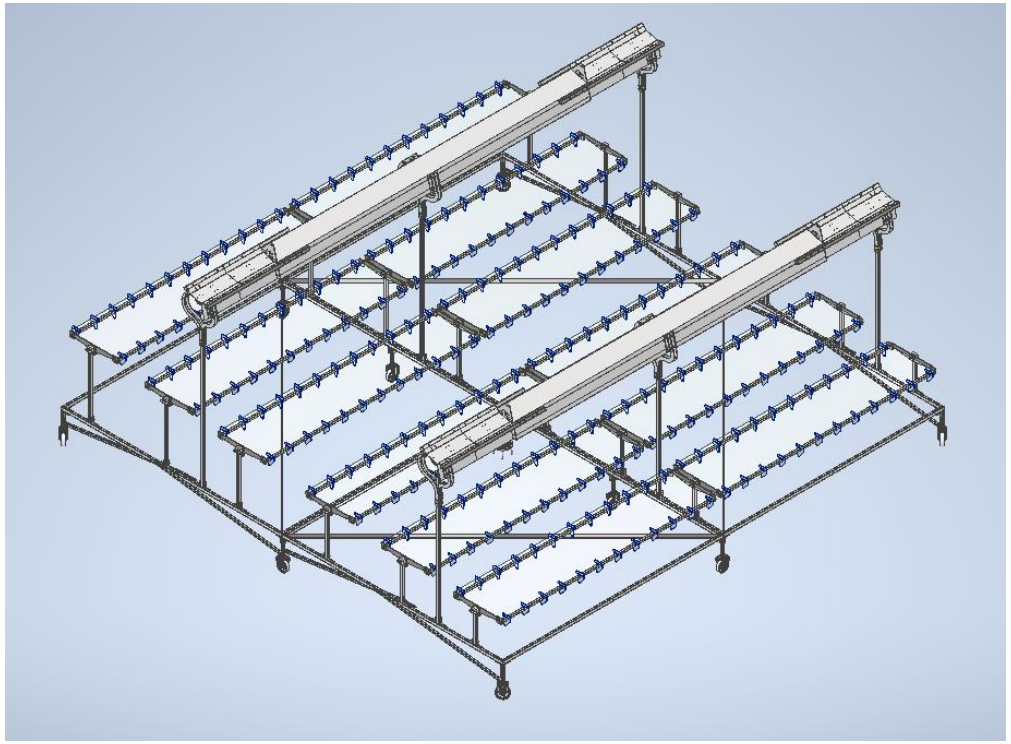
High efficiency achieve by:

- Sun in the symmetry plane
- Fresnel mount in a rotatory platform
- Collector is tilt
- The receiver has an offset
- Evacuated single-tube receivers 70mm

- 47.5 m^2 reflecting surface.
- Final platform: 8.3x8.3 m^2.
- Maximum high: 3.4 m.
- Receivers' length: 8 m.
- Mirrors: 6.3 m and 5.3 m long.



SunDial Hgh Latitude features



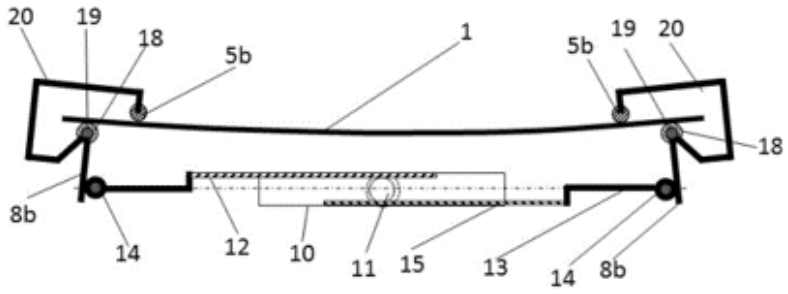
Low cost achieved by:

- 3 mm-thick non-solar mirrors are easily installed and bend
- Modular collector
- Compactness

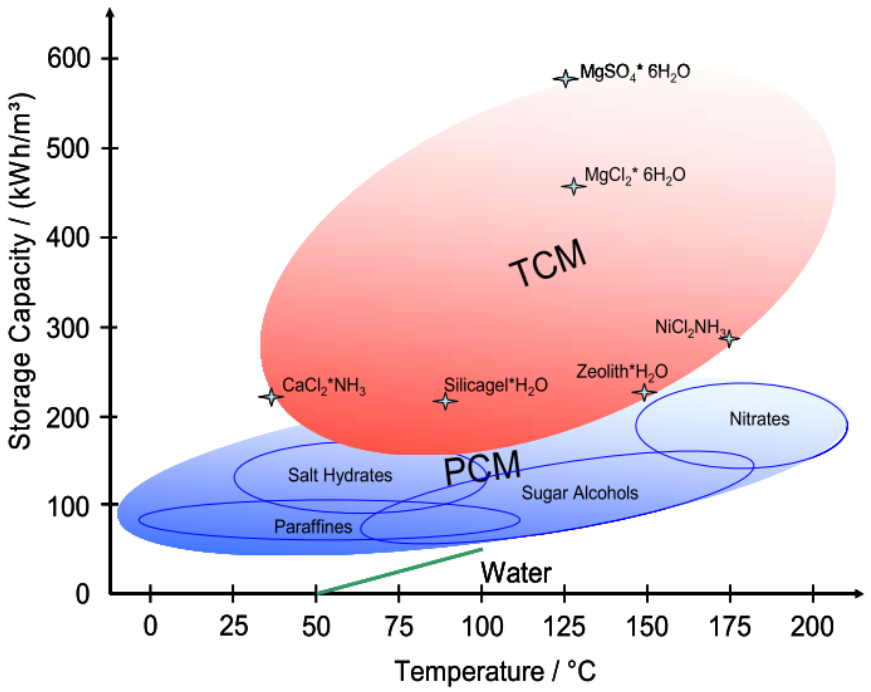
High efficiency- Compactness achieve by:

- Sun in the transversal plane.
- Two-axis tracker system:
  - Rotating platform
  - Mirrors
- Collector is tilt
- Evacuated single-tube receivers 70mm

- 44 m^2 reflecting surface.
- Final platform: 8x8 m^2.
- Maximum high: 2.55 m.
- Receivers' and mirrors' length: 8 m



Thermal latent storage

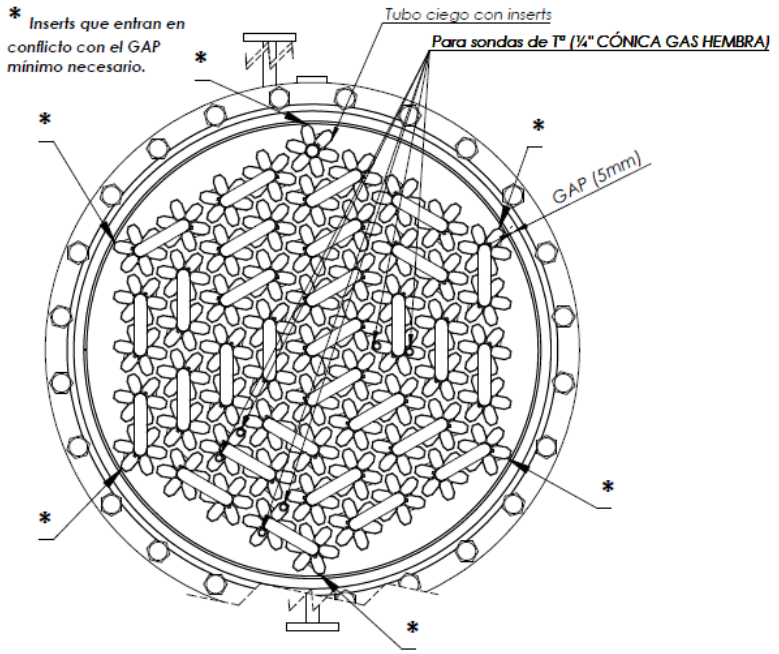


Phase Change materials benefits:

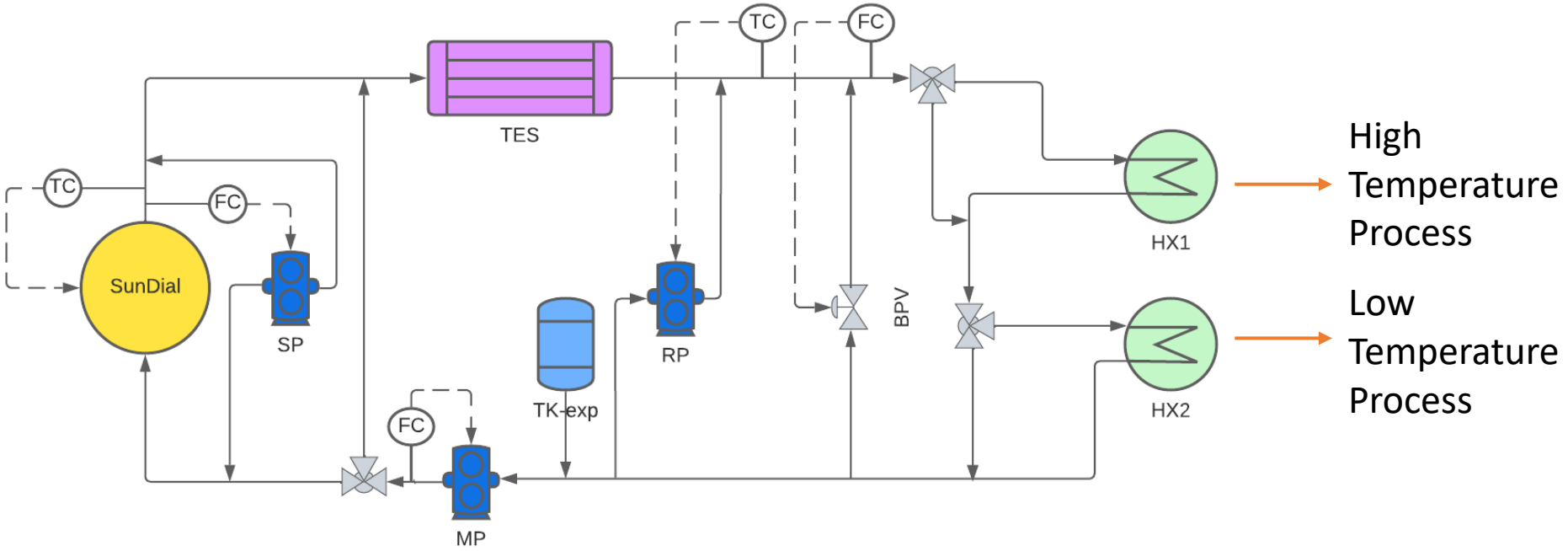
- 4 to 5 times higher energy density than sensible storage
- Constant discharge temperature
- Implies less volume and space

Storage tank features:

- Metal inserts to improve heat transfer
- HTF inside tubes
- PCM salts outside the tubes
- TES energy 89 kWh per module



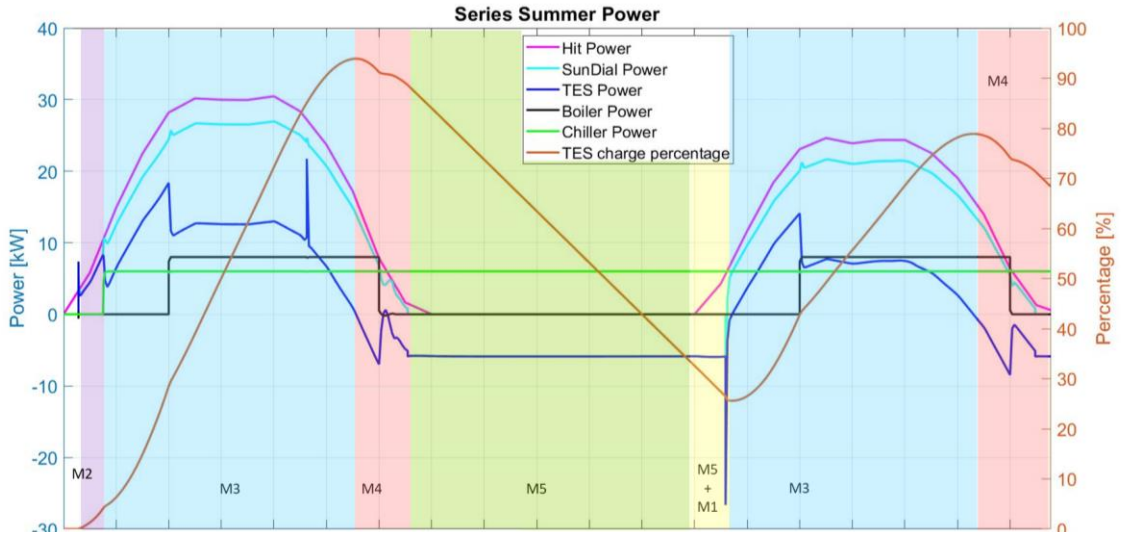
Integration with the process

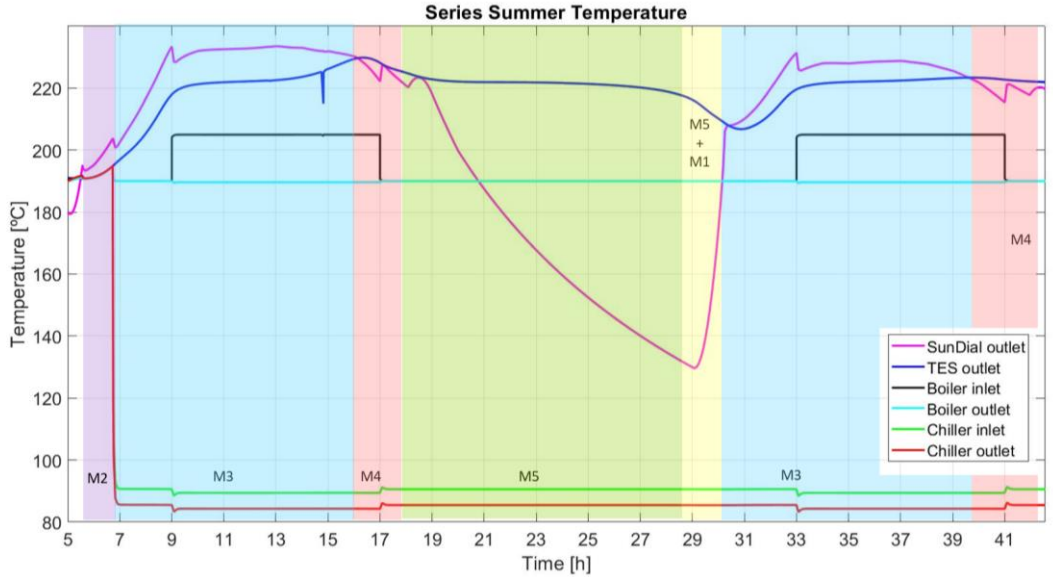


Dynamic simulation for the two industrial sites achieve the KPIs of the project:

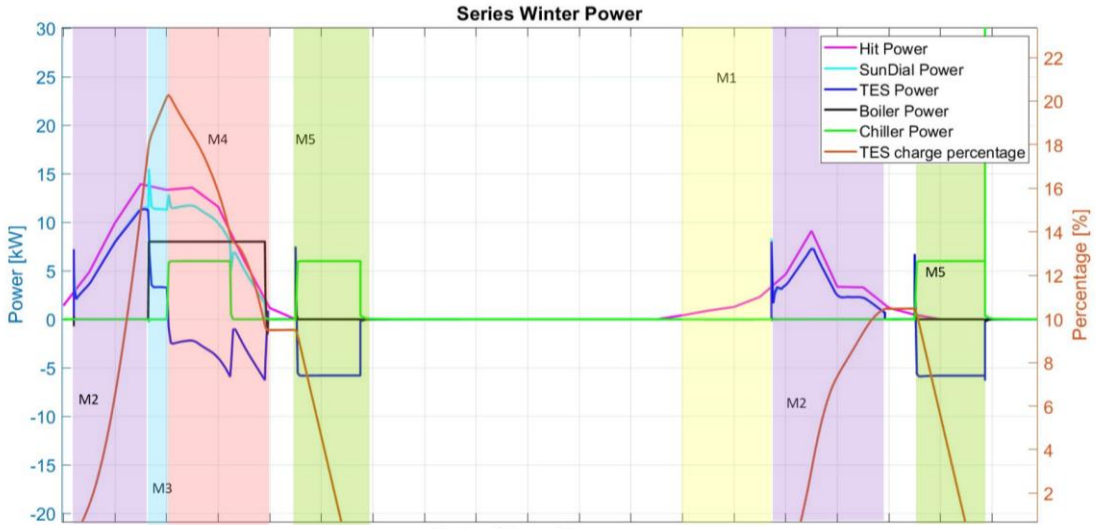
SunDial	Tracking	Area reflective (m^2)	Area total (m^2)	Energy (MWh/anual)	Performance (kWh/m^2 reflective)	Land Performance (kWh/m^2 total)
Iasi (47° N)	2- axis	44	102	27.8	631.8	272.5
Corinth (37° N)	1-axis	47	113	27.8	591.5	246.0

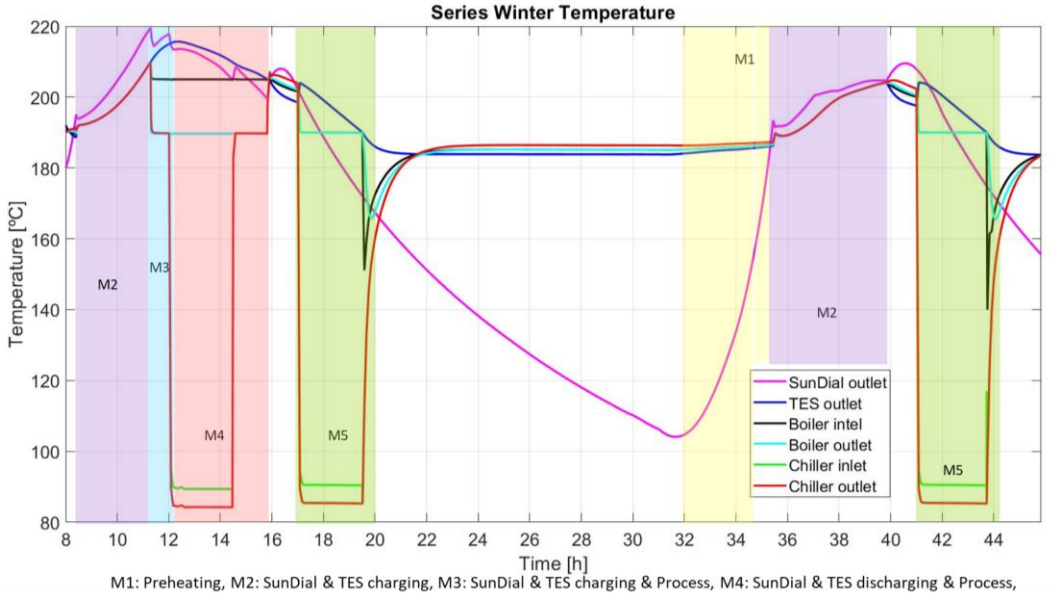
Operational Modes





M1: Preheating, M2: SunDial & TES charging, M3: SunDial & TES charging & Process, M4: SunDial & TES discharging & Process, M5: TES discharging + Process, M6: TES full & SunDial defocusing & Process.





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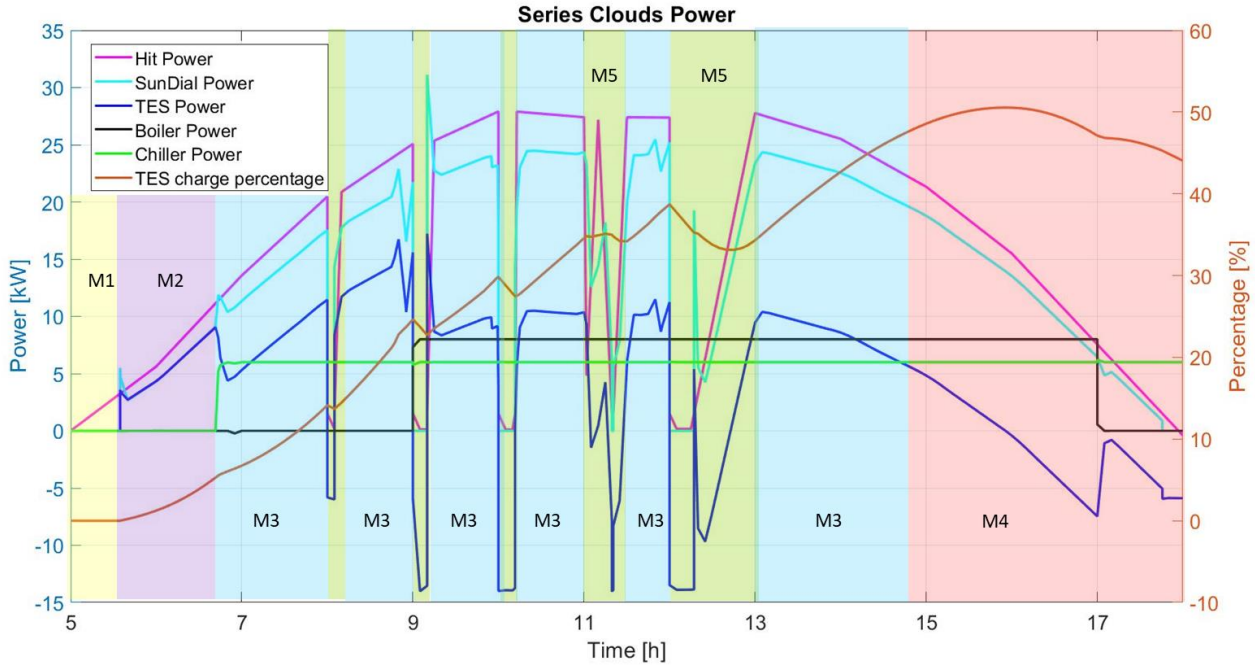
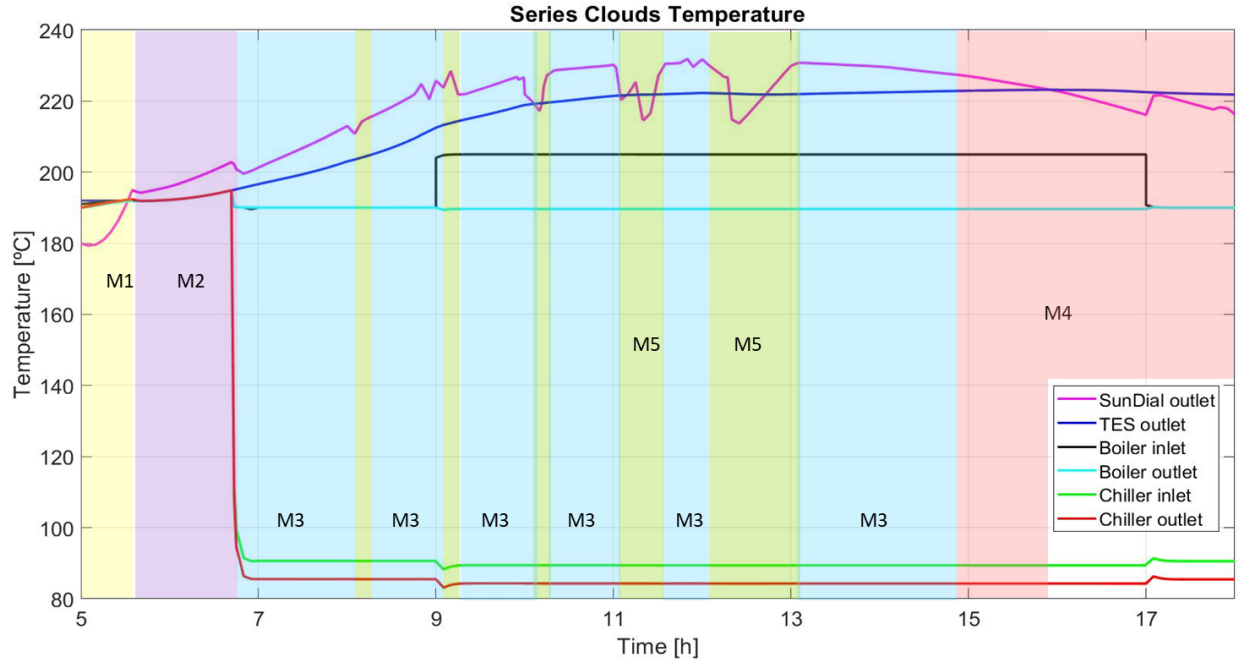
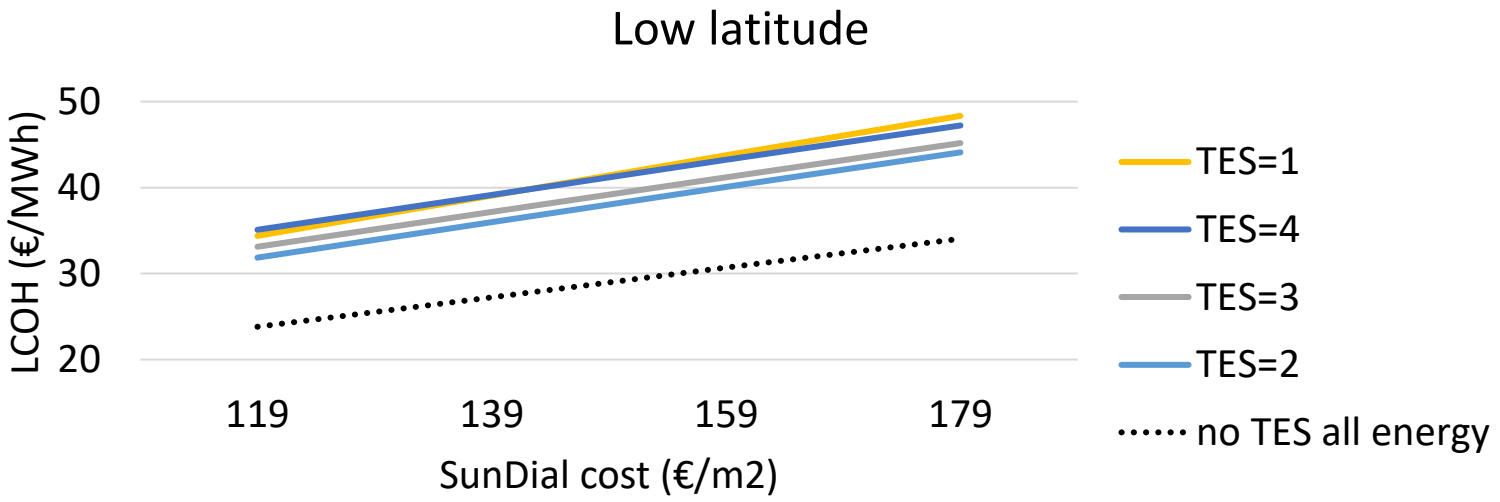
Controllability against clouds



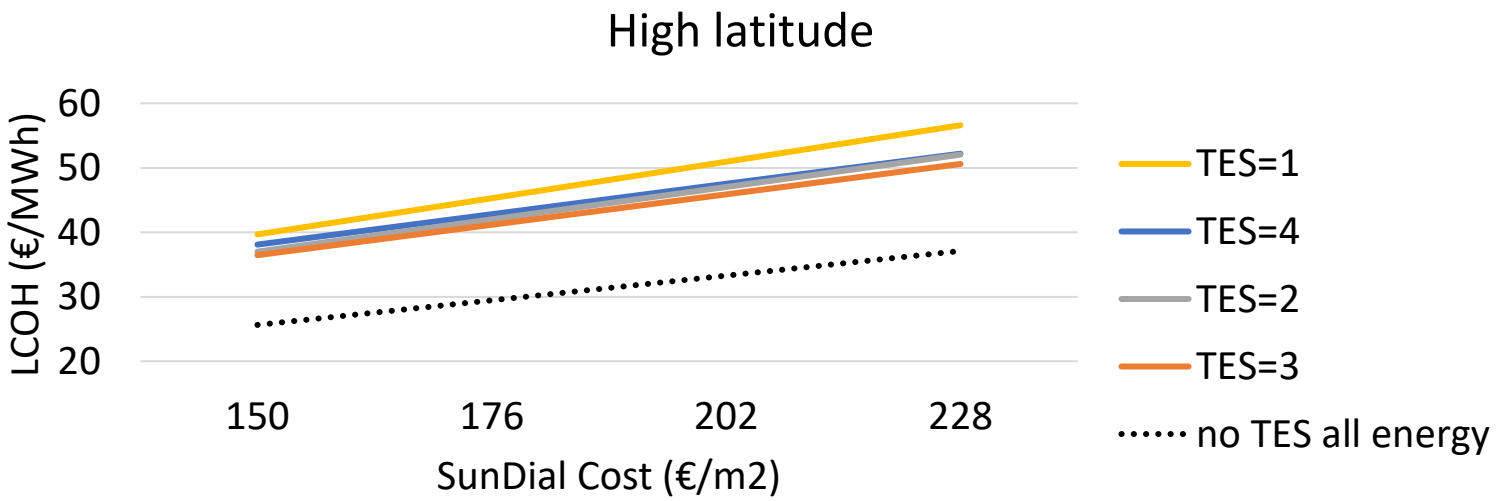
M1: Preheating, M2: SunDial & TES charging, M3: SunDial & TES charging & Demand, M4: SunDial & TES discharging & Demand, M5: TES discharging + Demand, M6: TES full & SunDial defocusing & Demand.



M1: Preheating, M2: SunDial & TES charging, M3: SunDial & TES charging & Demand, M4: SunDial & TES discharging & Demand, M5: TES discharging + Demand, M6: TES full & SunDial defocusing & Demand.



BOP 10% of SunDial costs
TES 10 €/kWh



Conclusions

- The ASTEP annual energy yield is optimized by two temperatures demands operation strategy
- The performance of the system is reliable with variable radiation days thanks to the TES
- The SunDial's low latitude cost was driven down by the fewer motors and easy bending mirror structure
- The SunDial's high latitude efficiency and compactness are achieved by the two-axis tracking system
- The ASTEP LCOH 40-60 €/MWh is lower than the average cost of projects in central Europe 92 €/MWh
- The ASTEP efficiency can be increased with a larger solar collector
- This will also drive down costs by scaling-up effect

ASTEP project was presented with the need of the industry in mind, and part of its objectives from the start were to develop a technology easy to install, maintain, and operate.

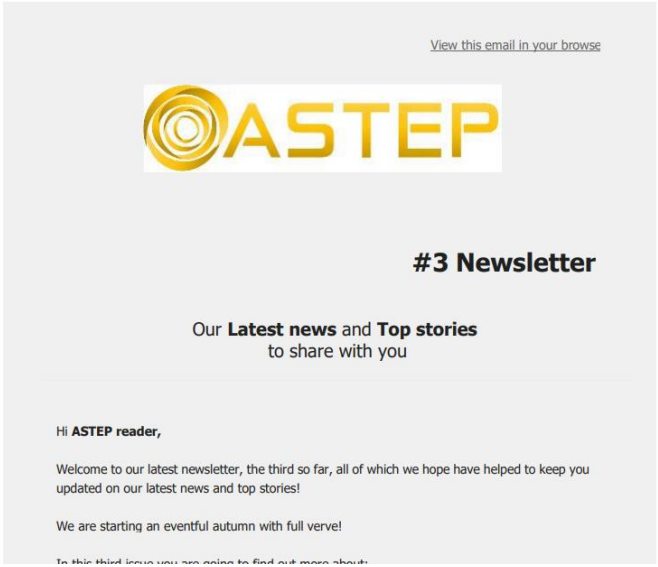
Keep up with the project

Website: https://astepproject.eu/

Twitter: @AstepProject

Newsletter – twice a year

- 5 already published
- To sign up: https://astepproject.eu/subscribe-to-our-newsletter/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ASTEP

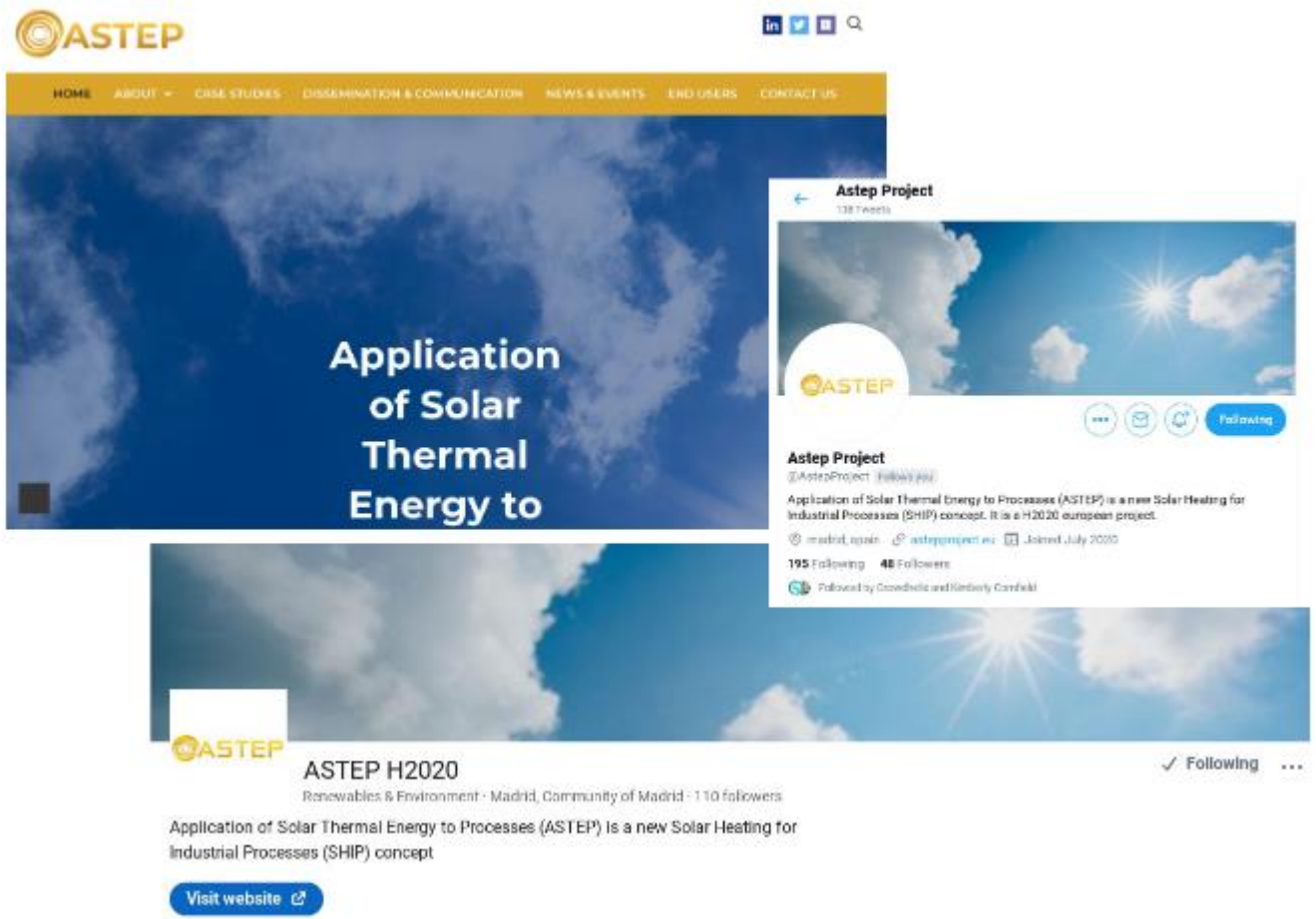
#3 Newsletter

Our **Latest news** and **Top stories**
to share with you

Hi **ASTEP reader,**

Welcome to our latest newsletter, the third so far, all of which we hope have helped to keep you updated on our latest news and top stories!

We are starting an eventful autumn with full verve!



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Creation of significant visibility to the potential of applying solar thermal energy in industrial processes.

Pierre Dury and Puneet Saini (FRIENDSHIP)

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Need for visibility

- Solar thermal is a “hidden” and a less marketed technology solutions
  - Few technological suppliers.
  - Few installations compared to other RE technologies
  - Perception of being “complicated”

➢ Visibility is key to take this technology to right stakeholder.

➢ Lack of visibility may hamper the market

We don’t want this to happen

INES approach

Create visibility to the potential of SHIP

Forthcoming Research and Industry for European and National Development of SHIP

- **Produce educational resources**
  - Explain the technical content of the project
  - Provide industry decision-makers with information on a technology that is not yet widely used

- Approach industries via an **acceptability survey**

- **Communicate on social networks and websites** about the two subjects mentioned above

Indicators

Create visibility to the potential of SHIP

- **Number of industries** reached
- **Response rate** to questionnaire
- **Number of views** on educational videos

Acceptability study - Presentation

Create visibility to the potential of SHIP

FRIEND SHIP
Forthcoming Research and Industry for European and National Development of SHIP

Objective: to obtain industry views on the solution developed by the project

Means:

- Build up a **list of contacts in industry**
- Create **a questionnaire** distributed to industrial companies

The two objectives of the study:

1. **Evaluate acceptance** (attitude towards the technology, highlighting psycho-social factors hindering acceptance).
2. **Evaluate the compatibility of the plant** with the integration of solar thermal energy (to bring out the technical obstacles).

In order to make it as relevant as possible and not miss out on specificity, each partner consulted the questionnaire and sent their comments.

Acceptability study - Presentation

Create visibility to the potential of SHIP

Forthcoming Research and Industry for European and National Development of SHIP

Questionnaire dissemination strategy:

- **Quantitative approach** (via "weak links"), to be sure to **reach a large number** of targets in the market and obtain numerical results
  - ✓Sending the questionnaire by email to the FRIENDSHIP **contacts in the database**
  - ✓Dissemination of the questionnaire via the **social networks of the various project partners** in particular.

-> Numerical results obtained

- **Qualitative approach** (via "strong links"), to discuss and ensure an answer
  - ✓Focus on certain targets that are most concerned and/or easier to contact.
  - ✓Other companies **to be determined according to proximity and interest** (Spire sectors)

-> Results from reliable respondents , described and interpreted

E-learning videos

Create visibility to the potential of SHIP

FRIEND SHIP
Forthcoming Research and Industry for European and National Development of SHIP

Production of 5 educational videos:

1st video :
- give an **overall presentation** of the project and the technical solution
- attached the video to the acceptability survey

2nd to 4th videos :
- Bring details to the **different technical bricks** studied throughout the project

5th video :
- Present the **real installation of SHIP 200**, in CEA Grenoble

4th & 5th video in process

Results

Create visibility to the potential of SHIP

FRIEND SHIP
Forthcoming Research and Industry for European and National Development of SHIP

Number of targets reached (in process):

- **8800 impressions – 160 clicks - 85 reactions** on LinkedIn posts
- **60 direct contacts** by emails
- **5 meetings** with industries
- **275 views** for the videos

Survey response rate:

7 industries answered the survey

Meetings : 80 % (4 answers over the 5 meetings)

Emails + LinkedIn : 1,9 % (3 answers over the 160 post readings)

+ 1 article in specialized press ***Technique de l'ingénieur (FR)***

+ 2 new close contacts from French regional representative organisations : **UIMM** (Union of Metallurgies Industries) ; **CCI** (Public institution - represents the interests of commercial, industrial and service companies)

Discussion

Create visibility to the potential of SHIP

Global results:

- Gave an indication of the difficulty in making contact with industries and assessing their interests, as they are often contacted about decarbonation, energy/numerical transition, and other subjects
- But participate to the visibility of SHIP (survey, videos)
- Bring educational material to make these kind of solutions more familiar and attractive
- Potential new partnerships to develop the subject

Discussion

Create visibility to the potential of SHIP

Limits:

- Need more “power” to be considered as a high-potential solution (economic and environmental) by manufacturers

➢ **SOLUTIONS :**

- more pilots for solar heating
- more communication (in the press? Specialized press? Newsletters?)
- Better involvement of public authorities? more lobbying entities on SHIP?
- Hybridisation with other technologies

More pilots

FRIEND SHIP
Forthcoming Research and Industry for European and National Development of SHIP

- **Key to obtain stakeholder's confidence**
- **Good learning and research possibilities**
- **Need of more pilots with innovative concepts.**

Pilots example 1

ABSOLICON SOLAR COLLECTORS

FRIEND SHIP
Forthcoming Research and Industry for European and National Development of SHIP

Location	Thessaloniki, Greece
Industry	Brewery
Footprint	1600 m^2
Solar Field	660 m^2
Production	354 MWh/year
Heat	Steam 150 °C

Pilots example 2

ABSOLICON SOLAR COLLECTORS

FRIEND SHIP
Forthcoming Research and Industry for European and National Development of SHIP

Location	Bari, Italy
Industry	Brewery
Footprint	1600 m^2
Solar Field	660 m^2
Production	354 MWh/year
Heat	Steam 150 °C Hot Water 85 °C

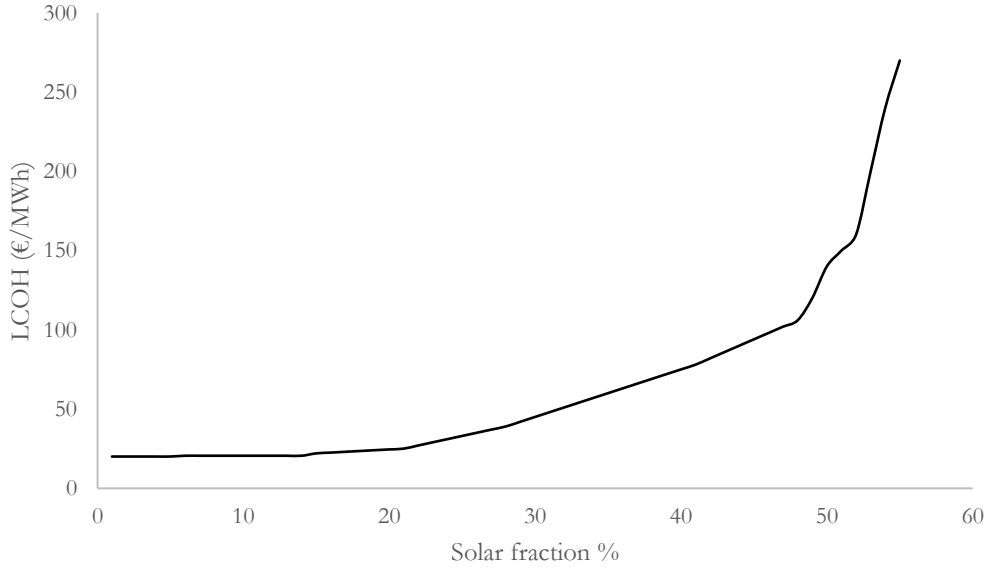
Hybridisation with other technologies

Why hybridization ?

High renewable fraction possible: **More visibility**

More CO2 can be displaced**: More impact**

Technology compliments each other**:**
Improved economic feasibility



Example of hybridisation

ABSOLICON SOLAR COLLECTORS

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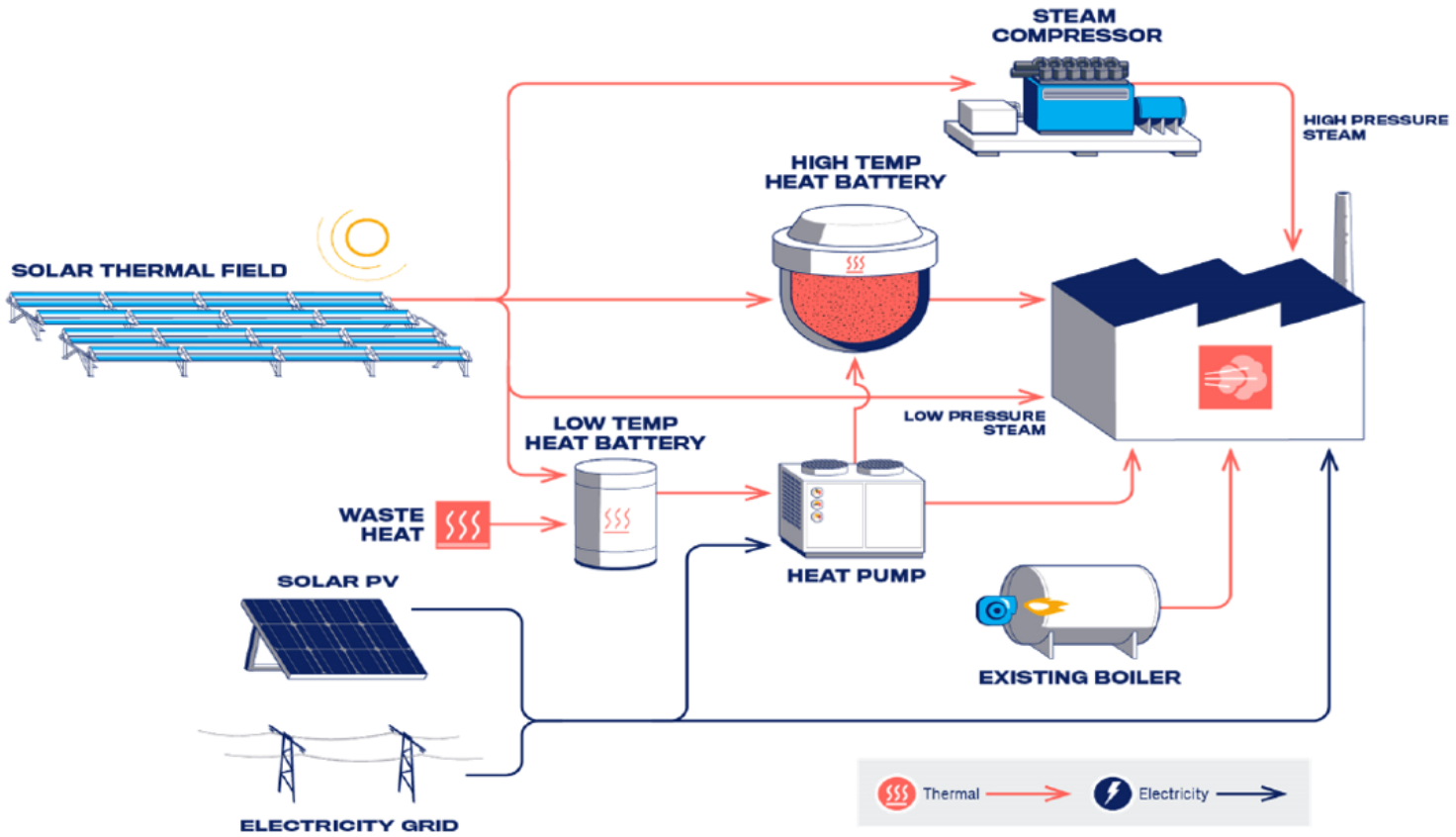
Forthcoming Research and Industry for European and National Development of SHIP

Combined solar thermal and steam heat pump solution

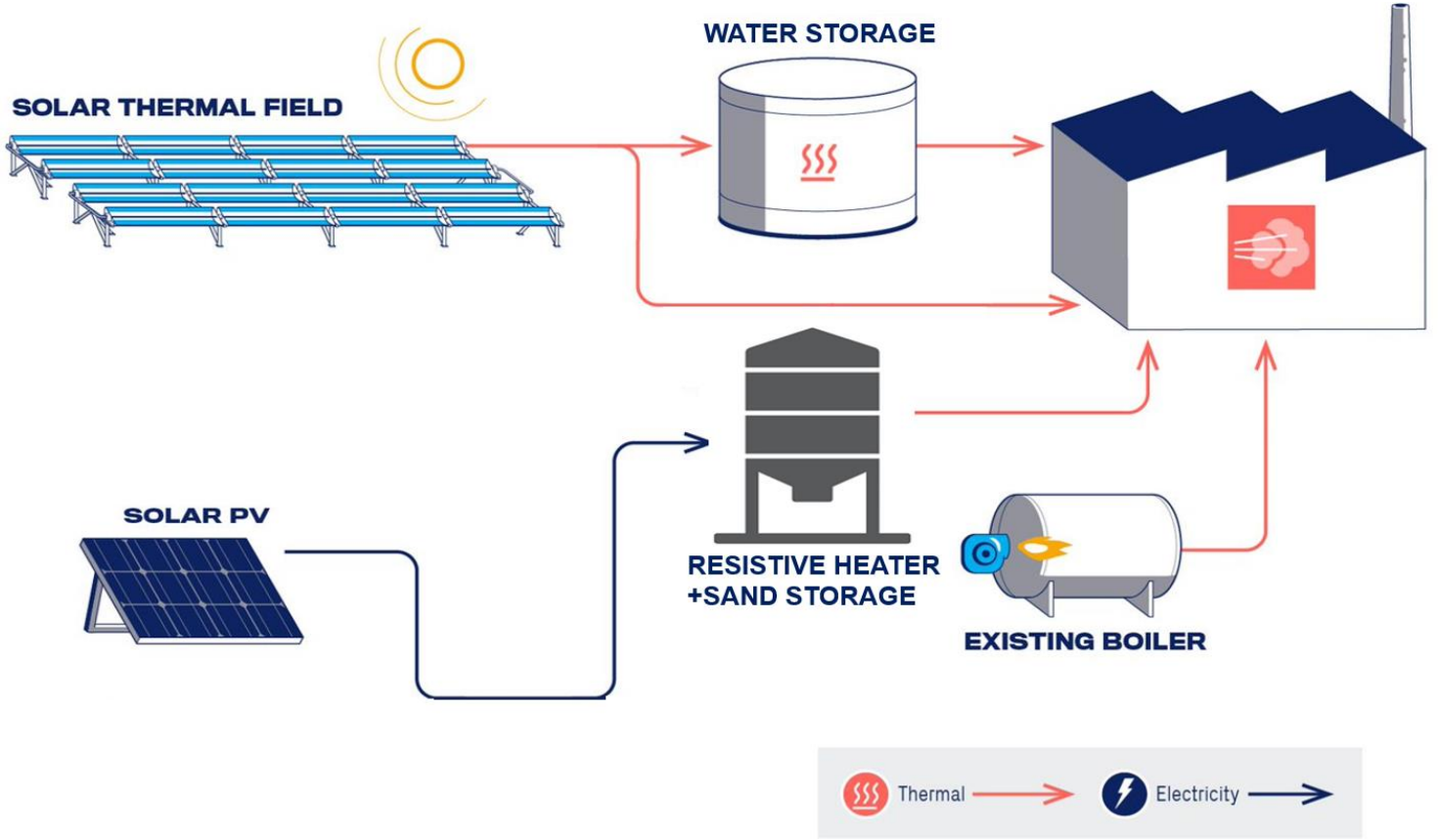


Example of hybridisation

ABSOLICON SOLAR COLLECTORS

FRIEND SHIP
Forthcoming Research and Industry for European and National Development of SHIP

Combined solar thermal and PV sand storage system



Summary

Despite the high potential of solar thermal :

- The techno is “hidden” and less marketed technology solutions
- It is not easy to reach manufacturers and present these solutions to them

Need of :

- **Educational material**
- **More supported pilot industries ; possibility of hybrid systems**
- **More communication ; success stories**

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Solar Energy in Industrial Processes: how to meet the expectations of the European Commission

PANEL DISCUSSION

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