SUSTAINABLE PLACES 2023

SHIP2FAIR

Solar Heat for Industrial Processes

EXLOITING UNTAPPED POTENTIAL OF INDUSTRIAL SOLAR HEAT: SHIP2FAIR

Day 2 – Thursday 15 June, 2023 - Madrid, Spain

sustainableplaces.eu

R2M RESEARCH TO MARKET SOLUTION

POLITÉCNICA

SHIP2FAIR

Solar Heat for Industrial Processes towards Food and Agro Industries commitment in Renewables

Project Welcome and Presentation

Final Event SP23, 15/06/2023

Miguel Zarzuela – mzarzuela@fcirce.es

circe - **Project Coordinator**

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 792276.

SHIP2FAIR Agenda

TIME	TOPIC	SPEAKERS
09h00	**SHIP2FAIR welcome and presentation** SHIP2 FAIR main goal, objectives and introduction to project's set of technologies and tools.	Miguel Zarzuela (CIRCE)
09h15	**Solar thermal technologies for the agro-food industry**	Dimitrios Papageorgiou (TVP) and Irapua Ribero (IS)
09h35	**Presentation of the Control Tool**	Viktor Unterberger (BEST)
09h55	**Presentation of the Replication Tool**	Giorgio Bonvicini (RINA-C)
10h10	**Hand-on experience & good practices in solar thermal adoption in the agro-food sector - RODA**	Esperanza Tomas (RODA)
10:25	**Questions**	
	BREAK	

SHIP2FAIR Agenda

11h00	**SHIP2FAIR welcome – Part II**	Miguel Zarzuela (CIRCE)
11h05	**Hand-on experience & good practices in solar thermal adoption in the agro-food sector – M&R**	Antonino Giummulè (M&R)
11h20	**Business and financing schemes for SHIP installation**	Dimitrios Papageorgiou (TVP) and Irapua Ribero (IS)
11h40	**Presentation of Replication Studies for solar thermal in industry**	Giorgio Bonvicini (RINA-C) and Irapua Ribero (IS)
12h55	**Roadmap for deployment of Solar Heating for Ship2Fair**	Nicola Chiara (LINKS)
12h05	**Renewable penetration in Spanish Industry**	Susana Rivera (Cooperativas)
12h15	**Lessons learnt and Policy Recommendations**	Luis Heras (CIRCE)
12h25	**Questions**	

SHIP2FAIR
Concept

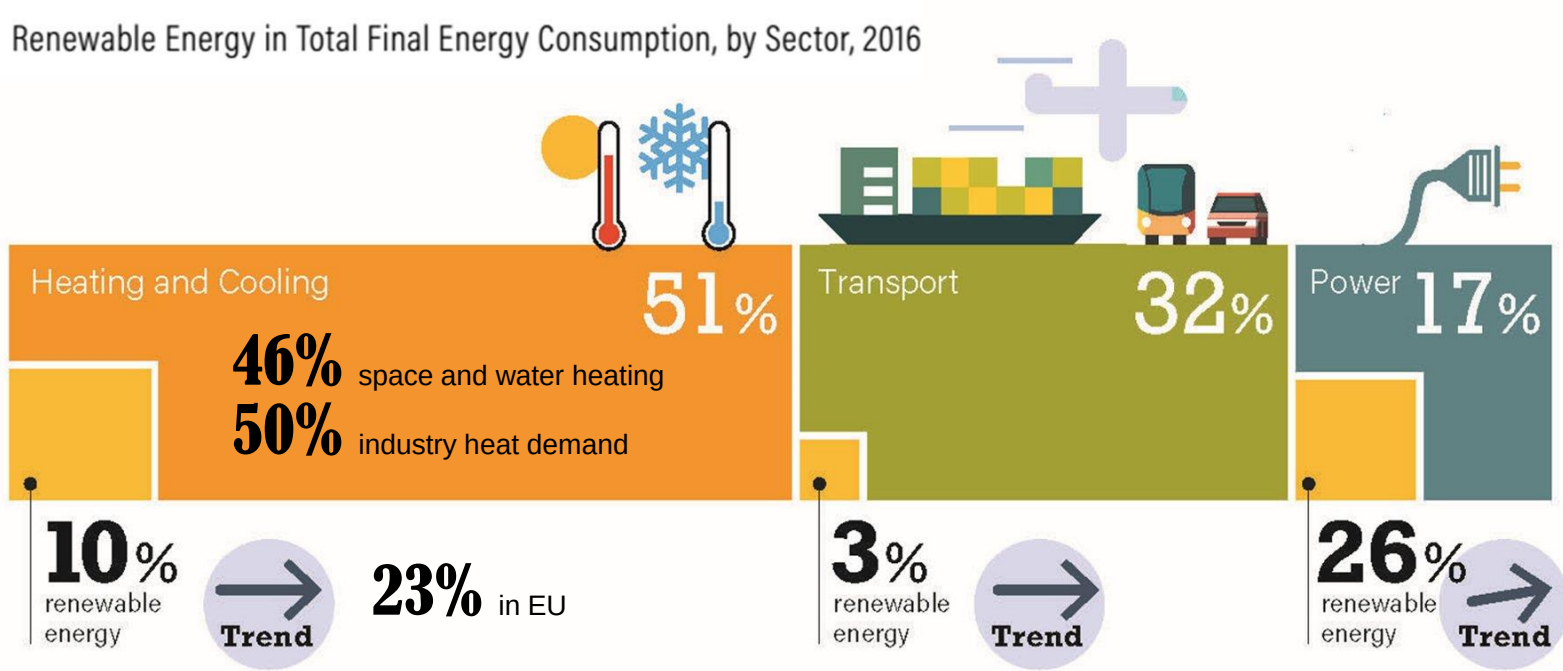
Unveiling the untapped potential of solar heat for agroindustries in EU

Fostering the integration of solar heat in industrial processes - **SHIP** from agro-food sector, by developing and demonstrating a set of tools and methods for the development of industrial solar heat projects during its whole life-cycle.

BUDGET: 8M €
DURATION: 2018-2023

Global Outlook – Energy Demand

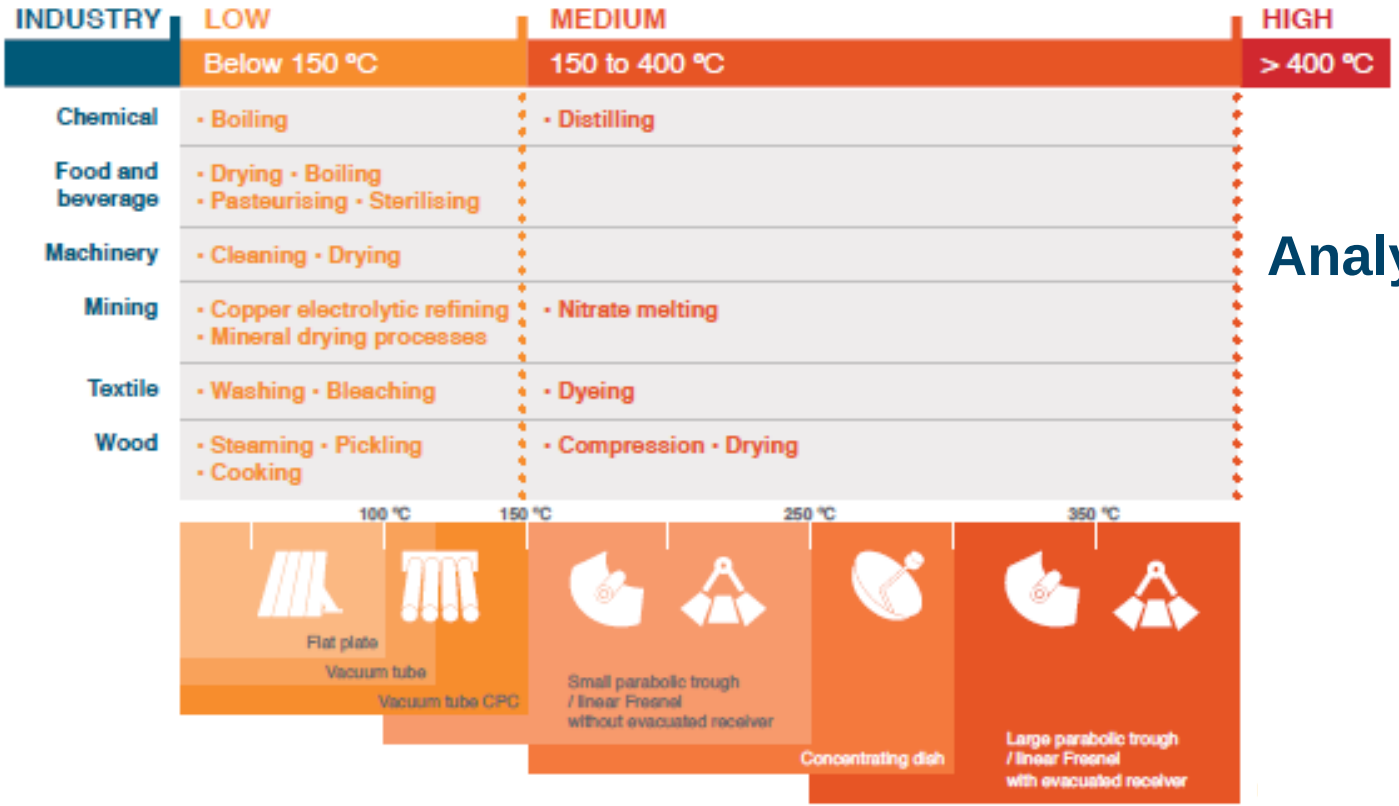
SHIP2FAIR



Solar Heat for Industrial Processes towards Food and Agro Industries commitment in Renewables

SHIP2FAIR

Market Analysis State of the Art



Source: *SHC*

Solar Heat for Industrial Processes towards Food and Agro Industries commitment in Renewables

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SHIP2FAIR Partners

- Coordination
- Solar technologies providers
- R&D and consulting
- Agro-food field experts
- Dissemination & Training

circe

INDUSTRIAL SOLAR
renewables onsite

SOLID
solarinstallation+design

TVP SOLAR

BEST
Bioenergy and Sustainable Technologies

cea

EDF

LINKS
ISMB

RINA

cooperativas agro-alimentarias España

LARNAUDIE
FIGEAC - CASTELNAU/DIARY

MARTINI

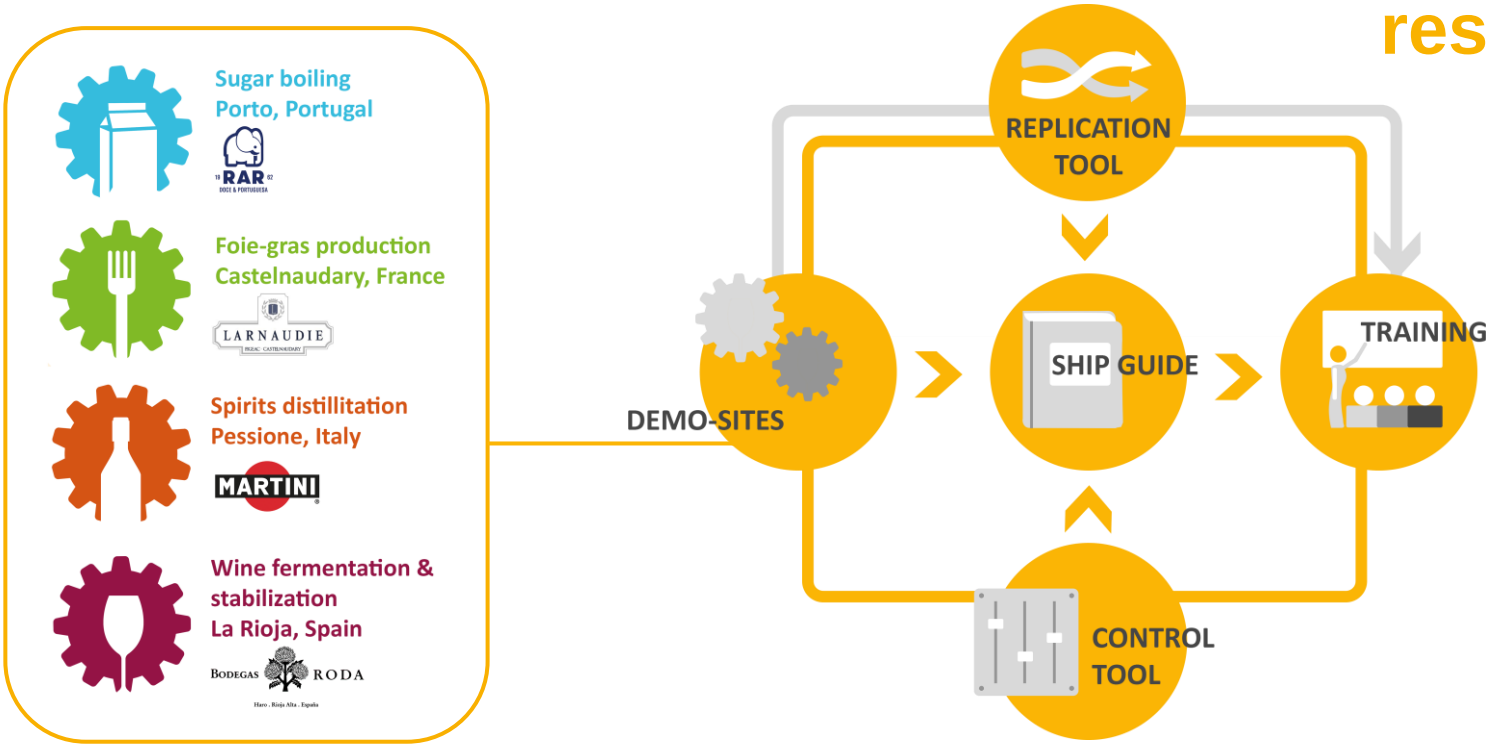
RAR
DOCE & PORTUGUESA

BODEGAS RODA
RIOJA ALTA

EUREC
The Association of European Renewable Energy Research Centres

SHIP2FAIR will develop & demonstrate, in a 4 real industrial sites - **demo-sites**, a set of **tools & methods** for the development of industrial solar heat projects during their whole life-cycle.

SHIP2FAIR Expected results



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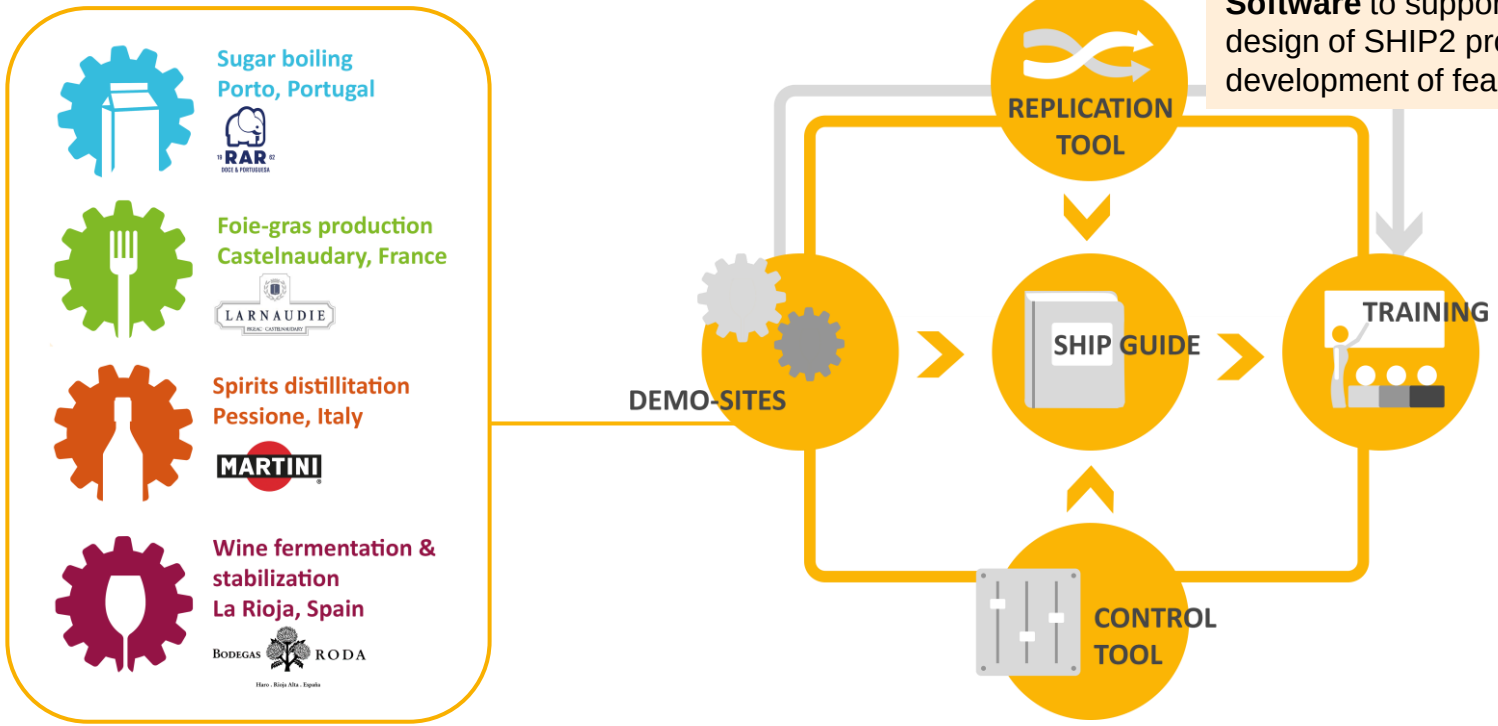
SHIP2FAIR Expected

Software to support the concept design of SHIP2 projects & the development of feasibility studies



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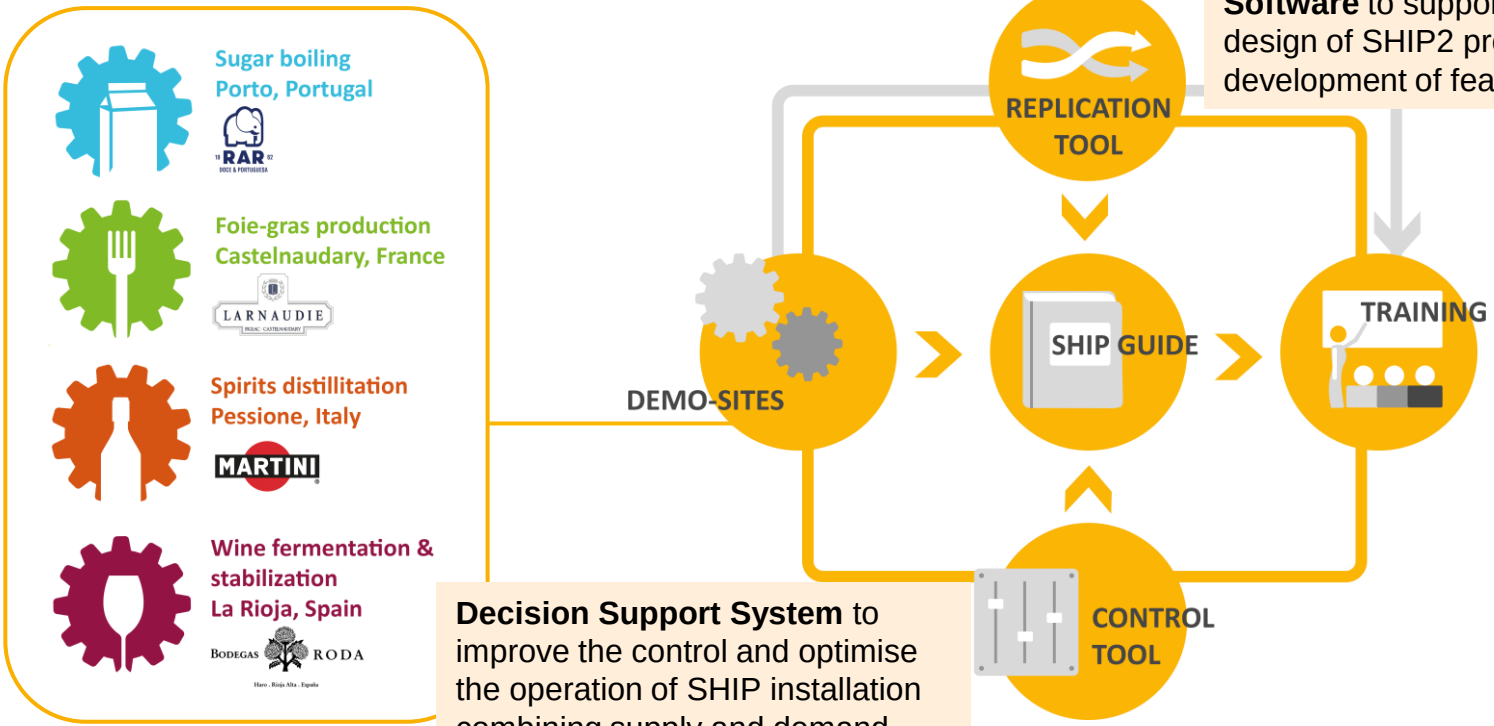


Decision Support System to improve the control and optimise the operation of SHIP installation combining supply and demand data

SHIP2FAIR will develop & demonstrate, in a 4 real industrial sites - **demo-sites**, a set of **tools & methods** for the development of industrial solar heat projects during their whole life-cycle.

SHIP2FAIR Expected

Software to support the concept design of SHIP2 projects & the development of feasibility studies

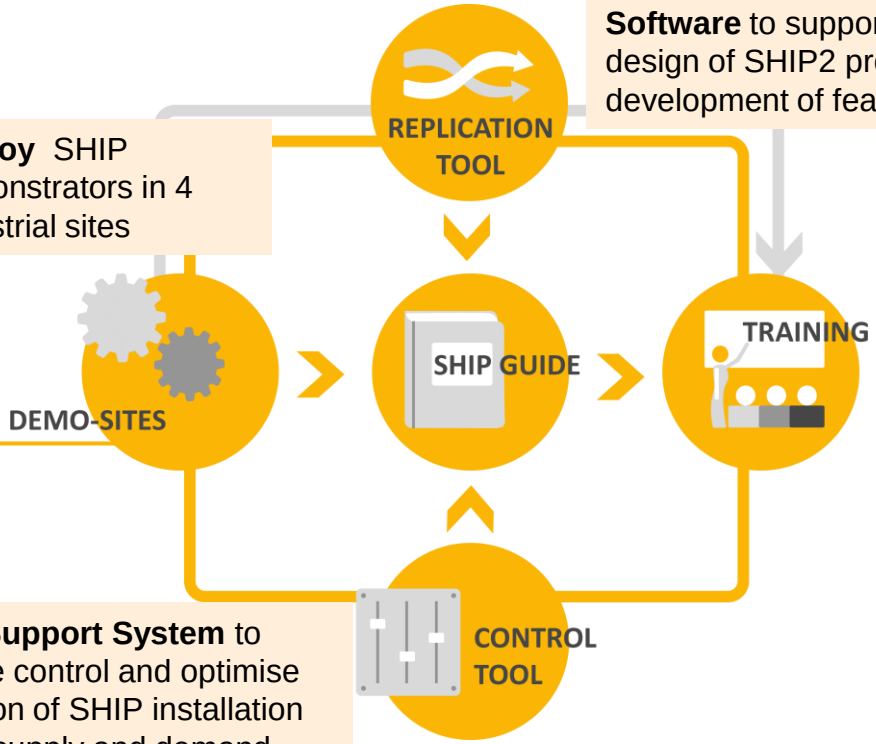
Deploy SHIP demonstrators in 4 industrial sites

Sugar boiling
Porto, Portugal

Foie-gras production
Castelnaudary, France

Spirits distillitation
Pessione, Italy

Wine fermentation & stabilization
La Rioja, Spain



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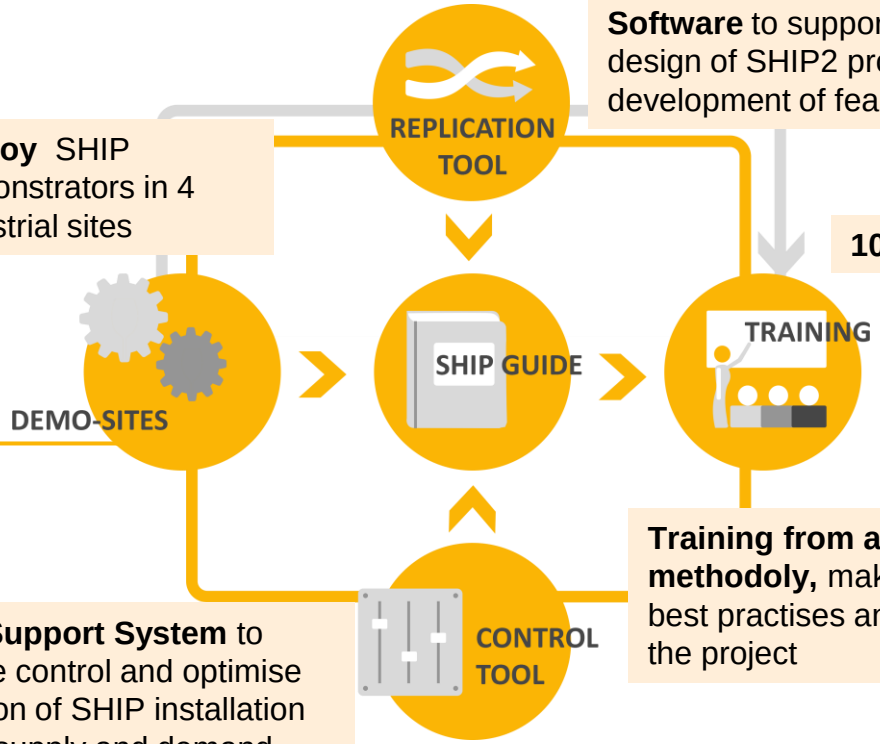


10 feasibility studi

Training from a practical methodoly, making use of best practises and results of the project

Decision Support System to improve the control and optimise the operation of SHIP installation combining supply and demand data

The demo-sites & the flagship projects

SHIP systems fully validated in real processes:

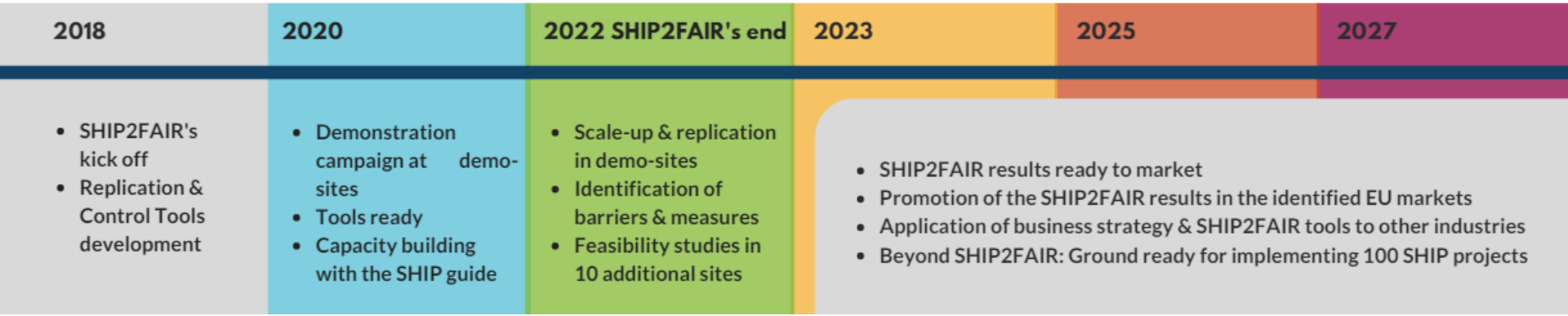
Novel solar collectors demonstrated in average irradiance areas through demonstration campaign

- **Total capacity:** 1.7 MWth
- **Solar fraction:** 24% av.
- **Yearly average solar efficiency:** 44% (M&R)-54% (RODA)

- **Primary energy savings:**
  - 2 GWh/year
  - 570 tCO_2/year avoided
  - 2.7 GWh/year increase of RES in industrial heating

SHIP2FAIR

From 2018 to 2022 and beyond

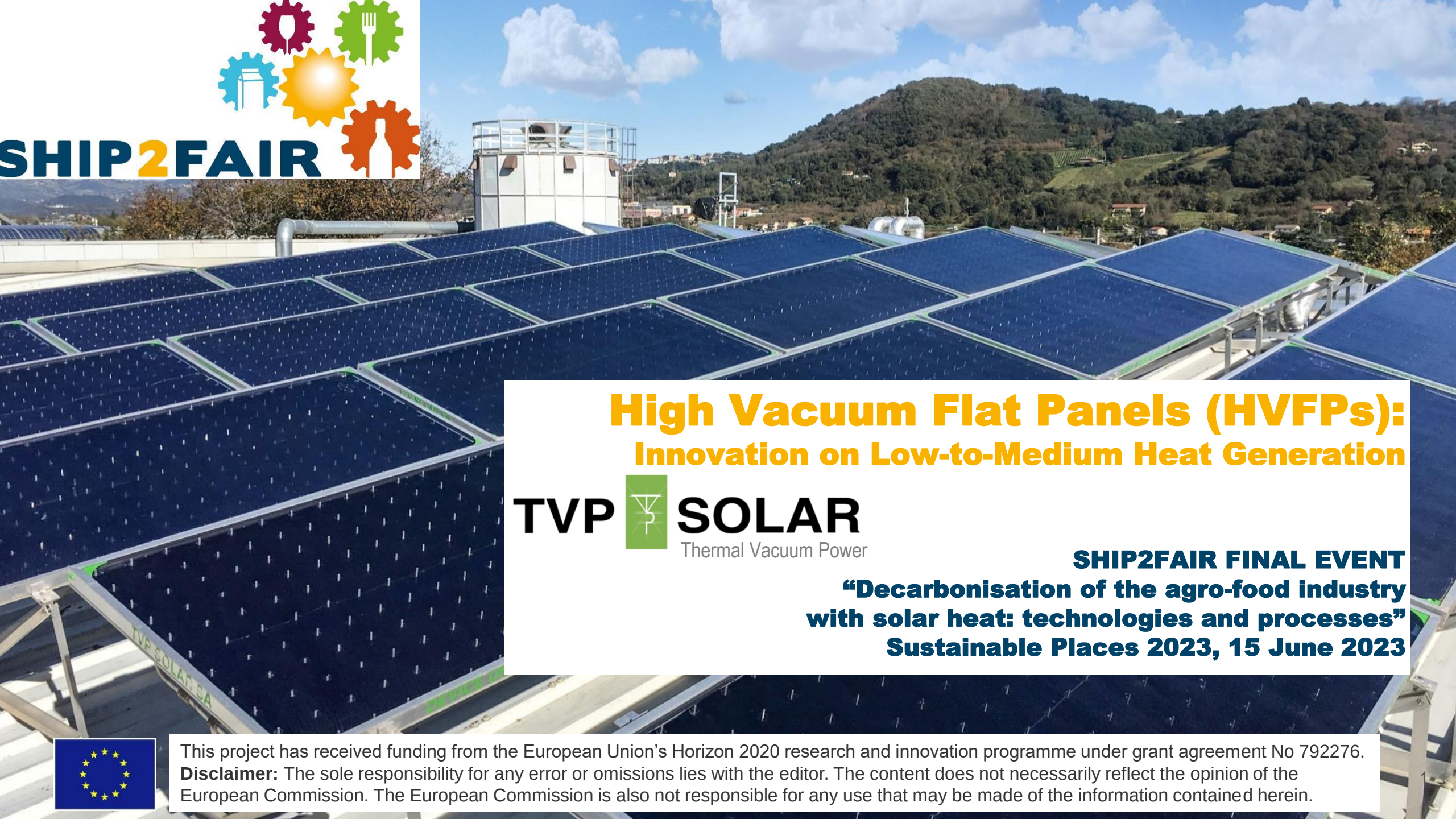


Solar Heat for Industrial Processes towards Food and Agro Industries commitment in Renewables

info@ship2fair-h2020.eu
www.ship2fair-h2020.eu

Thank you!

SHIP2FAIR



High Vacuum Flat Panels (HVFPs):
Innovation on Low-to-Medium Heat Generation

TVP SOLAR
Thermal Vacuum Power

SHIP2FAIR FINAL EVENT
"Decarbonisation of the agro-food industry with solar heat: technologies and processes"
Sustainable Places 2023, 15 June 2023

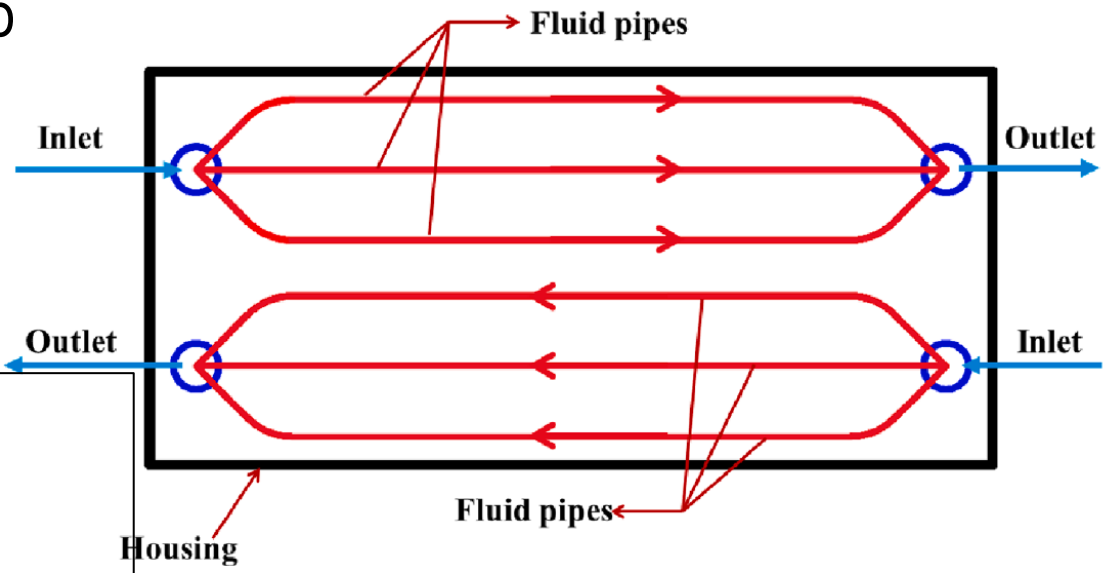
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 792276.

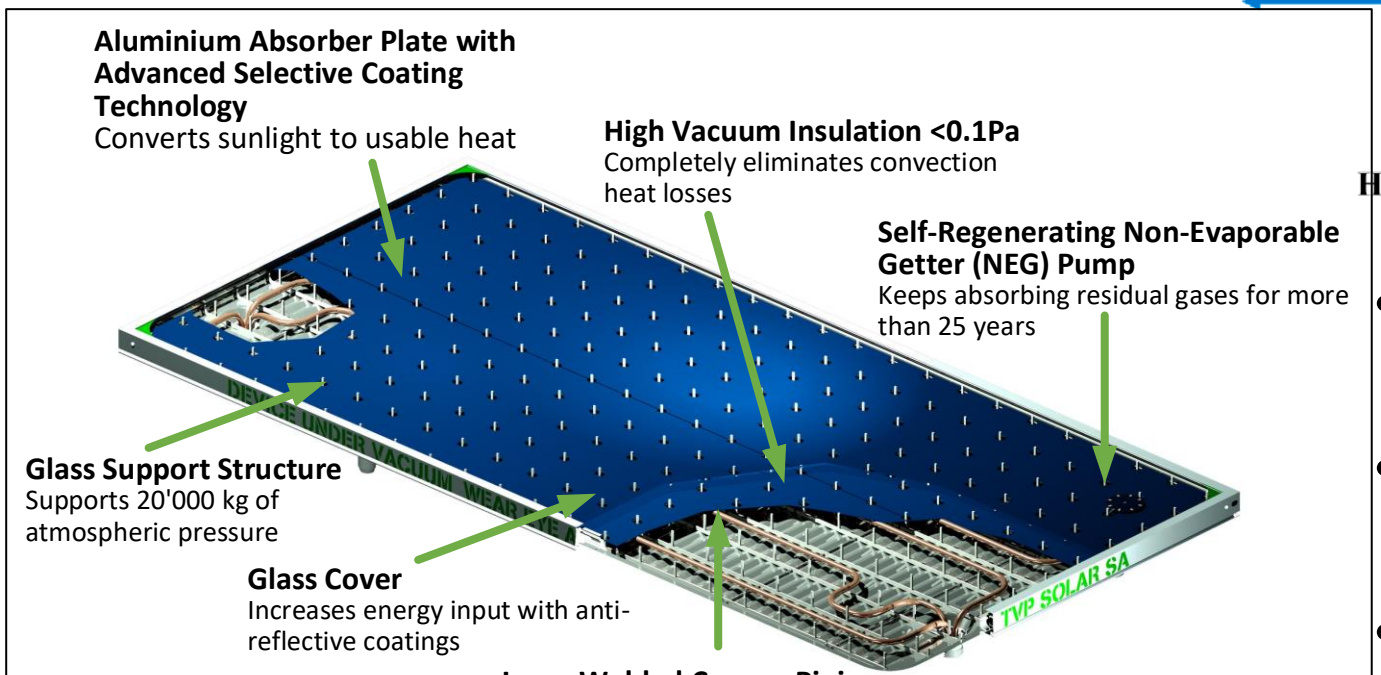
The High Vacuum Flat Panel (HVFP) Technology

The World Best Solar Thermal Collector

TVP SOLAR
Thermal Vacuum Power
SHIP2FAIR

- SolarKeyMark certified best performance 65˚C to 200˚C
- Best efficiency and highest energy production at any operating temperature, with any ambient temperature, in any climate condition





- High-vacuum insulation suppresses thermal losses
- 20 years consistent & predictable performance without any degradation
- Designed for industrial-scale applications

TVP SOLAR
Thermal Vacuum Power

SHIP2FAIR

Disruptive Patented Technology

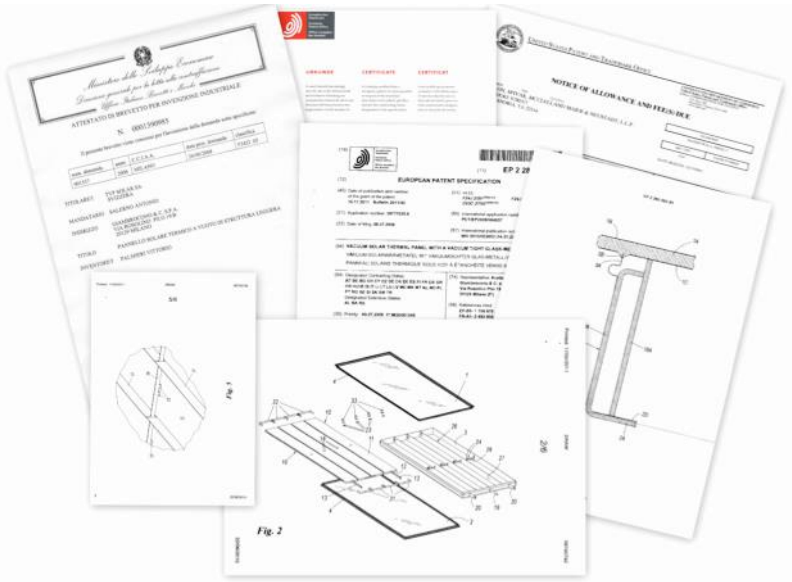
Make, maintain and inspect high-vacuum insulation in a flat plate, to supply super thermal performance, while withstanding 10 ton/m^2 atmospheric pressure and securing 25 years vacuum integrity

Vacuum Solar Thermal Panel with a Vacuum-Tight Glass-Metal Sealing
grant nr. EP2283282

Lightweight Structure Vacuum Solar Thermal Panel
grant nr. EP2274559

Vacuum Solar Thermal Panel with Radiative Screen
grant nr. EP2229561

Method for Performing an Exhaust Cycle of a Vacuum Solar Thermal Panel
grant nr. EP2472194



Method for Performing a Frit Firing Cycle in the Manufacturing of a Vacuum Solar Thermal Panel
grant nr. EP2658819

Vacuum Solar Thermal Panel with Pipe Housing
grant nr. EP2474795

Vacuum Solar Thermal Panel Provided with an Internal Pressure Indicator
grant nr. EP2530402

Method for Manufacturing a Vacuum Solar Thermal Panel and Related Vacuum Solar Thermal Panel
grant nr. EP2543938

Vacuum Solar Thermal Panel With Non-Evaporable Getter Pump Assembly
grant nr. EP2551609

Solar Thermal Panel Array Field Arrangement and Related Vacuum Solar Thermal Panel
grant nr. EP2672194

10 patent families
184 patents
177 already granted!

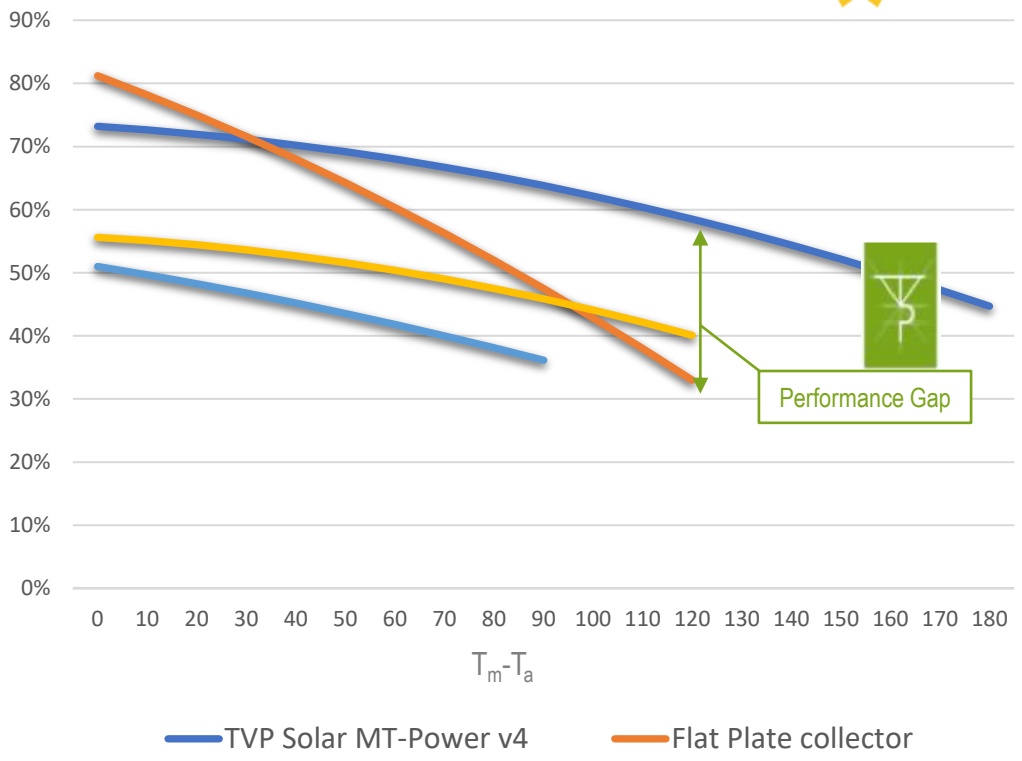
Best Solar Thermal

TVP SOLAR
Thermal Vacuum Power
SHIP2FAIR

Best efficiency and energy output in any climate conditions,
with any irradiance, at any operating temperature up to 200C

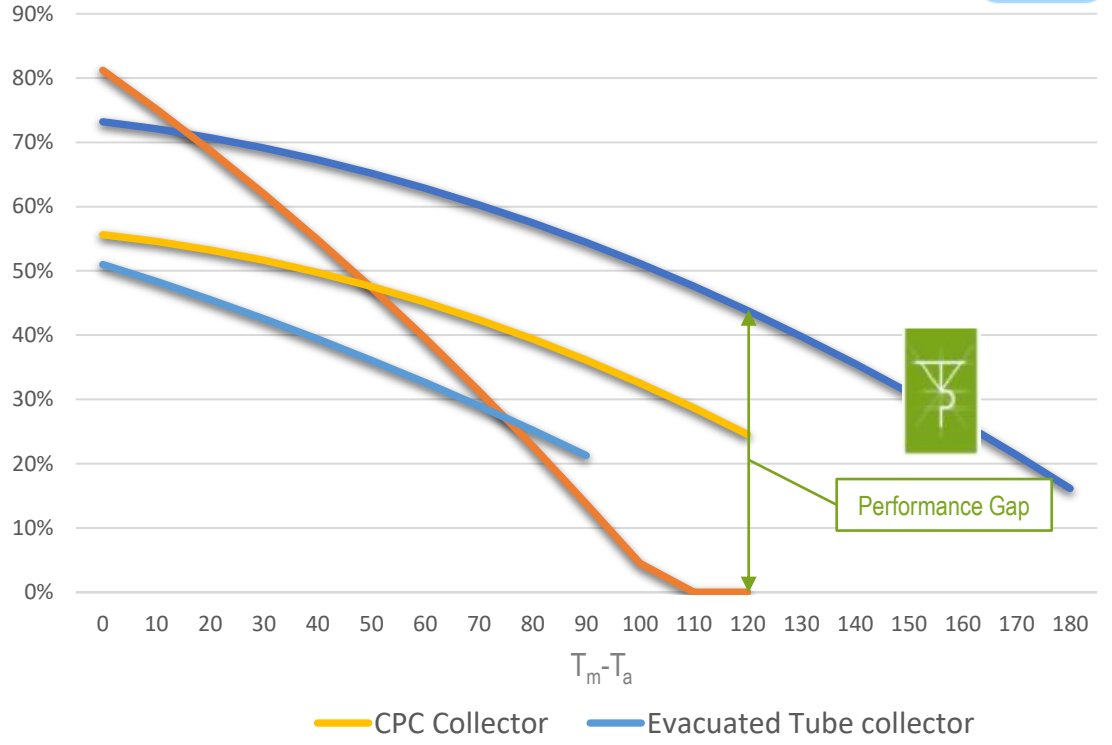
Solar Collectors Efficiency @ 1000 W/m² (full sun)

full sun
~1 h/d



Solar Collectors Efficiency @ 500 W/m² (average daylight)

Average daylight

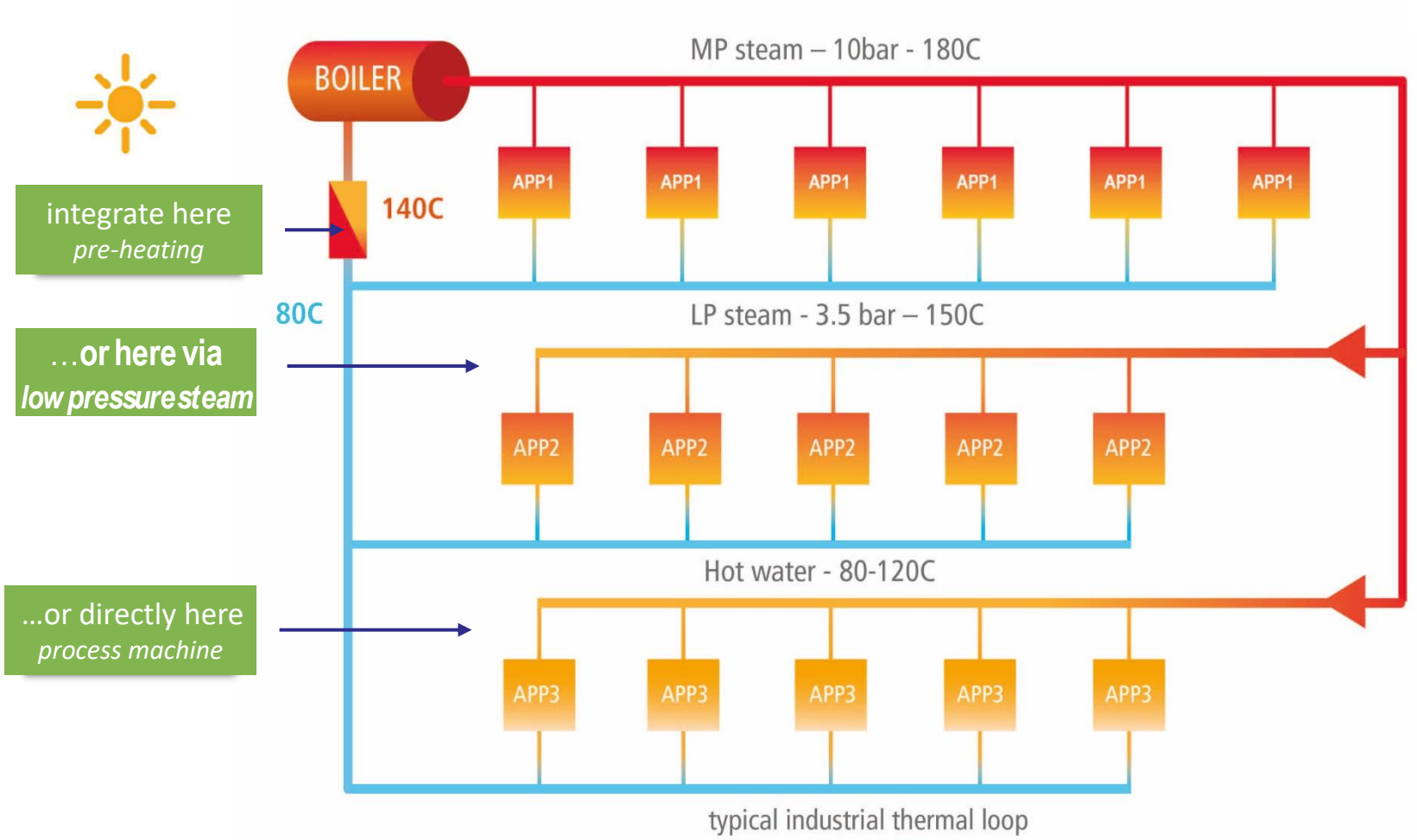


Seamless Integration to Industrial Processes

TVP SOLAR
Thermal Vacuum Power

SHIP2FAIR

TVP's solar thermal system requires no change of the customer process



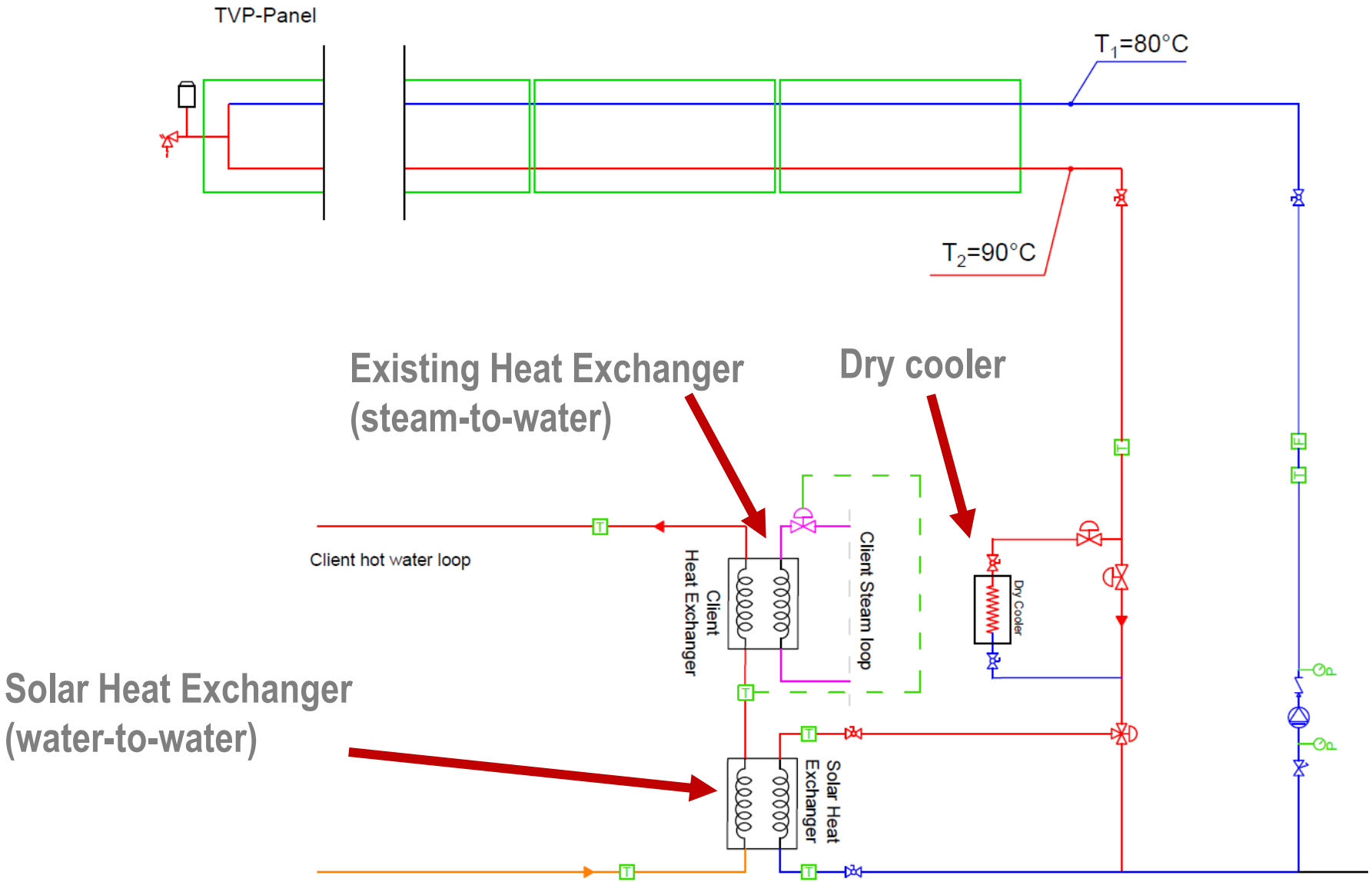
Primary Target Industries

- Food
- Beverage
- Agricultural
- Paper
- Textile
- Oil & Gas
- Pharma
- Automotive
- Mining
- District Networks

Primary Target Processes

- Pre-heat water
- Boiler feedwater
- Sterilization
- Pasteurization
- Drying
- Dying
- Water treatment
- AC & cooling
- Washing
- Pressing
- Bleaching
- Decreasing

Solar Process Heat: example of integration



Solar Process Heat Economics in Europe

TVP SOLAR Thermal Vacuum Power

SHIP2FAIR

Typical setup

Collectors gross area	1,600 m^2 / MW
Footprint	3,000 m^2 / MW
Heat Production	1’280 MWh /MW /y

Cost baseline

CAPEX	960K€ / MW
OPEX	6’400 € /MW /y
Lifetime	25 years

No performance degradation over lifetime
Product & performance guarantees

Possible optimizations

- Significant economies for large scale systems
- Include subsidies

Economic assumptions

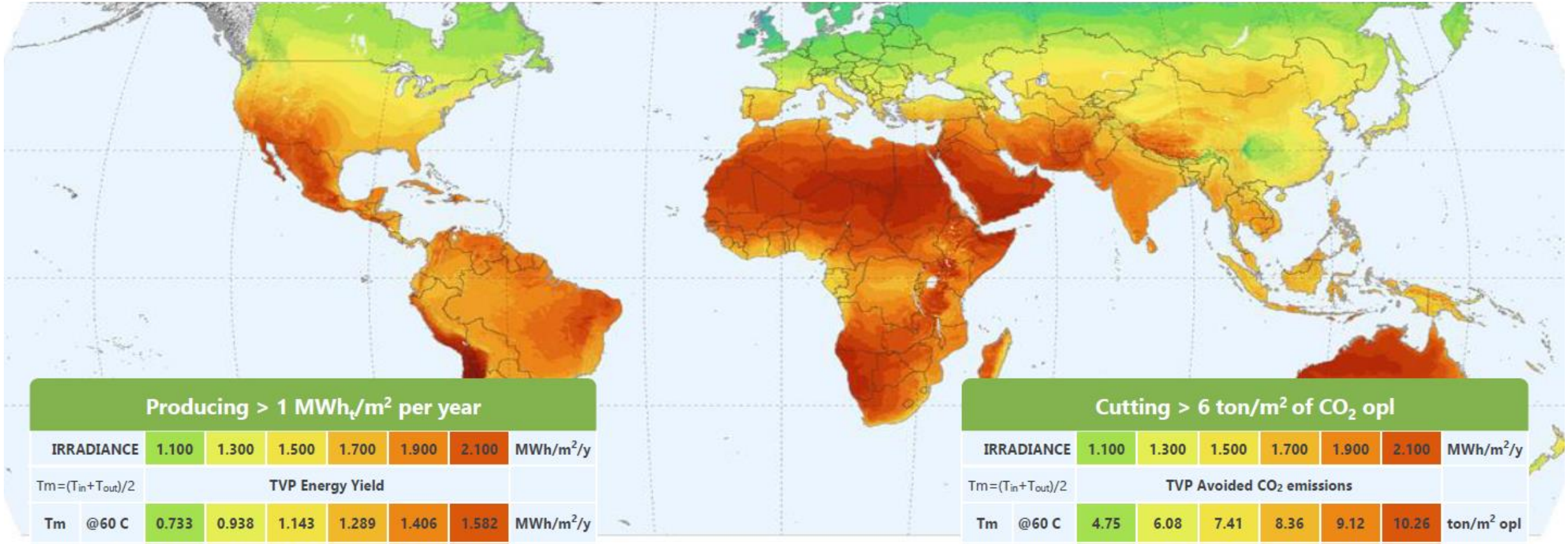
- OPEX includes O&M, electricity, spares
- Solar plant lifetime: 25 years

TVP SOLAR
Thermal Vacuum Power

SHIP2FAIR

Competitive Worldwide

Game changing performance: > 50% sun to energy conversion efficiency up to 150 ° C on yearly average



Producing > 1 MWh_t/m^2 per year

IRRADIANCE		1.100	1.300	1.500	1.700	1.900	2.100	$MWh/m^2/y$
$Tm=(T_{in}+T_{out})/2$		TVP Energy Yield						
Tm	@60 C	0.733	0.938	1.143	1.289	1.406	1.582	$MWh/m^2/y$
Tm	@95 C	0.682	0.791	0.967	1.113	1.231	1.406	$MWh/m^2/y$
Tm	@120 C		0.750	0.850	0.967	1.084	1.260	$MWh/m^2/y$
Tm	@150 C				0.791	908	1.084	$MWh/m^2/y$

Cutting > 6 ton/m^2 of CO_2 opl

IRRADIANCE		1.100	1.300	1.500	1.700	1.900	2.100	$MWh/m^2/y$
$Tm=(T_{in}+T_{out})/2$		TVP Avoided CO_2 emissions						
Tm	@60 C	4.75	6.08	7.41	8.36	9.12	10.26	ton/m^2 opl
Tm	@95 C	4.42	5.13	6.27	7.22	7.98	9.11	ton/m^2 opl
Tm	@120 C		4.86	5.52	6.27	7.10	8.18	ton/m^2 opl
Tm	@150 C				5.12	5.89	7.03	ton/m^2 opl

solargis
http://solargis.info

(i) vs natural gas with 9.59 LHV and 1.99 kg/m^3 CO_2 footprint; 80% burner efficiency;
(ii) opl = over product lifetime (25 years)

TVP SOLAR

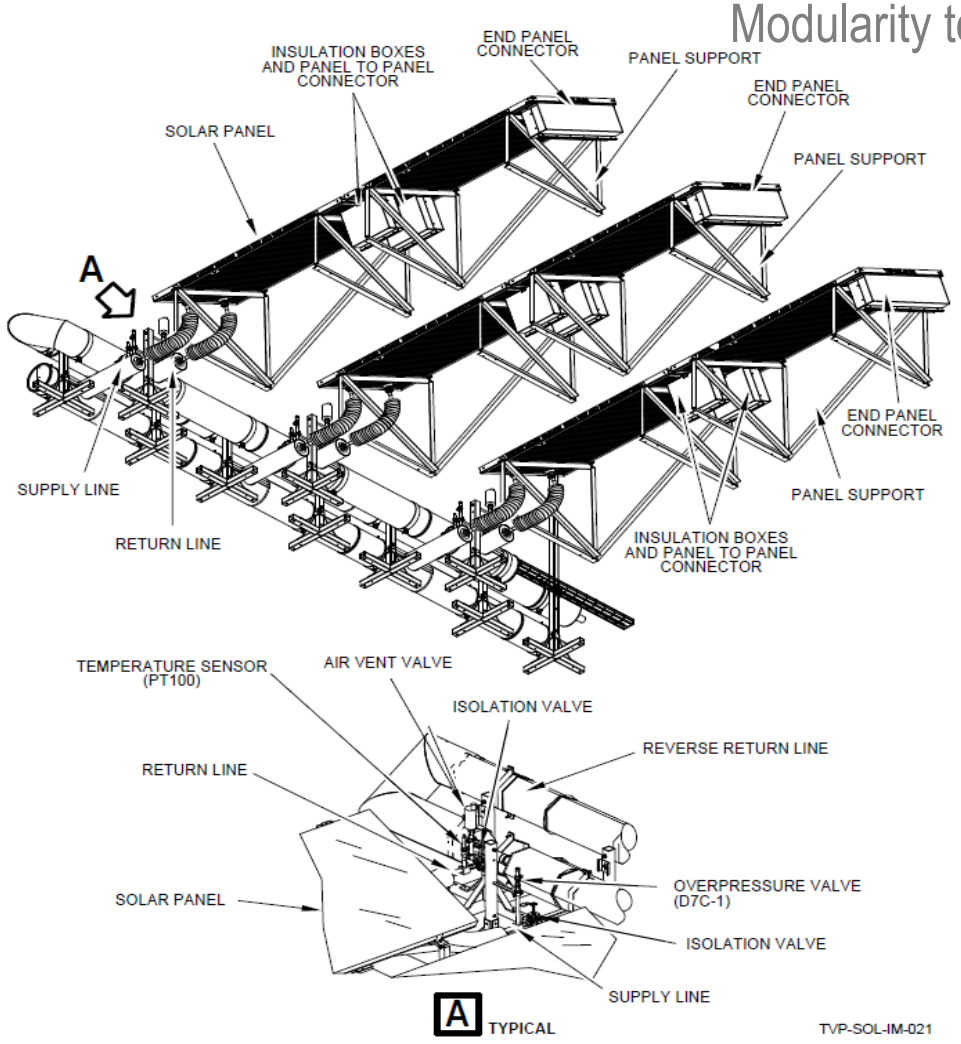
Standardized and Modular Solar System

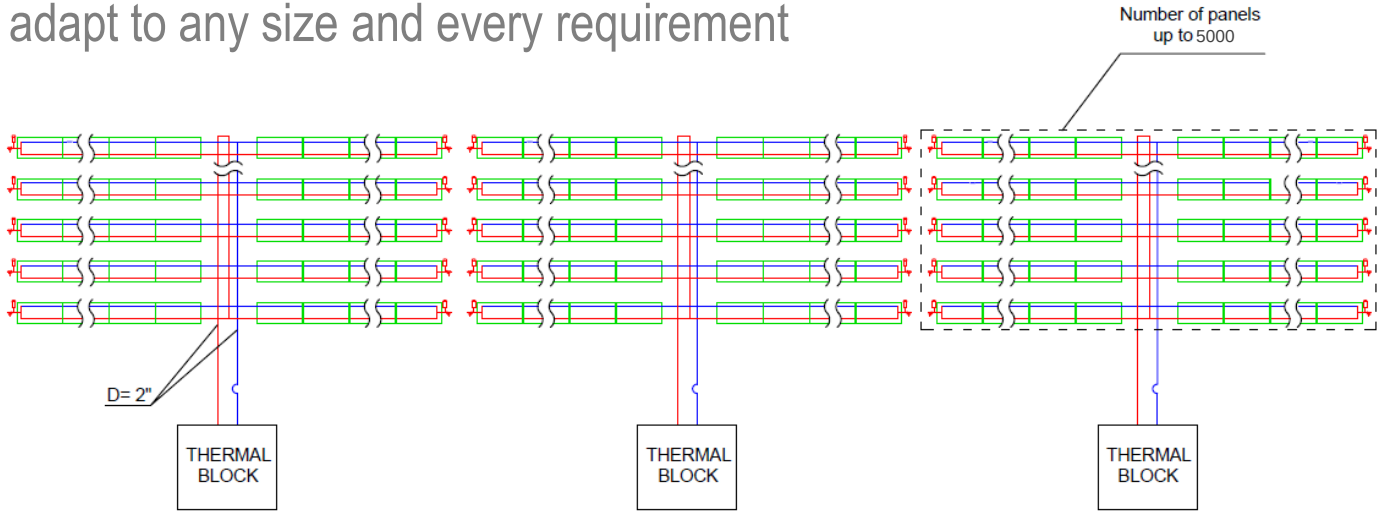
TVP SOLAR
Thermal Vacuum Power

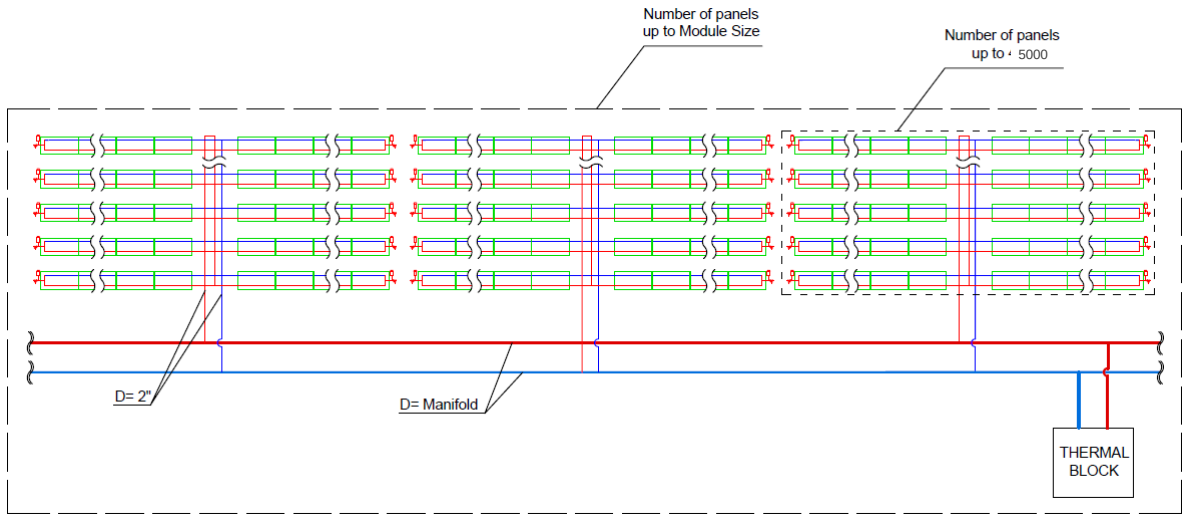
SHIP2FAIR

Standardized solar system components ease installation and maintenance

Modularity to adapt to any size and every requirement







TVP Solar Field – Assembly

Project Examples

TVP for industrial process heat

End-client	Martini & Rossi
Location	Pessione/Chieri (TO), Italy
Application	Summer: Indirect steam generation (4 bar) @175°C Winter: Space Heating @70°C
Project	600 m^2 solar field; 0.4 MW; 400 MWh/y
Savings	49,070 m^3/y of NG and 96 ton/y of CO_2
Energy Cost	34 €/MWh
TVP role	EPC

SHIP2FAIR project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 792276.

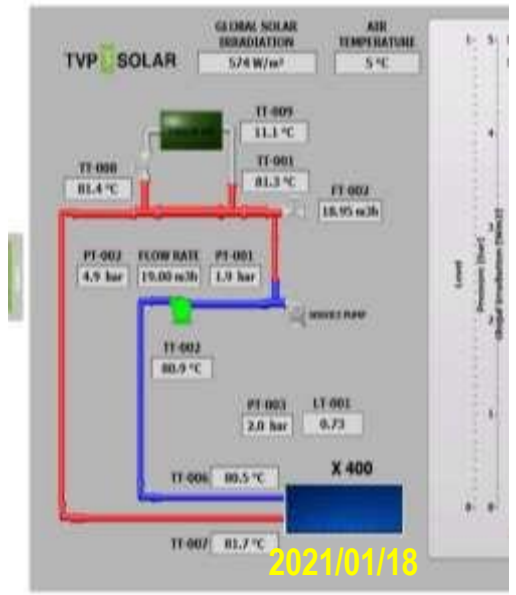
TVP for oil processing

End-client	Saudi Aramco
Location	Qurayyah Seawater Treat ment Plant , KSA Diesel
Application	Boiler Feedwater Pre-Heating 1.8 MW; 93°C to 164°C [5 ,520 lb/h; 24 /7]
Project	1,020 m^2 solar field; 0 .6 MW; 3,410 MMBtu/y
Savings	138 ,269 lit er/y of diesel and 372 ton/y of CO_2
Energy Cost	8.5 $/MMBtu
TVP role	single source contractor, EPC

Commissioned December 26th 2020

TVP for district heating

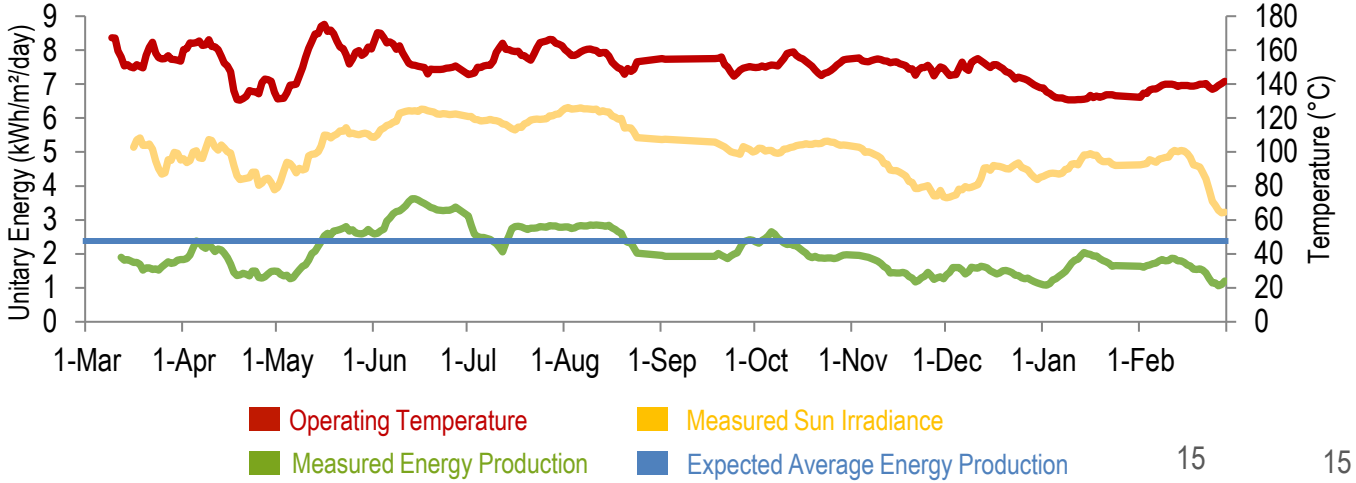
End-client	Service Industriels de Geneve
Location	Le Lignon DH Thermal Plant (GE), Switzerland
Application	District network return flow heating 0 .5 MW; 45°C to 85°C [20 m^3 /h; 10 h/d 36 5 d/y]
Project	800 m^2 solar field; 0.55 MW; 517 MWh/y
Savings	55,543 m^3 /y of NG and 119 ton/y of CO_2
Energy Cost	38 CHF/MWh
TVP role	EPC



TVP for air conditioning

End-client	Agility
Location	Sulabiya - Kuwait
Application	Solar Cooling @165°C with 2E absorption chiller
Project	234 m^2 solar field; 110 kW_t; 34TR_{cool} 240 MWh_{cool}/y (measured)
Savings	120 MWh_e and 75 ton/y of CO_2
Energy Cost	76 USD/MWh_{cool}
TVP role	EPC

TVP supplies 2.25 kWh_{th}/m^2/day (vs 2.34) up to 165°C



15

Product Certifications

DIN CERTCO
Gesellschaft für Konformitätsbewertung mbH

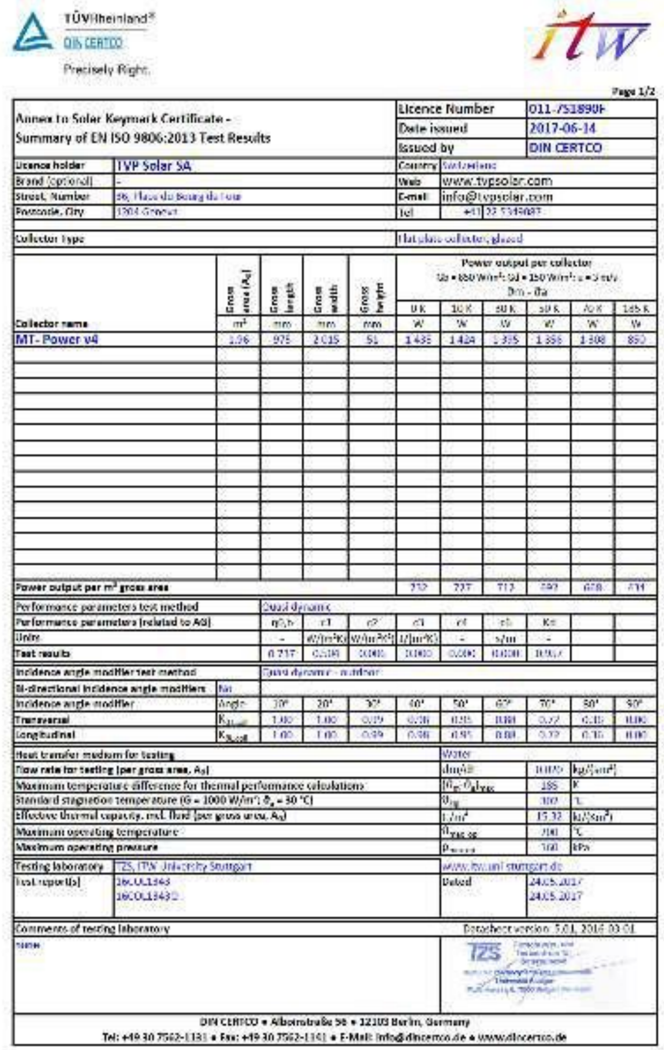
CERTIFICATE

Certificate holder	TVP Solar SA Place du Bourg-de-Four 36 1204 Geneva SWITZERLAND
Production facility	Avellino
Product	Solar collectors
Type, Model	MT-Power v4
Testing basis	DIN EN 12975-1:2011-01 DIN EN ISO 9806:2014-06 Specific CEN Keymark Scheme Rules for Solar Thermal Products Version 29.00 (2016-12)
Mark of conformity	
Registration No.	011-7S1890 F
Valid until	2022-03-31
Right of use	This certificate entitles the holder to use the mark of conformity shown above in conjunction with the specified registration number. See annex for further information.

2017-07-06
Dipl.-Wi.-Ing. (FH) Sören Scholz
Head of Certification Body

DAkkS Deutsche Akkreditierungsstelle D-ZE-11125-01-00

DIN CERTCO Gesellschaft für Konformitätsbewertung mbH · Alboinstraße 56 · D-12103 Berlin · www.dincertco.de



TÜVRheinland®
DIN CERTCO
Precisely Right.

itw

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Annex to Solar Keymark Certificate - Summary of EN ISO 9806:2013 Test Results		
	Licence Number	011-7S1890F
	Date issued	2017-06-14
	Issued by	DIN CERTCO

Licence holder	TVP Solar SA	Country	Switzerland
Brand (optional)	-	Web	www.tvpsolar.com
Street, Number	36, Place du Bourg de Four	E-mail	info@tvpsolar.com
Postcode, City	1204 Geneva	Tel	+41 22 [illegible]
Collector type		Flat plate collector, glazed	

Collector name	Gross area (A_G)	Gross length	Gross width	Gross height	Power output per collector 0 K	10 K	30 K	50 K	70 K	185 K
	m²	mm	mm	mm	W	W	W	W	W	W
MT- Power v4	1.96	975	2 015	51	1 435	1 424	1 395	1 356	1 308	850
Power output per m² gross area					732	727	712	692	668	434

Performance parameters test method	Quasi dynamic								
Performance parameters (related to AG)	$\eta_{0,b}$	c1	c2	c3	c4	c5	Kd		
Units	-	W/(m²K)	W/(m²K²)	J/(m³K)	-	s/m	-		
Test results	0.737	0.508	0.006	0.000	0.000	0.000	0.957		
Incidence angle modifier test method	Quasi dynamic - outdoor								
Bi-directional incidence angle modifiers	No								
Incidence angle modifier (Angle)	10°	20°	30°	40°	50°	60°	70°	80°	90°
Transversal $K_{\theta T,coll}$	1.00	1.00	0.99	0.98	0.95	0.88	0.72	0.36	0.00
Longitudinal $K_{\theta L,coll}$	1.00	1.00	0.99	0.98	0.95	0.88	0.72	0.36	0.00

Heat transfer medium for testing	Water		
Flow rate for testing (per gross area, A_G)	dm/dt	0.020	kg/(s m²)
Maximum temperature difference for thermal performance calculations	$(\vartheta_m - \vartheta_a)_{max}$	185	K
Standard stagnation temperature (G = 1000 W/m²; ϑ_a = 30 °C)	ϑ_{stg}	302	°C
Effective thermal capacity, incl. fluid (per gross area, A_G)	C/m²	15.32	kJ/(Km²)
Maximum operating temperature	$\vartheta_{max\,op}$	200	°C
Maximum operating pressure	$p_{max,op}$	300	kPa

Testing laboratory	TZS, ITW University Stuttgart	www.itw.uni-stuttgart.de	
Test report(s)	16COL1343 16COL1343D	Dated	24.05.2017 24.05.2017

Comments of testing laboratory — Datasheet version: 5.01, 2016-03-01
none

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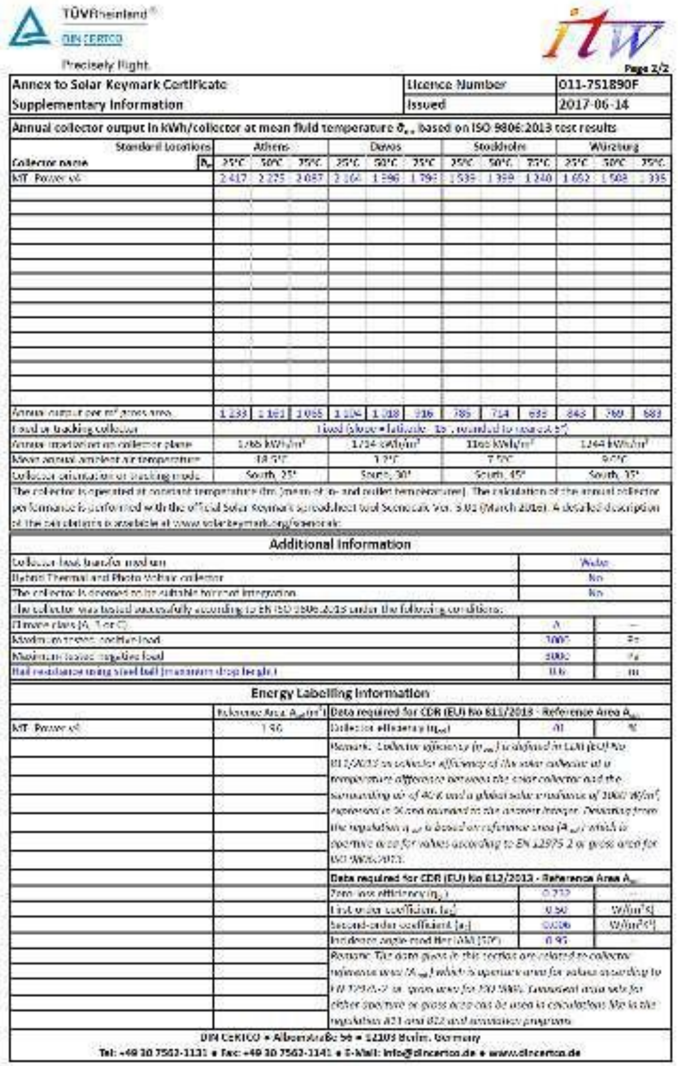

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Precisely Right.

itw

Page 2/2

Annex to Solar Keymark Certificate Supplementary Information	Licence Number	011-751890F
	Issued	2017-06-14

Annual collector output in kWh/collector at mean fluid temperature ϑ_m, based on ISO 9806:2013 test results

Collector name	Athens 25°C	Athens 50°C	Athens 75°C	Davos 25°C	Davos 50°C	Davos 75°C	Stockholm 25°C	Stockholm 50°C	Stockholm 75°C	Würzburg 25°C	Würzburg 50°C	Würzburg 75°C
MT- Power v4	2 417	2 275	2 087	2 164	1 996	1 794	1 539	1 399	1 240	1 652	1 508	1 335
Annual output per m² gross area	1 233	1 161	1 065	1 104	1 018	916	785	714	633	843	769	681
Fixed or tracking collector	Fixed (slope = latitude - 15°, rounded to nearest 5°)											
Annual irradiation on collector plane	1765 kWh/m²			1714 kWh/m²			1166 kWh/m²			1244 kWh/m²		
Mean annual ambient air temperature	18.5°C			3.2°C			7.5°C			9.0°C		
Collector orientation or tracking mode	South, 25°			South, 30°			South, 45°			South, 35°		

The collector is operated at constant temperature ϑm (mean of in- and outlet temperatures). The calculation of the annual collector performance is performed with the official Solar Keymark spreadsheet tool Scenocalc Ver. 5.01 (March 2016). A detailed description of the calculations is available at www.solarkeymark.org/scenocalc

Additional Information

Collector heat transfer medium	Water	
Hybrid Thermal and Photo Voltaic collector	No	
The collector is deemed to be suitable for roof integration	No	
The collector was tested successfully according to EN ISO 9806:2013 under the following conditions:		
Climate class (A, B or C)	A	-
Maximum tested positive load	3000	Pa
Maximum tested negative load	3000	Pa
Hail resistance using steel ball (maximum drop height)	0.6	m

Energy Labelling Information

	Reference Area A_{sol} (m²)	Data required for CDR (EU) No 811/2013 - Reference Area A_{sol}		
MT- Power v4	1.96	Collector efficiency (η_{col})	61	%

Remark: Collector efficiency (η_{col}) is defined in CDR (EU) No 811/2013 as collector efficiency of the solar collector at a temperature difference between the solar collector and the surrounding air of 40 K and a global solar irradiance of 1000 W/m², expressed in % and rounded to the nearest integer. Deviating from the regulation η_{col} is based on reference area (A_{sol}) which is aperture area for values according to EN 12975-2 or gross area for ISO 9806:2013.

Data required for CDR (EU) No 812/2013 - Reference Area A_{sol}		
Zero-loss efficiency (η_0)	0.737	-
First-order coefficient (a_1)	0.50	W/(m²K)
Second-order coefficient (a_2)	0.006	W/(m²K²)
Incidence angle modifier IAM (50°)	0.95	-

Remark: The data given in this section are related to collector reference area (A_{sol}) which is aperture area for values according to EN 12975-2 or gross area for ISO 9806. Consistent data sets for either aperture or gross area can be used in calculations like in the regulation 811 and 812 and simulation programs.

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TVP SOLAR
Thermal Vacuum Power

SHIP2FAIR

papageorgiou@tvpsolar.com

Thank you!

SHIP2FAIR

Solar Heat for Industrial Process towards Food and Agro Industries commitment in Renewables

SHIP2FAIR Replication Tool

Giorgio Bonvicini

15.06.2023

Sustainable Places Workshop

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 792276.

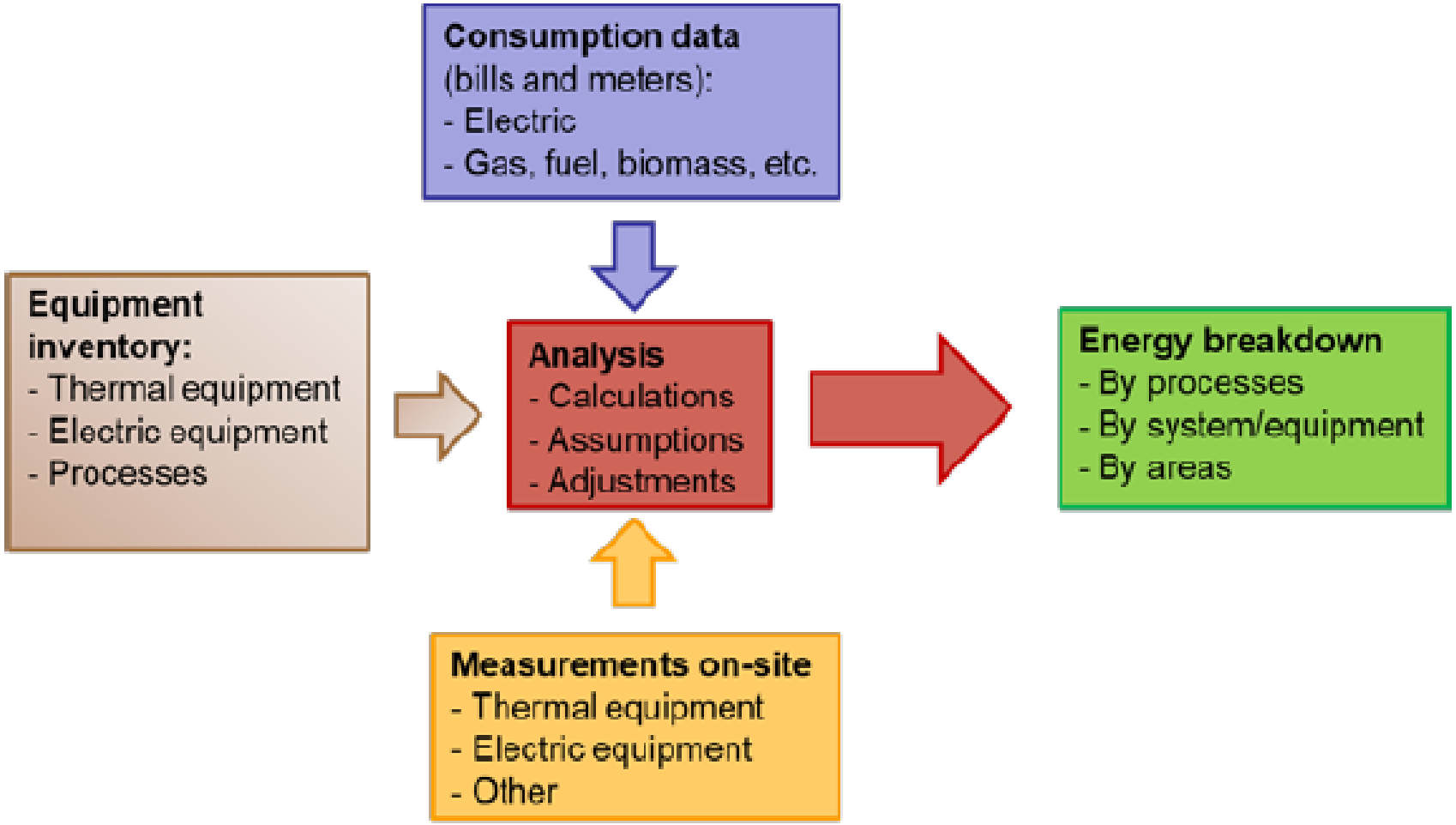
SHIP2FAIR Replication Tool

SHIP2FAIR

The SHIP2FAIR Replication Tool is conceived as a design tool to support concept engineering and pre-feasibility study of “SHIP” projects. This tool is able to combine the data from the solar generation and the industrial process features in order to provide a first outlook on the SHIP integration within the process and to optimise the system according to the user’s requirements.

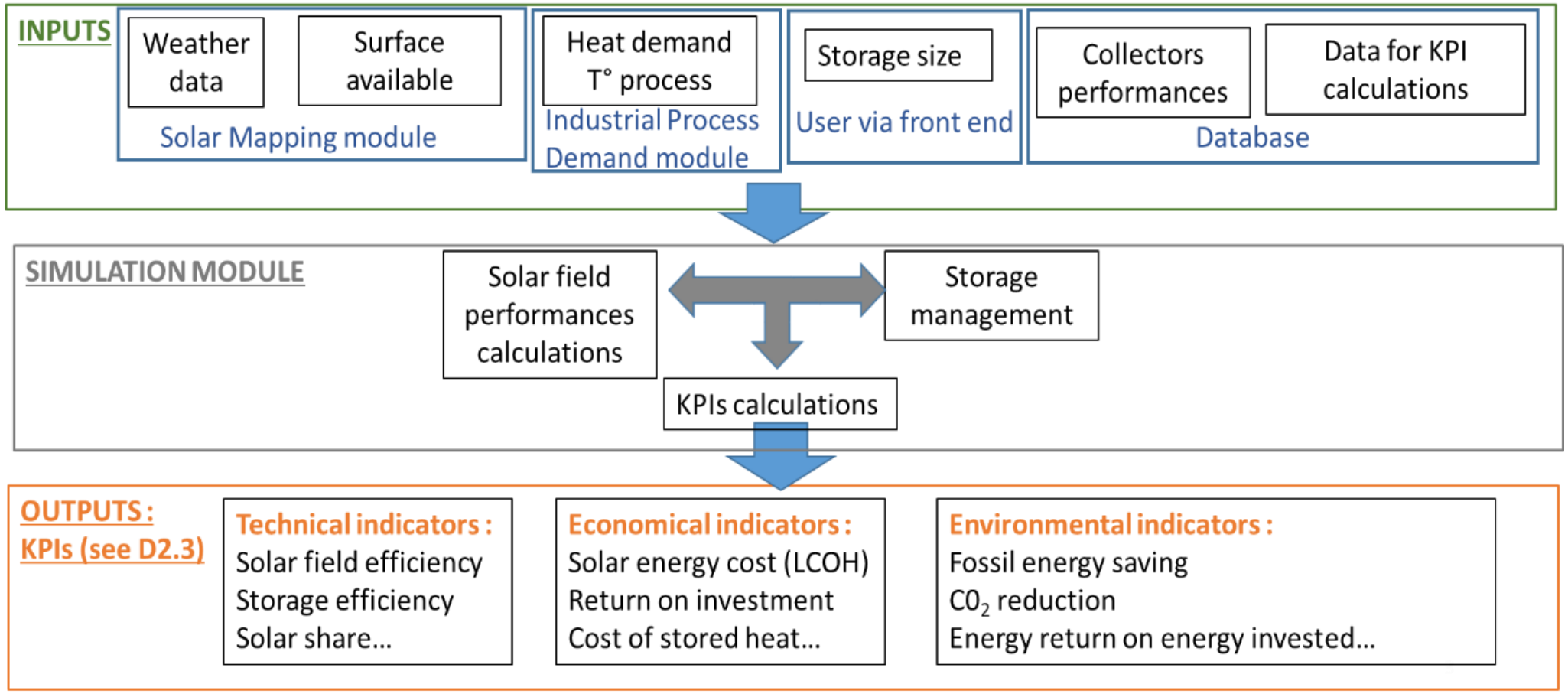
SHIP2FAIR Replication Tool Concept

SHIP2FAIR



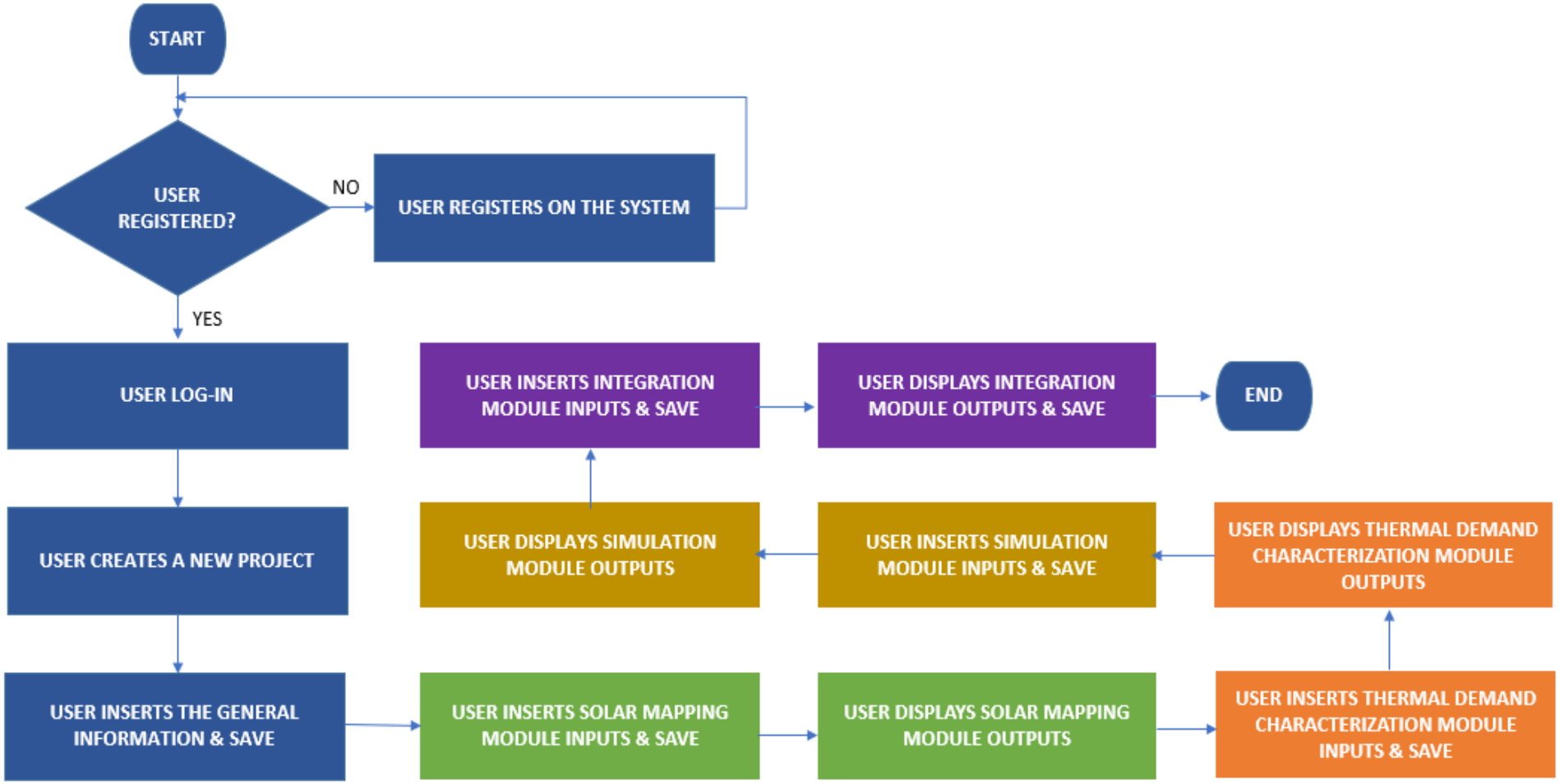
SHIP2FAIR Replication Tool Concept

SHIP2FAIR



SHIP2FAIR Replication Tool Workflow

SHIP2FAIR



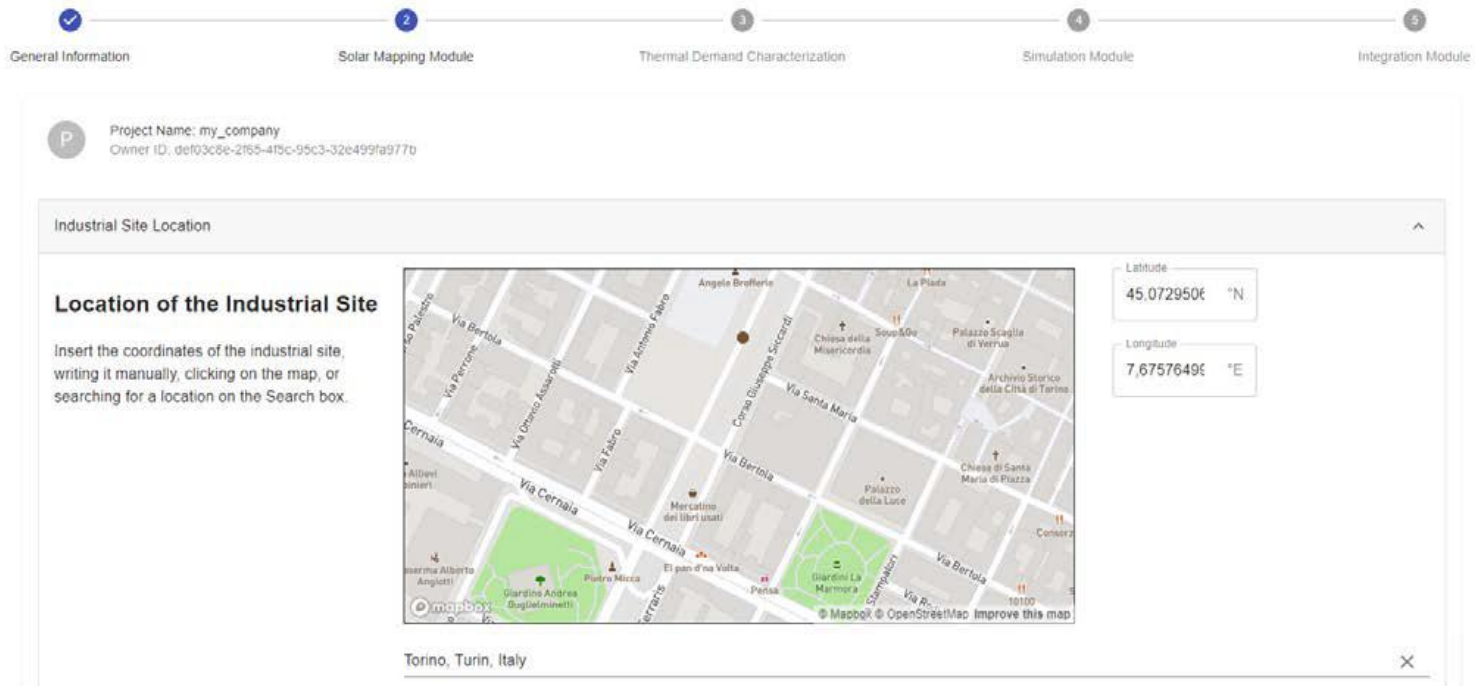
SHIP2FAIR Replication Tool Modules

SHIP2FAIR

Solar Mapping Module

SHIP2FAIR

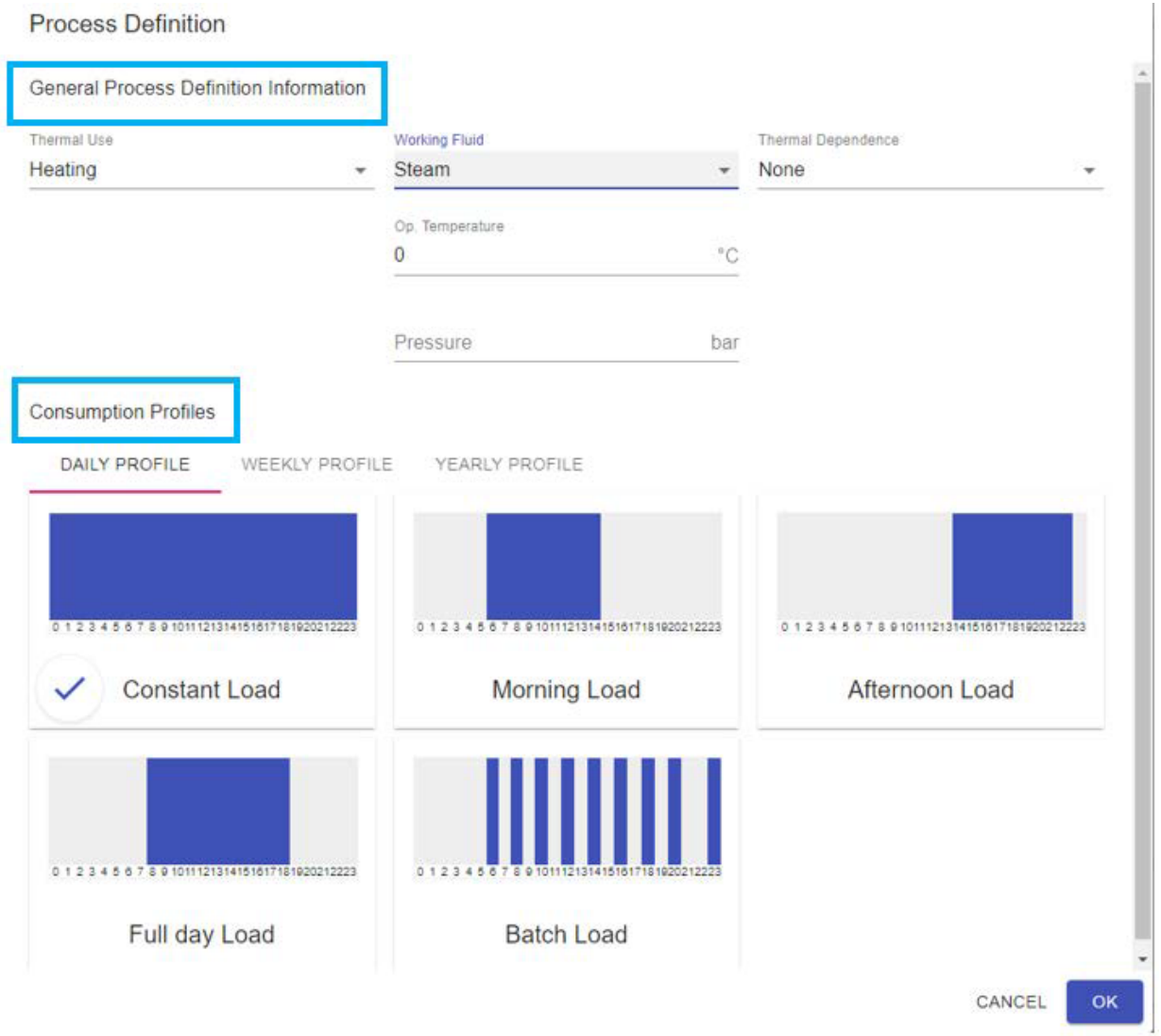
- Location of the Industrial Site
  - address
  - coordinates
- Assessment of Solar Radiation and Sun Position
  - optimize azimuth/slope
  - reference years
- Solar Field Characterization
  - available area
  - roof/ground installation
  - obstacles/shading



Process Characterization Module

SHIP2FAIR

- Energy Sources
  - monthly consumption by fuel
- Equipment Inventory
  - boilers/chillers data
- Process Definition
  - temperature
  - fluid type
  - daily/weekly/yearly distribution

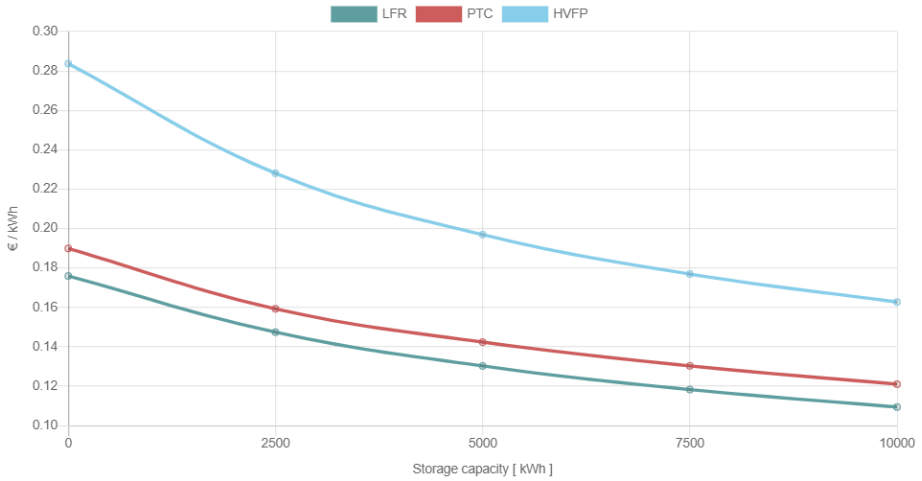


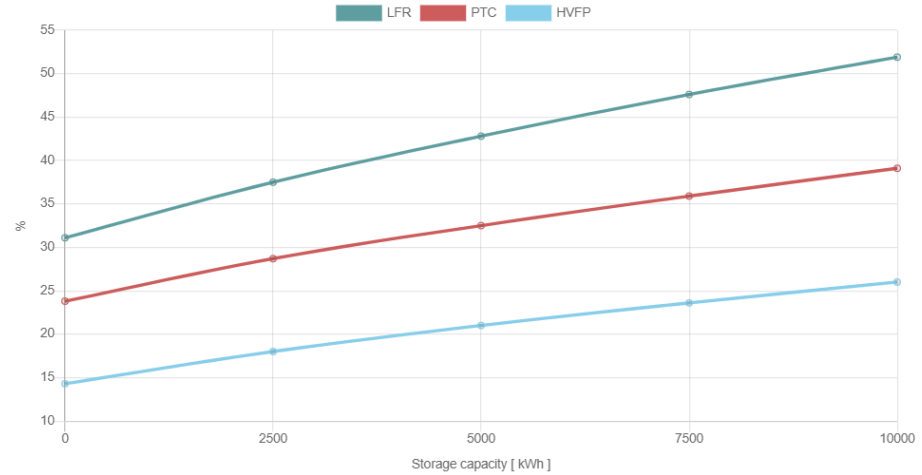
Simulation Module

SHIP2FAIR

- Common parameters
  - prices, emission factors, technology features
  - thermal storage size range
- Single case parameters
  - specific solar thermal technology

- Output (among others)
  - monthly comparison production-demand
  - solar share
  - financial parameters - LCOH, PBT, ROI
  - avoided GHG emissions





Integration Module

SHIP2FAIR

- Optimal Integration for Solar Heat
  - energy-based
  - exergy-based
  - energy&exergy-based

- Output (among others)
  - optimized hourly trend of solar heat production and heat demand

Conclusions

SHIP2FAIR

- Useful tool for pre-feasibility studies, e.g. in the context of energy audits
- “Technology-agnostic” tool, allowing comparison of different solar thermal solutions
- Only basic data on the industrial site are required for the analysis
- Default values are provided for technical and financial parameters, which can be customized based on user needs
- Optimization is carried out on solar thermal system size and thermal storage volume

Practical Examples

SHIP2FAIR

An example of study done with the SHIP2FAIR Replication Tool will be presented later in the session on SHIP2FAIR Replication Studies

SHIP2FAIR

Thank you!

giorgio.bonvicini@rina.org

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 792276.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 792276.

D.O.Ca. RIOJA

BODEGAS RODA

Haro . Rioja Alta . España

- More than 60.000 hectares.
- Influence of 3 climates (Continental, Atlantic and Mediterranean)
- Amplitude of soils and heights, which gives an incredible diversity

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 792276.

Bodegas RODA

- **1987** marks the starting point
- Owners: Mario **RO**tllant & Carmen **DA**urella
- The technical team has a very important weight in the winery
- A modern construction (built in four stages, 1991, 1996 and 2000, 2019)
- In the heart of the most traditional neighborhood of Rioja: El **Barrio de la Estación**.
- The classic and the modern (a 19th century draft on which a winery was built 21st century)

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PHILOSOPHY

- We want our wines to show the essence of the place. **Rioja landscape**.
- **SUSTAINABILITY**
- **Elegance**
- **RODA is committed to R + D + i as the engine of progress.**.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 792276.

VINEYARD

- Goblet or bush vine systems: traditional viticulture methods in Rioja
- 120 hectares, 70 of them ours. They are classified in different vineyards
- Sustainability
- 550 clones of Tempranillo
- Two Tempranillo ripening profiles: red fruit and black fruit
- We mostly work with vineyards over 30 years old
- R + D + i

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 792276.

SHIP2FAIR IS BORN

- RODA´S ROLE IN THE PROJECT: DEMOSITE
- WHY - WHAT DOES RODA BRING:
- RENEWABLE ENERGY.
- USE OF SOLAR-THERMAL ENERGY TO GENERATE HEAT and COLD.
- INTEGRATION OF VACUUM TUBES IN THE WAREHOUSE ARCHITECTURE: CARING FOR THE AESTHETIC OF THE FACILITIES.
- DECREASE IN ENERGY EXPENDITURE.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 792276.

Vinification flux diagram

BODEGAS RODA
Haro . Rioja Alta . España

COLD SOAK 7ºC

ALCOHOLIC FERMENTATION (Exotérmica 30ºC)

MALOLACTIC FERMENTATION 20ºC

AGEING 14ºC - 80%hr

STABILIZATION (5ºC)

CLEANING & DISINFECTION

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 792276.

ALCOHOLIC FERMENTATION

BODEGAS RODA
Haro . Rioja Alta . España

- **COLD** soak
- Wild yeasts
- French oak vats. Great thermal inertia

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 792276.

SHIP2FAIR

BODEGAS RODA

Haro . Rioja Alta . España

MALOLACTIC FERMENTATION

All our wines undergo Malolactic Fermentation in French oak.
We installed a UNDERFLOOR heating system to have a temperature of 20ºC.
Once the malolactic fermentation is finished, the windows are opened and the north wind enters to lower the temperature (stabilization).

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 792276.

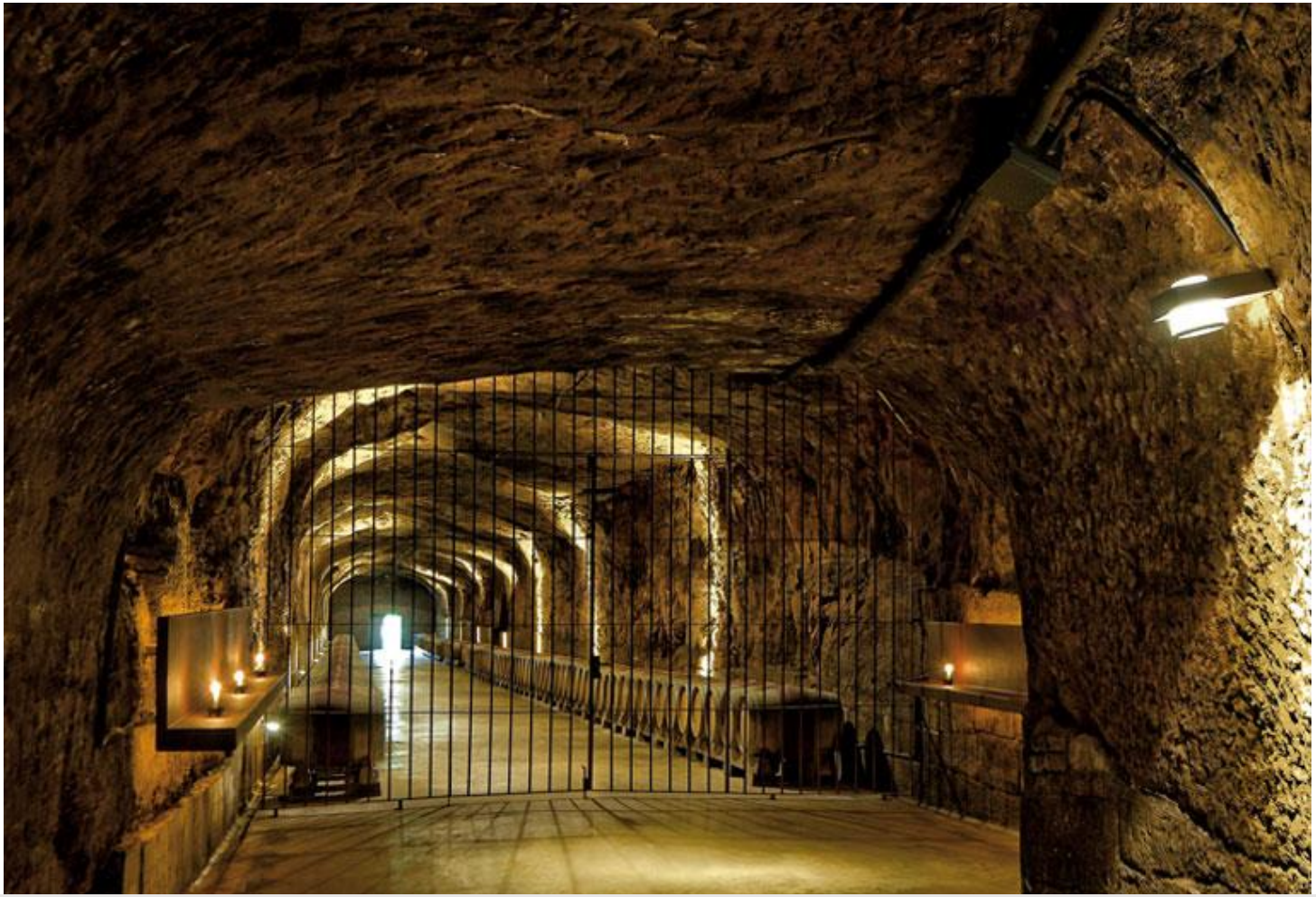
AGEING

We installed a REFRESHING FLOOR cooling system to have a temperature of 13ºC in the summer period (stabilization).

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 792276.

AGEING

CONTROLLED HUMIDITY



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 792276.

STEPS

Engineering site visit.

Permits and documentation.

Ordering equipment.

Solar panel installation.

Approval and interconnection.

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ENERGY NEEDS

Processes: heating and cooling oriented to wine fermentation and stabilization.

Site: Haro, La Rioja

Country: Spain

Longitude: 02º50’46.7’’W

Latitude: 42º 35’08.7’’N

GHI: 1,641 kWh/m2@35º

Add equipment: Absorption chiller

Space opportunities: the site has availability of around 100 m2 of rooftop, which is located approximately 100 m away from the plant

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 792276.

ENERGY NEEDS

Cooling demand is covered by chilled water produced at 7°C and variable pressure depending on the machine involved. Also a secondary system is present. In addition, heating is produced in form of water at 45°C and pressure of 1.5 bar. The system is monitored through a Siemens automaton monitoring system.

The selected processes are responsible of a high percentage of the total energy consumption of the factory. In particular, heating needs are covered using LPG as a fuel and are considered to be constant at monthly and daily scale during the heating period, i.e. from October to March. On the other hand, regarding cooling, the total demand is currently covered by an electric chiller.

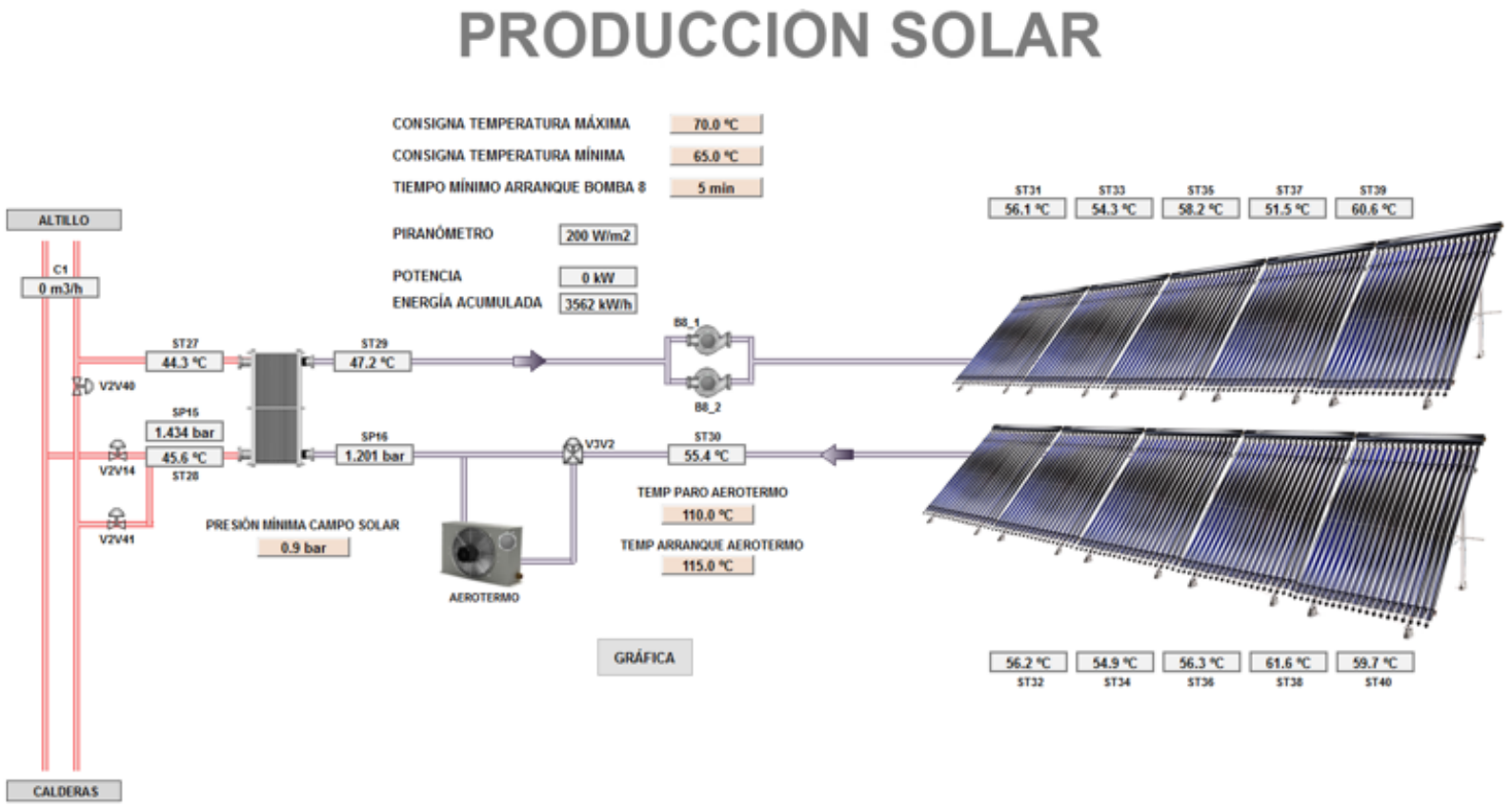
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 792276.

SHIP project to be implemented in RODA

Evacuated Tubes + Absorption chiller+ adsorption dehumidifier Heat Transfer Fluid: Water for secondary and tertiary circuit and glycol for the primary one Net Aperture Area: 70 m^2 Gross Area: 110 m^2 Peak power: 50 kW	Gross heat production per year: 49 MWhth Yearly global efficiency: 54% Solar fraction: 39% average, 74% peak (October) CO_2 savings: 11.44 tCO_2 Heating cost: 5 c€/kWh Payback: 6-7 year

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 792276.

SOLAR PRODUCTION



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 792276.

WHAT IS SHIP2FAIR GIVING US; EXPECTATIONS:

- PROS:
  - SUSTAINABLE PROCESS.
  - IMPROVING THE ENERGY EFFICIENCY OF THE VINIFICATION-STORAGE / AGEING PROCESS.
  - DECREASE IN ENERGY EXPENDITURE (€).
  - VISIBILITY.
  - CERTIFICATION WfCP
  - FIGHT AGAINST CLIMATE CHANGE.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 792276.

SHIP2FAIR

BODEGAS RODA
Haro . Rioja Alta . España

WHAT IS SHIP2FAIR GIVING US; EXPECTATIONS:

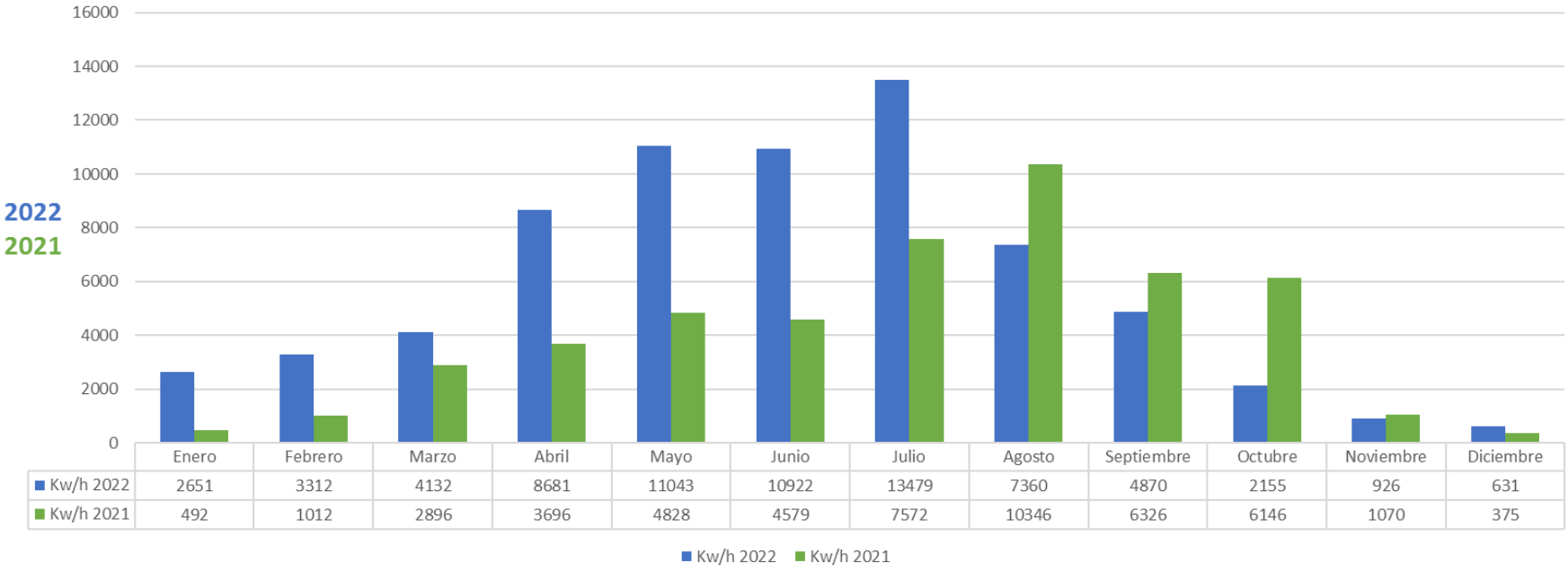
- CONS:
  - ECONOMIC DISBURSEMENT FOR INVESTMENT.
  - CONCEPTUAL DIFFICULTIES. WE ARE NOT ENERGY EXPERTS.
  - DIFFERENT “TIMINGS” AMONG THE PROJECT PARTICIPANTS.

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 792276.

RODA´S SOLAR FIELD

Bodegas RODA
Haro . Rioja Alta . España

SOLAR PRODUCTION 2021 Y 2022



	Enero	Febrero	Marzo	Abril	Mayo	Junio	Julio	Agosto	Septiembre	Octubre	Noviembre	Diciembre
Kw/h 2022	2651	3312	4132	8681	11043	10922	13479	7360	4870	2155	926	631
Kw/h 2021	492	1012	2896	3696	4828	4579	7572	10346	6326	6146	1070	375

- info@ship2fair-h2020.eu

RODA´S SOLAR FIELD

SOLAR FIELD FOR THERMAL ENERGY PRODUCTION

- 20 Vacuum tubes solar collectors
- Total opening area [m2]: 65.2
- Energy produced: 60 MWh/year
- Saving of propane gas: 4.500 kg/year
- CO2 emission reduction: 13 tons/year
- The amount of energy that satisfies the solar field is 13%

Analysis data period: 2021-2022

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 792276.

SHIP2FAIR

Solar Heat for Industrial Process towards Food and Agro Industries commitment in Renewables

Hand-on experience & good practices in solar thermal adoption in the agro-food sector

Sustainable Places, 15th June 2023

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 792276.

Demo site example and successful results

ITEM	AGENDA
1	*Company description: Martini & Rossi*
2	*Technology description*
3	*System integration*
4	*Lessons learnt and next steps*

ROLE OF PESSIONE OC

Is the **CRADLE OF MARTINI** and the producer of **FLAGSHIP BRANDS** within the Bacardi portfolio

CENTER OF EXCELLENCE and **PROFICIENCY** for production, development and industrialization of **VERMOUTHS**, **SPARKLING WINES** and **BACARDI BOTTLING**

1863

MARTINI, SOLA e C.ia officially was born

1993

Bacardi acquire MARTINI & ROSSI

Company description

Martini & Rossi

It all began with three men...

Teofilo Sola
1831-1879

Alessandro Martini
1834-1905

Luigi Rossi
1828-1892

JULY 1ST, 1863: Martini, Sola e Compagnia was **OFFICIALLY BORN IN TURIN**.
Alessandro Martini and Teofilo Sola were two of the founders.

Luigi Rossi, **SKILLED HERBALIST AND WINE TECHNICIAN**, was part of the company with a participating share.

In 1864 **PRODUCTION MOVED TO PESSIONE**, a strategic centre for its closeness to the railway line that links up Turin and Genoa towards the international markets.

Company description

Pessione: How it looks now

Solar Heat for Industrial Process towards Food and Agro Industries commitment in Renewables

KEY DATA FY 2022

Formulas and products

27 Martini

16 Sparkling wines

20 Bacardi

3 Liquors and Spirits

Countries supplied

over 100

Plant surface

161,000 m2 - 40 acres

Volume

19.7 M 9L cases bottling

Covered surface

68,000 m2

SKUs handled

775 (production + co-packing)

Certifications

ISO 14001 since 2002

OSHAS 18001 (ISO 45001) since 2006

ISO 9001 since 2007

Equalitas in 2020

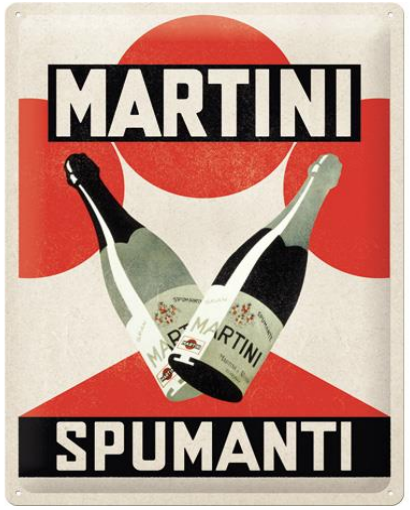
Great Place to Work 2022

Company description

Martini & Rossi: 3 main families of product

MARTINI APERITIFS

MARTINI SPARKLING



BACARDI

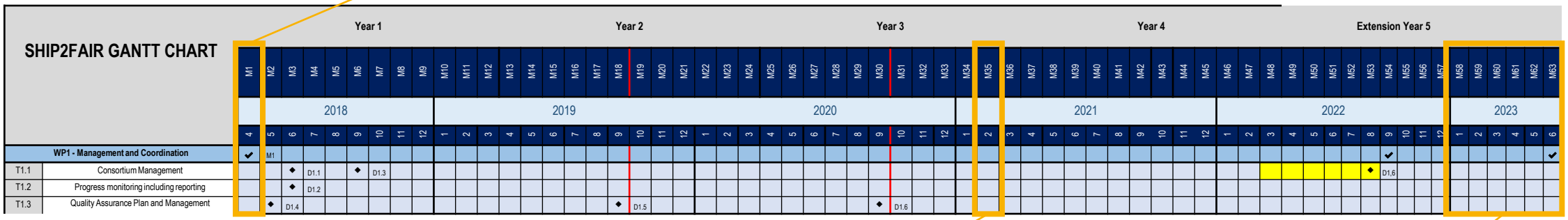
BACARDÍ

Solar Heat for Industrial Process towards Food and Agro Industries commitment in Renewables

Technology Description

New solar field installation

April 2018: Project Start, Martini & Rossi applied to the SHIP2FAIR program as a Demo site



Feb 2021: Solar Field installation completed

Feb 2023 till the end of the project (June 2023): Fine tuning ongoing

SHIP2FAIR

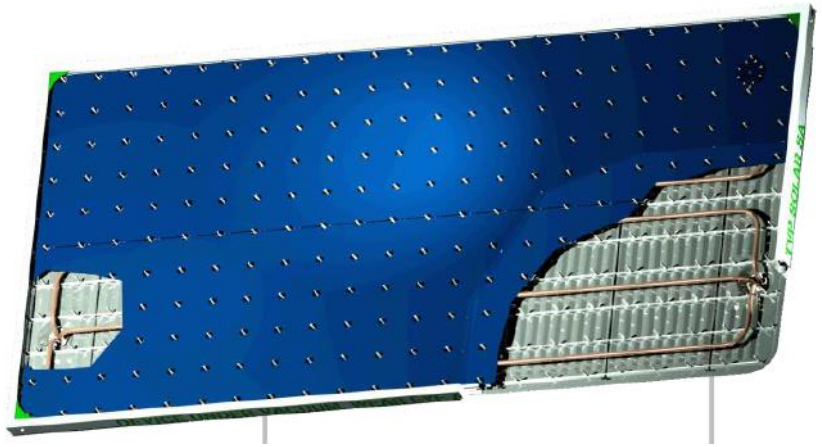
Technology Description

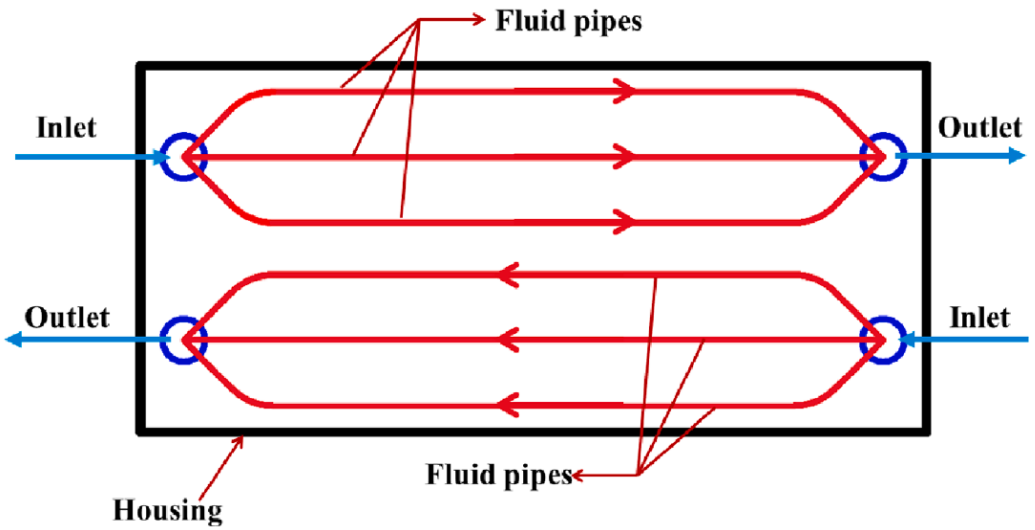
New solar field installation

SOLAR FIELD SPECS		
SF Inlet Temperature	152	°C
SF Outlet Temperature	~~165~~ 177	°C
Hot Water Density	912,3	kg/m³
Hot Water Specific Heat	4,3	kJ/kg/K
Solar Field Peak Efficiency	56%	
Safety Factor	113%	
# Of Panels	298	#
Gross Area	596	m²
Installed Area	1.073	m²
Solar Field Peak Power	329	kW
Panels' Tilt Angle	35	°

Technology Description

New solar field installation





TVP SOLAR

- SolarKeyMark certified up to 200˚C
- Highest energy production with any ambient temperature, in any climate condition
- High-vacuum insulation suppresses thermal losses
- 20 years consistent & predictable performance without any degradation
- Designed for industrial-scale applications

Technology Description

M&R Energy Source

Winter mode

Warm air

Between 60° C and 120° C hot water is sent to unit heaters

Summer mode

Steam

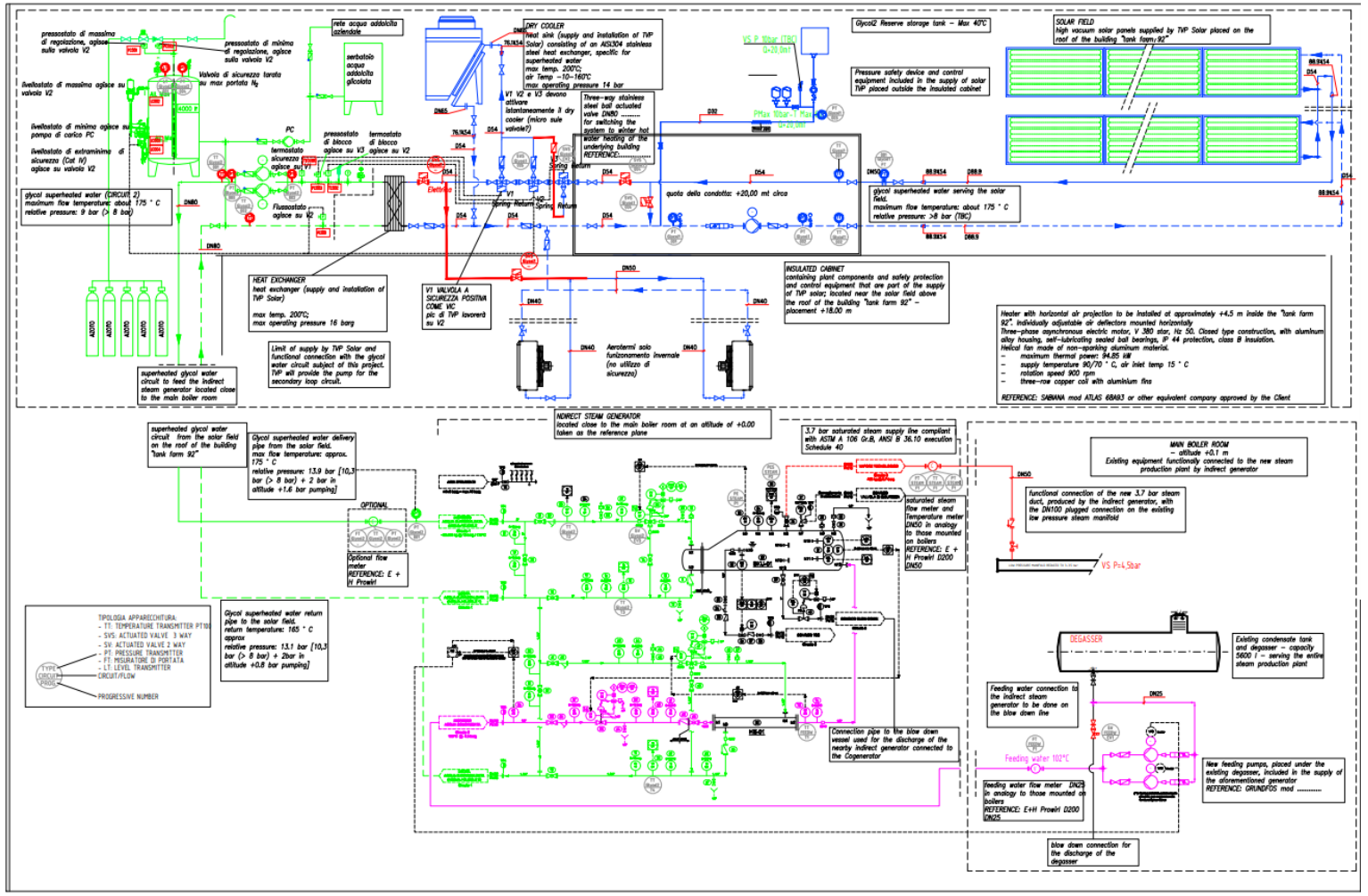
3,7 bar saturated steam

- Fossil fuel savings: 55k m³/year
- CO2 Savings: 93 ton/year
- Energy Savings: 394 MWh/year

SHIP2FAIR

P&ID

M&R Energy Source

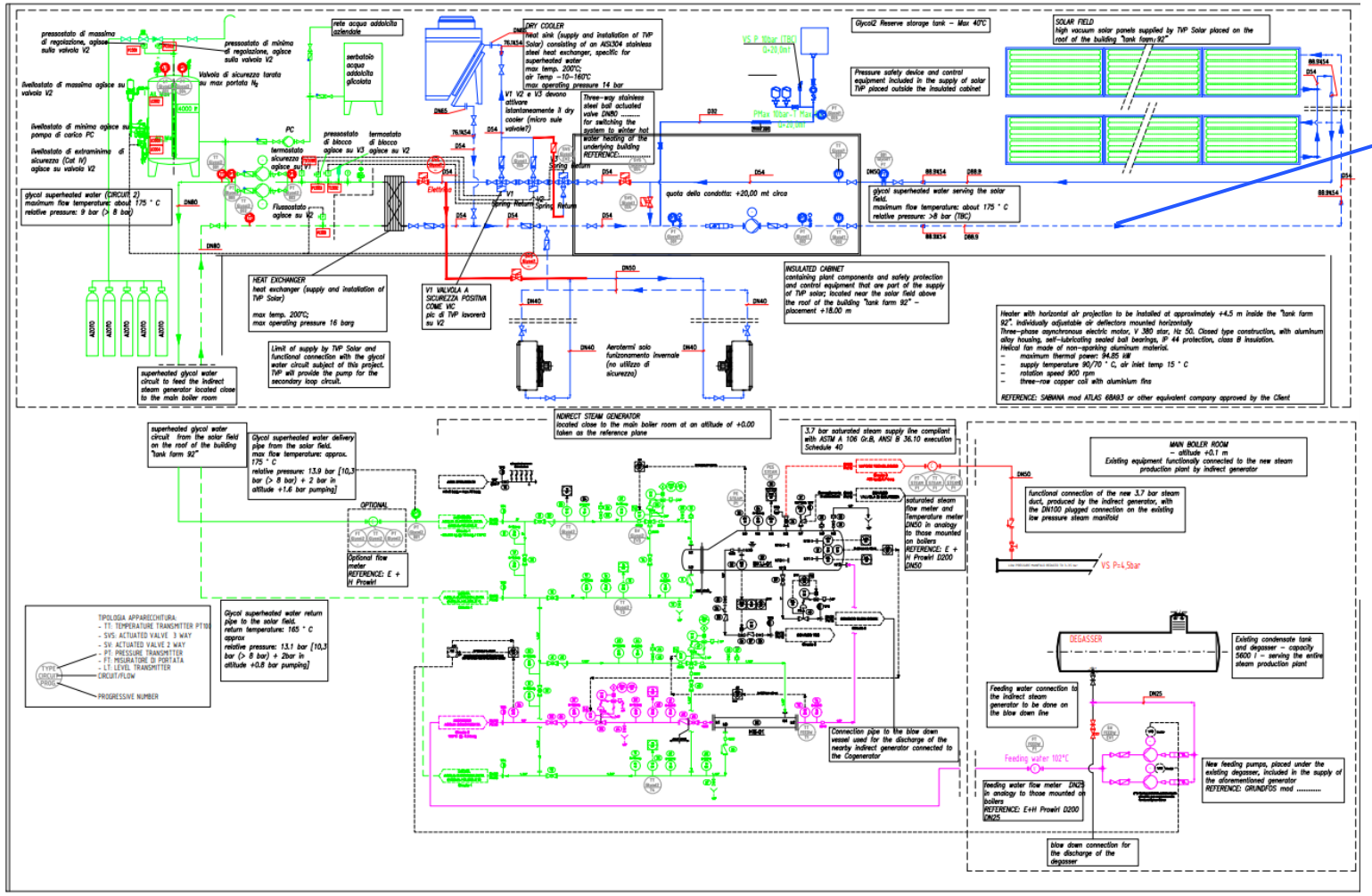


Solar Heat for Industrial Process towards Food and Agro Industries commitment in Renewables

SHIP2FAIR

P&ID

M&R Energy Source



Circuit 1: Flow from/to Solar Field

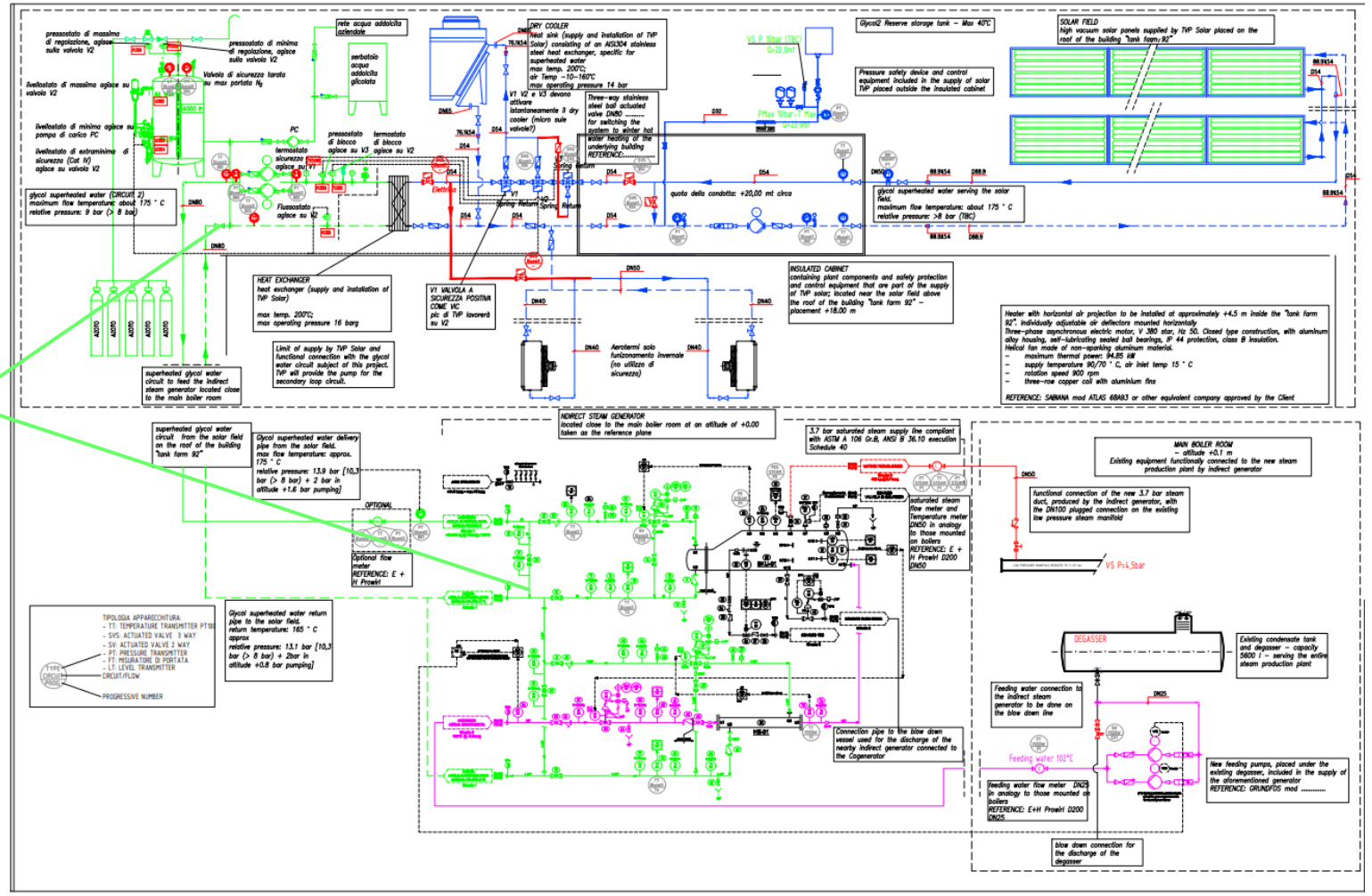
Solar Heat for Industrial Process towards Food and Agro Industries commitment in Renewables

SHIP2FAIR

P&ID

M&R Energy Source

Circuit 2: Flow from/to Indirect Steam Generator

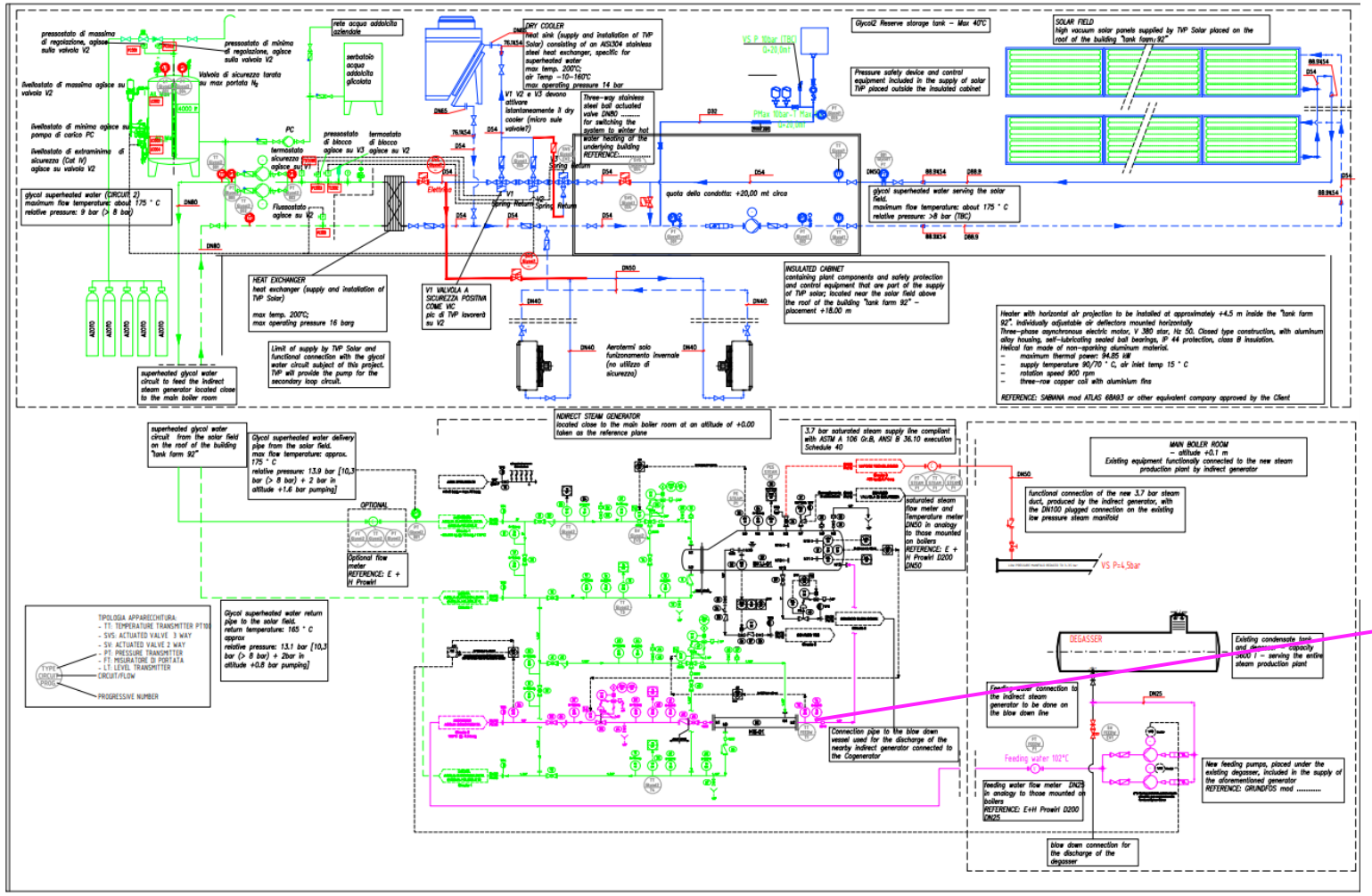


Solar Heat for Industrial Process towards Food and Agro Industries commitment in Renewables

SHIP2FAIR

P&ID

M&R Energy Source



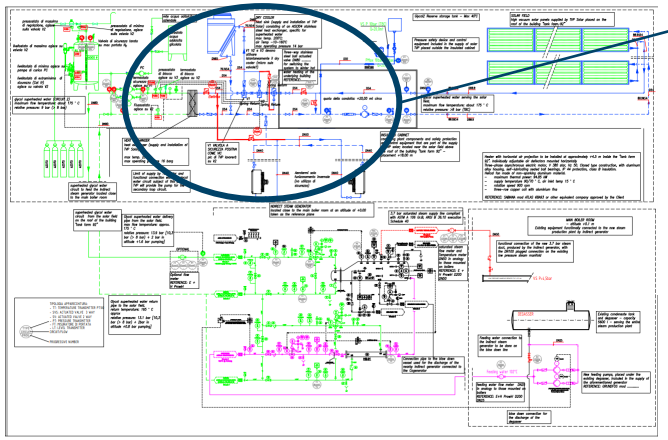
Steam generator feed water **circuit**

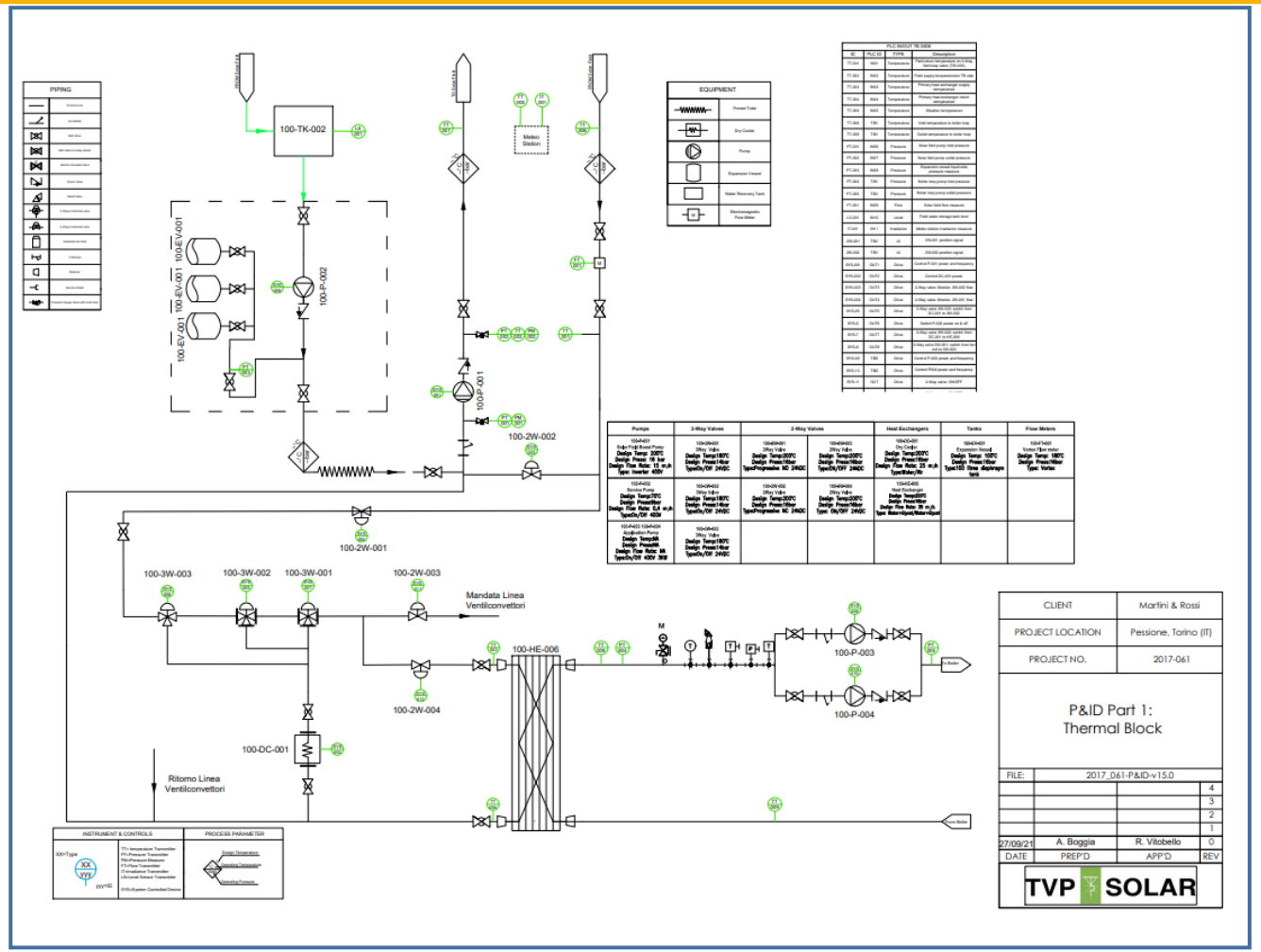
Solar Heat for Industrial Process towards Food and Agro Industries commitment in Renewables

Focus on thermal block

M&R Energy Source

How the system is able to drive the flow based on circuit 1 temperature and pressure.



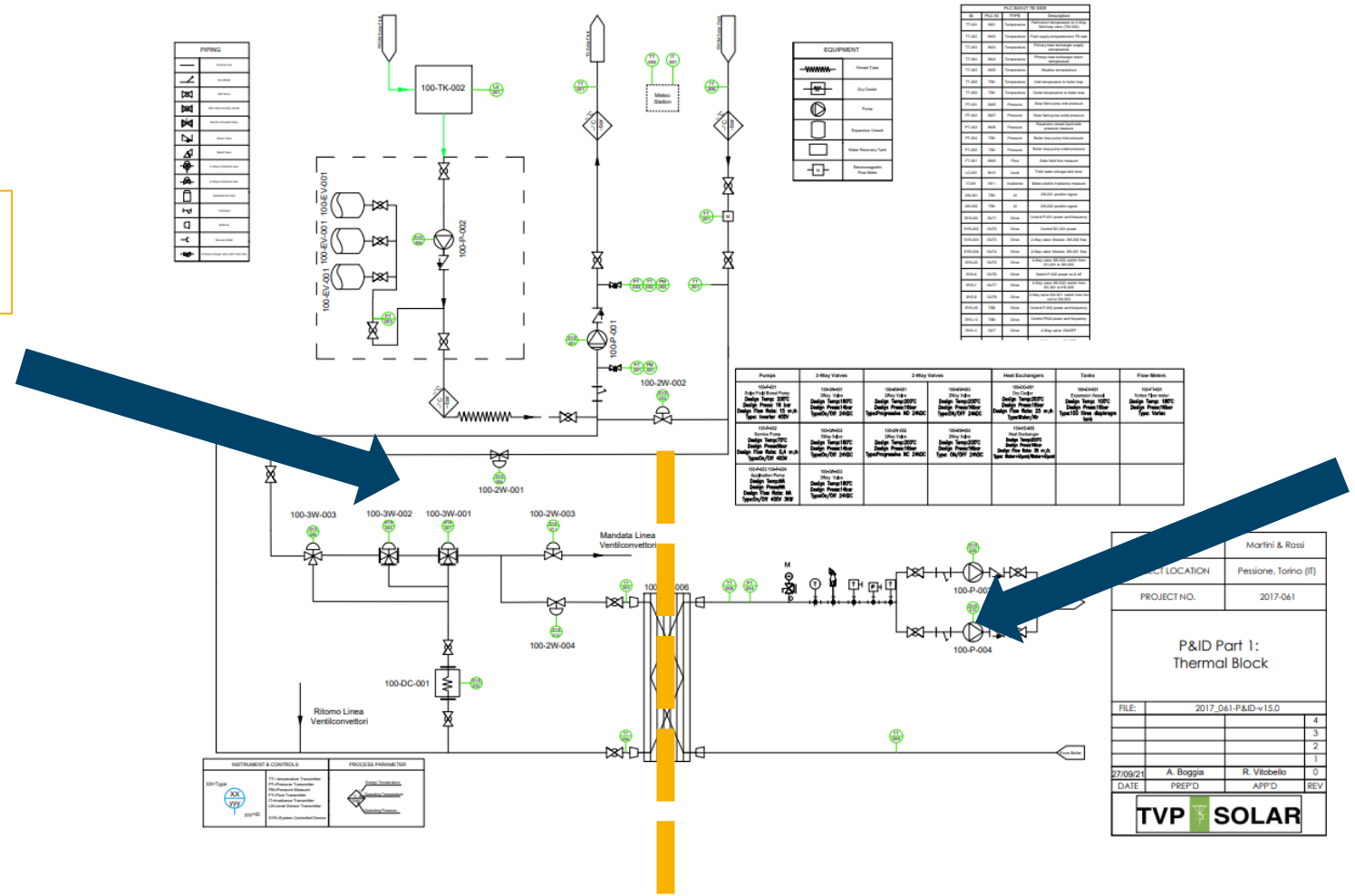


Solar Heat for Industrial Process towards Food and Agro Industries commitment in Renewables

Focus on thermal block

M&R Energy Source

Circuit 1: Flow from/to Solar Field



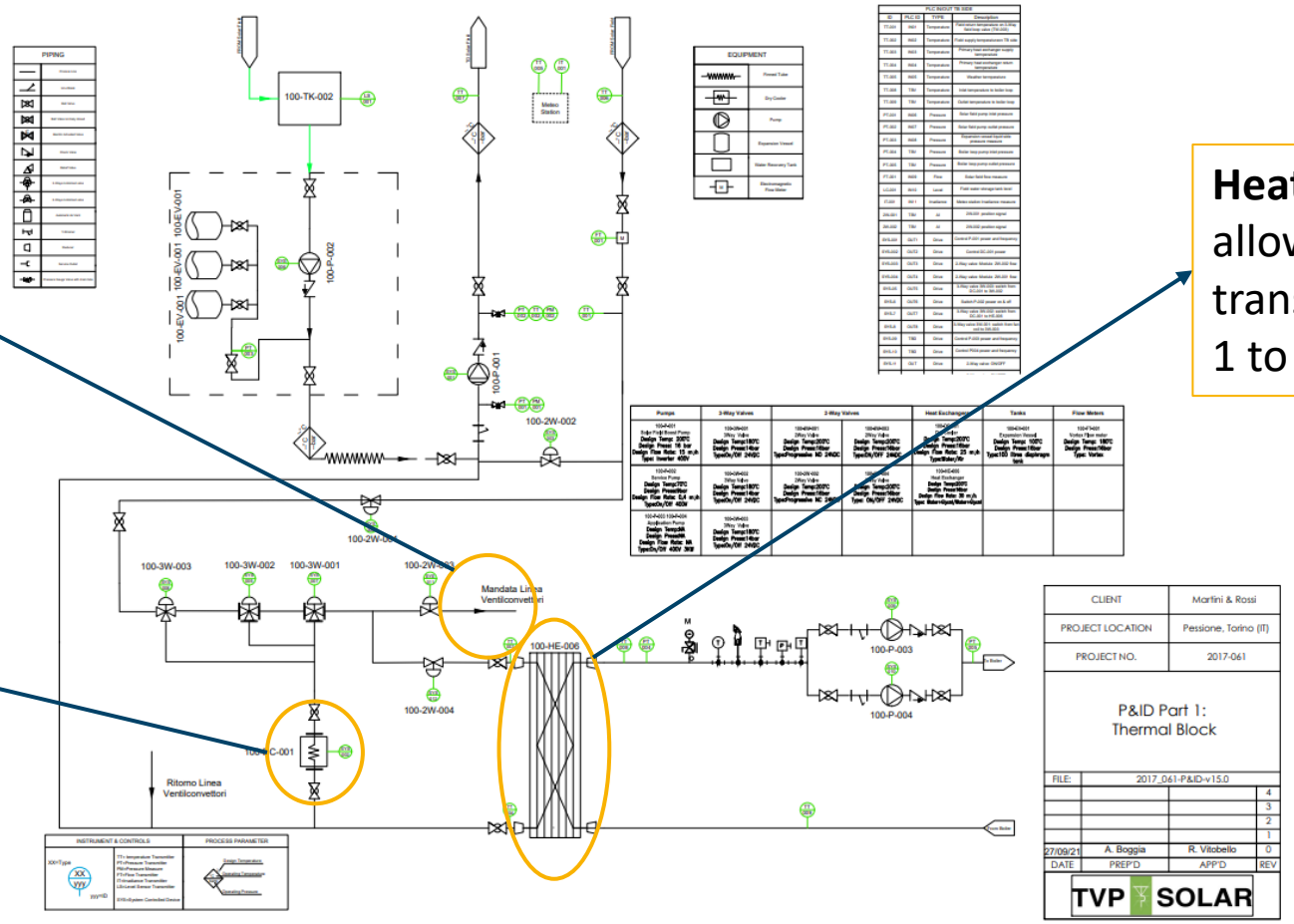
Circuit 2: Flow from/to Indirect Steam Generator

Focus on thermal block

M&R Energy Source

Unit heaters pipeline

Dry Cooler: To allow the energy dissipation, in case of emergency

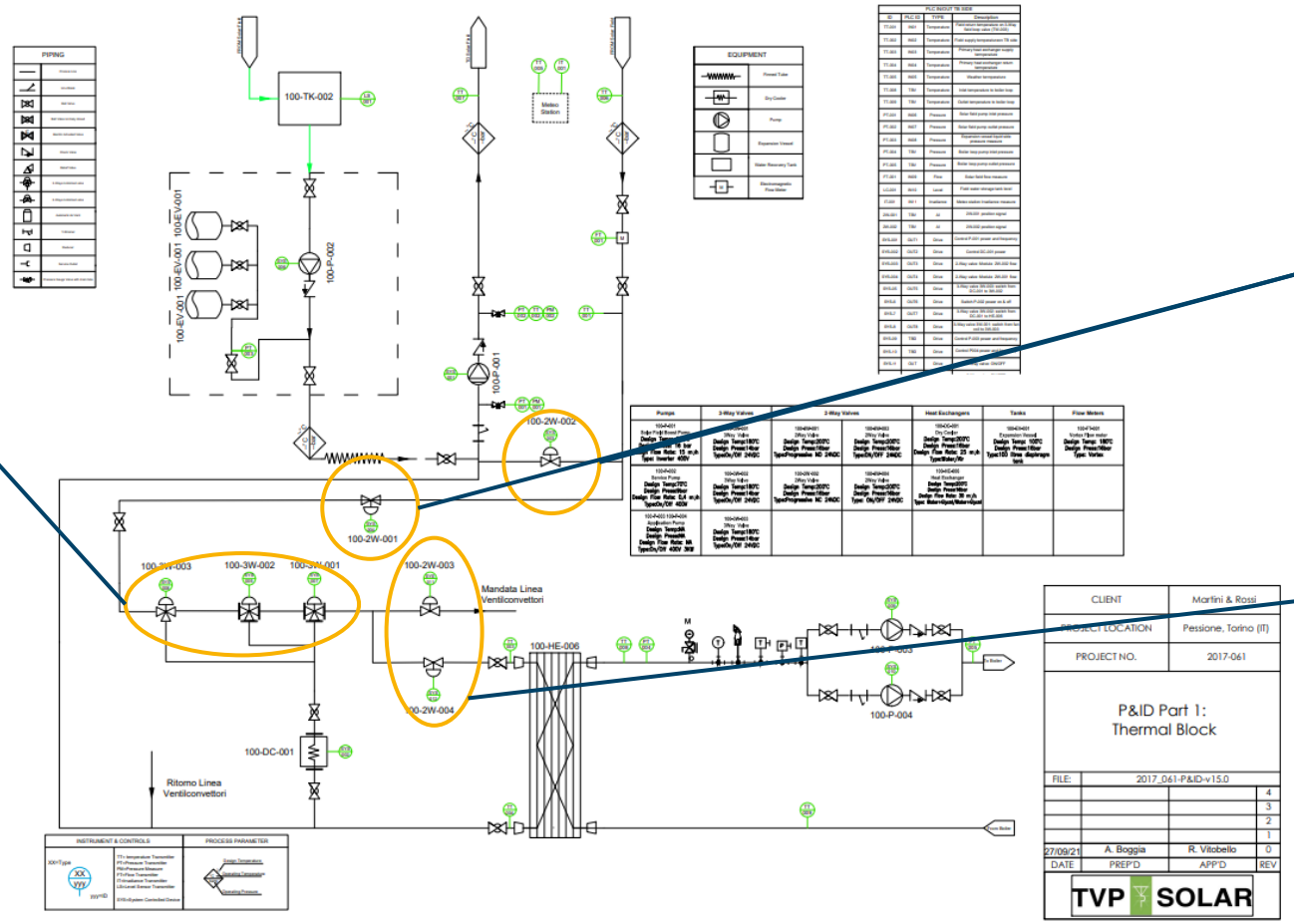


Heat Exchanger: To allow the energy transfer from circuit 1 to circuit 2.

Focus on thermal block

M&R Energy Source

N°3 3-way valves for driving the flow to the Dry Cooler or the «Application»



N°2 2-way valves to send the flow to the thermal block

N°2 2-way valves to drive the flow to the Heat Exchanger or to the Unit heaters

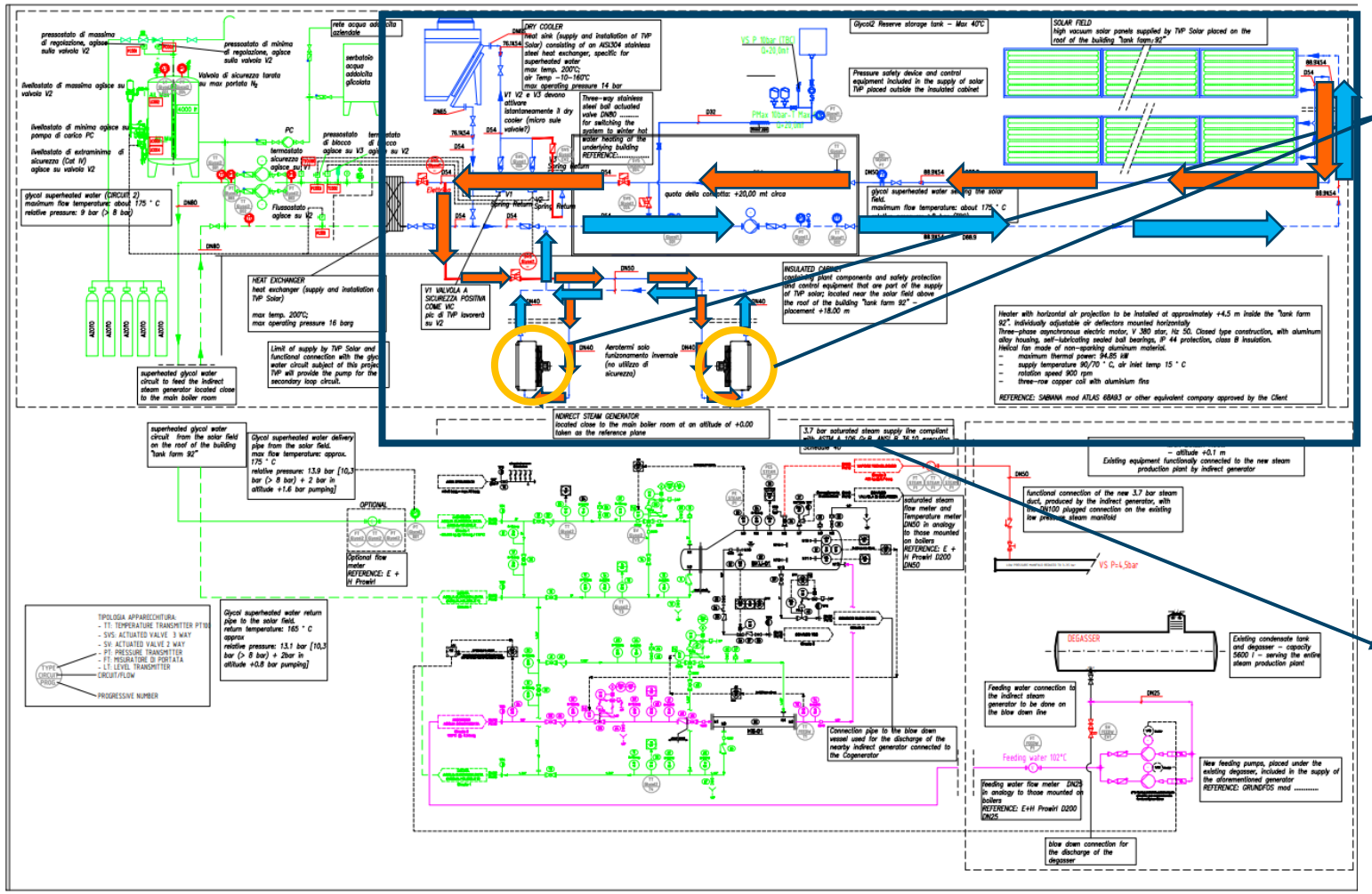
Winter Mode

Operation Mode details

Winter mode

Warm air

Between 60° C and 120° C hot water is sent to unit heaters



Unit Heaters: to provide energy to the environment

How the **circuit 1** works in **winter** mode: **Energy Production**

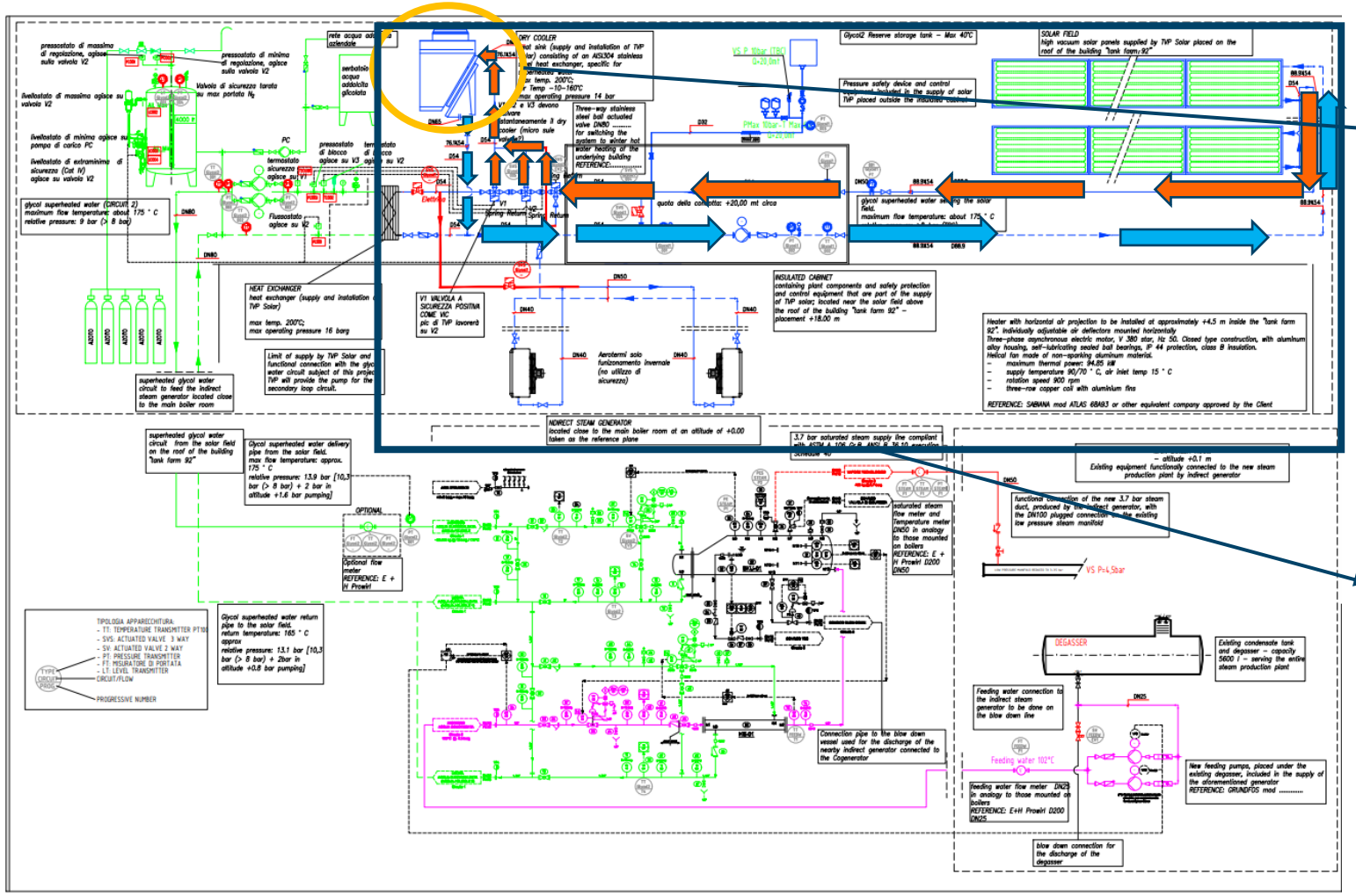
Winter Mode

Operation Mode details

Winter mode

Warm air

Between 60° C and 120° C hot water is sent to unit heaters



How the **circuit 1** works in **winter** mode: **Dry Cooler – Heat Dissipation** Temperature above 120 °C

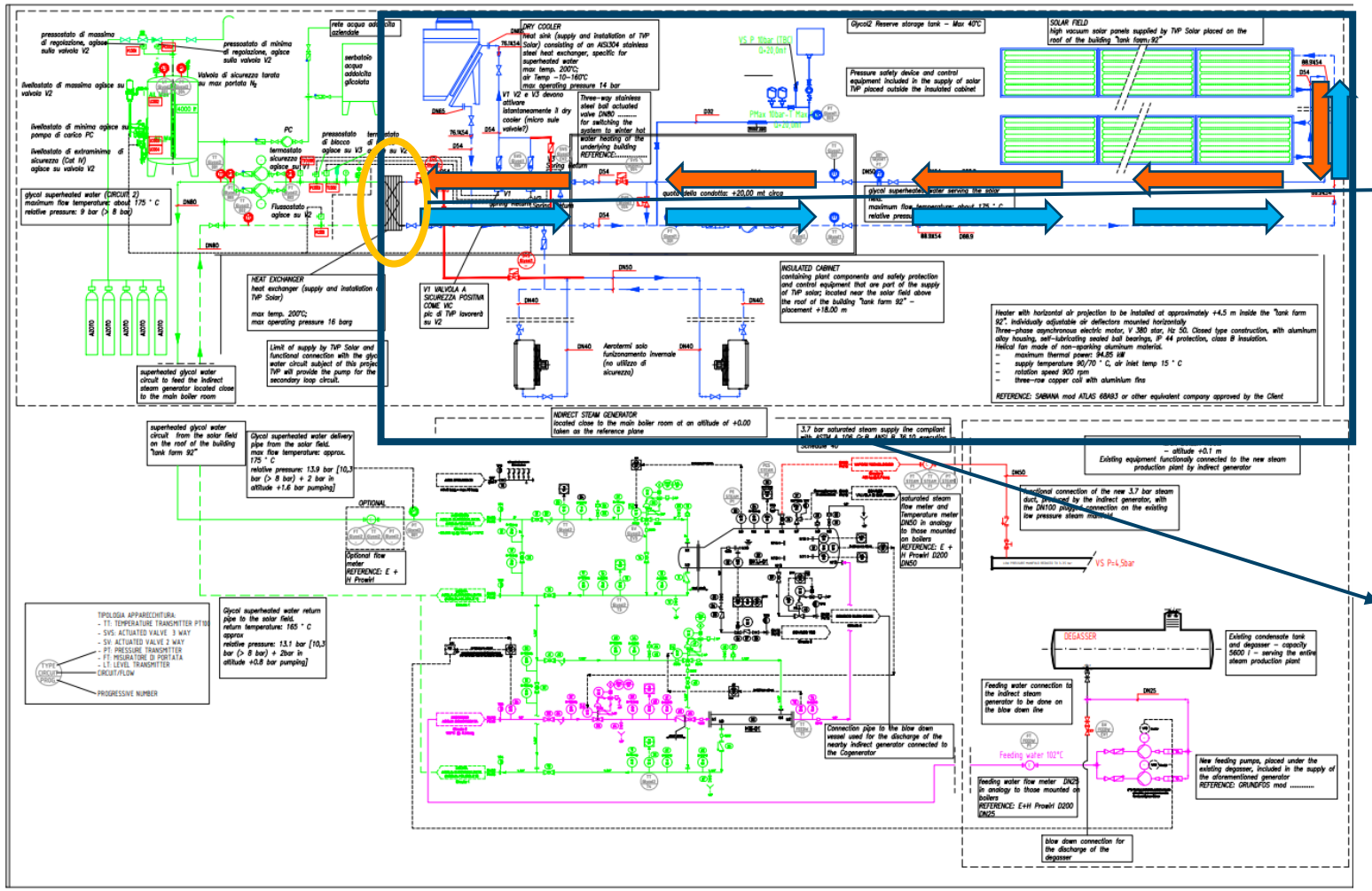
Summer Mode

Operation Mode details

Summer mode

Steam

3,7 bar saturated steam



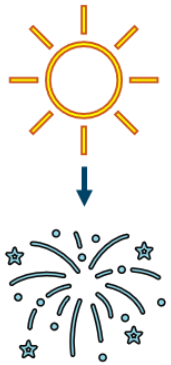
Heat Exchanger: To transfer energy from circuit 1 to circuit 2

How the **circuit 1** works in **summer** mode: **Energy Production. Temperature between 110 °C and 177 °C**

Summer Mode

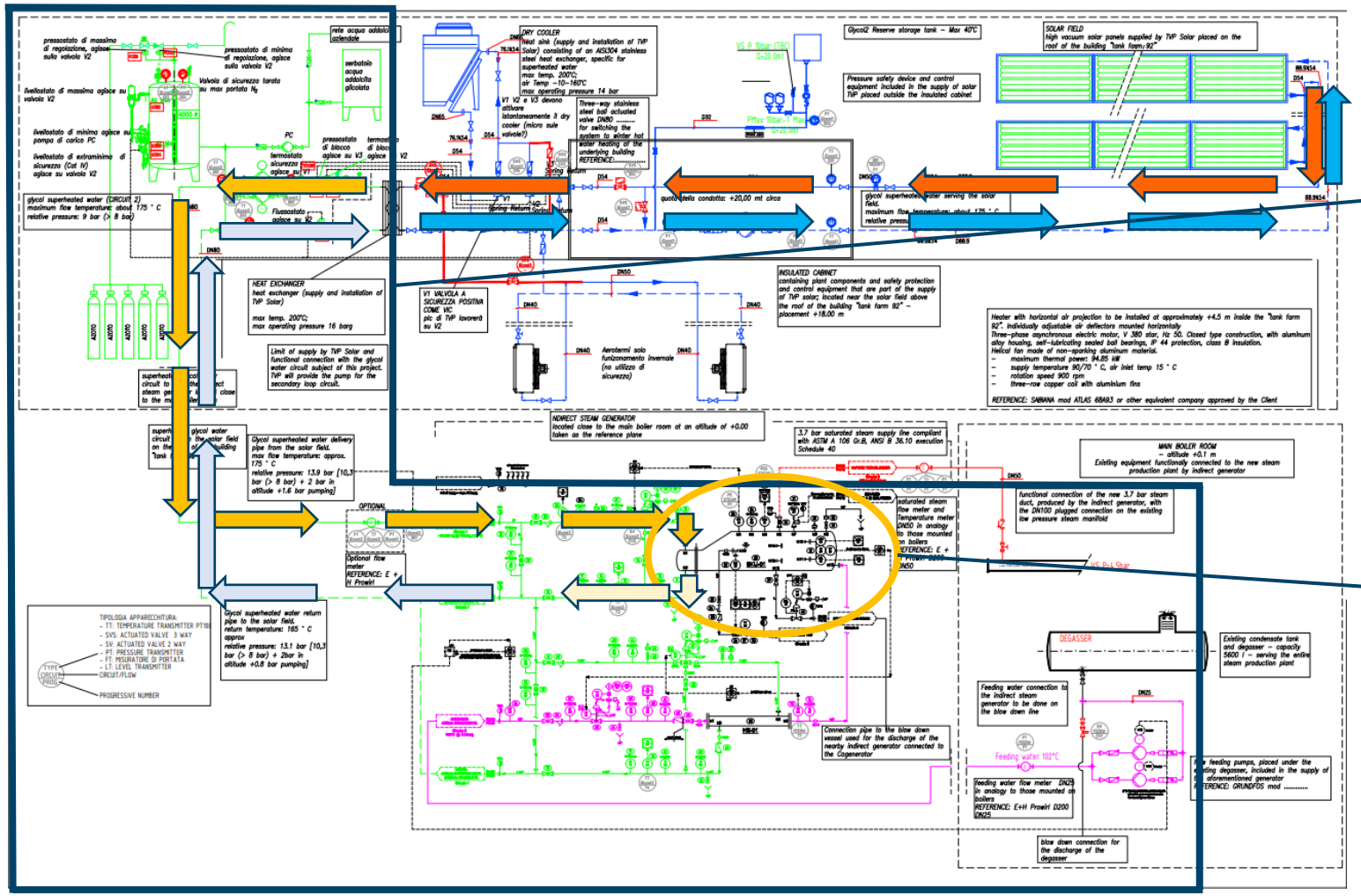
Operation Mode details

Summer mode



Steam

3,7 bar saturated steam



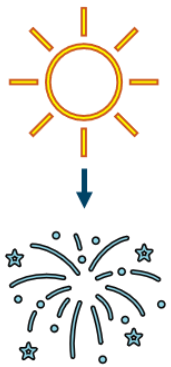
How the **circuit 2** works in **summer** mode: **Energy Production.**

Indirect steam generator: To feed the main steam collector with new green 3.7 bar steam.

Summer Mode

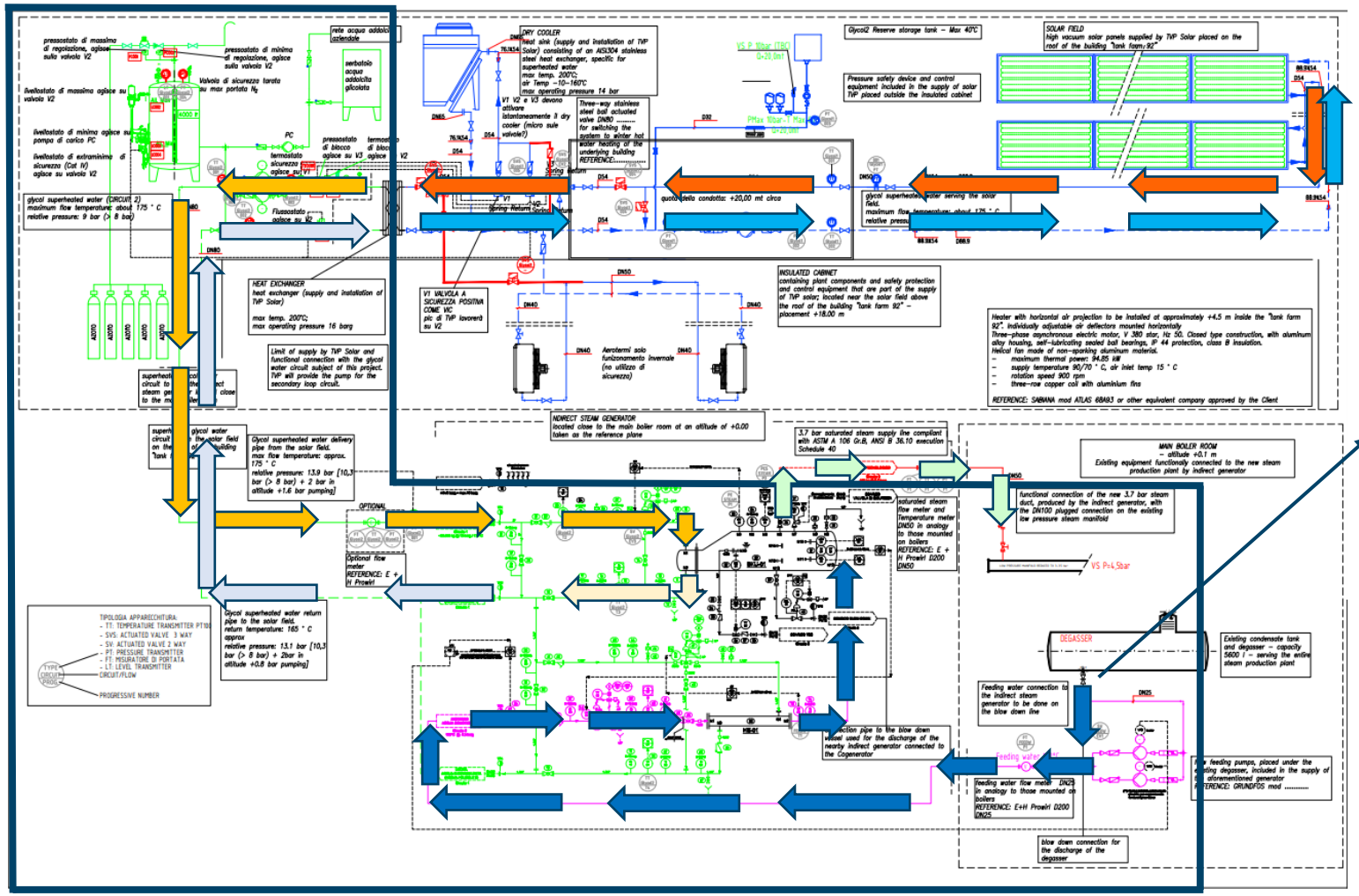
Operation Mode details

Summer mode



Steam

3,7 bar saturated steam



Feed water circuit: The water entering the ISG comes from the Degaser **(104 °C)**

Solar Heat for Industrial Process towards Food and Agro Industries commitment in Renewables

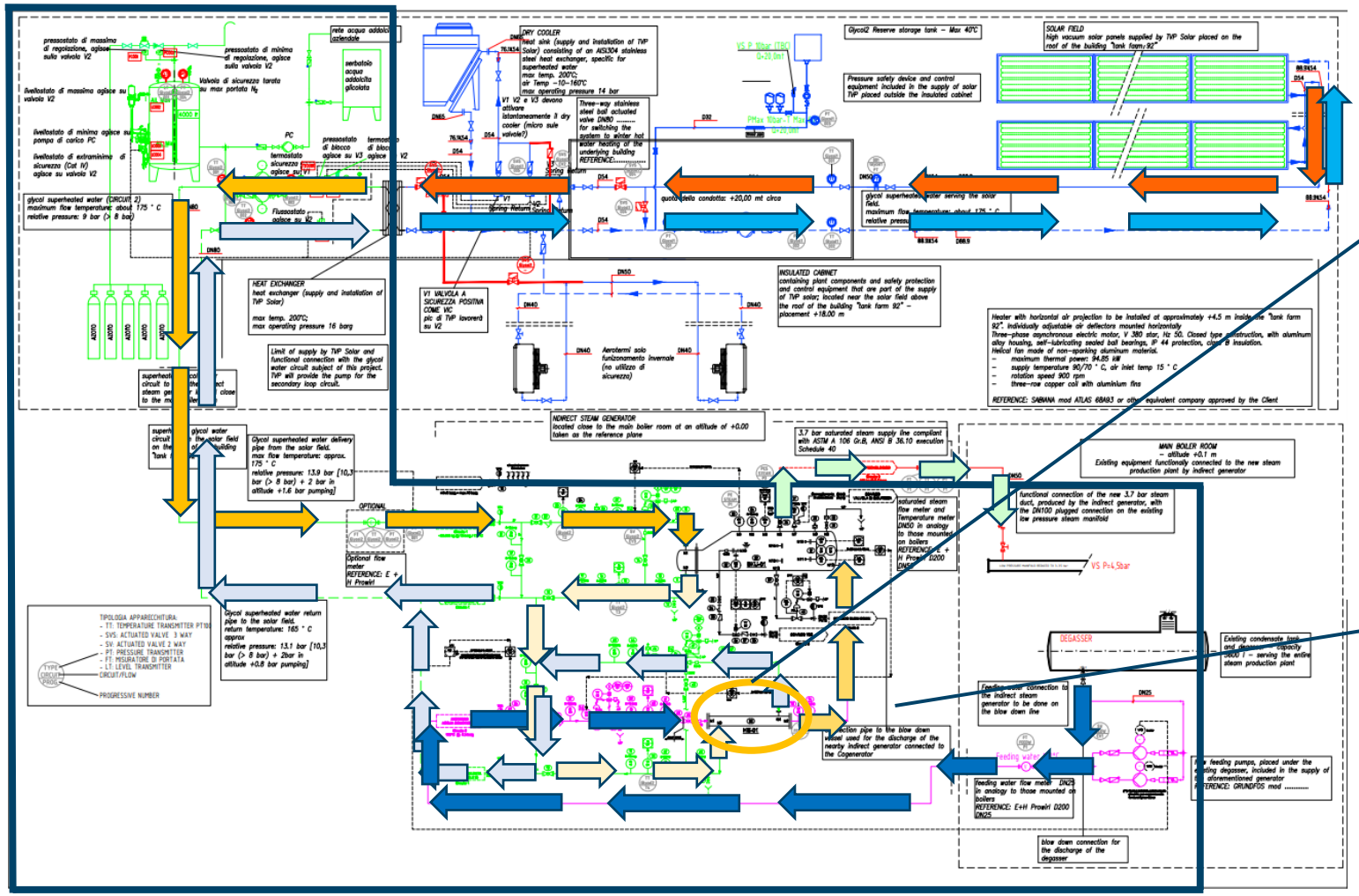
Summer Mode

Operation Mode details

Summer mode

Steam

3,7 bar saturated steam



Heat Exchanger: Used for **pre-heating** the water entering the ISG

Feed water circuit: Before entering the ISG it is preheated using the return of circuit 2.

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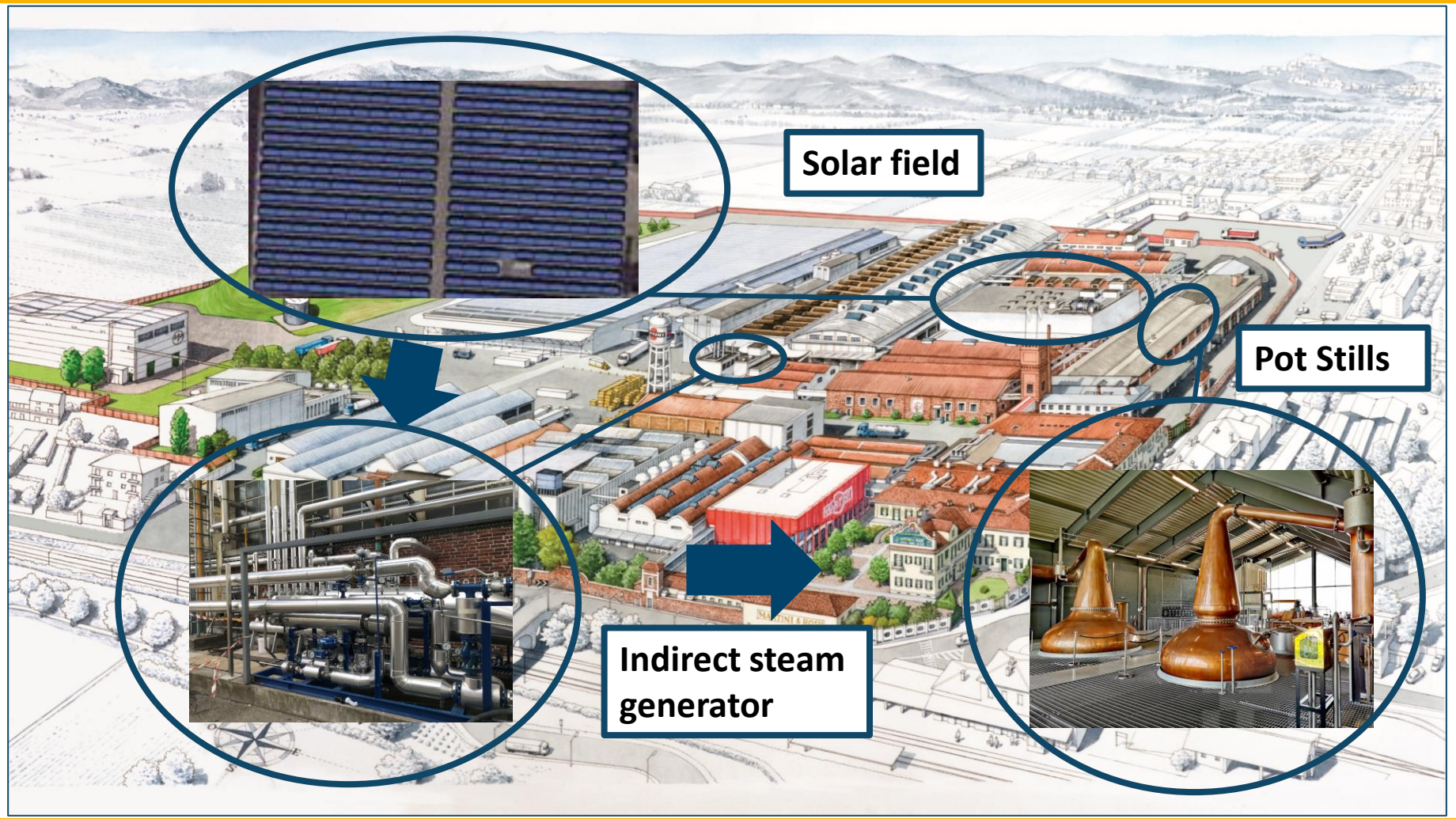
System Integration

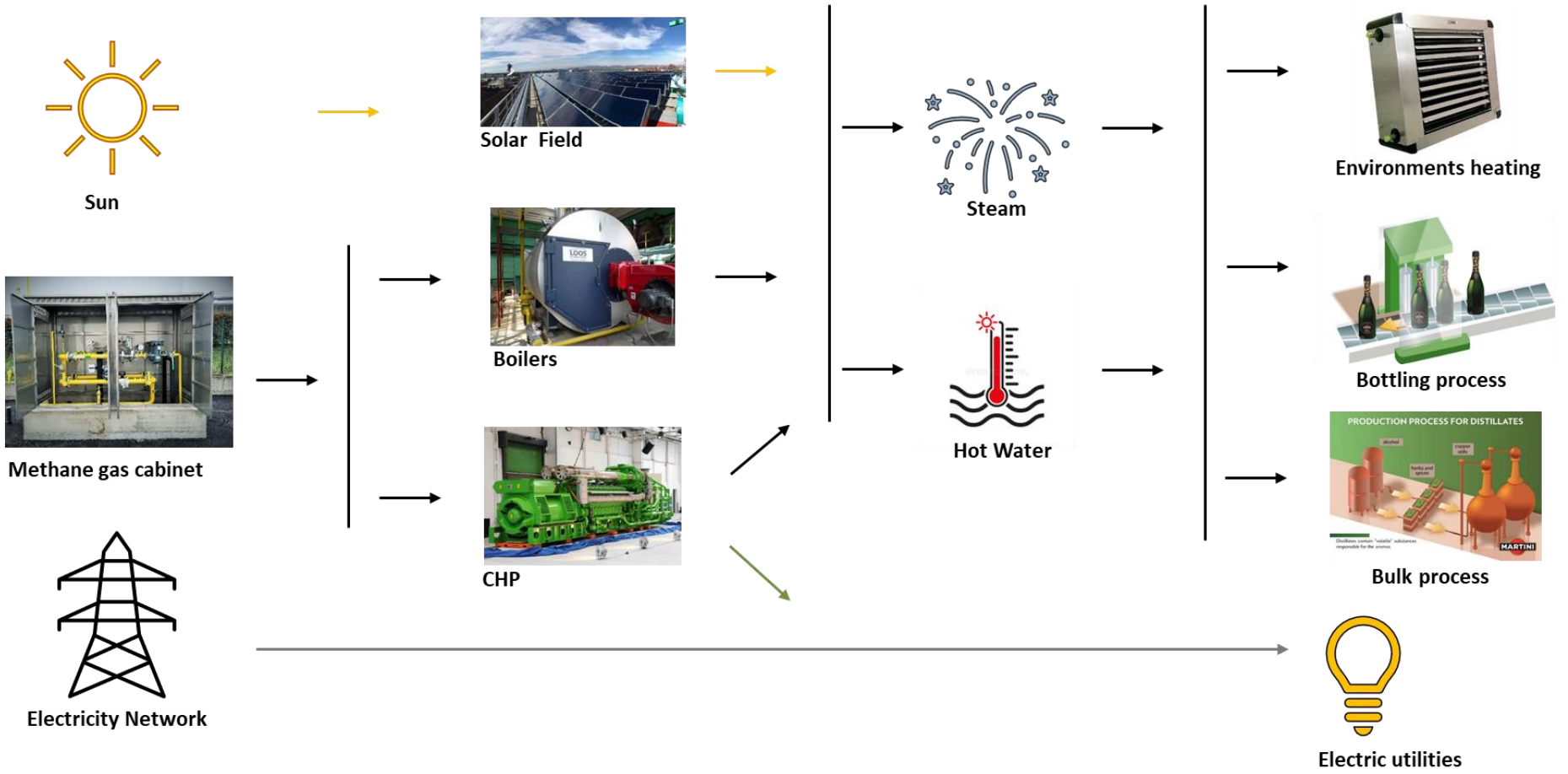
M&R Energy Archtecture



SHIP2FAIR

System Integration

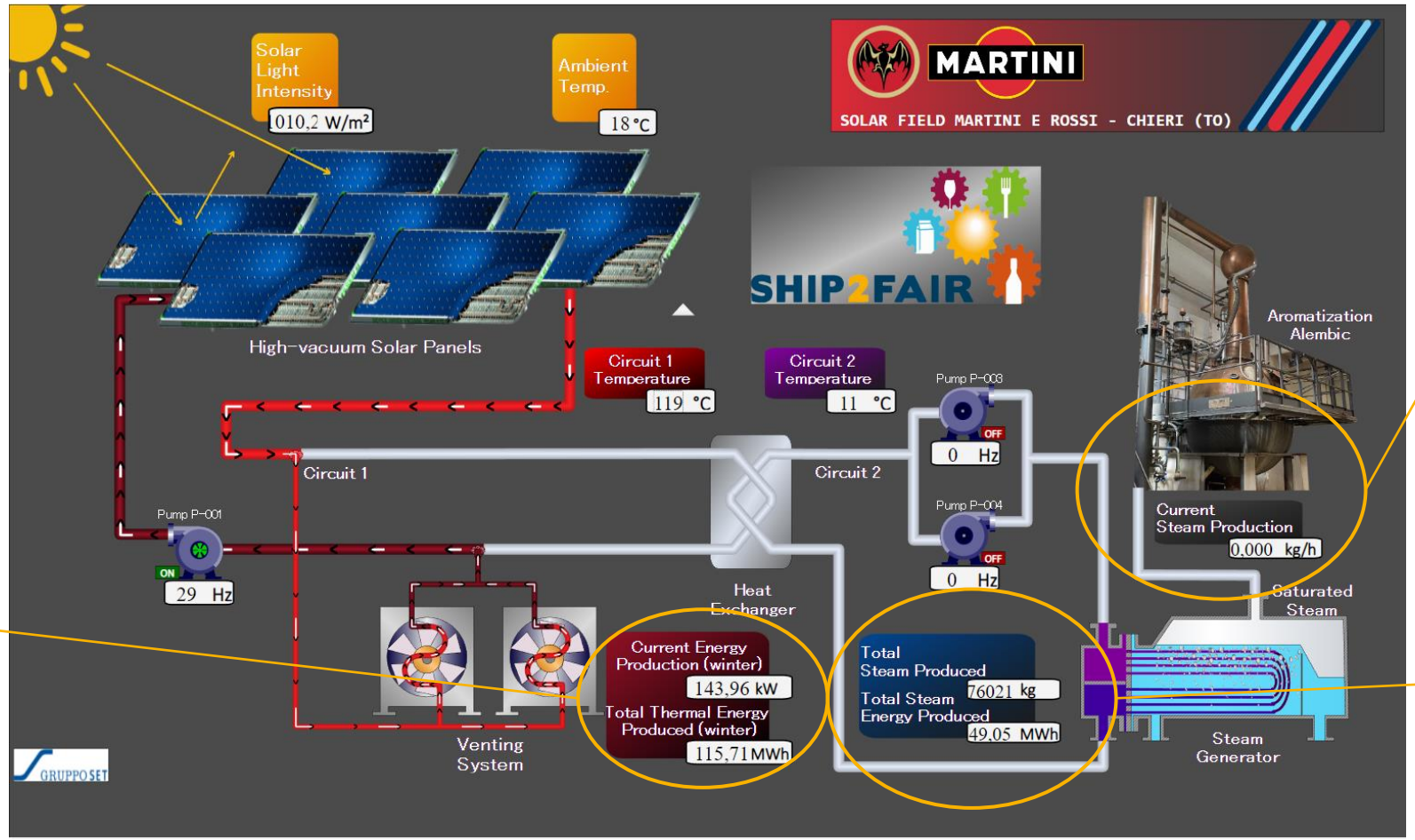
M&R Energy Architecture



Solar Heat for Industrial Process towards Food and Agro Industries commitment in Renewables

Technology Description

System integration



Total and real time energy production in Winter Mode

Real time steam production in Summer Mode

Total energy produced in Summer Mode

Lesson learnt

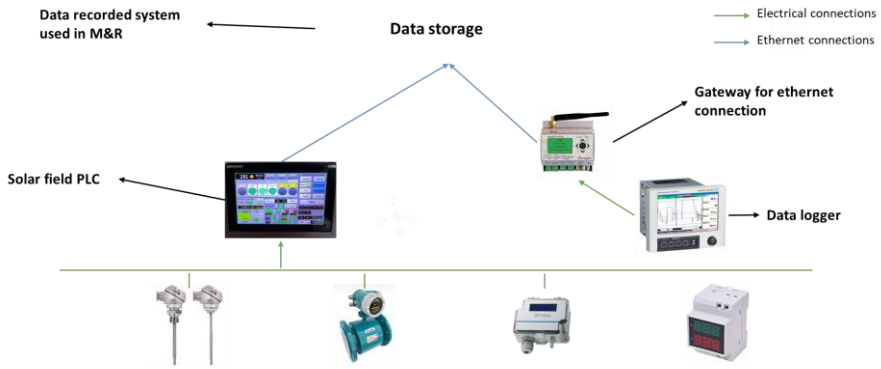
3 main categories

Regulatory aspects

Due to the high temperatures and pressures reachable by the system, it is mandatory to meet the requirements for standard technologies.
There is still no specific regulation for solar power plants in the industrial sector in Italy.

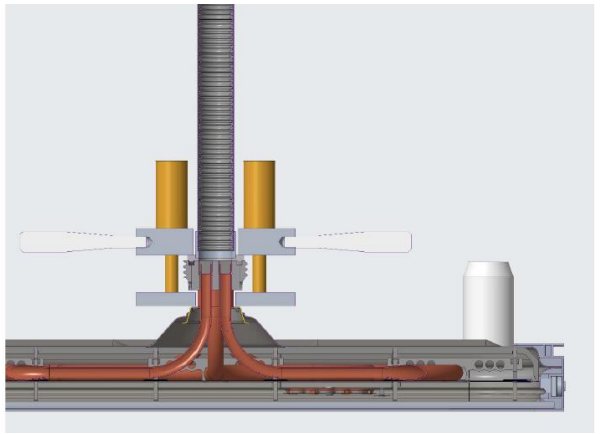
IT infrastructure

To enable the right interconnection between the system and the project partners, it was necessary to build a proper infrastructure compliant with both internal IT policies and project requirements.



Mechanical defeats

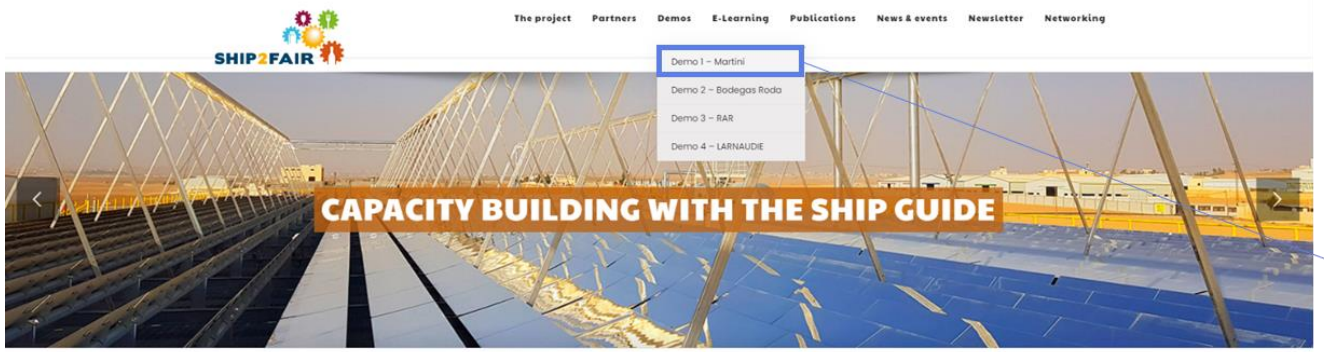
Due to the significant temperature differences between day and night, an in-depth analysis and testing phase was necessary on the mechanical components of the system.

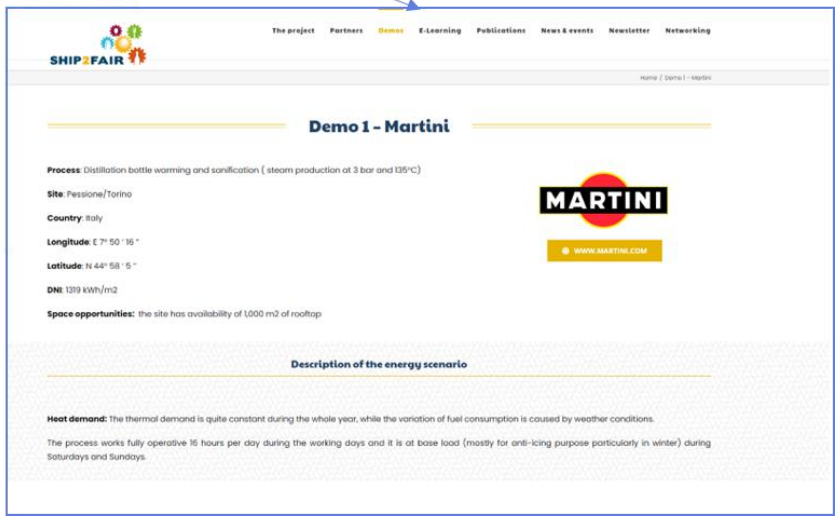


Next steps

Nr	Objective description	M&R Next Steps
1.	Systems operating modes.	Fine Tuning ongoing: • Finding the best solution for the settings of the two circuit pumps to maximize the efficiency of the heat exchange. • Finding the best valve opening setting to maximize boiler efficiency
2.	Remote Supervision system	Create an IT infrastructure to allow TVP to enter the solar field PLC remotely for maintenance and analysis purposes.

ShipToFair Website





Solar Heat for Industrial Process towards Food and Agro Industries commitment in Renewables

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Thank you!

agiummule@bacardi.com

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 792276.

Solar Heat for Industrial Process towards Food and Agro Industries commitment in Renewables

SHIP2FAIR

Suitable business and financing schemes for SHIP* installation

*Solar Heat for Industrial Processes

SHIP2FAIR FINAL EVENT
"Decarbonisation of the agro-food industry with solar heat: technologies and processes"
Sustainable Places 2023, 15 June 2023

TVP SOLAR — **Dimitrios Papageorgiou**

INDUSTRIAL SOLAR renewables onsite — **Irapua Ribeiro**

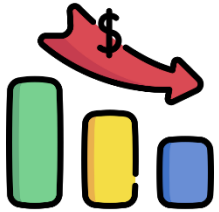
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 792276.

SHIP Market Prospects

Summary

Several successful stories of implemented projects around the world

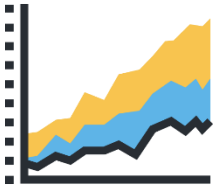
Diverse funds resources available for SHIP projects



Decreasing SHIP costs throughout time

High fossil fuels prices & climate commitments boost solar thermal market

Possible alternative for several segments of the industrial sector



Trending technologies for the last 15 years

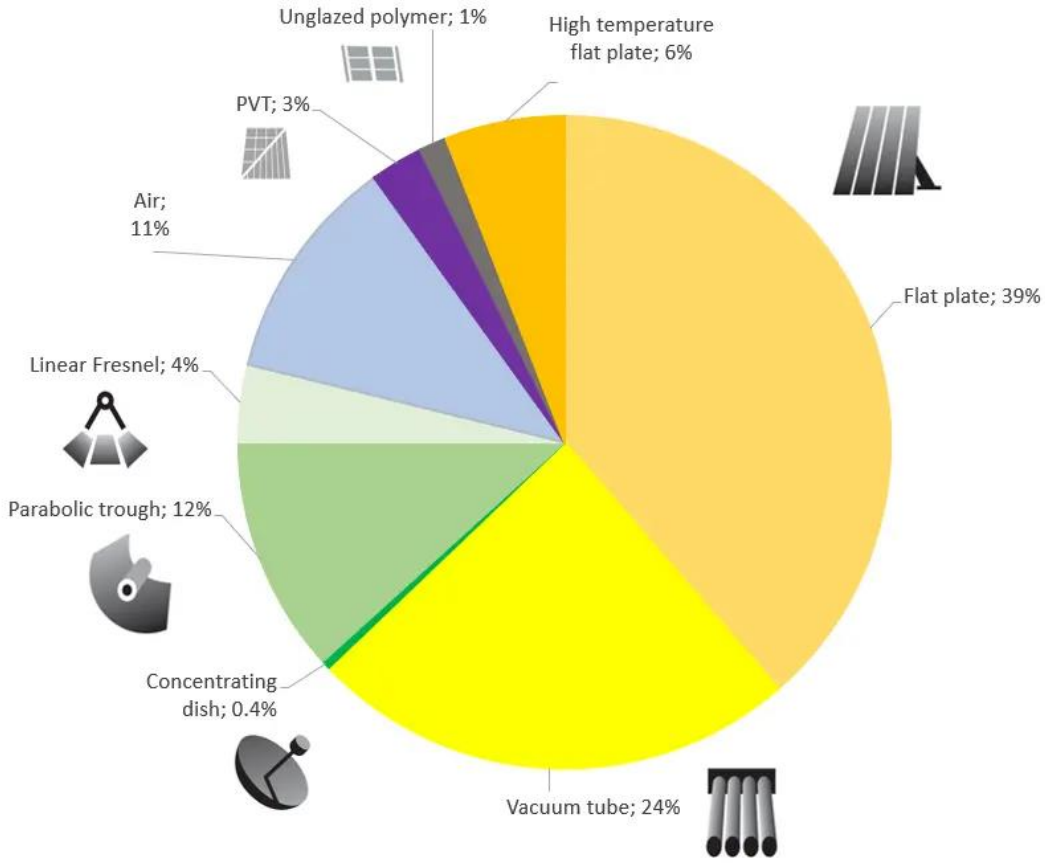
SHIP Market Prospects

A dynamic market

High level of dynamism on the SHIP world market in 2022

	2017	2018	2019	2020	2021	2022	Total until 2022
No. of SHIP systems	107	99	86	85	71	114	at least 1,089

Source: SolarThermalWorld



Stats of 2022 by technology type

SHIP Project Value Chain

Stakeholders

Industrial Companies

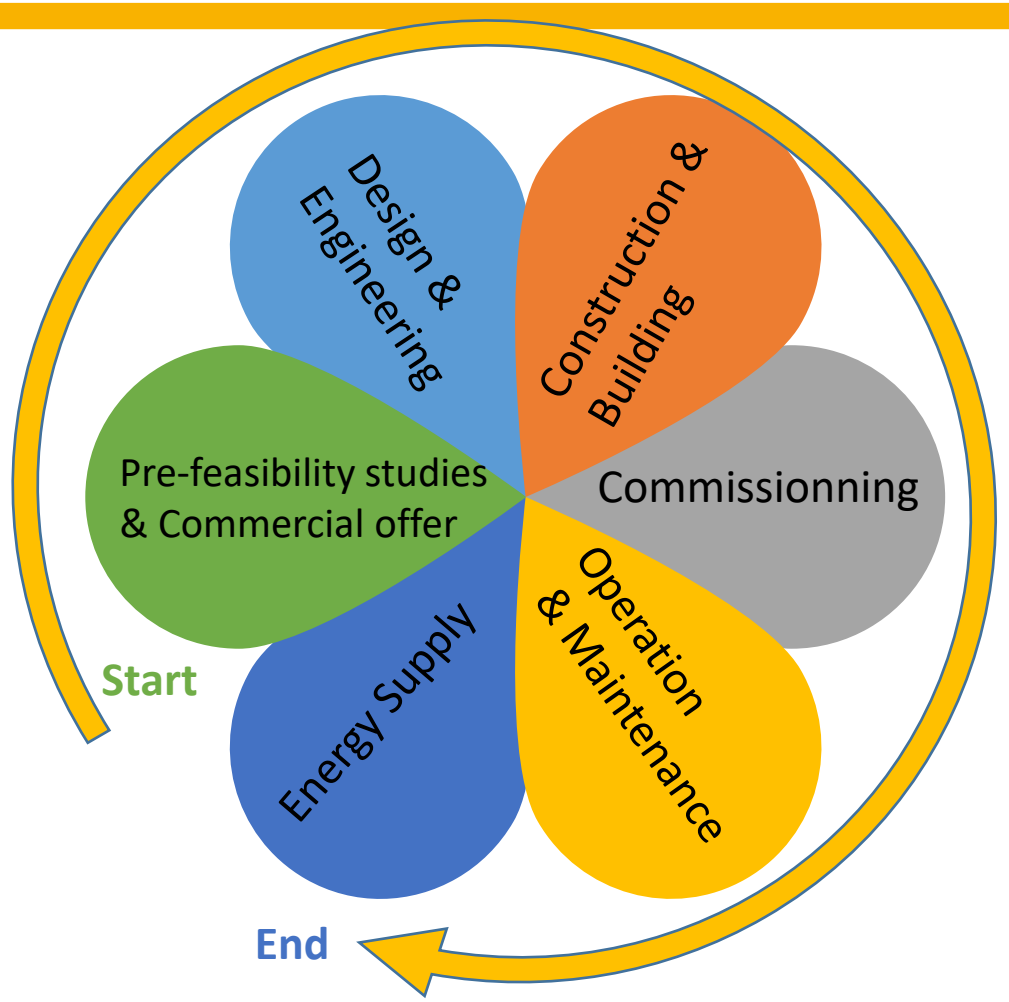
Industrial companies whose heat demand fits the range of application of solar thermal (i.e. the agro-food industry). They are the potential clients in the value-chain

Energy/Heat Suppliers

Companies that are supplying heat to their customers. They can also assume the role of facility operator

Government, Policy Makers, European organisations and national institutions

Policy makers in charge of changing regulation related to renewable heat sources. They shape the environment within the different players evolved. They provide guidance for the development of less traditional systems



Energy Consulting Companies

Companies that help their customers make informed choices about their energy consumption/provisions. They can also assist them in the building phase

Solar Thermal Equipment Manufacturers or suppliers

Companies that manufacture the different types of solar thermal equipment

Third party investors

investment companies that specialises in the third-party financing of renewable heat production projects and energy efficiency projects.

EPC Contractors and O&M

Third party in charge to physically build the installation once materials and detailed design are provided. This role could be assumed by the equipments manufacturers or supplier

SHIP Project Launch

Sales engagement process flow

Phase 0

"Discovery Estimate"

- Quick assessment of the solar heat potential
- FREE

Phase 1

"Feasibility Study"

- Site-unseen engineering study
- FREE or an fee basis (depending on the case)

Phase 2

"Engineering Study"

- Full-spec engineering study + bill of components
- On a fee basis

Phase 3

Turnkey Contract/ Heat Purchase Agreement

- Signed contract / agreement

BUSINESS MODELS

SHIP2FAIR Business Model

Business Model Options

Build & Handover Model

- The industrial customer pays for & operates the solar thermal system
- Optional operation & maintenance contract

Build & Operate Model

- SHIP project developer pays the investment cost, owns & operates the solar thermal system
- The industrial partner buys solar heat

Hybrid Model

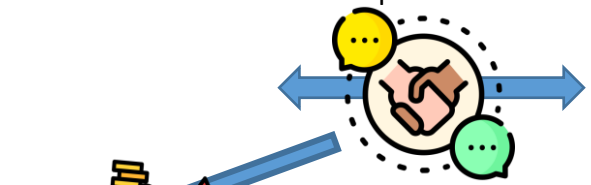
- Like the Build & Operate model with one difference:
- After 10 or 15 years of operation the ownership of the solar thermal system is transferred to the industrial customer

SHIP2FAIR Business Model

Business Model – Build & Handover

Industrial Customer willingness to decarbonize using solar thermal to cover its heat demand

Contract between both parties



Solar Thermal turnkey supplier & SHIP projects developer

Energy Consulting Companies
Solar Thermal Equipment Manufacturers, etc.

Industrial Customer pays for the installation, investment and risks are allocated on the Industrial Customer

Potential incentives or subsidies from local authorities or EU institutions

Development of the project with the turnkey supplier & SHIP developer handling the different stages

Handover of the facility to the Industrial Customer (owner)

Industrial Customer uses the SHIP plant to supply its heat demand, and operates and maintain the plant

Solar Heat for Industrial Process towards Food and Agro Industries commitment in Renewables

SHIP2FAIR Business Model

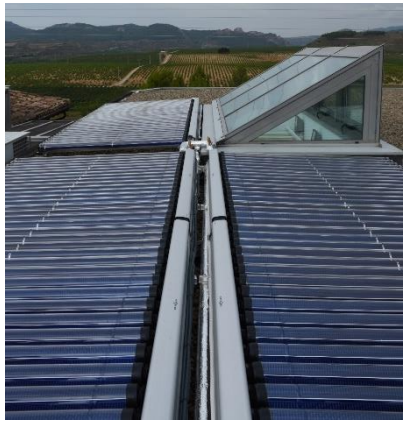
Build & Handover: SHIP2FAIR Demo-sites

Business model:

- Build
- Demonstrate (fine-tune)
- Transfer the ownership (*not applied in RODA case)
- O&M support agreement

BODEGAS RODA RIOJA ALTA

RODA, La Rioja, ES



MARTINI

M&R, Turin, IT

Jean LARNAUDIE DEPUIS 1951

Jean Larnaudie, Castelnaudary, FR

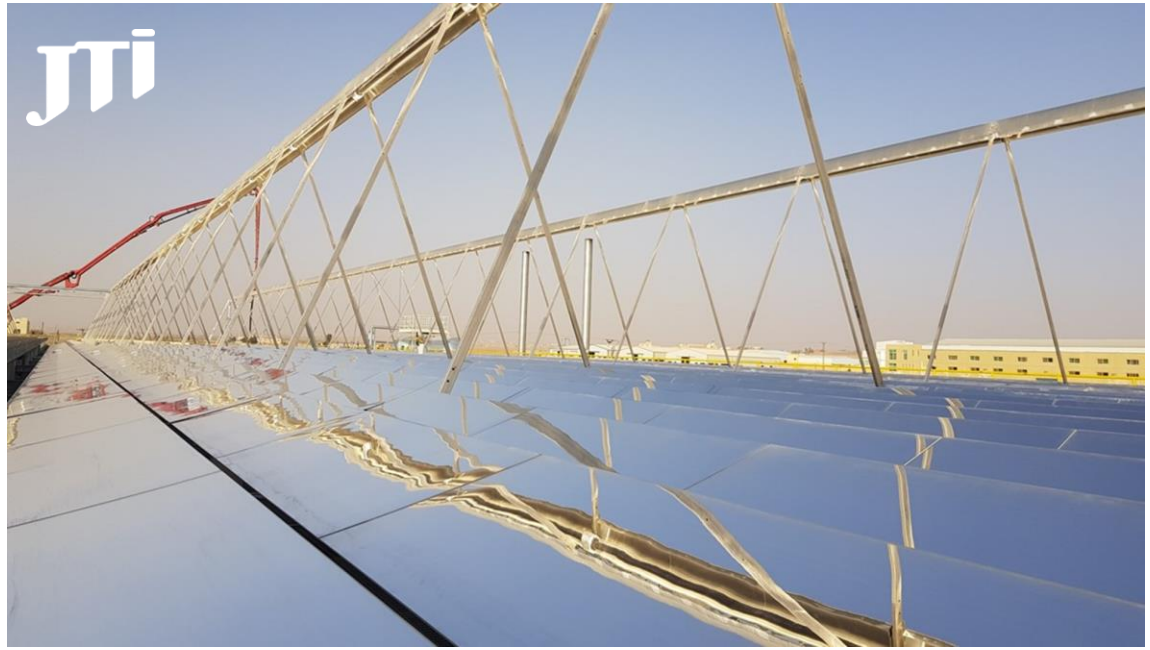
SHIP2FAIR Business Model

Build & Handover: other examples

Business model:

- Build
- Transfer of ownership
- O&M support agreement in place since 2017

JTI Jordan, Amman

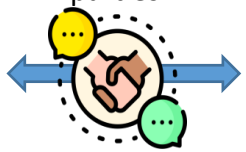


SHIP2FAIR Business Model

Business Model – Build & Operate

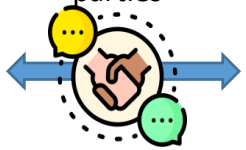
Solar Thermal turnkey supplier & SHIP projects developer

Agreement between both parties



ESCO sells projects to use solar thermal to cover the Industrial Customer´s heat demand

Agreement between both parties



Industrial Customer willingness to decarbonize using solar thermal to cover its heat demand

Project development by ESCO and its subcontractors

Technical inputs regarding the process constraints

ESCO pays for the installation investment and risks are allocated on the ESCO

ESCO owns the plant, operates and maintains it

ESCO sells the heat to the Industrial Customer to recover from expenses

Industrial Customer using solar heat energy from the facility for its processes

Also known as: HPA - Heat Purchase Agreements

SHIP2FAIR Business Model

Build & Operate: Example of Solar District Heating

Dorkwerd project, Groningen, NL

Project developer:	Novar (Solarfields), NL
Connected consumers:	10’000 citizens
Annual solar share:	25% of heating needs
Solar field:	Tech provider: TVP Solar Capacity: 37MW Heat delivery: 25GWh/y Size: 48’000 m2

Business model

A Special Purpose Vehicle (SPV) was founded by the:

- ⇨ Project developer (Novar)
- ⇨ Investor (K3)
- ⇨ Technology provider (TVP Solar)

The SPV owns & operates the SDH system

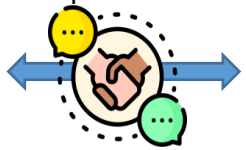
A 30-year Heat Purchase Agreement (HPA) has been signed with local DHN operator (utility Warmtestad)

SHIP2FAIR Business Model

Business Model – Hybrid

Solar Thermal turnkey supplier & SHIP projects developer

Agreement between both parties



ESCO sells projects to use solar thermal to cover the Industrial Customer´s heat demand

Agreement between both parties

Industrial Customer willingness to decarbonize using solar thermal to cover its heat demand

Project development by ESCO and its subcontractors

Technical inputs regarding the process constraints

ESCO pays for the installation investment and risks are allocated on the ESCO

ESCO owns the plant, operates and maintains it

ESCO sells the heat to the Industrial Customer

Industrial Customer using solar heat

For the first 10+ years

ESCO sells the facility to the Industrial Customer

Industrial Customer using solar heat

After the first 10+ years

Solar Heat for Industrial Process towards Food and Agro Industries commitment in Renewables

Funding Programmes & Incentives

SHIP2FAIR Incentives for Solar Thermal

Overview of funding schemes in Europe

European Funding Programmes

- ❑ Innovation Fund
- ❑ LIFE

Type of funding: grants as a % on the project eligible cost

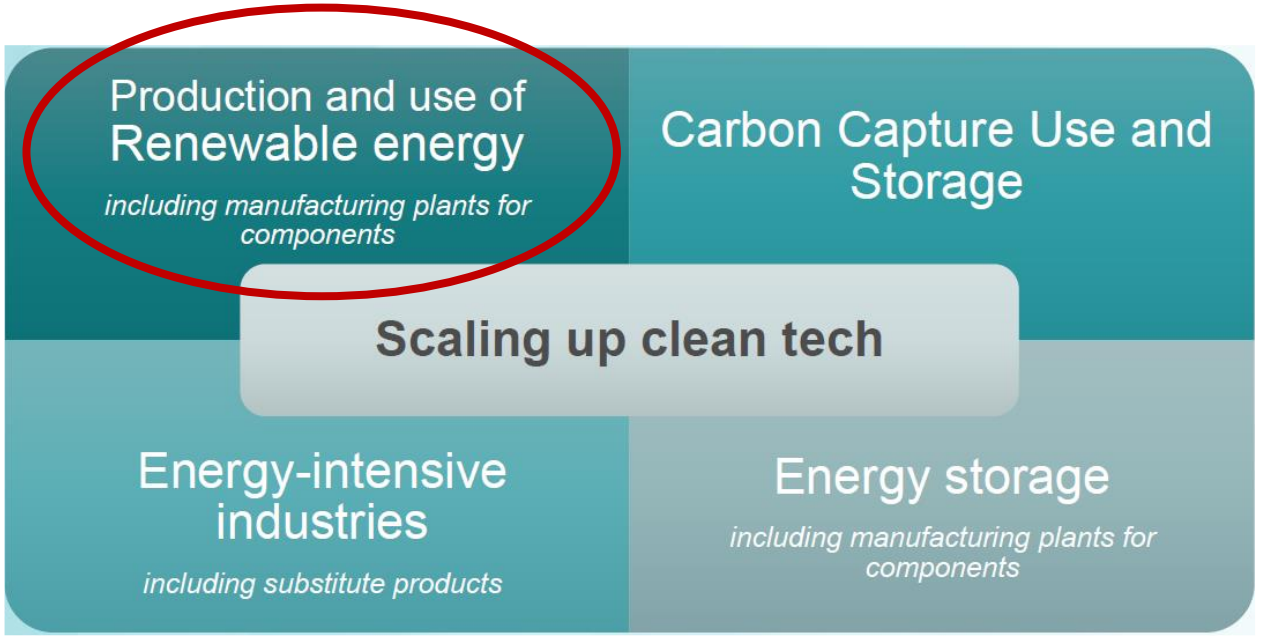
National/ Regional Funding Programmes / Subsidies

- ❑ Using national financial resources
- ❑ Using a mix of national & European financial resources

Type of funding: grants or subsidies on the capital expenditure, tax exemptions, loans under advantageous conditions, feed in tariffs, etc.

SHIP2FAIR Incentives for Solar Thermal

The Innovation Fund



The IF supports:

- ❑ Highly innovative technologies
- ❑ Sufficiently mature
- ❑ With strong potential to reduce GHG emissions

Details here

Funding available for:

- ❑ Small-scale projects: projects with a capital expenditure between €2.5 and 7.5 million
- ❑ Large-scale projects: > €7.5 million

Key features

Volume of at least EUR 38 billion until 2030 (at EUR 75 carbon price)	Support of up to 60% of CAPEX (small-scale)	40% of grant disbursed at financial close
Financed from the revenues of the EU Emissions Trading System	Annual calls for large-scale and small-scale projects (CAPEX < EUR 7.5 million)	60% of grant disbursed during construction and 3-years operating period against GHG emission avoidance

Solar Heat for Industrial Process towards Food and Agro Industries commitment in Renewables

SHIP2FAIR Incentives for Solar Thermal

National funding institutions – EU examples

- Austria: BMK (Bundesministerium für Klimaschutz, Umwelt, Energie, Mobilität, Innovation und Technologie
- France: ADEME
- Germany: BAFA (Federal Office for Economic Affairs and Export Control)
- Italy: MISE (Ministero Sviluppo Economico)
- Spain: IDEA (Institute for Diversification and Energy saving)

Further fundings for commercial and R&D projects

IEA Task 64: Collection of available solar process heat related national and trans-national research and funding programs

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Thank you!

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 792276.

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Solar Heat for Industrial Process towards Food and Agro Industries commitment in Renewables

SHIP2FAIR Replication Studies

Giorgio Bonvicini / Irapuã Ribeiro

15.06.2023

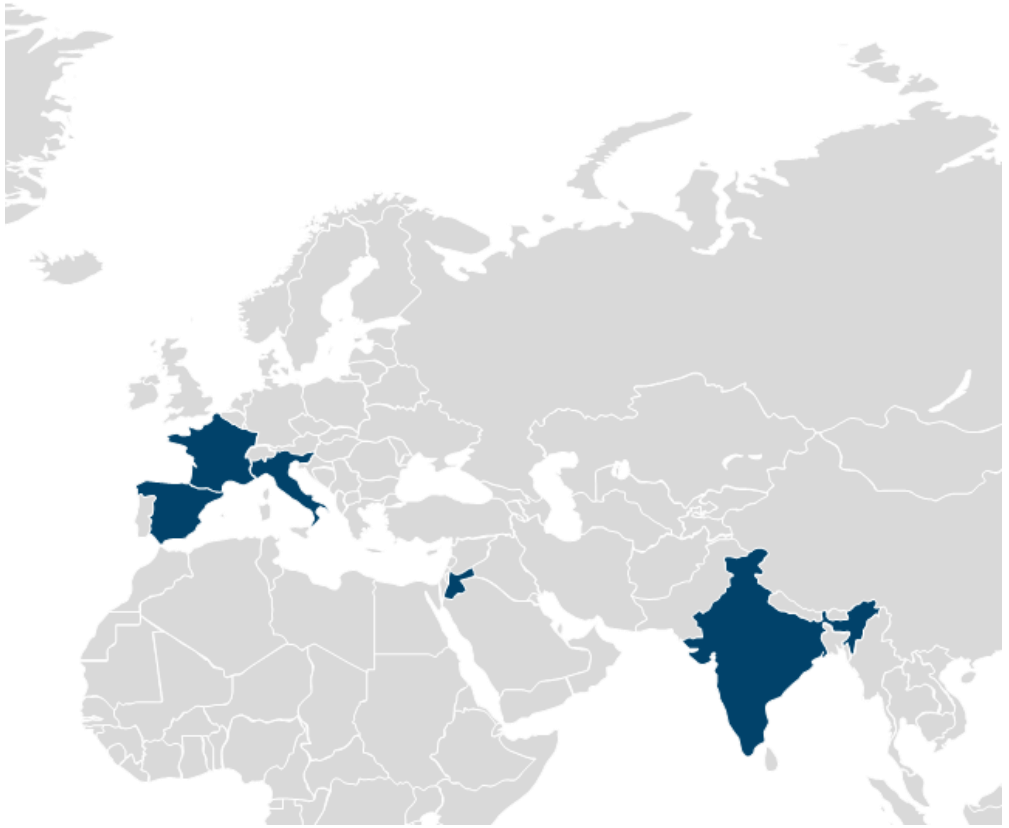
Sustainable Places Workshop

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 792276.

SHIP2FAIR Replication Studies

SHIP2FAIR

- **10 industrial sites**
- **8 industrial sectors** (textile, chemical, wastewater treatment, dairy, meat curing, brewery, food, laboratory)
- **6 Countries** (Italy, Spain, France, Slovenia, Jordan, India)
- **Heat demand between 30°C and 195°C**



Scope of Replication Studies

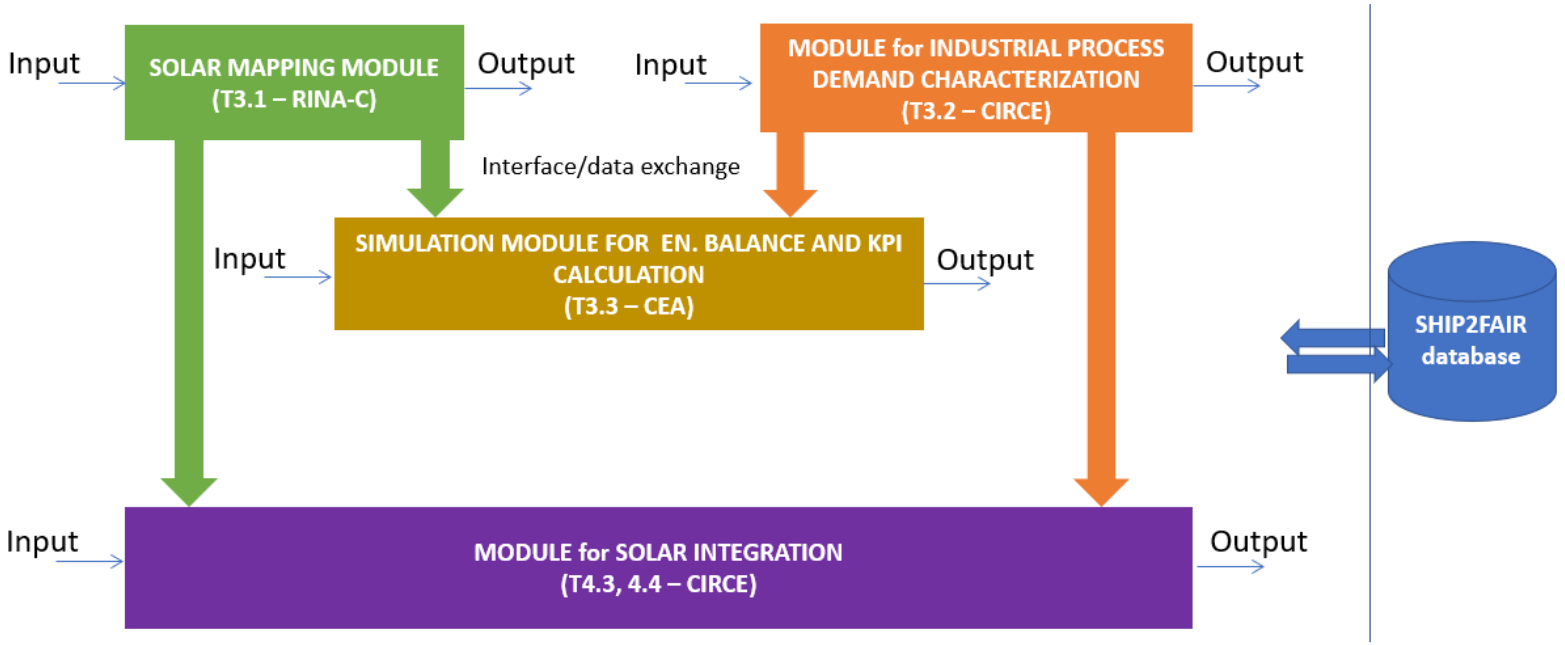
SHIP2FAIR

Scope of the pre-feasibility studies:

1. **Preliminary analysis** of the potential for solar integration in the industrial processes
2. **Full pre-feasibility study** through the SHIP2FAIR Replication Tool
3. **Results discussed** and fine-tuned to find suitability to each case
4. **Direct contact with solar thermal technology providers** to proceed with further studies
5. **Discussion of results before publishing** the report and possibility to protect confidential data by avoiding any reference to the specific site

Replication Tool

SHIP2FAIR



Replication Study: Chemical Industry

Replication Study – Chemical plant

SHIP2FAIR

- **Location:** Tarragona, Spain
- **Main products:** industrial cleaners, personal care products, and emulsionants.
- **Current heat supply:** natural gas steam boiler, 4 MW nominal power
- **Processes:**
  - ❑ several processes, running 24/7
  - ❑ analyzed process works at 195°C with steam at 13 bar

- **Annual thermal demand:** 13.205 MWh
- **Annual associated CO2 emissions:** 3401 tons

Replication Study – Chemical plant

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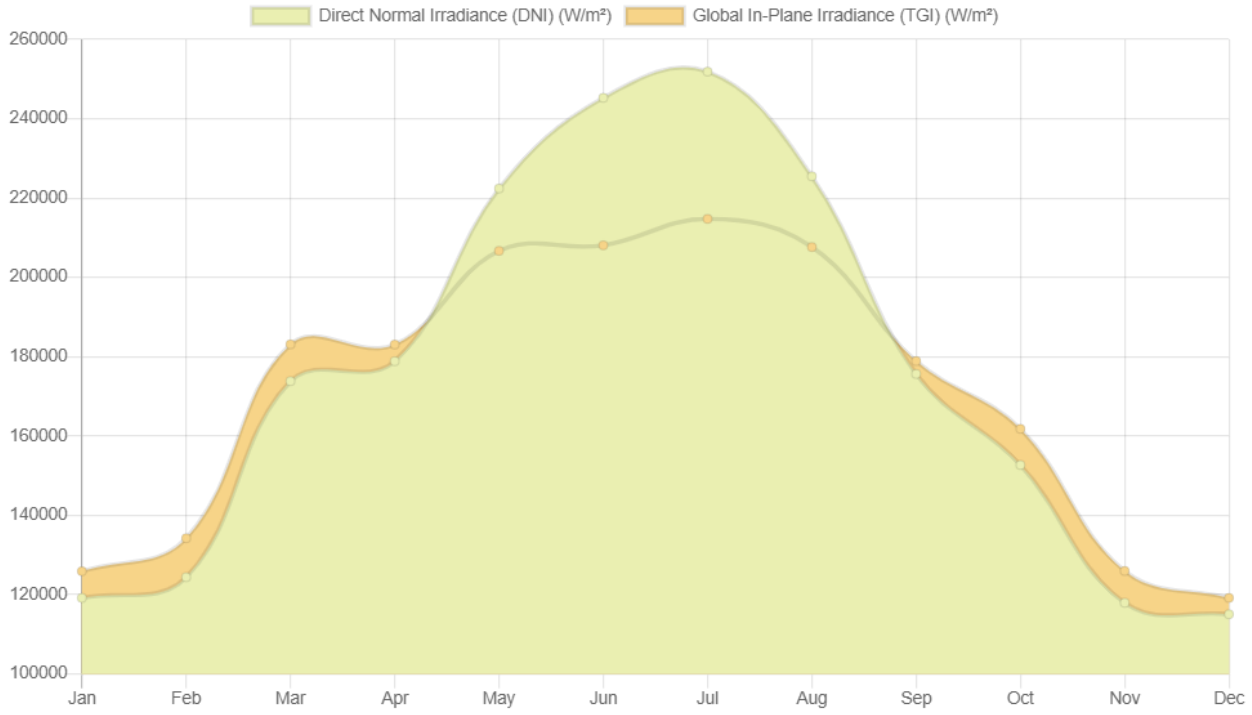
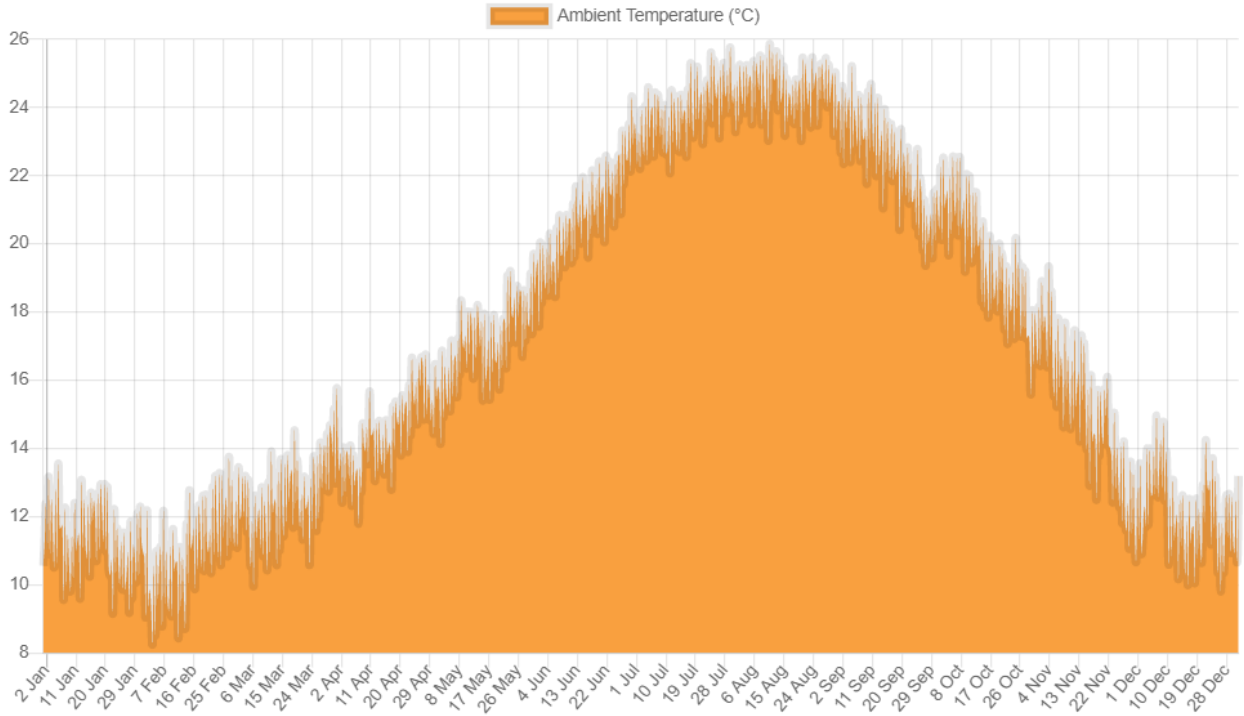
Solar Mapping Module Results





Replication Study – Chemical plant

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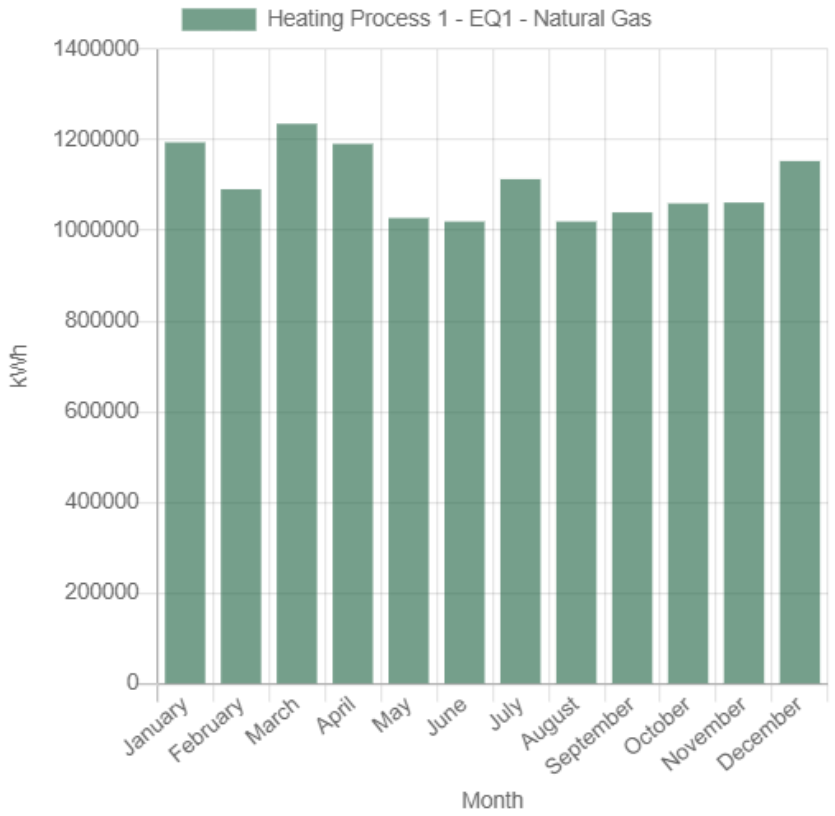
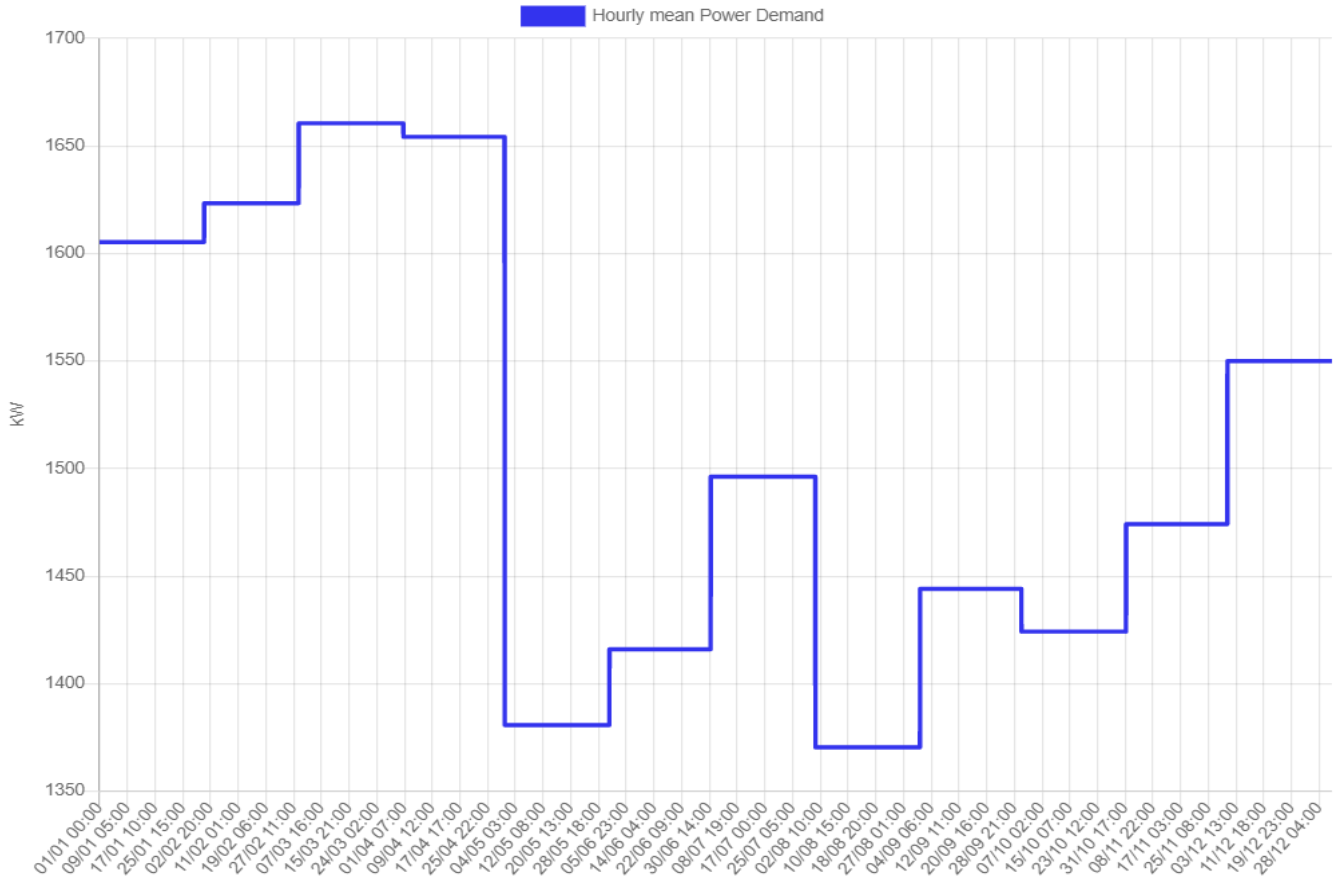
Thermal Demand Module Results





Replication Study – Chemical plant

SHIP2FAIR

Simulation Module – Technology selection

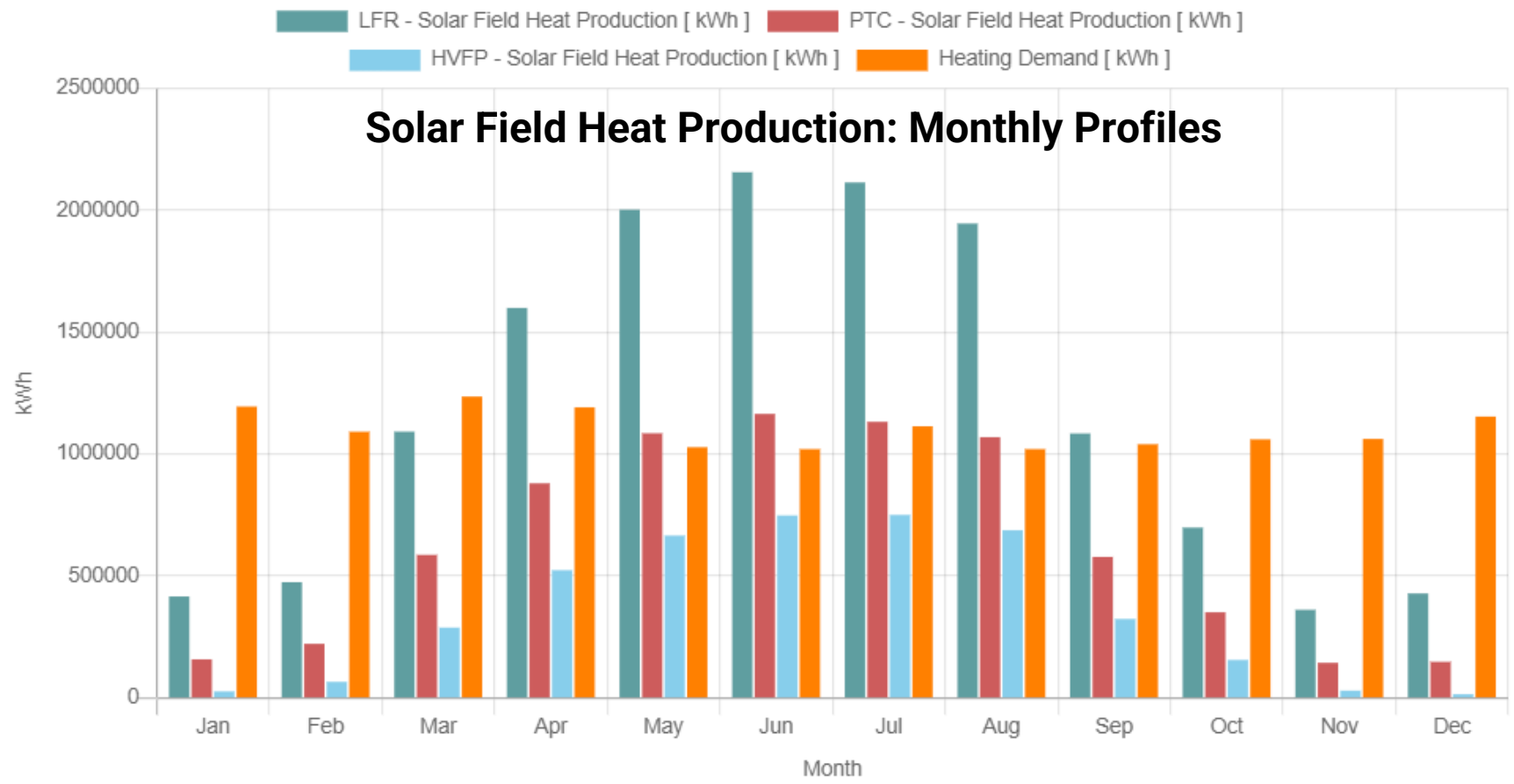
Available area: ground 26.245 m²

Technology selected	**Collector aperture area**
Parabolic Trough Collectors (PTC)	13,123 m²
Linear Fresnel reflectors (LFR)	19,684 m²
High Vacuum Flat Plate (HVFP)	14,566 m²

Replication Study – Chemical plant

SHIP2FAIR

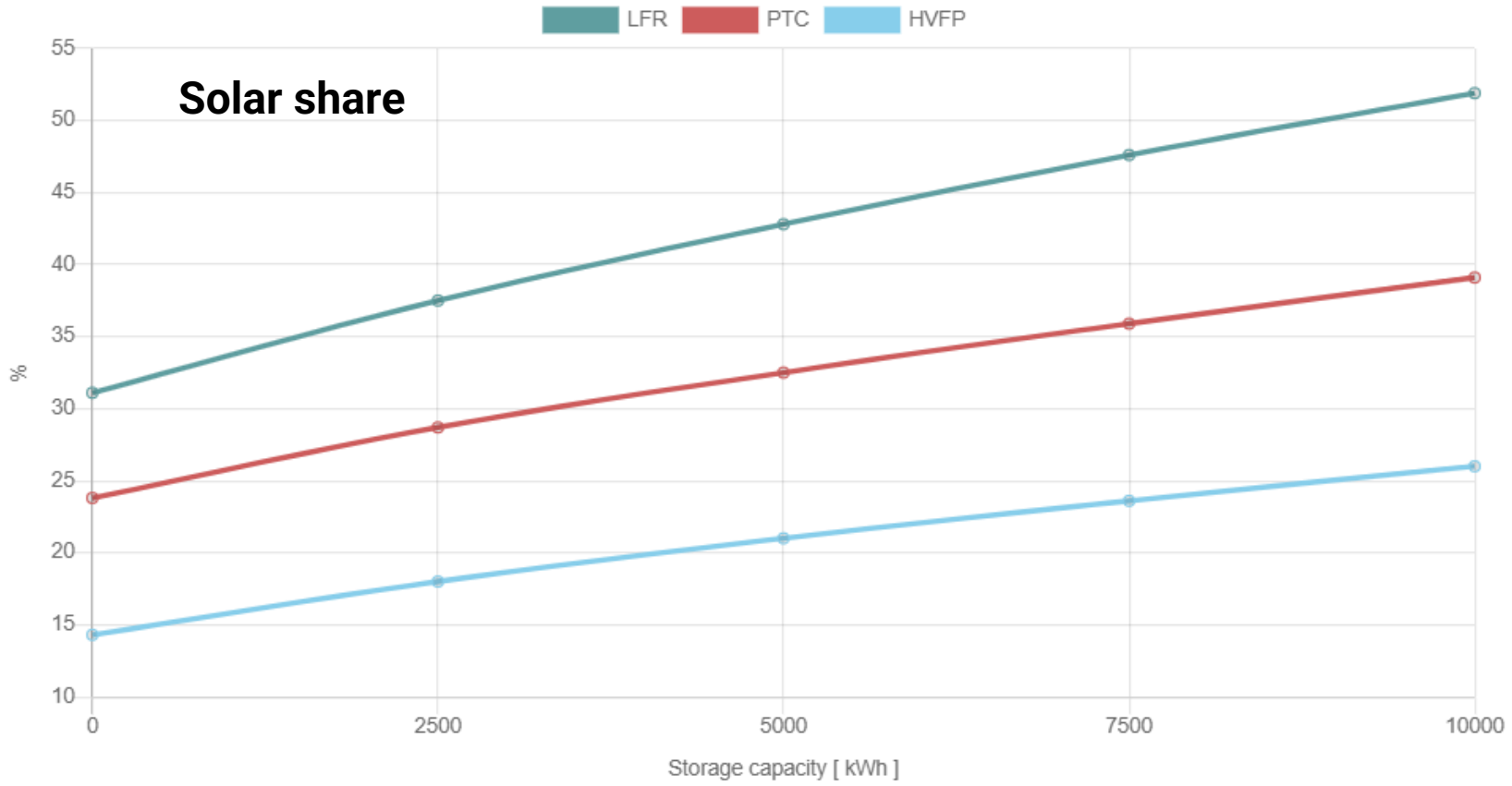
Simulation Module Results



Replication Study – Chemical plant

SHIP2FAIR

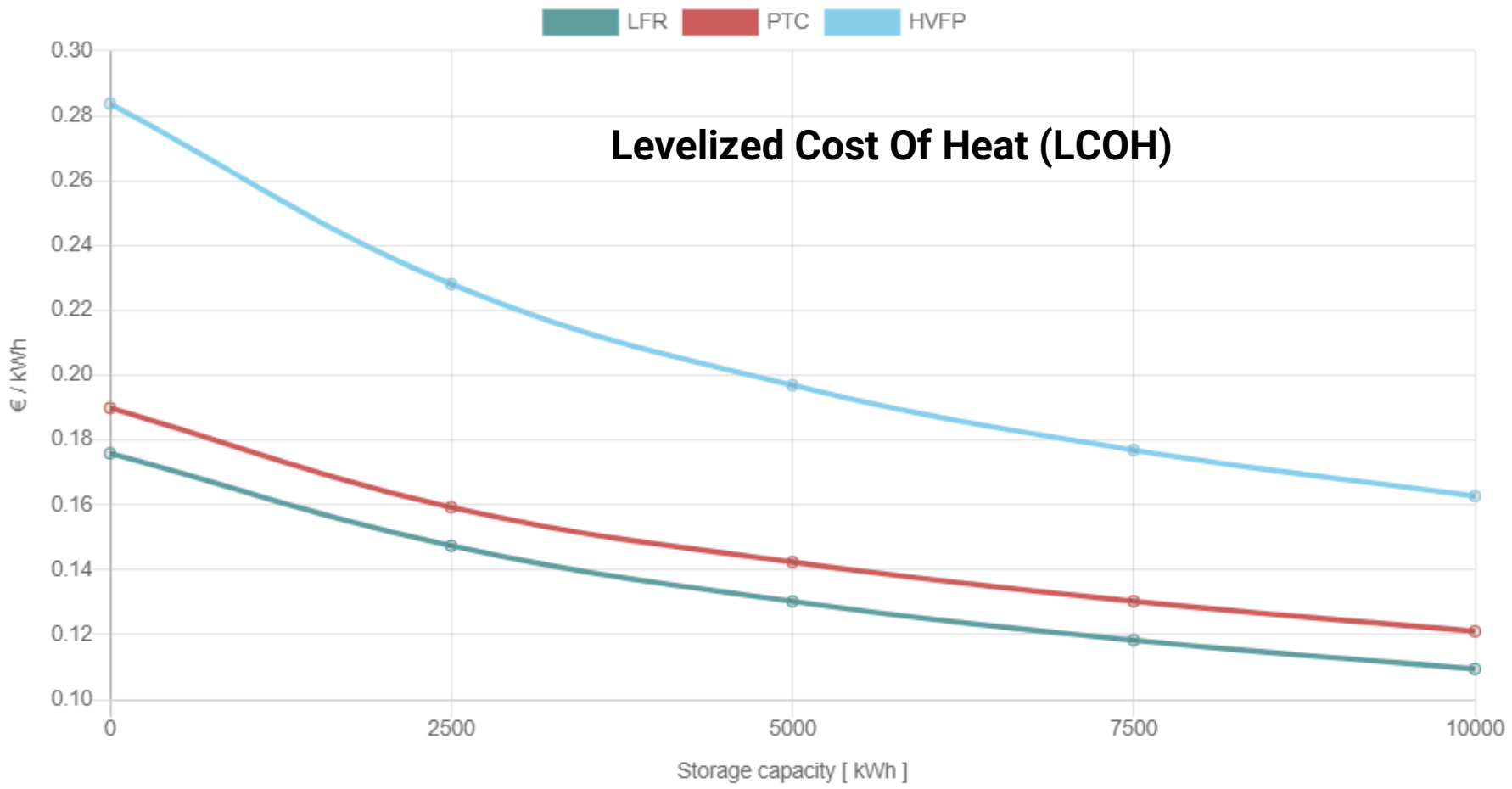
Simulation Module Results



Replication Study – Chemical plant

SHIP2FAIR

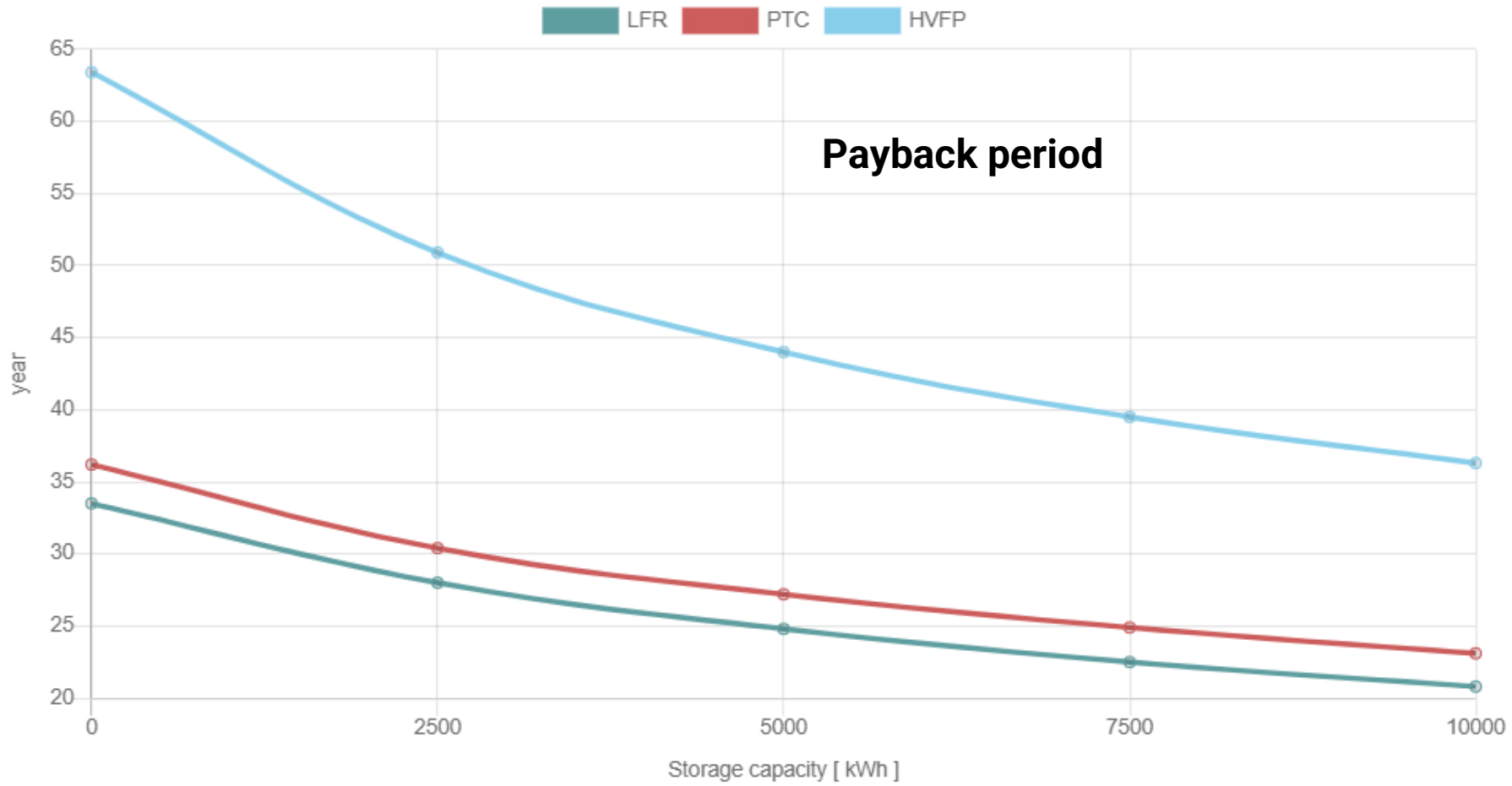
Simulation Module Results



Replication Study – Chemical plant

SHIP2FAIR

Simulation Module Results



Replication Study – Chemical plant

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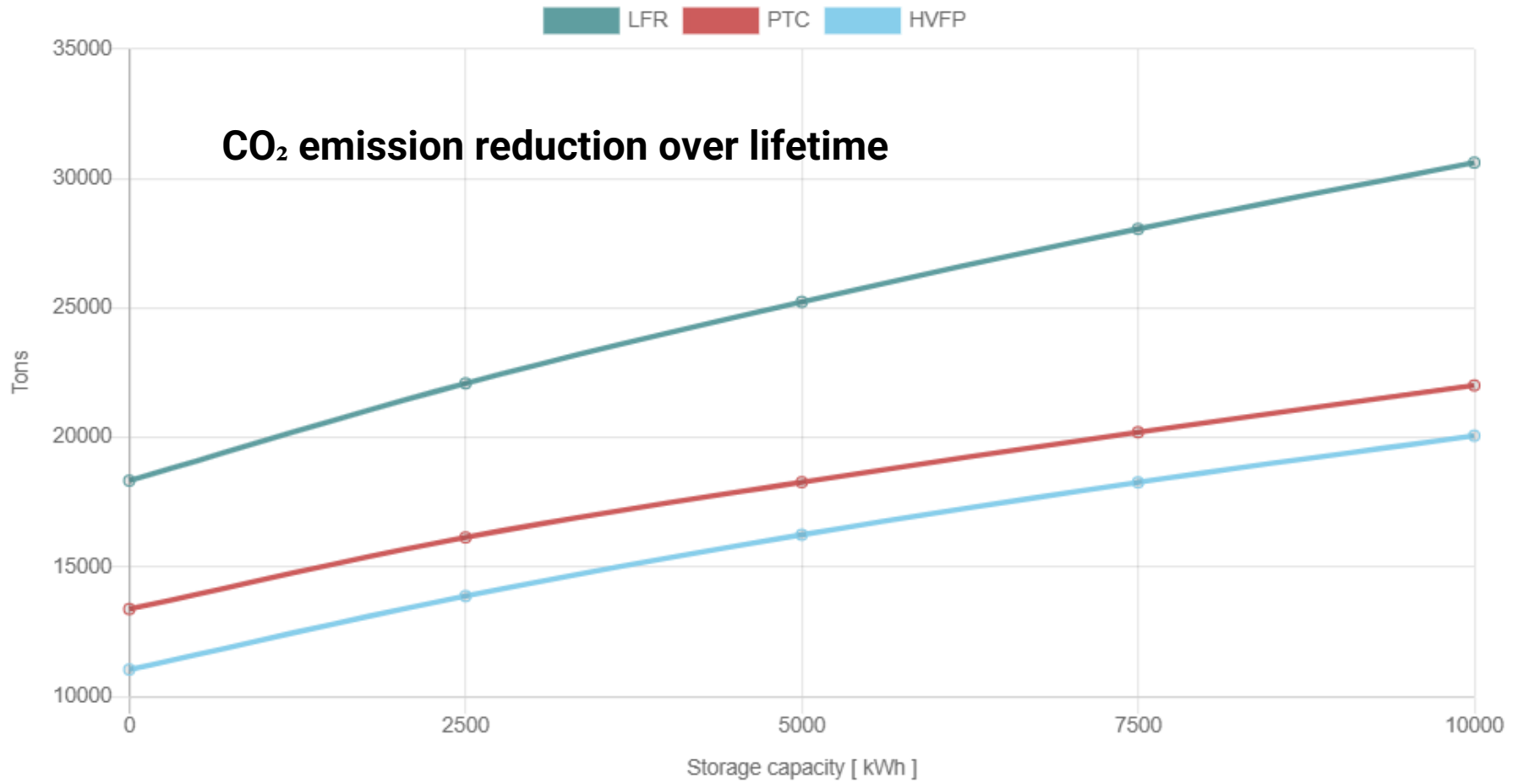
Simulation Module Results



Replication studies: discussion

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 792276.

Summary of Replication Studies

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	Thermal Demand Temperature	Best Technology Selected	Collectors Area	LCOH	PBT	Solar Share	GHG Emissions Avoided
	°C	-	m^2	EUR/MWh	y	%	tCO_2e/y
Case Study 1 – Textile, Italy	50-70	FPC	827	76.4	18.5	2.3	68
Case Study 2 – Chemical, Slovenia	130-180	LFR	25,981	44.9	11.0	6.0	2,315
Case Study 3 – Office/Laboratory, Italy	90-160	LFR	180	49.8	12.1	2.0	434
Case Study 4 – Waste Treatment, France	57-90	HVFPC	190	54.9	n.a.	n.a.	n.a.
Case Study 5 – Dairy, Spain	85	HVFPC	1,665	17.5	3.4	78.7	301
Case Study 6 – Meat Processing, France	55-96	HVFPC	2,200	44.0	12.0	18	520
Case Study 7 – Brewery, Spain	35-100	HVFPC	6,577	34.7	5.6	7.2	1,240
Case Study 8 – Food, Jordan	175	LFR	2,216	51.0	4.4	80.9	581
Case Study 9 – Chemical, Spain	195	LFR	19,684	109.0	20.2	51.9	1,224
Case Study 10 – Textile, India	170	LFR	17,100	16.8	8.0	4.3	7,633

Conclusions – Technical Aspects

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- **High Vacuum Flat Plate Collectors** (HVFP) and **Linear Fresnel Reflectors** (LFR) are recurring as most suitable technologies:
  - HVFP for thermal demand slightly below 100°C
  - LFR for thermal demand between 100 and 200°C
- In most cases the limiting factor is **space availability**:
  - most industrial sites can satisfy only less than 10%) of heat demand with solar thermal
  - sites having much space available, even on ground, can reach very high solar shares, between 50% and 80% of the total heat demand, also exploiting thermal storage
- **Avoided GHG emissions** are strongly correlated with the solar share, which influences the absolute amount of GHG emissions avoided together with the fuel used in the baseline (natural gas in practically all cases except for the Indian one, using coal)

Conclusions – Financial Aspects

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- **Levelized Cost of Heat** (LCOH) and investment **Pay-Back Time** (PBT) are strongly variable, depending on:
  - ratio between the initial investment for the installation of the solar thermal plant (including storage) and the thermal energy production of the site during the year
  - baseline thermal energy production cost, in turn depending on type and price of fuel used and on boilers efficiency
- All replication studies were carried out considering "normal" **fuel prices**, i.e. those before 2022 energy crisis; considering 2022 natural gas prices, much better financial performances would be achieved
- No **public incentive** was considered in the evaluation of financial performance: this could further improve the investment profitability
- General conclusion: solar thermal has a **very good potential** for implementation in all industrial sectors characterized by thermal energy demand, provided that site-specific pre-requisites are met especially in terms of solar resource availability (depending on latitude and on local conditions like orientation/slope/obstacles) and of space availability for the installation of solar thermal collectors

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Thank you!

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 792276.

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Solar Heat for Industrial Process towards Food and Agro Industries commitment in Renewables

Roadmap for the deployment of Solar Heating for Industrial Processes

Final Event , 15.06.2023

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 792276.

Roadmap for the deployment of Solar Heating for Industrial Processes

Agenda

Day 1 – June 15th		
TIME	**AGENDA**	**SPEAKER**
11:55 h	**Roadmap for the deployment of Solar Heating for Industrial Processes** • Main Objectives • Most promising use cases • Barriers • SHIP Deployment Roadmap • Conclusions	**LINKS** Nicola Chiara, Innovation & Business Analyst

Roadmap for the deployment of Solar Heating for Industrial Processes

Main Objectives

Tailor the project result to the most promising use cases

Identify and analyze the barriers

Present a possible roadmap of the replicability of SHIP2FAIR in other industrial sectors

Roadmap for the deployment of Solar Heating for Industrial Processes

Most promising use cases

Target Market

Industrial sectors with process temperatures in the range between 50°C and 250°C

Identified Sectors

- Food & beverage
- Transport equipment
- Textile
- Machinery
- Pulp and paper industries
- Chemical industries

Technology

- Vacuum tube solar thermal technology for process heating & cooling
- High Vacuum Flat Panel - HVFP solar thermal technology for space heating (winter period) and process steam (summer period)
- HVFP technology for boiler pre-heating and process heat

Roadmap for the deployment of Solar Heating for Industrial Processes

Barriers

Regulation Compliance

Start dealing with regulation compliance in parallel with the design phase, in order to avoid delays in commissioning phase

Language Barrier

Include multi-language interface on the tools to facilitate replication and scale-up of SHIP2FAIR solution

Lack of specialized personnel

- Difficult to find specialized personnel in the energy and solar sector within SMEs
- Lack of an IT department in many SMEs

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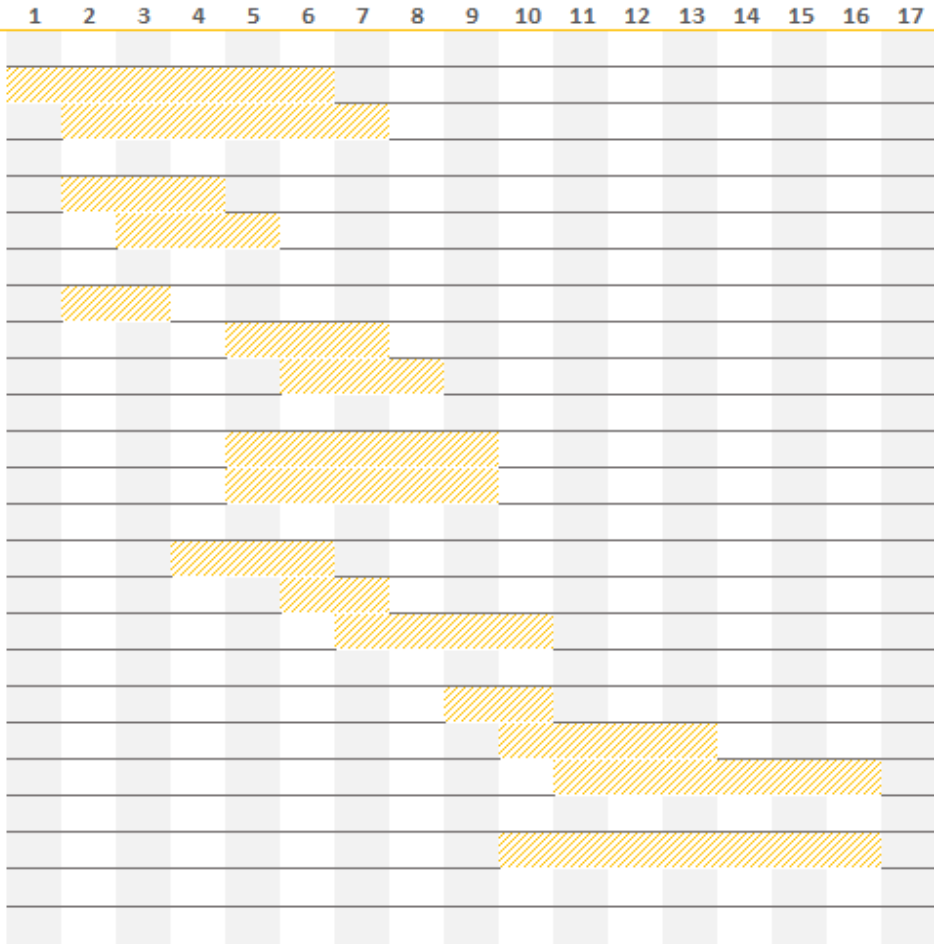
Roadmap for the deployment of Solar Heating for Industrial Processes

SHIP Deployment Roadmap

ACTIVITY	START	DURATION
Regulations Compliance		
Regulatory/ environmental authorisations	1	6
Construction permits	2	6
Design Phase		
Engineering	2	3
System Integration	3	3
Replication Tool		
Multi-language development and testing	2	2
Module Features Upgrade	5	3
Module Upgrade*	6	3
Local Business Ecosystem Development		
Engineering and construction companies selection	5	5
Installers, suppliers of energy equipment selection	5	5
Installation and Commissioning Phase		
Logistics	4	3
Components Procurement	6	2
System Installation and commissioning	7	4
Control Tool		
Multi-language development and testing	9	2
Communication protocols development and testing	10	4
MPC development and testing	11	6
Training		
Personnel training	10	7



*Module Upgrade depends on plant/new sector

Solar Heat for Industrial Process towards Food and Agro Industries commitment in Renewables

Roadmap for the deployment of Solar Heating for Industrial Processes

Conclusions

- The collaboration of the actors involved in SHIP2FAIR experience generated new knowledge that can evolve in the future to form local value chains or business ‘ecosystems’ on applications of Solar Heat for Industrial Processes (SHIP).

- Training activities on each new SHIP plant will be key. In order to effectively replicate the SHIP2FAIR solutions, it is important that staff training is supported by a comprehensive guidebook. This manual should include operation and maintenance standard procedures/ work instructions covering the respective integrated energy systems.

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Thank you!

Nicola Chiara – nicola.chiara@linksfoundation.com

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 792276.

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Solar Heat for Industrial Process towards Food and Agro Industries commitment in Renewables

Renewable penetration in Spanish Industry

Sustainable Places 2023, 15 June 2023

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 792276.

Background

- Climate neutrality by 2050.
- Decarbonisation of the economy, stable strategic framework:
  - Climate Change Law.
  - Integrated National Energy and Climate Plan
  - Fair Transition Strategy

Background

Integrated National Energy and Climate Plan

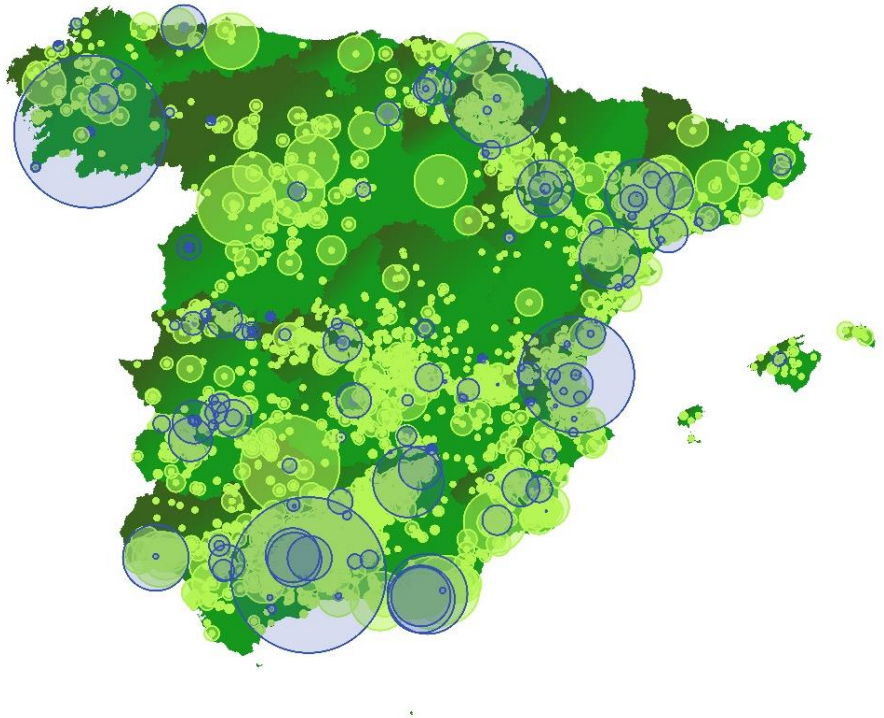
The following results are expected to be achieved:

- 21% reduction in greenhouse gas (GHG) emissions compared to 1990.
- **Significant growth in the penetration of renewable energies in Spain, reaching 74% in electricity and 42% in end use by 2030.**
- 39.6% improvement in energy efficiency.

Background

- The industrial sector is, after transport, the sector that consumes the most energy in Spain.
- Energy demands with a high thermal component.
- Need for change:
  - Decarbonised, circular and more sustainable economy model.
  - Greater weight of renewables.

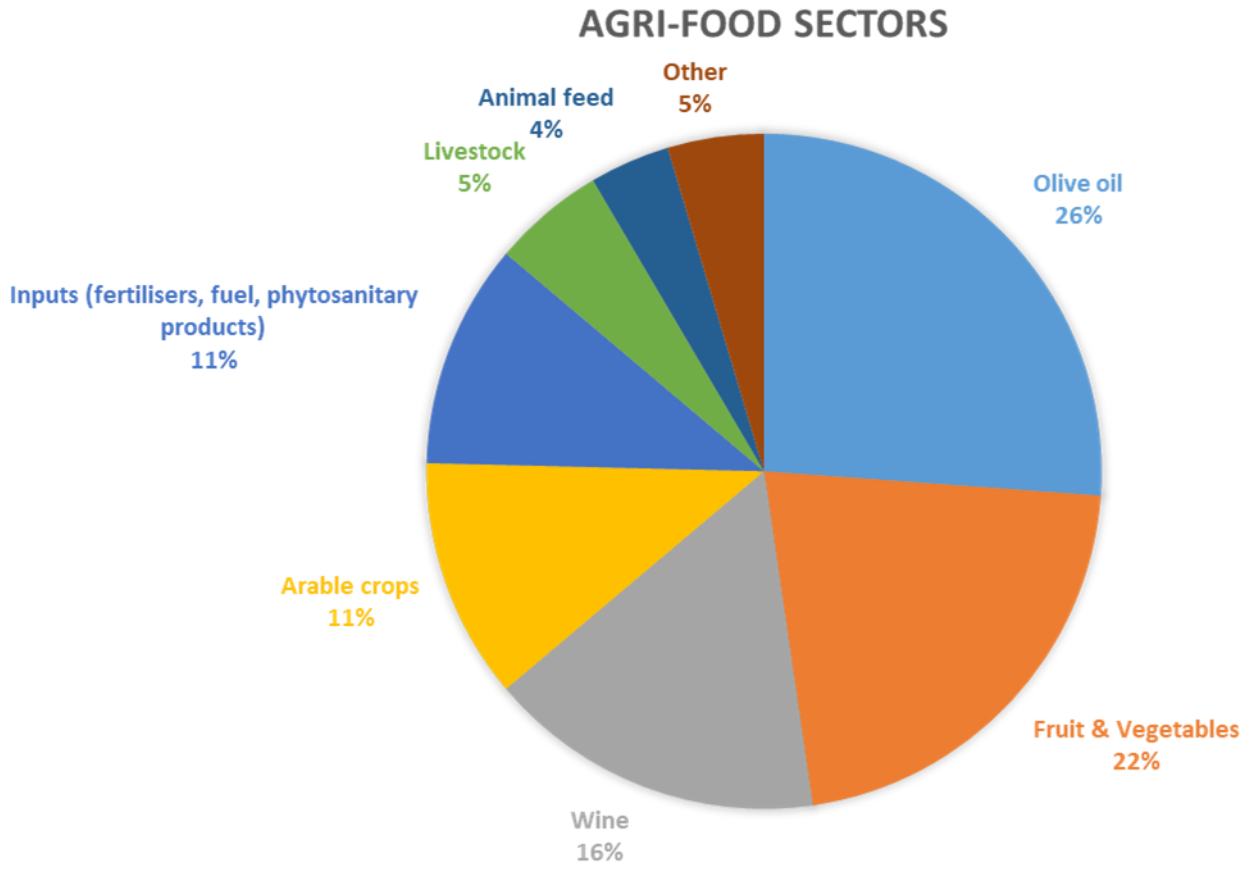
What is happening in agri-food cooperatives?



- **3.669** cooperatives (**3.190** agricultural + **479** CEC).
- **+ 1 Million** producer members.
- Turnover: **33.880** Million € (38.428 M€ included investee capital companies).
- **+123.700 direct employees**.

What is happening in agri-food cooperatives?

Survey

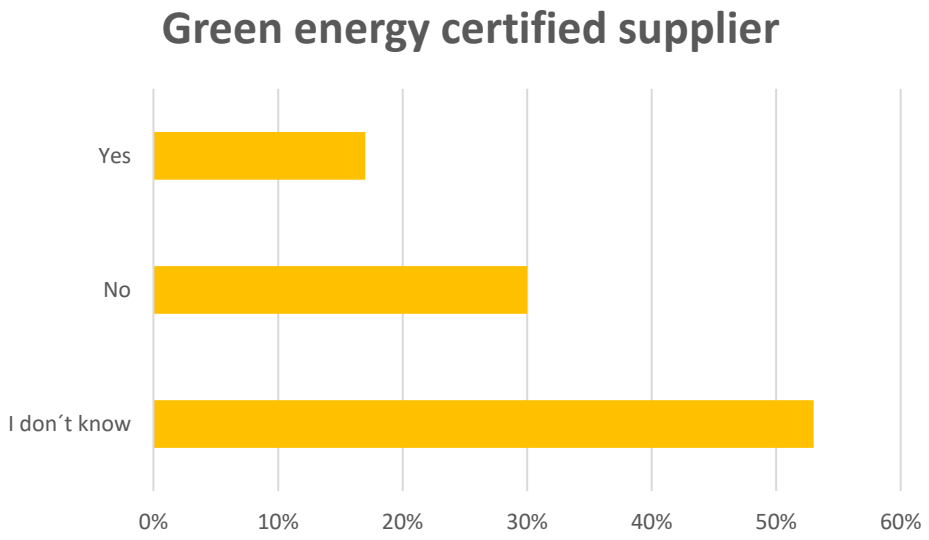


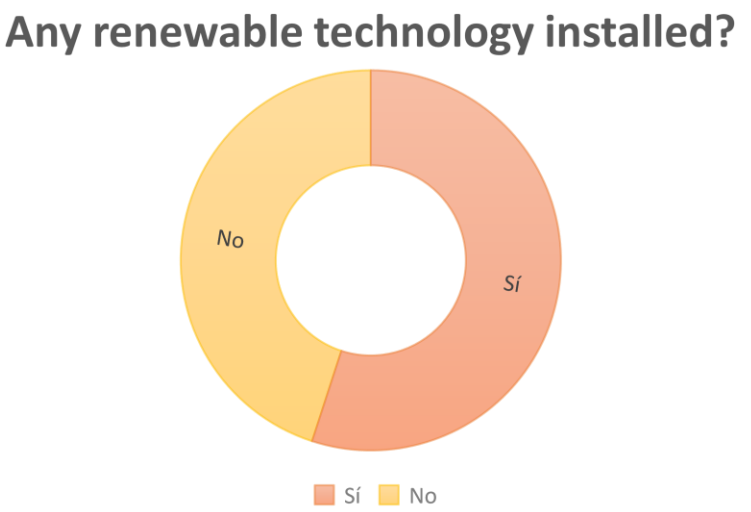
Solar Heat for Industrial Process towards Food and Agro Industries commitment in Renewables

What is happening in agri-food cooperatives?

Survey

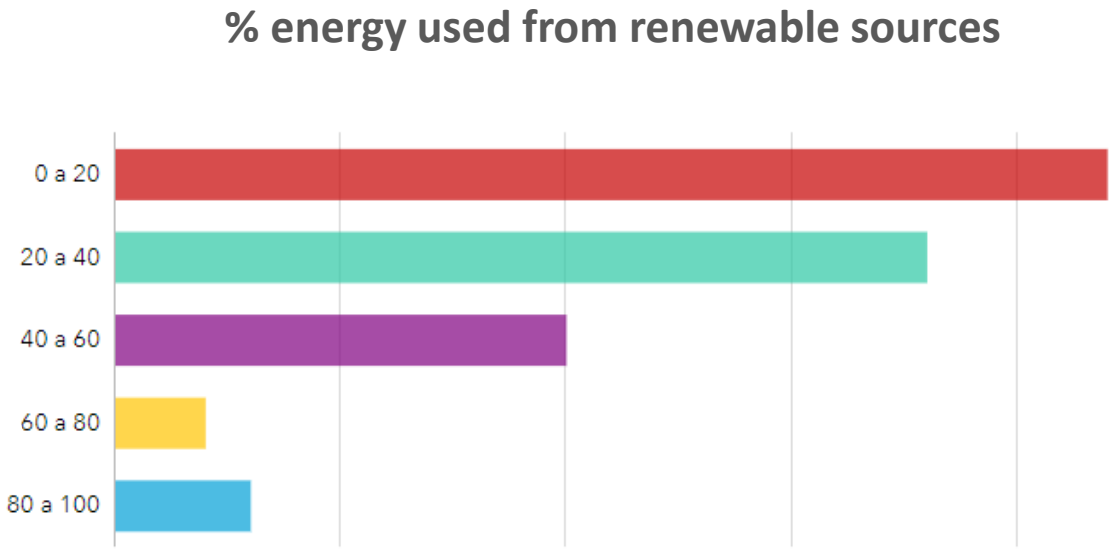
Annual energy consumption: 3 – 71,000 MWh (average 1,600 MWh)

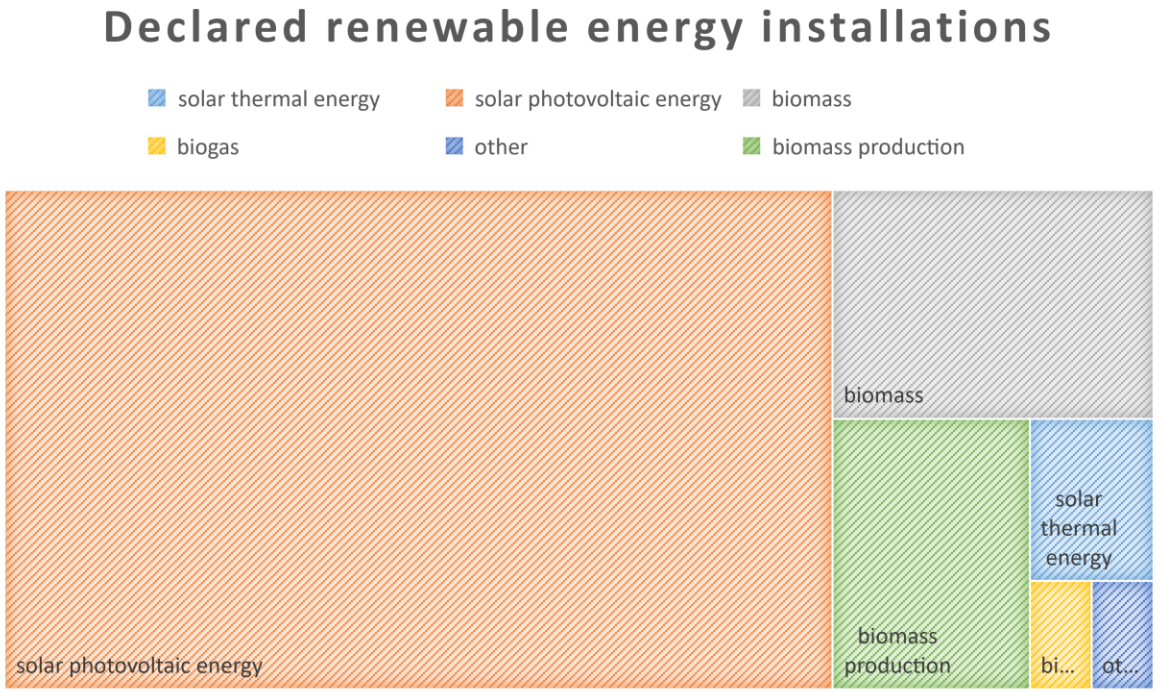




What is happening in agri-food cooperatives?

Survey





Solar Heat for Industrial Process towards Food and Agro Industries commitment in Renewables

What is happening in agri-food cooperatives?

Survey

✓ Solar thermal energy.

- **Total installed capacity:** average 28 kW
- **Annual generation:** average 29,025 kWh.
- **Ownership of the installations:** own.
- **Use:** drying, cooling, hot water, sterilisation.
- **Average temperature obtained:** 90 º C.
- **Location:** on roof.
- **Area used:** average 100 m2.
- **Technology:** flat plate collector.

✓ Solar photovoltaic energy.

- **Total installed capacity:** 10- 2,500 kW
- **Annual generation:** 10,000-2,5 million kWh
- **Ownership of the installations:** own.
- **Use:** 88 % self-consumption, 12 % only to the grid.
- **Self-consumption:**
  - Use: refrigeration, air-conditioning, lighting, drying, pre-cooling, dehydrating,
  - Discharge to the grid: 32%.
- **Location:** on roof.
- **Area used:** average 2,150 m^2. max. 40,000 m^2.

What is happening in agri-food cooperatives?

Survey

✓ Biomass consumption.

- **Total installed capacity:** 400-1,000 kW
- **Annual generation:** 100-16,000 kWh
- **Ownership of the installations:** own.
- **Use of biomass boilers:** Heat production
- **Use in industrial processes:**Drying, heating, oil shaking, heating of installations.

✓ Biogas

- **Use:** Heat production.

✓ Other technologies:

- Aerothermia.

✓ Biomass production:

- **Sources:** Olive pit>olive pomace>grape seeds>pruning
- **Annual production:** average 1,000 tons.
- **Destiny:** self-consumption, sale.

What is happening in agri-food cooperatives?

Survey

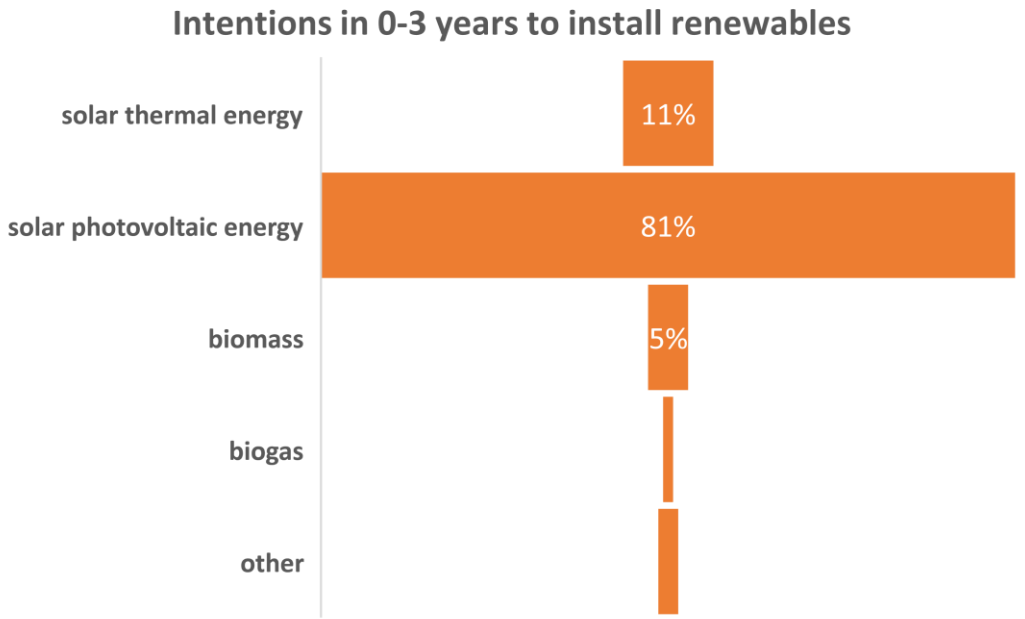
- Only 30% have carried out an energy audit.
- Around 50% have implemented energy efficiency measures.
- Between 50 - 60 %...
  - Has interest in energy communities.
  - Has an interest in agrovoltaics.
  - Considers that the cooperative should be a promoter of the deployment of both.

What is happening in agri-food cooperatives?

Survey

In the near future…

…66 % intend to expand their capacity or make use of other renewable technologies in 0-3 years.



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Thank you!

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