HIFLEX and PreMa
Innovative Solar Particle Technology for Power and Heat

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IN-POWER Workshop
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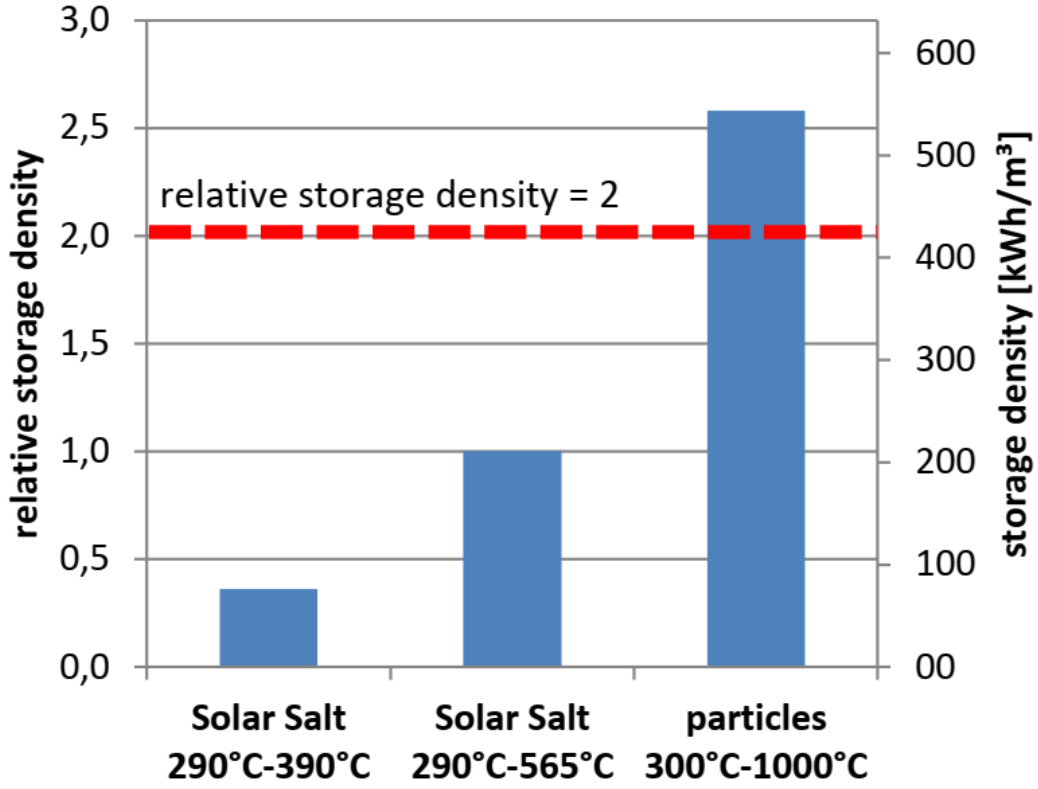
HIFLEX
HIgh Storage Density Solar Power Plant for FLEXible Energy Systems

- Particle Tower Technology: Storage capacity more than two times higher than current mainstream solutions

Bauxite particles, 0.3 < d < 1mm



Project information

HIFLEX

Grant agreement ID: 857768

Status

Ongoing project

Start date	End date
1 September 2019	**31 August 2023**

Funded under:

H2020-EU.3.3.2.

Overall budget:
€ 18 361 356,25

EU contribution
€ 13 557 625

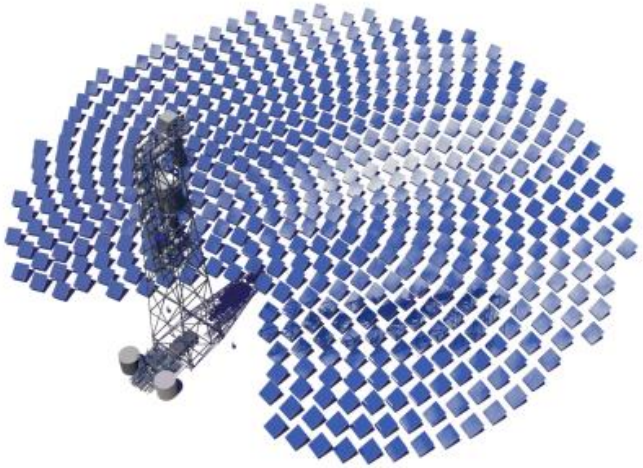
Coordinated by:

KT - KINETICS TECHNOLOGY SPA

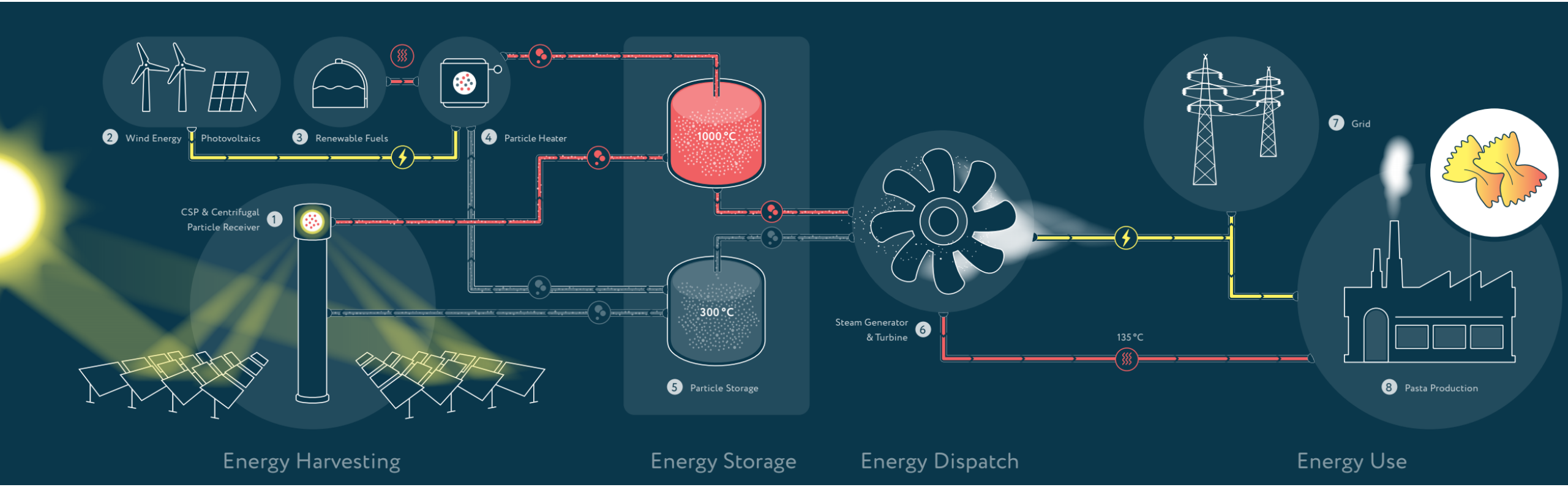
Italy

HIFLEX Objectives

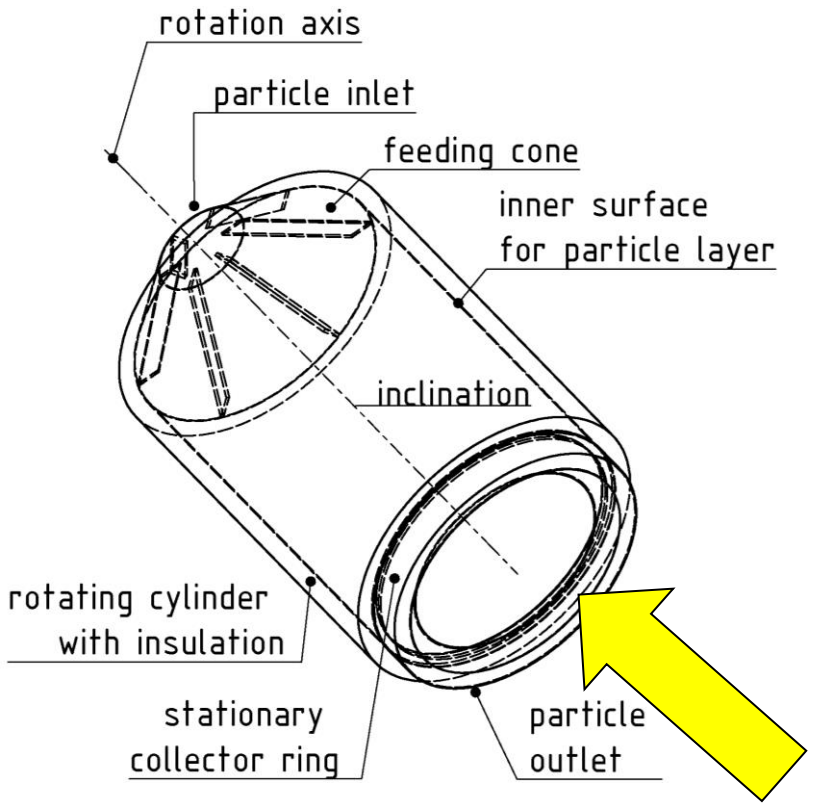
- Design, build and operate a pre-commercial particle-based solar tower system including:
  - 20 MWh_{th} particle storage system with 2.5x higher storage density
  - 6000 m² heliostat field, providing up to 2 MW/m² in the receiver aperture
  - 2.5 MW_{th} particle receiver
  - 800 kW_{th} particle to steam generator for 620°C
  - electric and fuel-based particle heaters
- develop component and system models for performance and cost prediction



HIFLEX: Solar power plant with storage for the supply of flexible energy

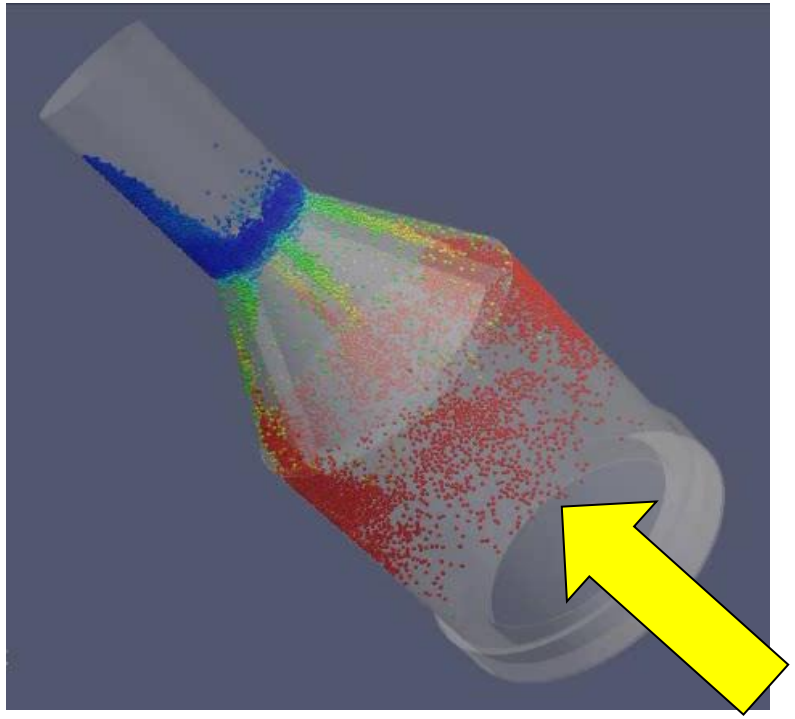


Centrifugal Direct Absorption Particle Receiver “CentRec“



Direct absorption concept:

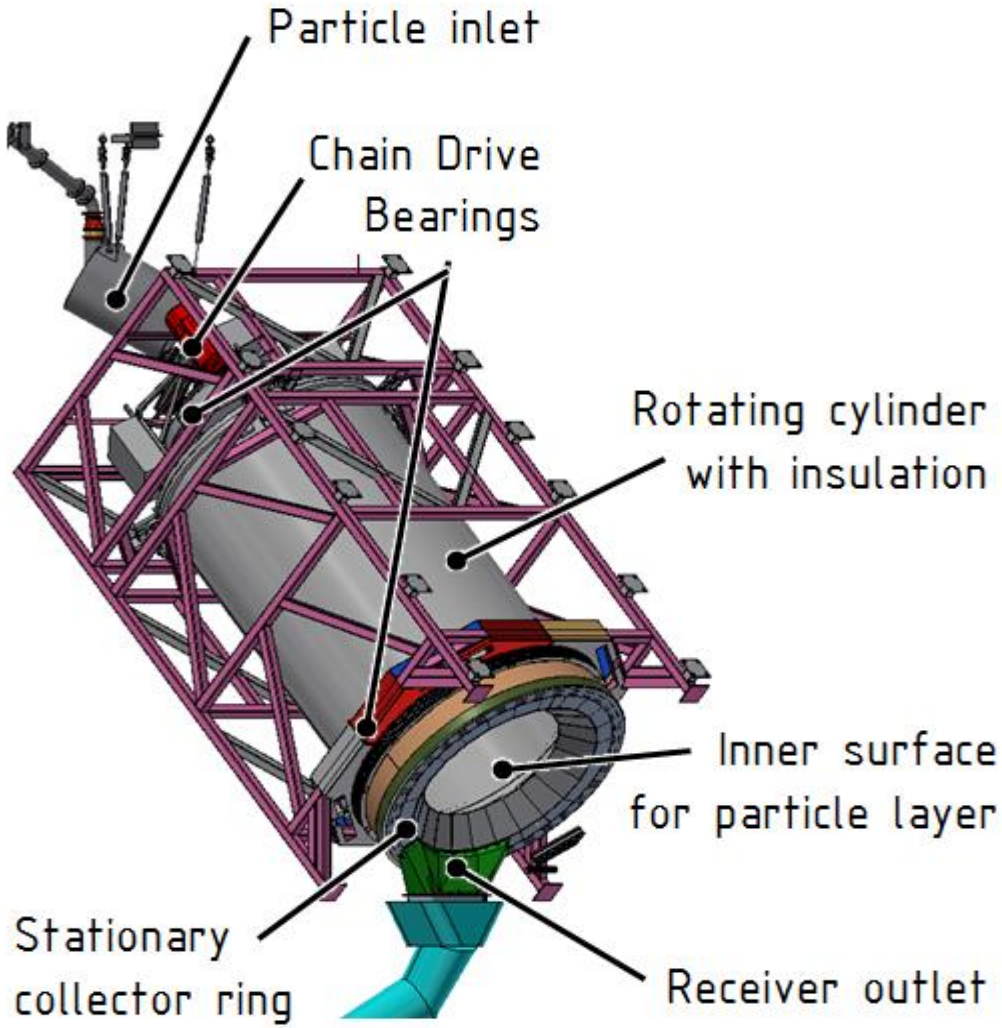
- Particles are directly irradiated and heated
- No conduction of solar heat through HT alloy materials



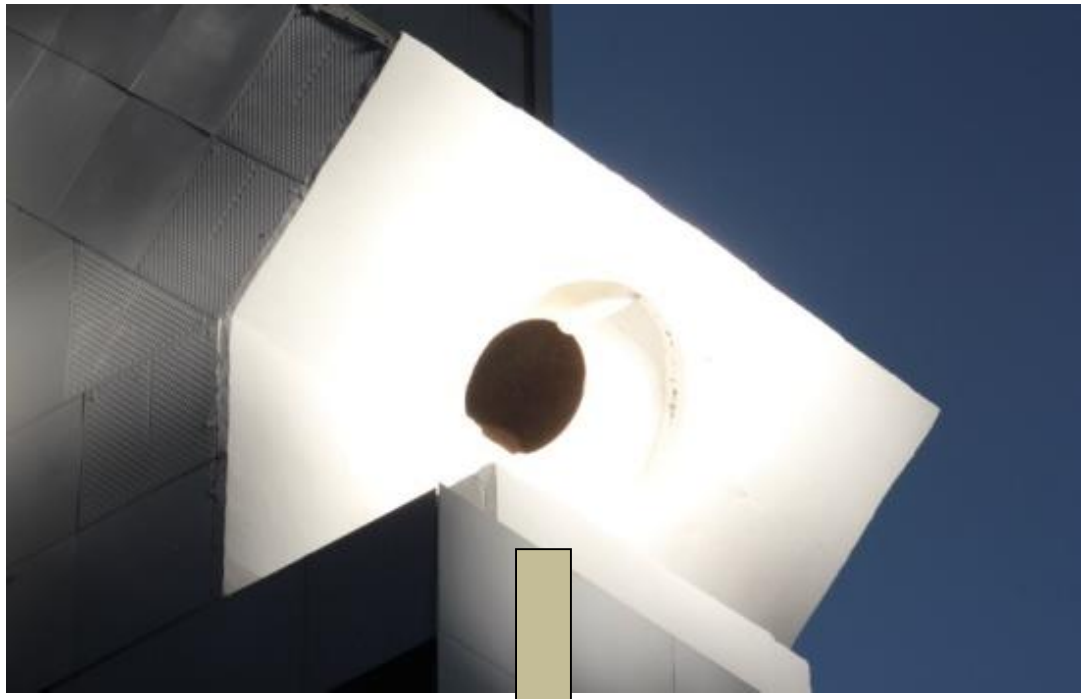
- Particle residence time / receiver outlet temperature controlled by adjusting rotational speed
- Thin, optical dense layer for all load conditions

Prototype Demonstration of CentRec® Receiver

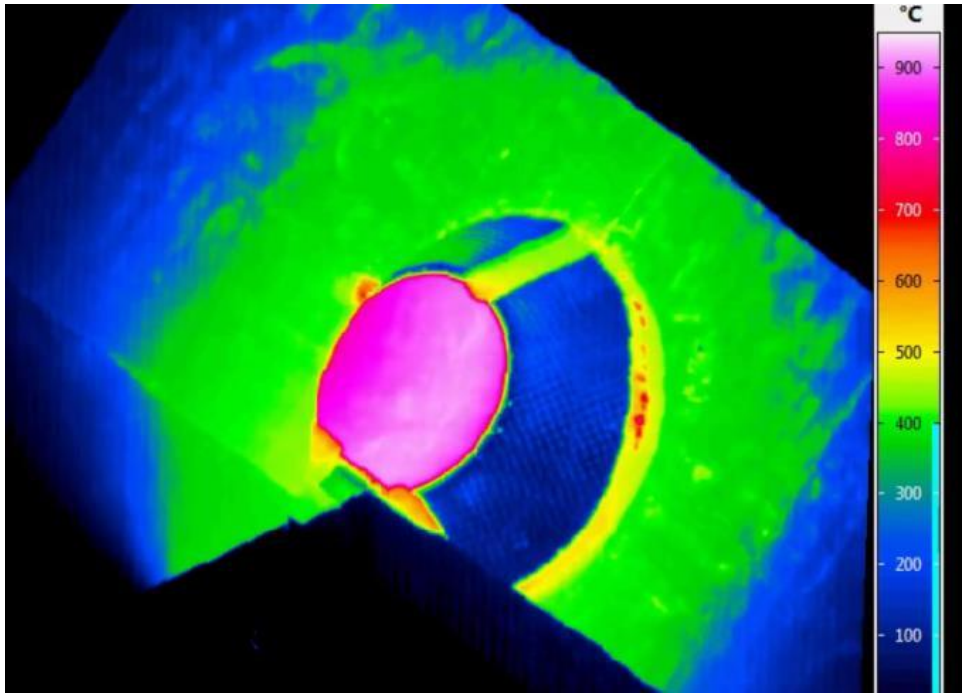
CentRec® Receiver Prototype during installation into DLR Solar Tower Jülich, Germany



The CentRec® Particle Receiver Tests at DLR Solar Tower



Tested in DLR Solar Tower up to 965°C



IR image taken during operation

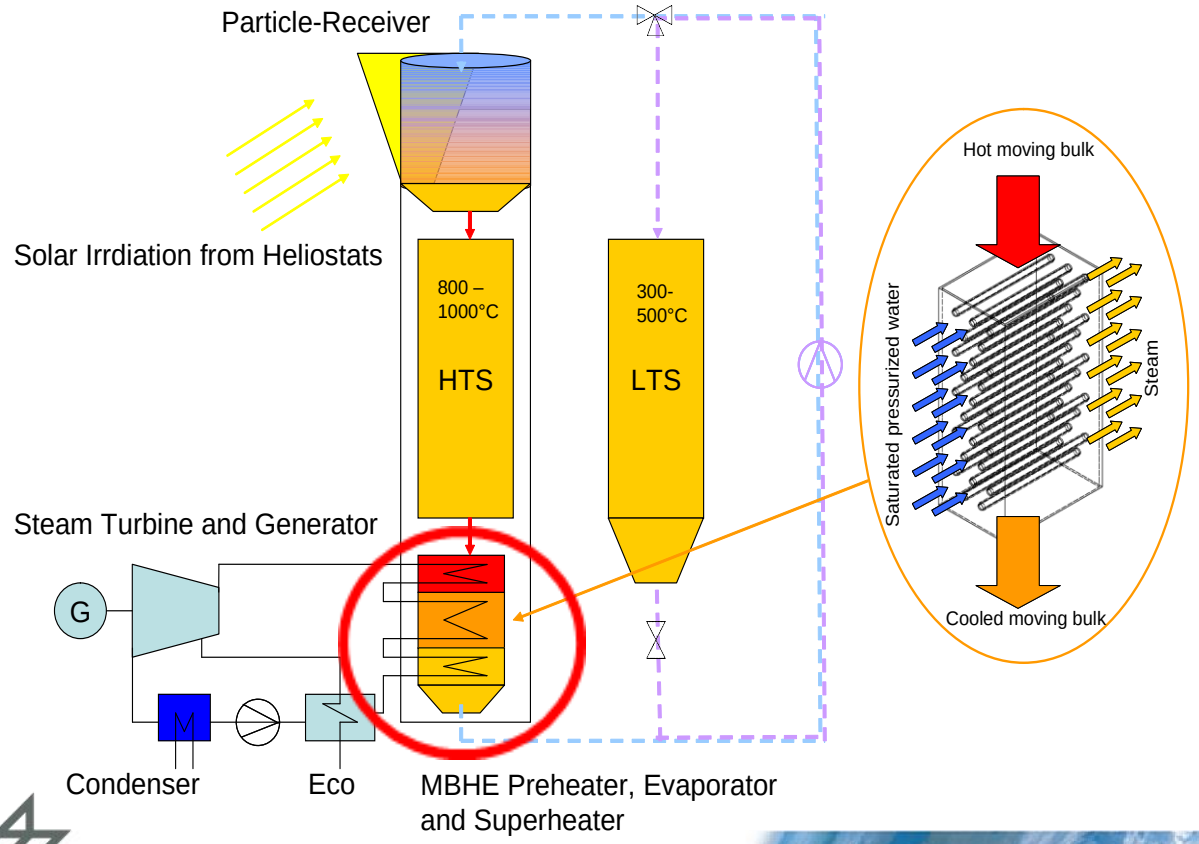
Particle Steam Generator

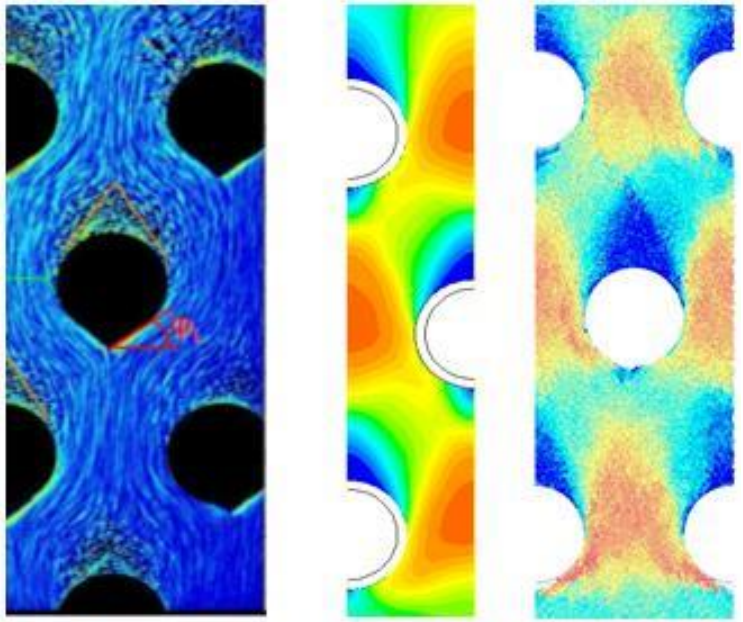
Demonstration of steam generation at 620°C (steam temperature suitable for modern steam cycles)

Concept: Moving bed (slow cross flow of hot particles over tubes with the fluid inside the tube)

+ Large experience in industrial and utility boilers (without particles)

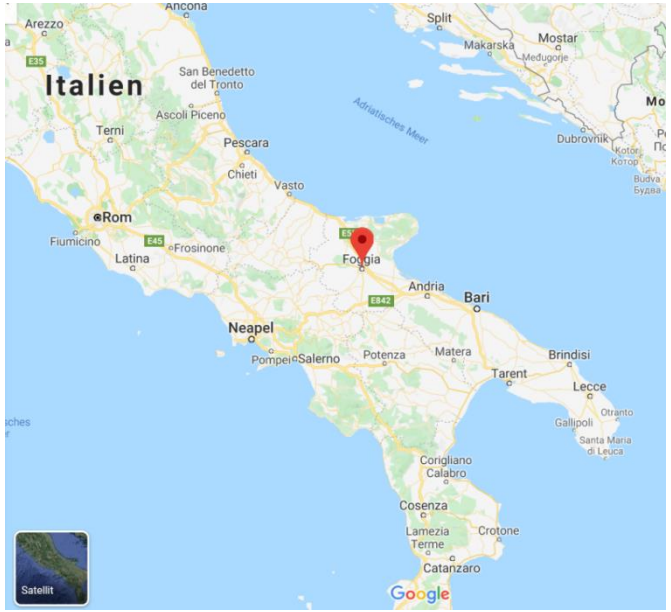
- Relative low heat transfer between particles and tubes: ~ 300 W/m²K





HIFLEX Plant Location

- Foggia, South Italy
- Aside of Barilla pasta plant
- Process heat delivered to plant for pasta drying

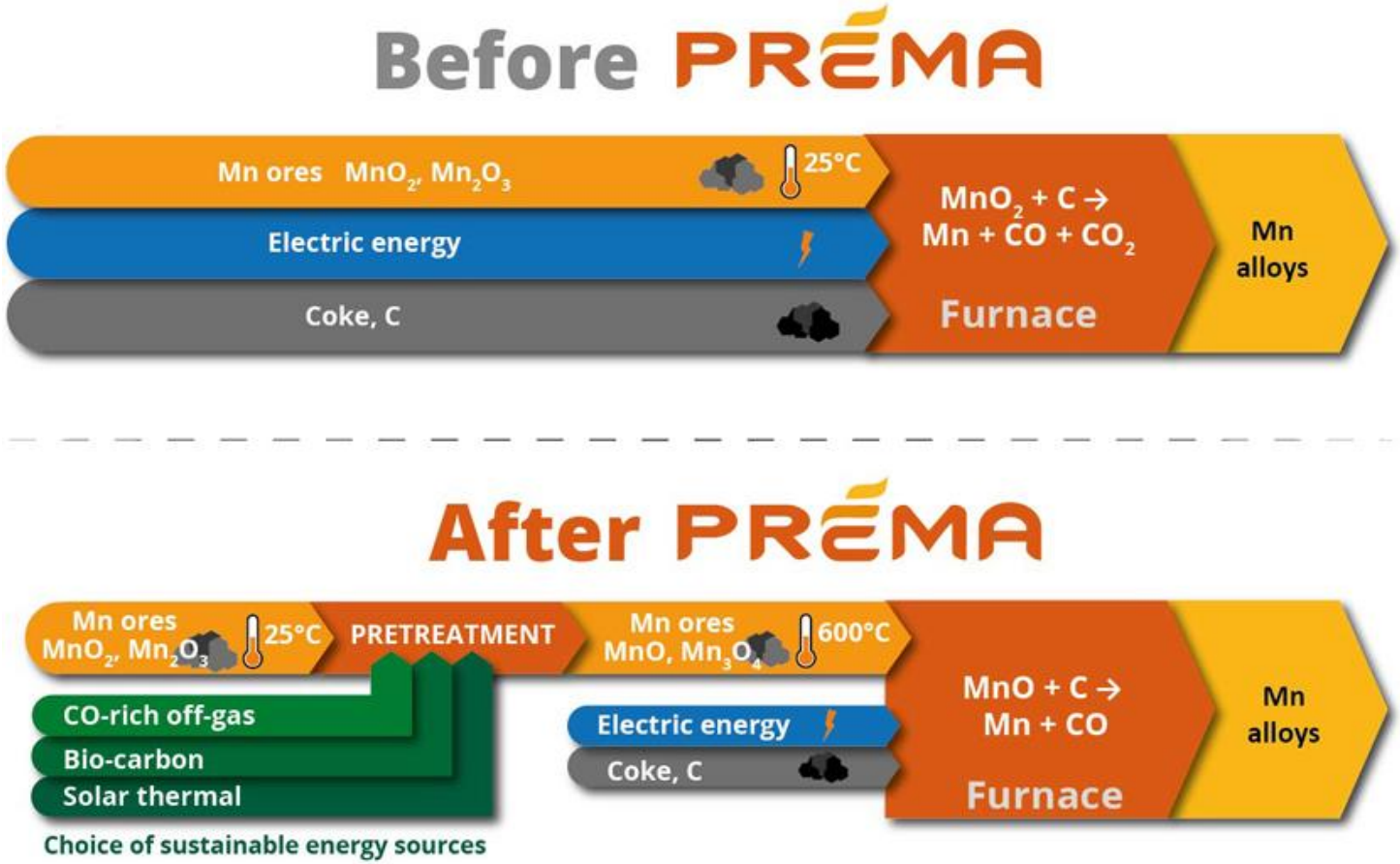


PreMa – Reduced CO_2 emissions and consumption of electrical energy in Mn-alloy production

Energy efficient, primary production of manganese ferroalloys through application of novel energy systems in the drying and pre-heating of furnace feed materials

PRÉMA

Project is co-funded from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement No 820561

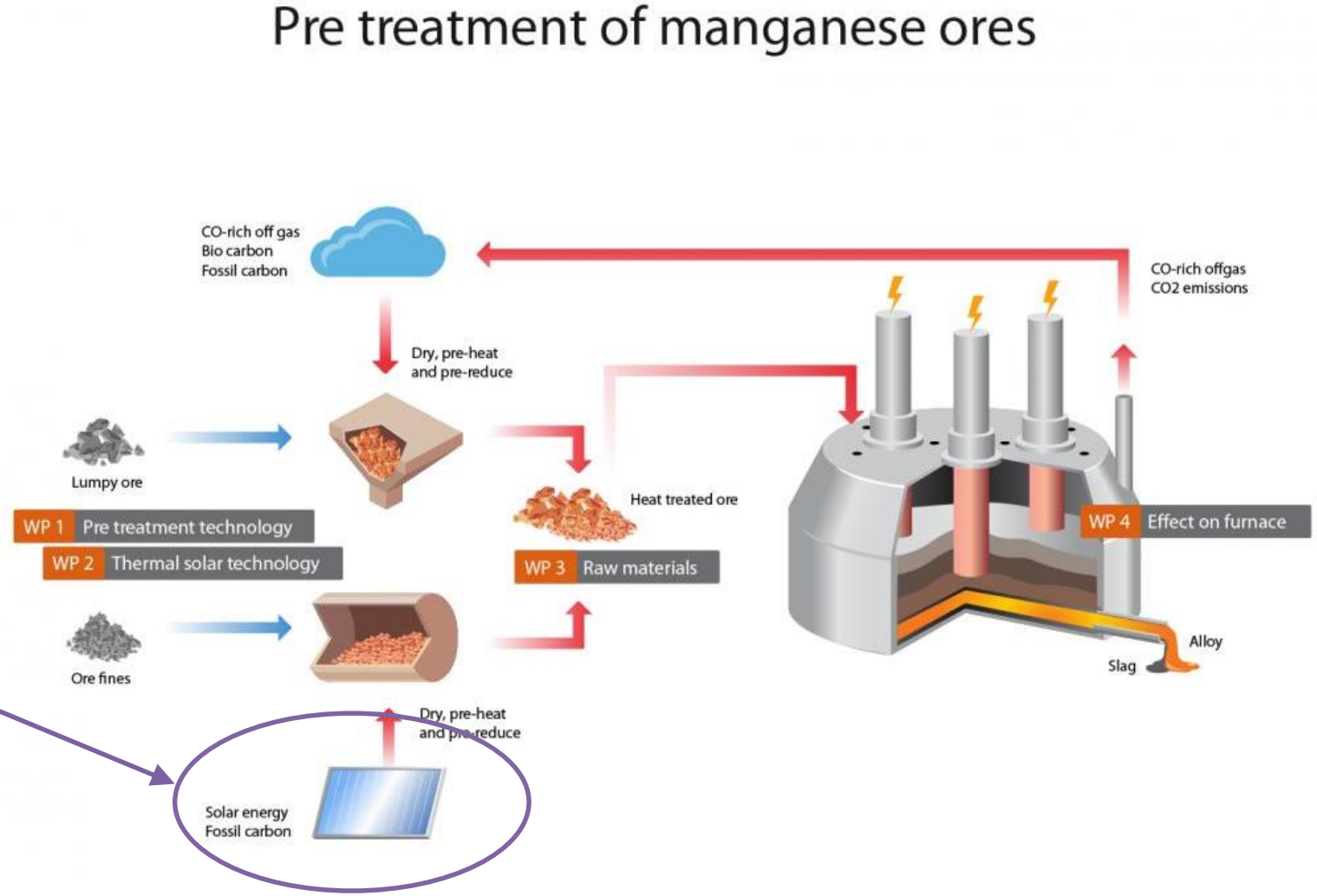


DLR

PreMa
Development of solar thermal technology

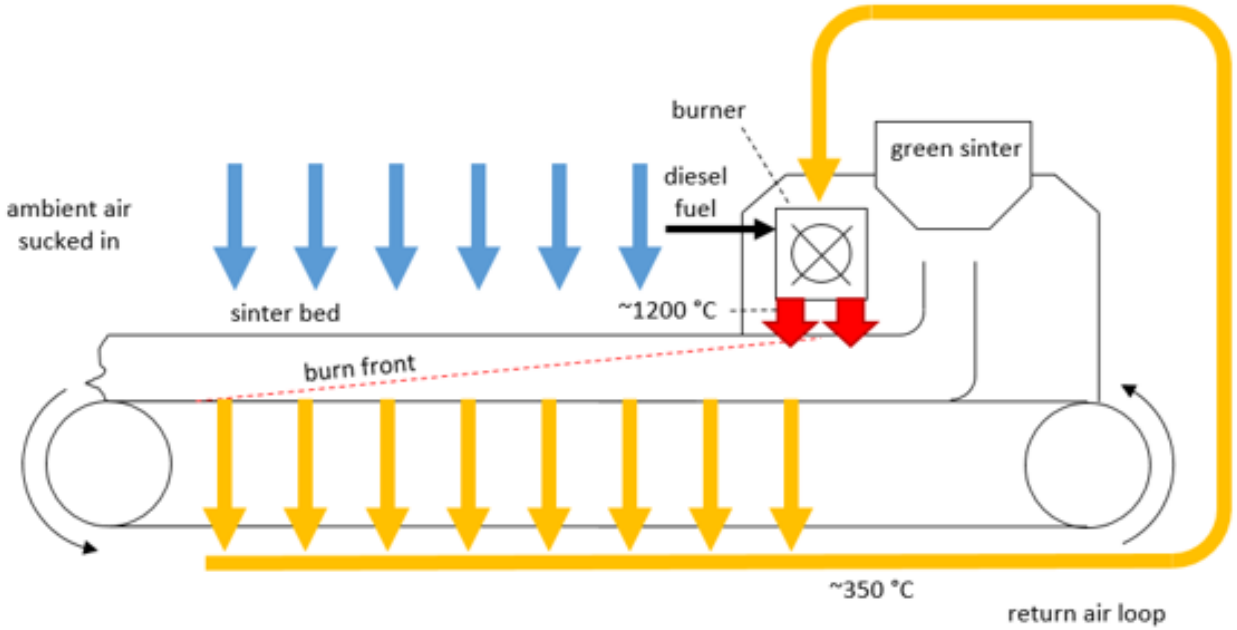
Two pilot facilities:

- solar thermal test plant with thermal storage for continuous production of hot air at 800°C (DLR Solar Tower, Germany)
- solar thermal plant to preheat manganese ores with hot air continuously at 800°C (South Africa)

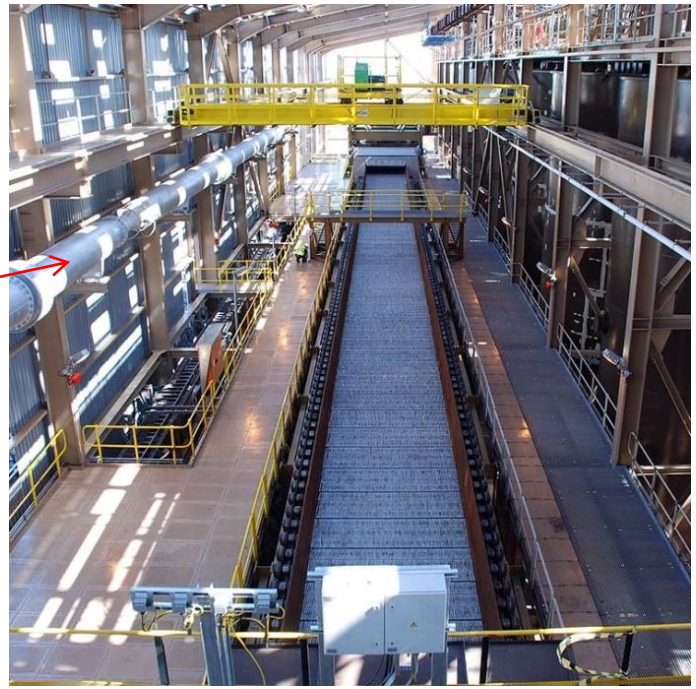


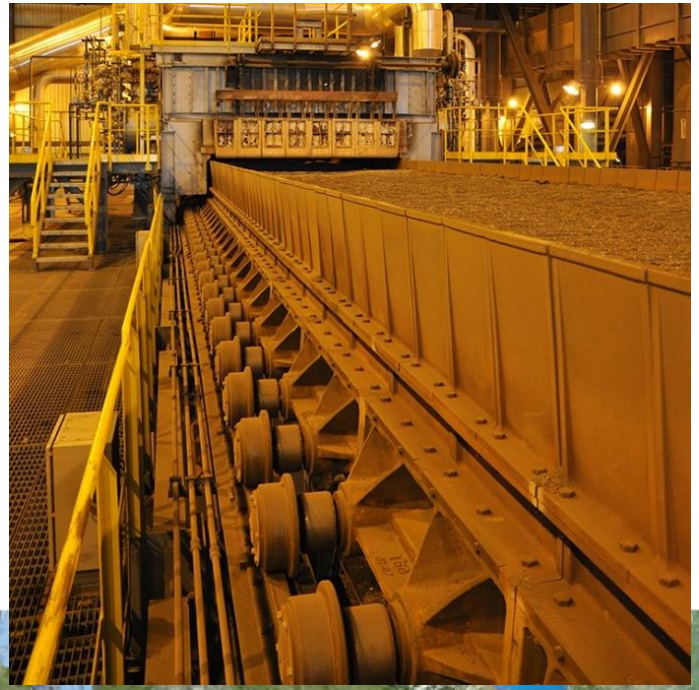
https://www.spire2030.eu/prema

Case Study: The Kalagadi Manganese Sinter plant, Northern Cape, South Africa



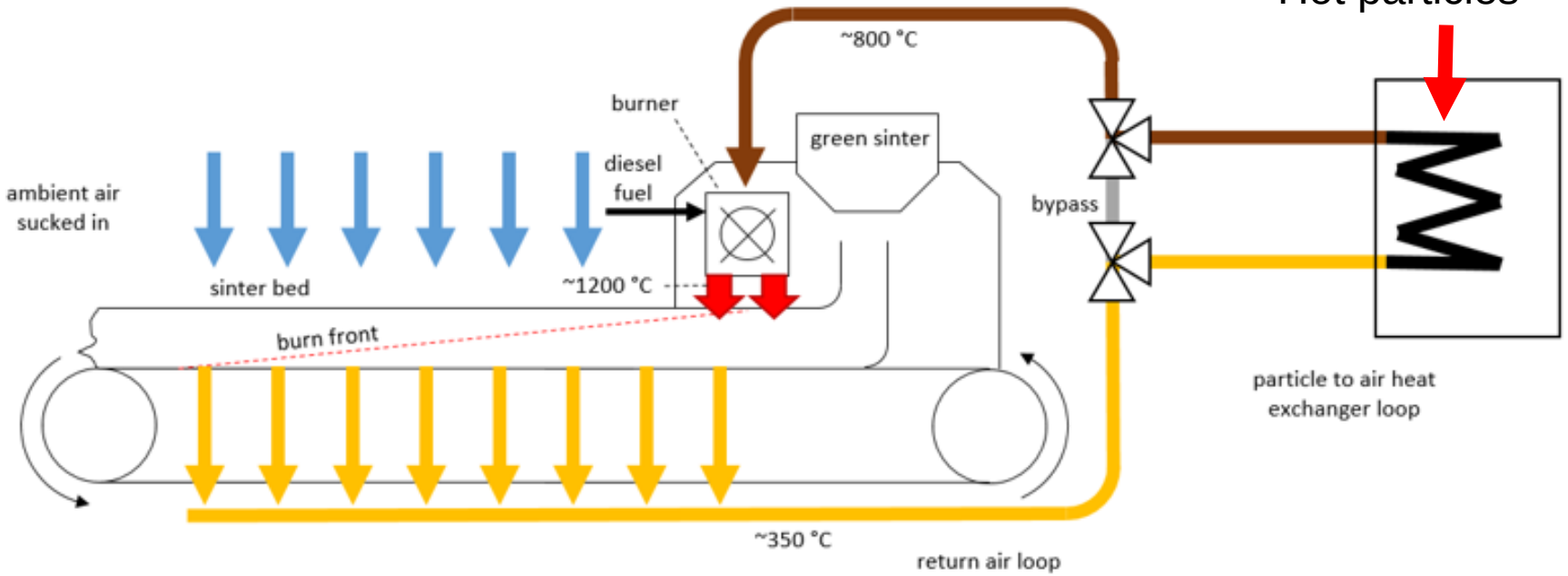
Air return pipe





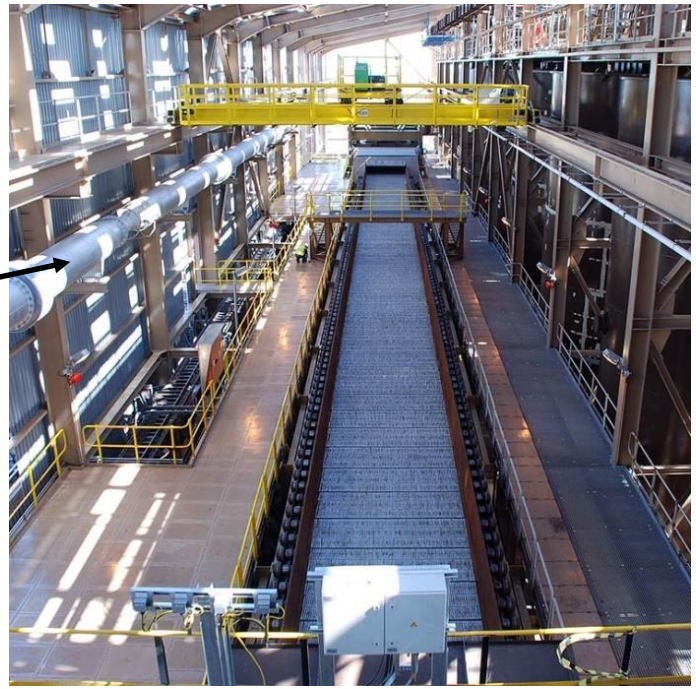
images: Outotec

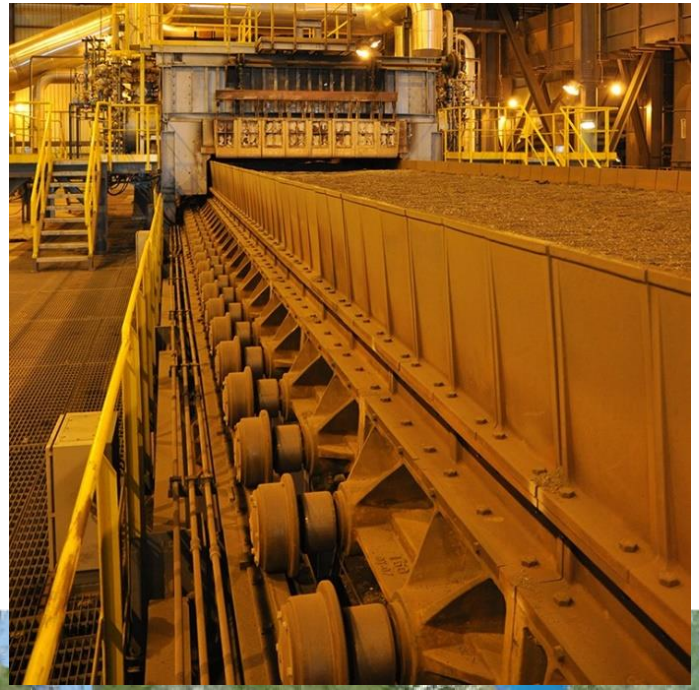
Case Study: The Kalagadi Manganese Sinter plant, Northern Cape, South Africa



Air return pipe

Hot particles



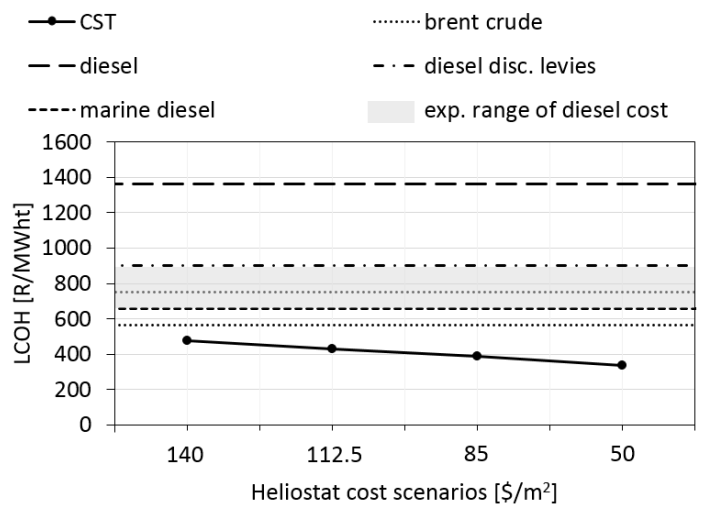


images: Outetec

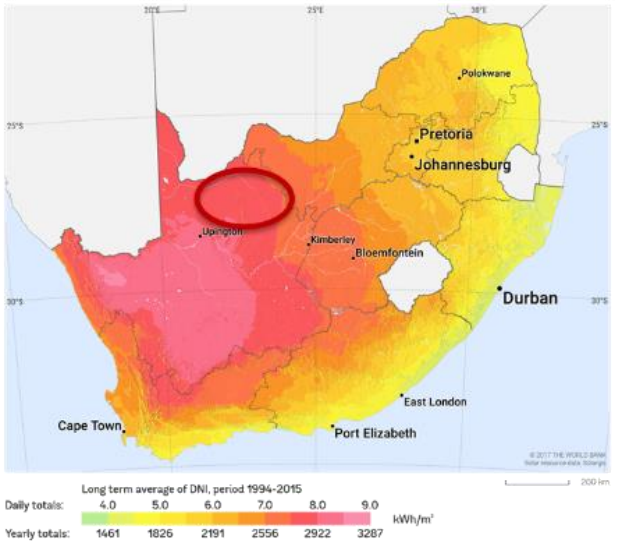
⇒ Introduction of solar hot air from stored particles can replace large fraction of Diesel fuel

Case Study: Kalagadi Manganese Sinter plant

100 AUD
60 USD
50 AUD
30 USD



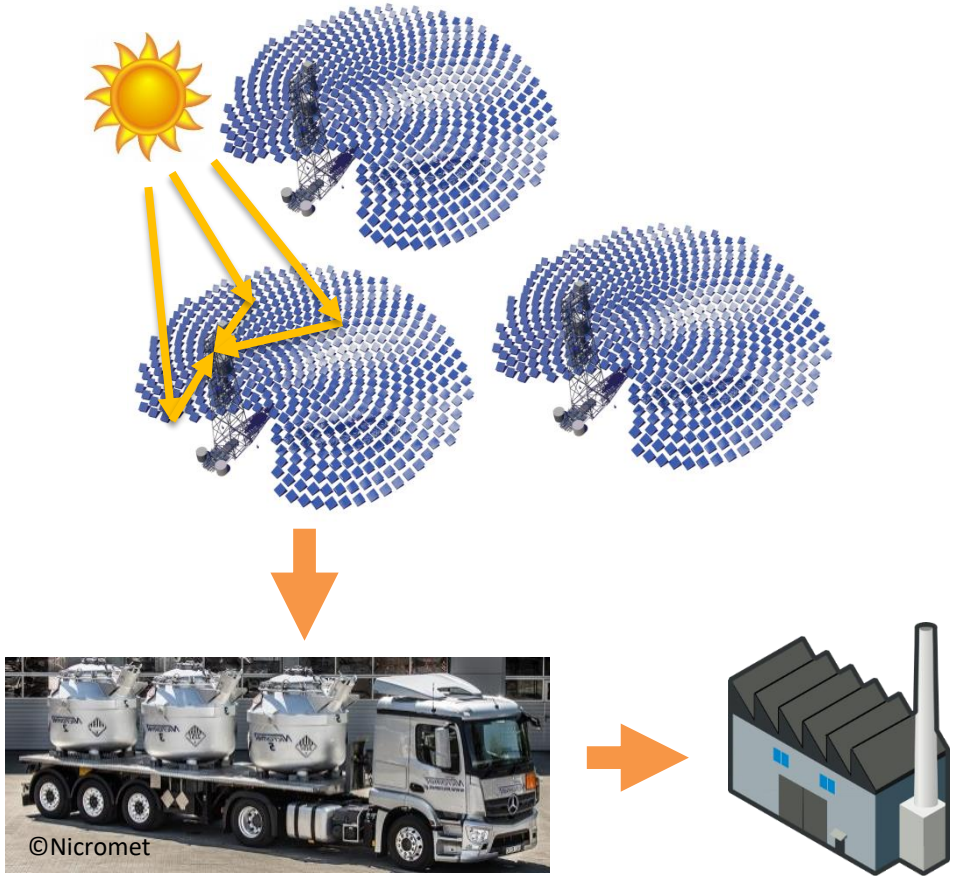
Kalagadi sinter plant



- Remote location with high annual DNI, high fuel price
- LCOH from solar process heat: projected at ~50% of burning Diesel (assumption: mature system cost, brent crude at 75 USD/barrel)
- payback period ~6 years estimated

Particle System: Scalability and Transport Options

Modular system



- Modular approach allows multiplying standardized subsystems to achieve desired power level
- Hot particles are transported in insulated containers
  - to central power station (power production)
  - to single or multiple use locations (process heat)
  - Allows placement of solar system in a certain distance of user (up to several km)

Thank you for your attention!

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