

# Évora Molten Salt Platform (EMSP)

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# The EMSP facility at a glance



HelioTrough® 2.0: 684 m, 4,500 m<sup>2</sup>  
HTF: Molten Salts  
Power: **3.5 MW<sub>th</sub>**  
Tmax: **565 °C**



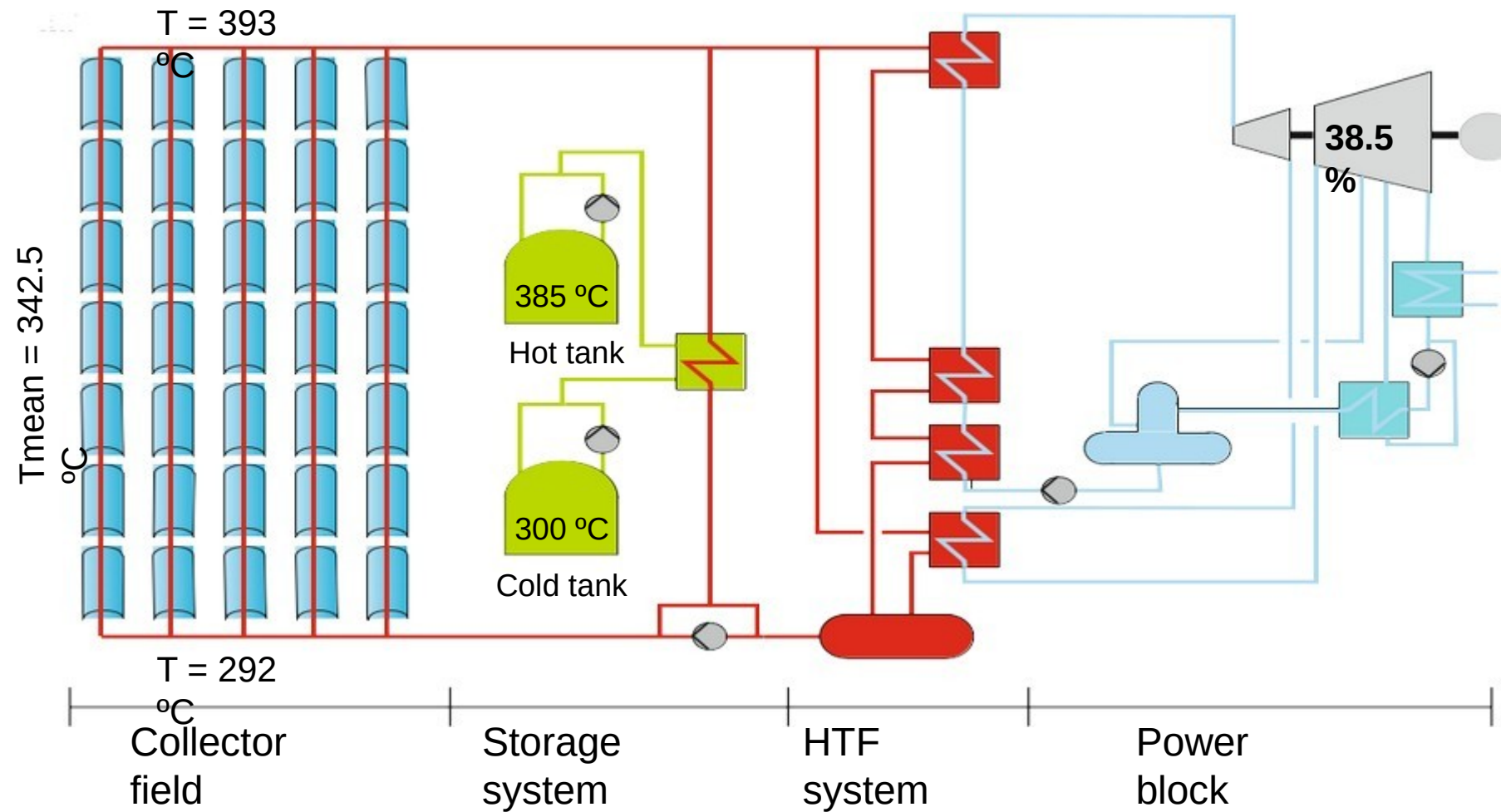
Power: **1.8 MW<sub>th</sub> @ 14.0 MPa / 560 °C**  
Economizer/evaporator,  
air cooled condenser,  
pressure reducing station



2-Tank TES  
34 m<sup>3</sup> (ca. 92 tons salt)  
Capacity: **5.4 MWh @ 565 °C / ΔT = 275 K**

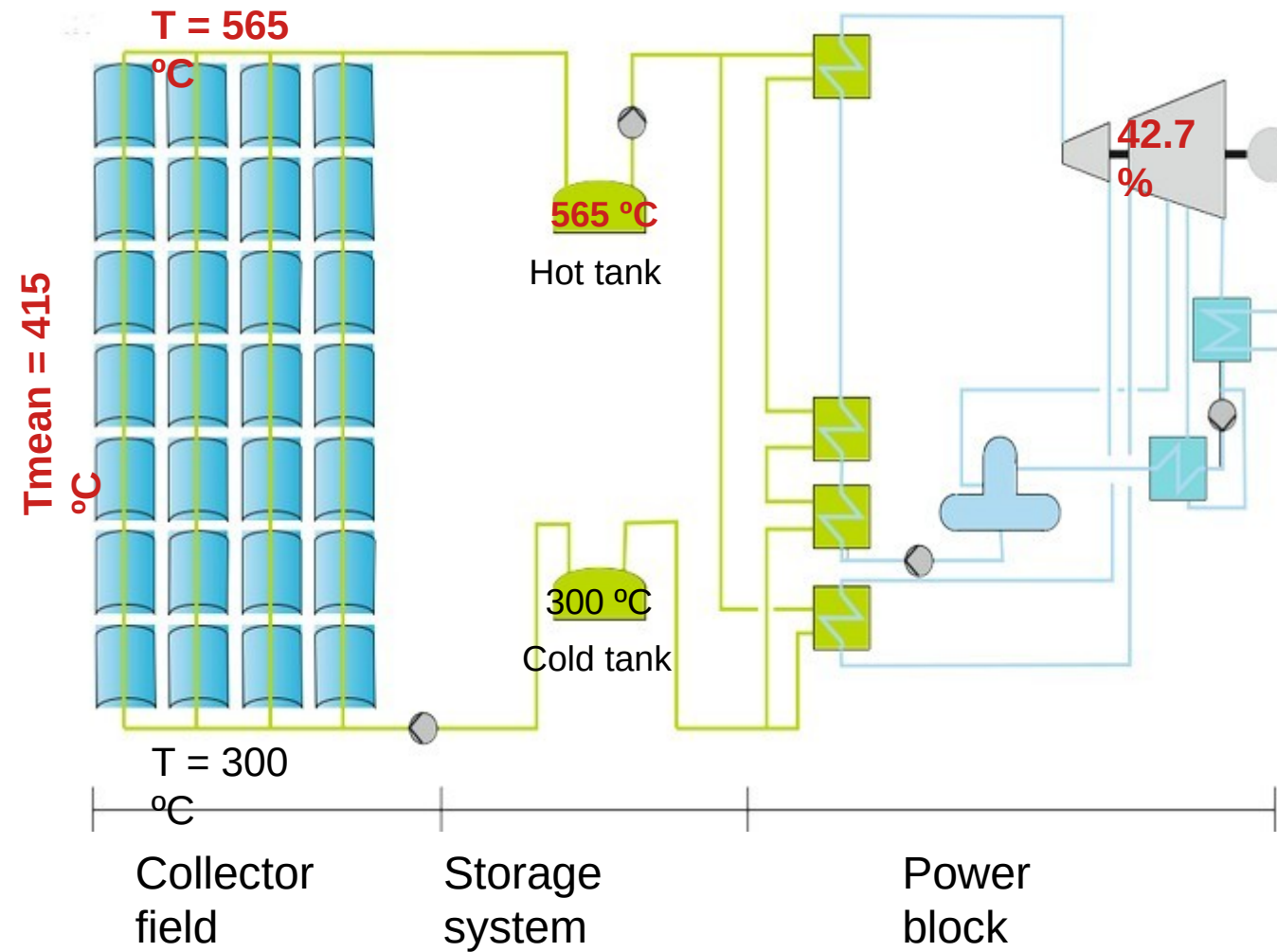


# Virtues of molten salts in parabolic troughs

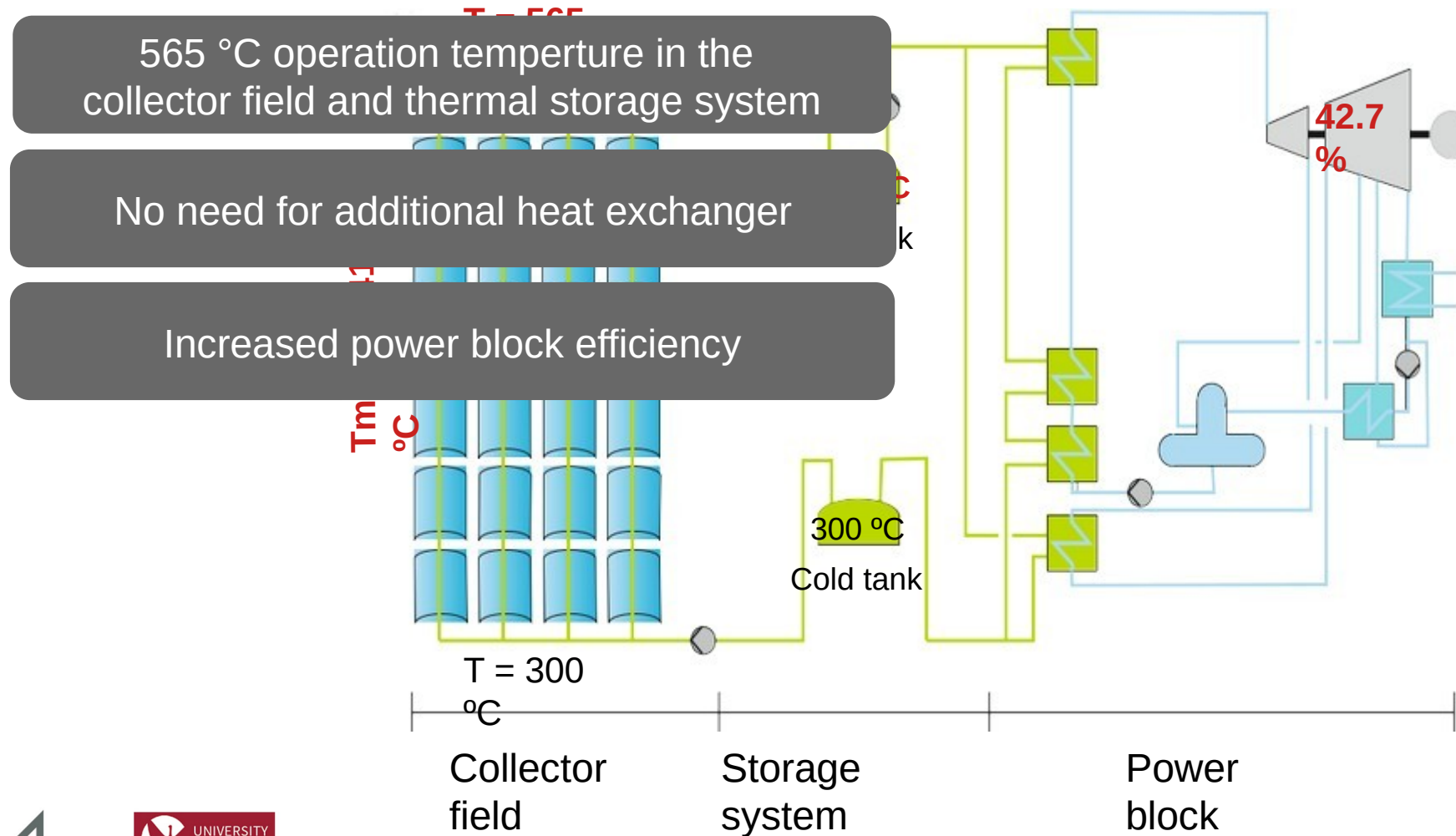




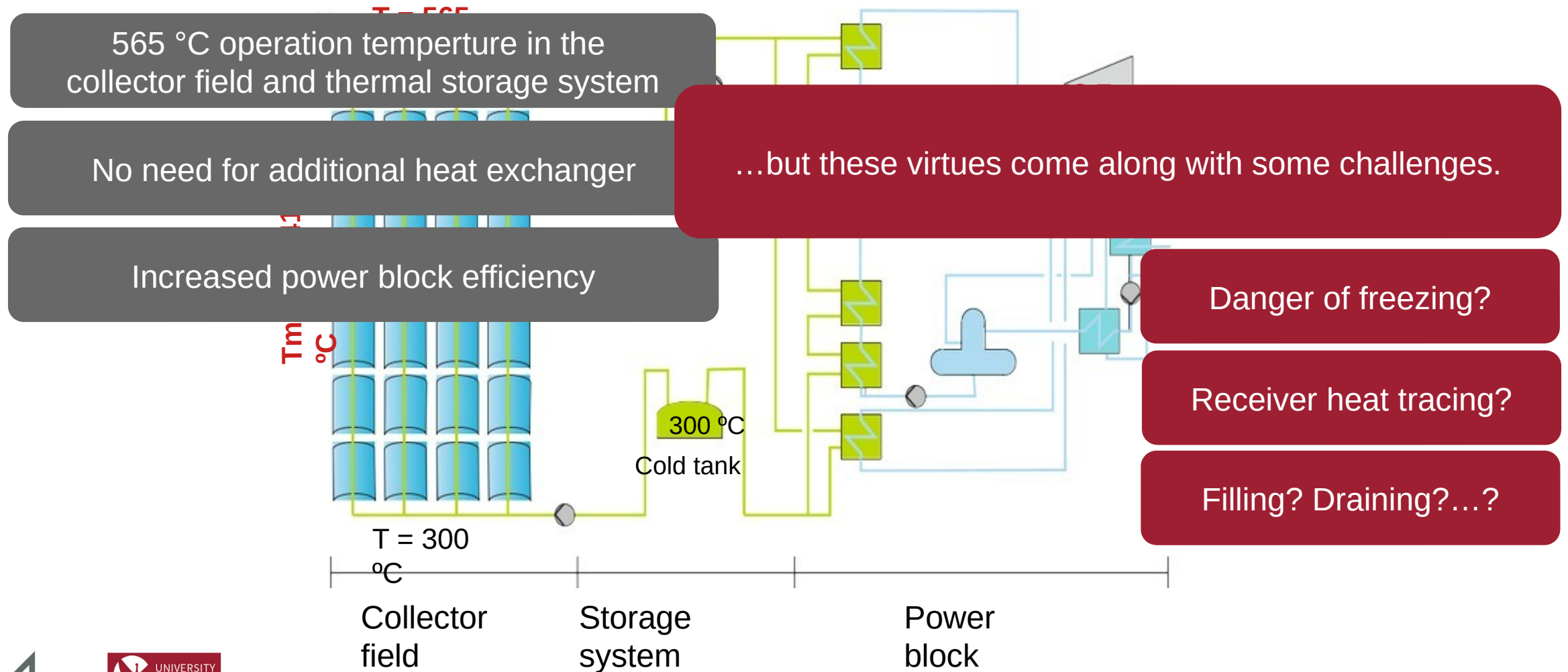
# Virtues of molten salts in parabolic troughs



# Virtues of molten salts in parabolic troughs



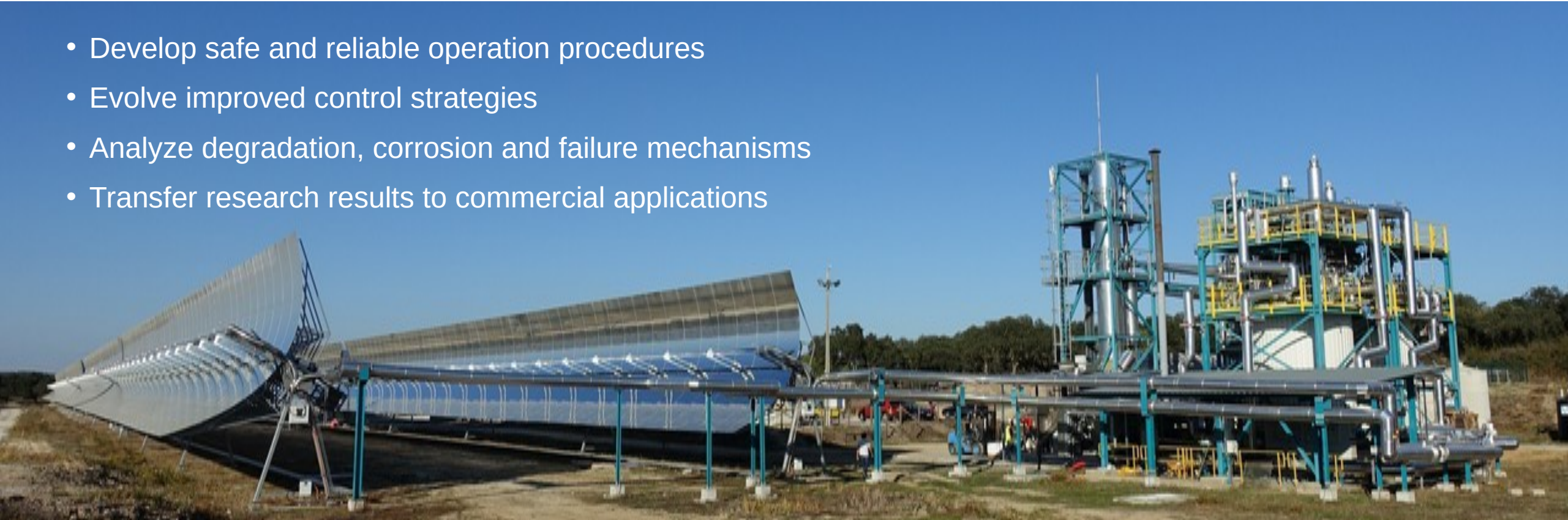
# Virtues of molten salts in parabolic troughs



# Our joint research targets

## Tackling major concerns

- Develop safe and reliable operation procedures
- Evolve improved control strategies
- Analyze degradation, corrosion and failure mechanisms
- Transfer research results to commercial applications





# Complementary roles of EMSP industrial and R&D partners

## HPS2 project consortium

Solar field &  
TSK FLAGSOL

Receiver  
RIOGLASS

Heat tracing  
eltherm®

Steam generator  
steinmüller  
engineering

Molten salts  
YARA

Gefördert durch:



aufgrund eines Beschlusses  
des Deutschen Bundestages

Coordination & operation

Operation co-funding



**RWE**



# Achievements in technical improvement

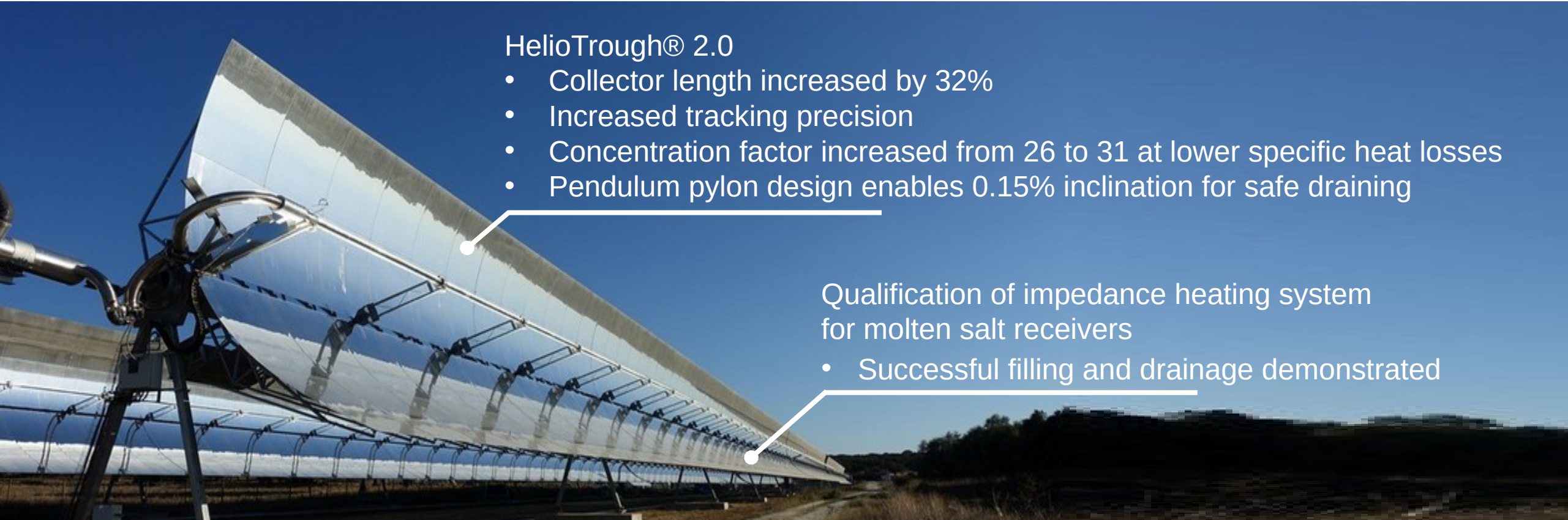
## Optimized components for molten salt operation

### HelioTrough® 2.0

- Collector length increased by 32%
- Increased tracking precision
- Concentration factor increased from 26 to 31 at lower specific heat losses
- Pendulum pylon design enables 0.15% inclination for safe draining

### Qualification of impedance heating system for molten salt receivers

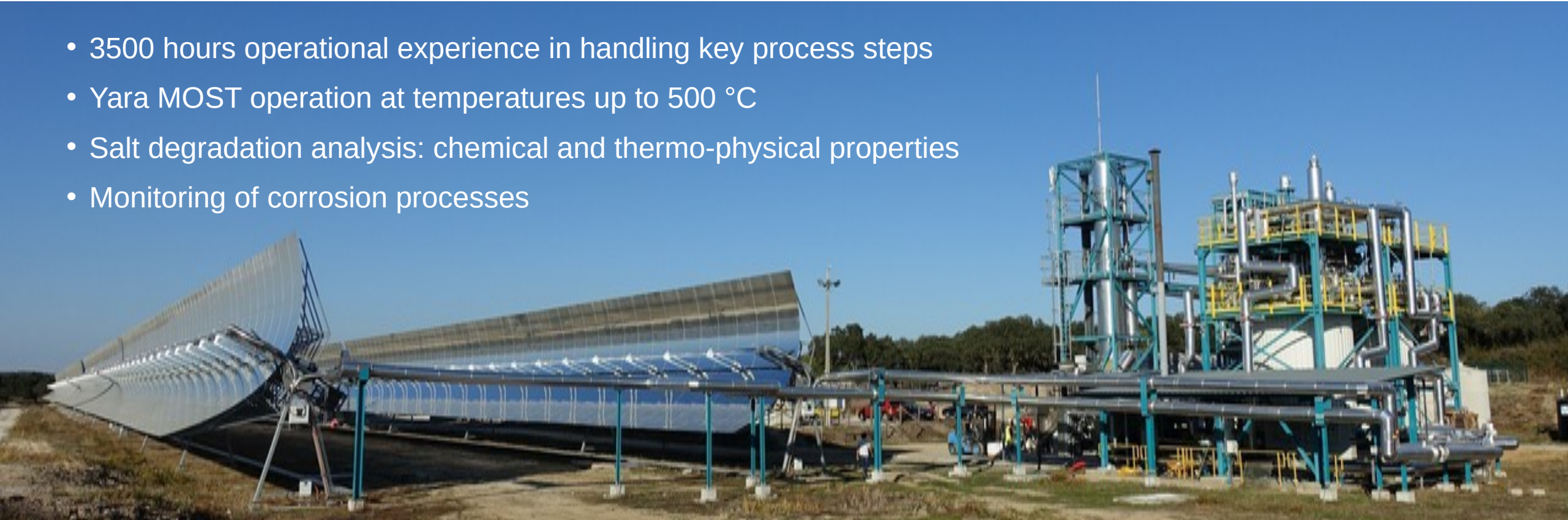
- Successful filling and drainage demonstrated



# Achievements in molten salt operation

## Safety and reliability demonstrated

- 3500 hours operational experience in handling key process steps
- Yara MOST operation at temperatures up to 500 °C
- Salt degradation analysis: chemical and thermo-physical properties
- Monitoring of corrosion processes

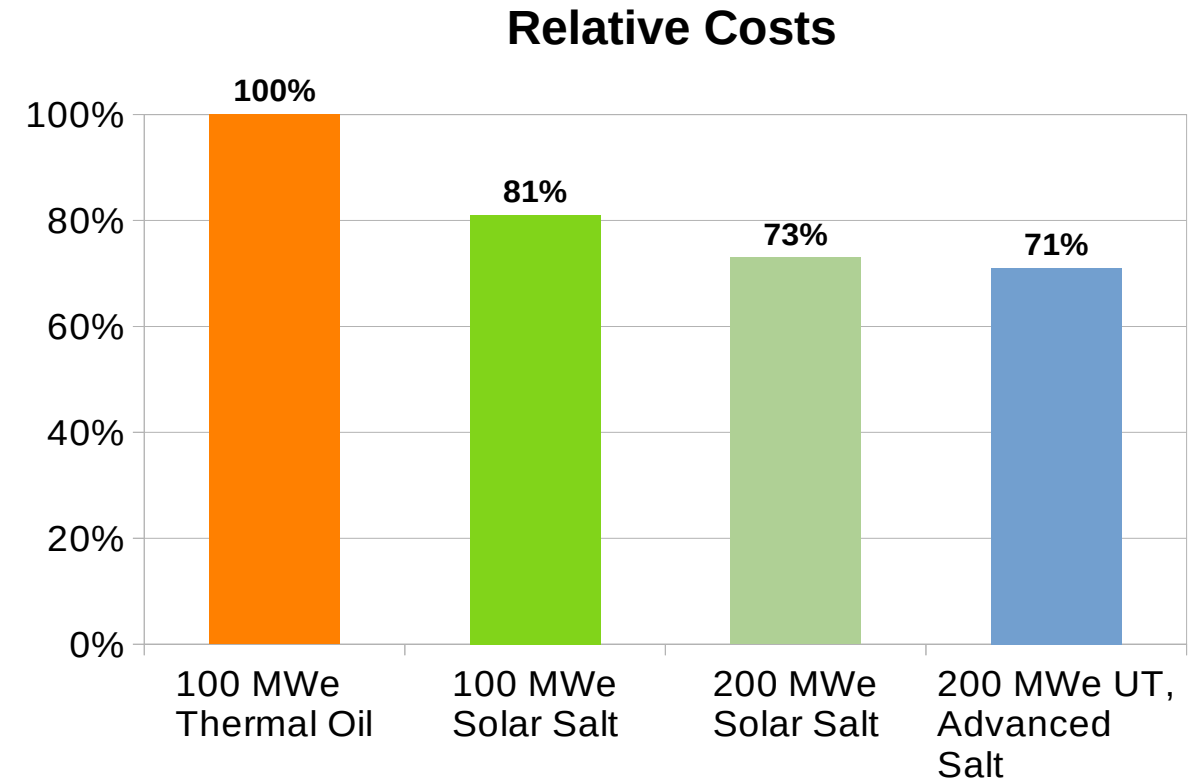


# Technology outlook

## Cost reduction potential of molten salt-based CSP

### Cost reduction by

- Higher cycle efficiency by increased outlet temperature
- Higher storage capacity
- Fewer components
- Cheaper, more stable and more sustainable heat transfer fluid
- Less pumping power – better scaling



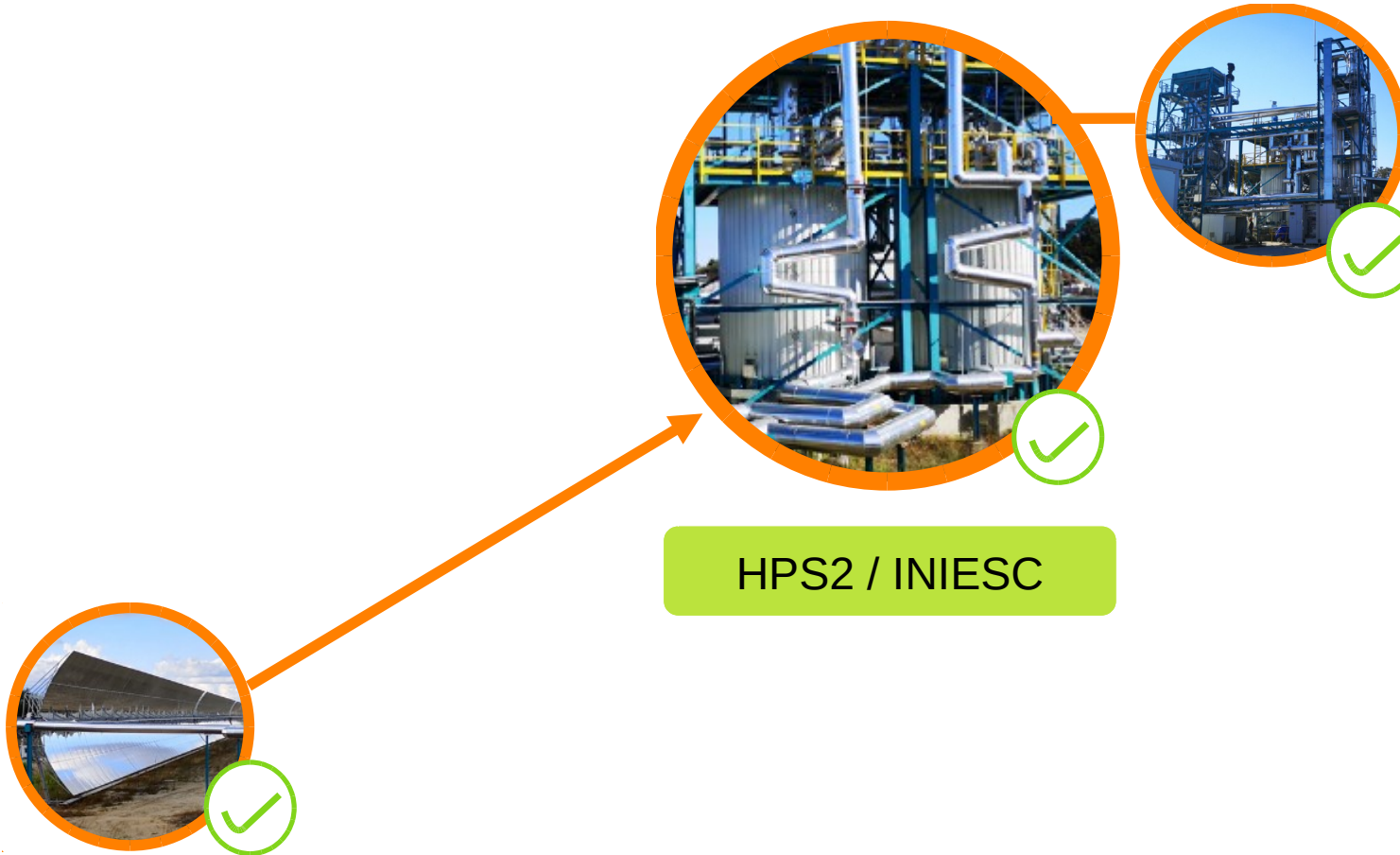
Weinrebe et al: SolarPACES 2013



# Role of molten salt in the future energy system

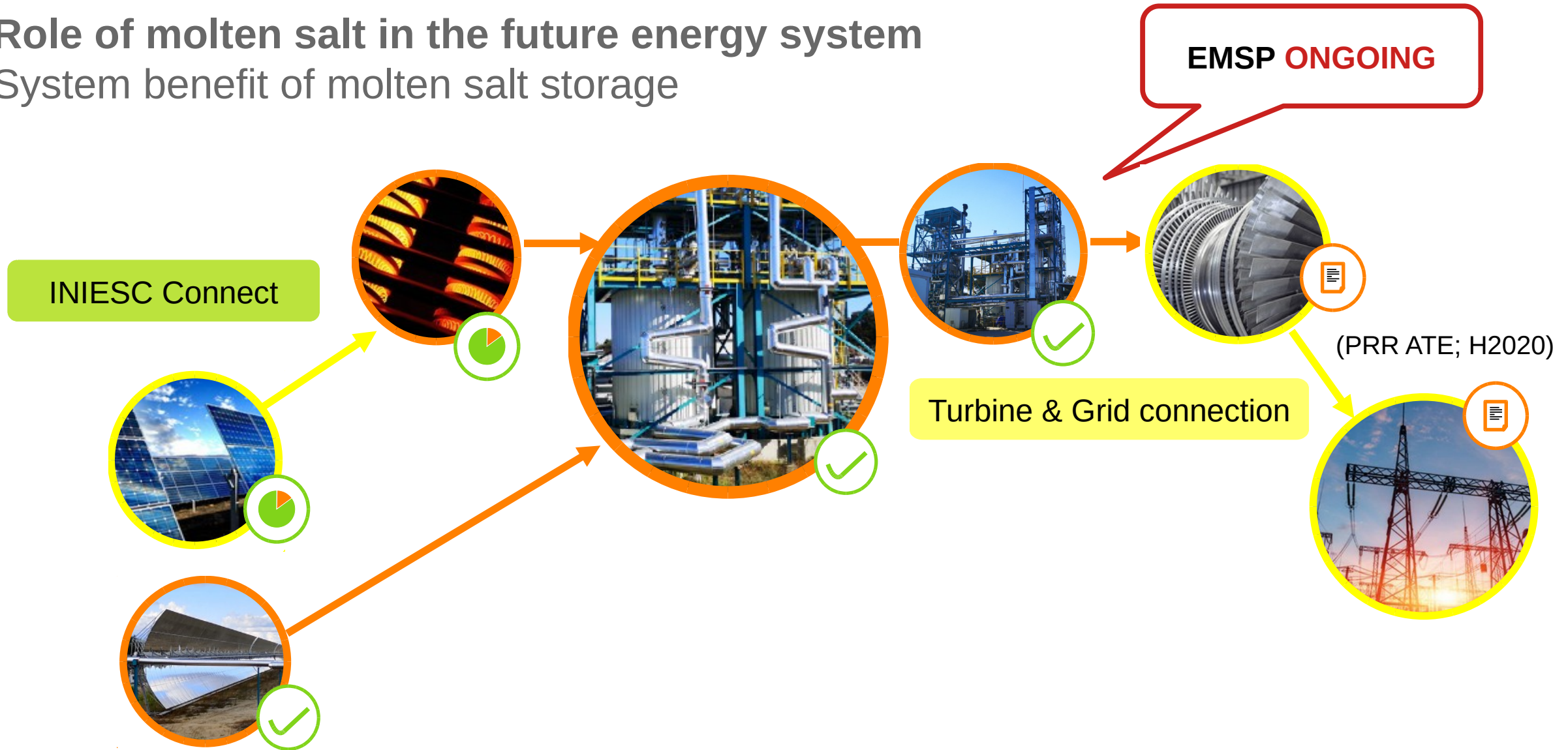
System benefit of molten salt storage

EMSP **CURRENT**



# Role of molten salt in the future energy system

## System benefit of molten salt storage



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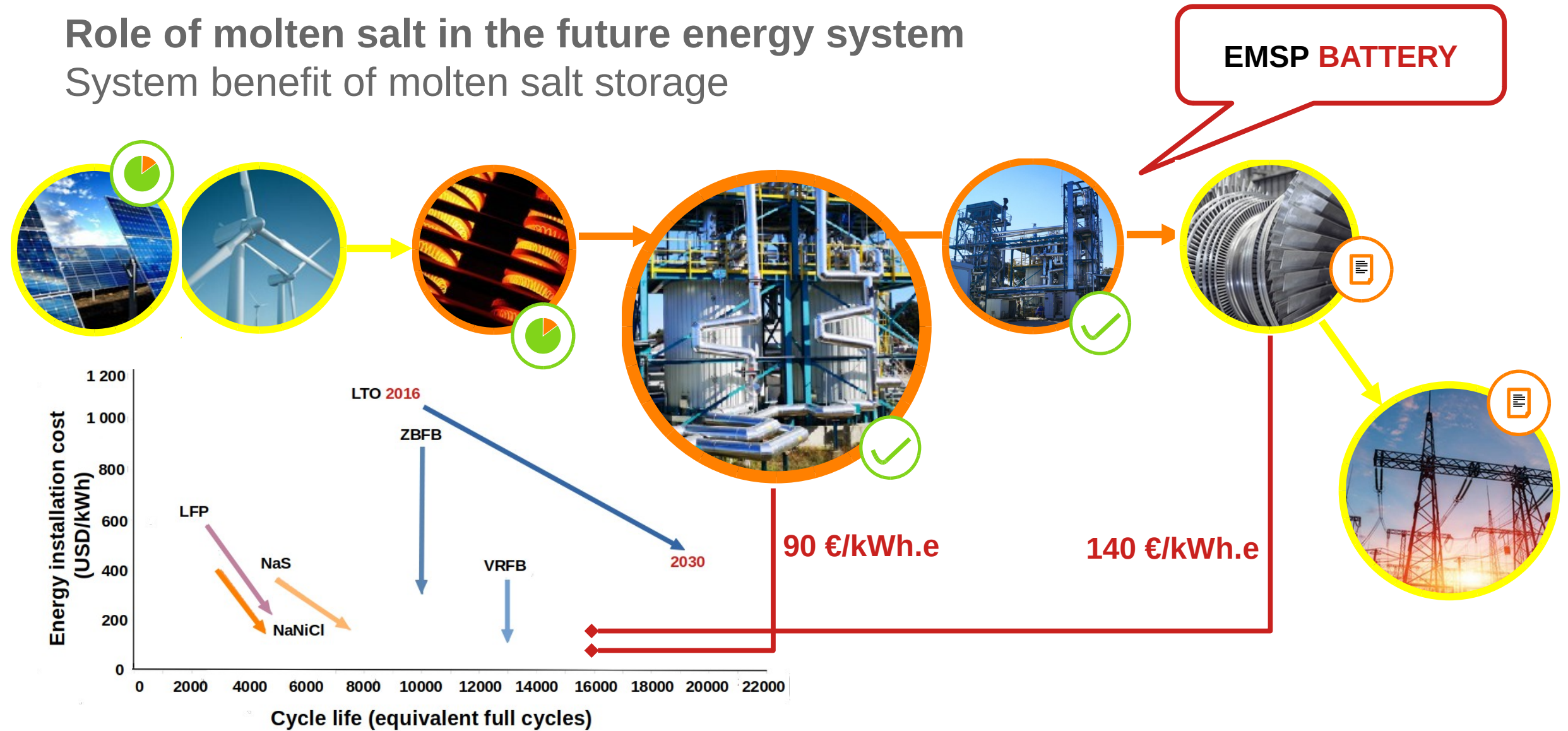


Pictures in <https://www.istockphoto.com/pt>



# Role of molten salt in the future energy system

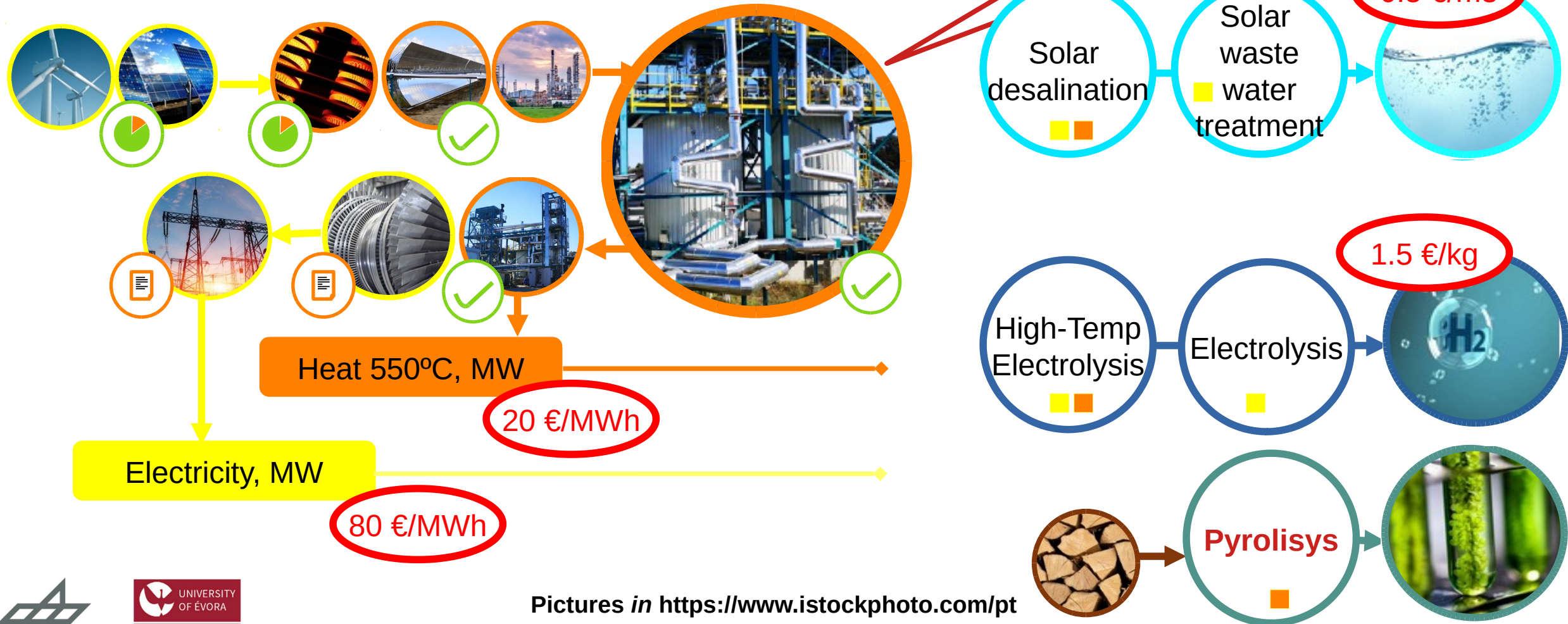
## System benefit of molten salt storage



Pictures in <https://www.istockphoto.com/pt>

# Role of molten salt in the future energy system

## Chances to accelerate hydrogen production



# Technology hub EMSP

Attracting new businesses in the Alentejo region



Manufacturer

Procurement

Manufacturing

Sales support

Commercial /  
Service

Marketing

After sales

Academia  
R&D

Management

Human resources

New technology

Raw materials

Steel, mirrors, concrete,  
power electronics &  
cabling

Steel,  
electrolyz.

Steel,  
RO

Reactors

IT, control

Financing

O&M

Accountants, Managers, Lawyers

Engineers, Technicians, Researchers

PCM-TES

sCO2

HT-Electr.

ZLD

Solar fuel

Salts

Brine

Biomass



# Technology hub EMSP

Impacting the economy and promoting Regional development

## Construction

- **GDP impact: 9 116 M€** (6 401 direct + 40% indirect)  
**2.9 x more than other renewables**

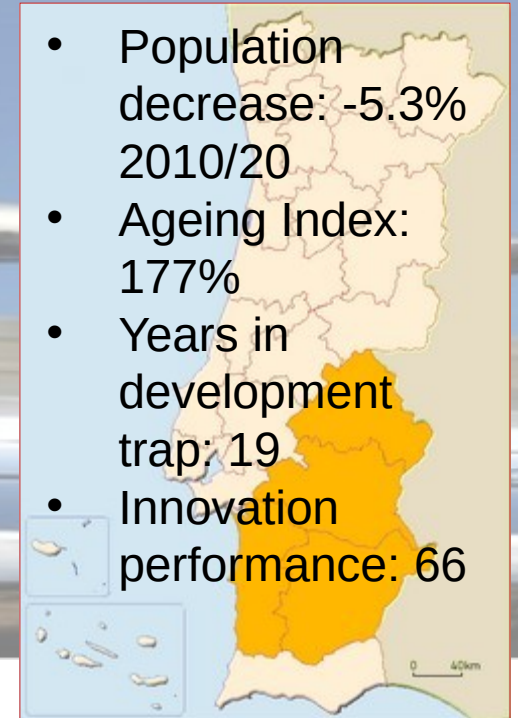
- **Job creation: 72 093 jobs** (23 437 direct + 200% indirect)

## Operation

- **Job creation: 2 109 jobs** (937 direct + 1172 indirect)
- **Electricity production: > 2.3 GWh / (GW.year)**
- **Capacity factor: > 35%** (PV 12%, Hydro 17%, Wind 24%)
- **Avoided emissions: 1.1 M tCO<sub>2</sub> / year**

## CSP Impacts (1 GW)

- Population decrease: -5.3% 2010/20
- Ageing Index: 177%
- Years in development trap: 19
- Innovation performance: 66



# Summary and Acknowledgements

## Achieved to date

- Successful demonstration of innovative “full Molten Salt” CSP Plant concept
- Improved component performance and overall Plant efficiency
- Experience with O&M enabling “fast track” to bankability and market
- Industry “show room” for MS components and O&M strategies

## Ensuing steps

- Power block and Grid connection to dispatchability demonstration
- MS electrification for Carnot Battery concept demonstration
- MS driven Renewable gases production via pyrolysis and H Electrolysis

• **DEMONSTRATION OF 100% RENEWABLE AND DISPATCHABLE ENERGY SYSTEM**

# Summary and Acknowledgements

## Financing



Gefördert durch:



Bundesministerium  
für Wirtschaft  
und Klimaschutz

aufgrund eines Beschlusses  
des Deutschen Bundestages

**RWE**



**FCT**  
Fundação  
para a Ciência  
e a Tecnologia

**ALENTEJO**  
2020

**PORTUGAL**  
2020



UNIÃO EUROPEIA  
Fundo Europeu  
de Desenvolvimento Regional

## Industrial Partners



**TSK FLAGSOL**

**RIOGLASS**

**eltherm®**



**steinmüller**  
engineering





# Contact information

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