TSK

Growth through innovation

SOLWARIS Project and CSP/PV hybrid concept plant

IN-POWER Online Workshop

27 October 2020

SOLWARIS project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement n°792103

TSK
Growth through innovation

Table of contents

*At **TSK,** we have pursued a clear objective since our foundation: to build **a leading business group in engineering development and the supply of facilities of the highest quality**.*

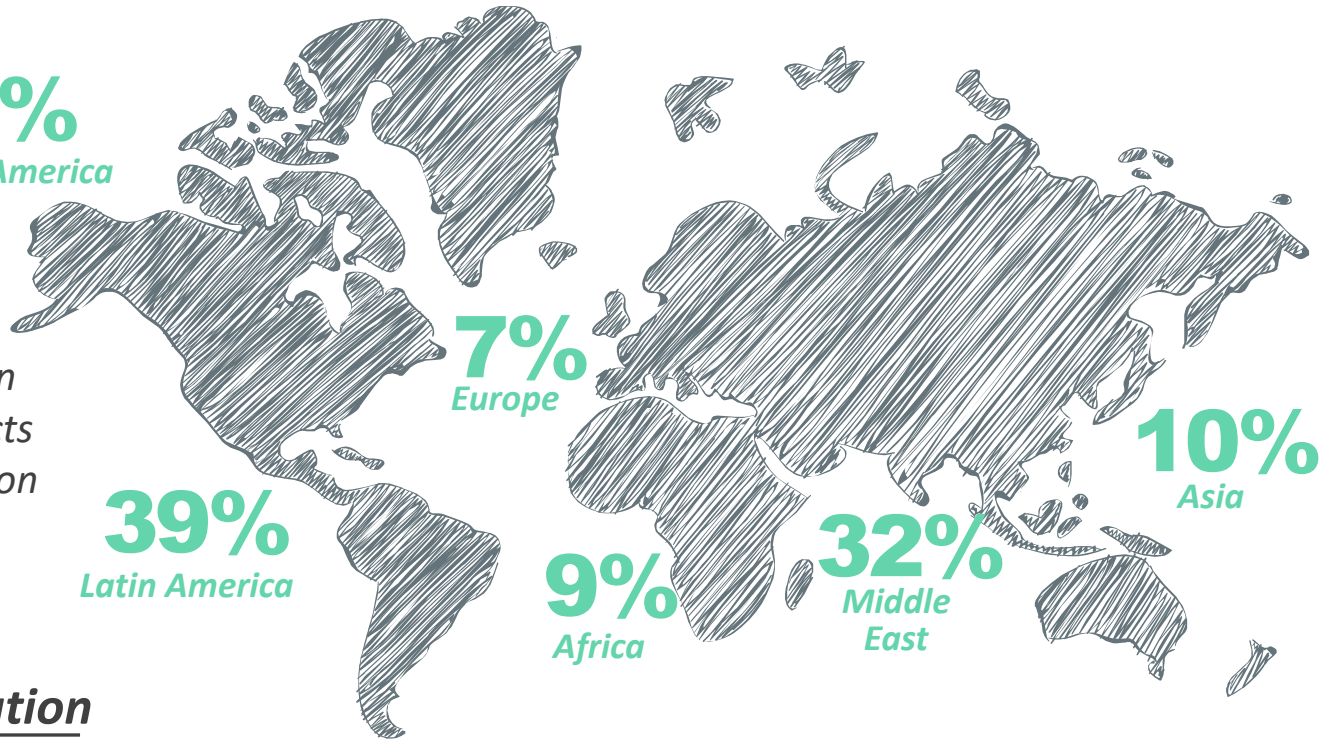
Our priority is to meet the needs of our customer, offering them all the technical and human resources necessary every step of the way.

Our achievements and the professional drive of our entire human team are the highest guarantee for continuing to fulfil our commitment:
Service excellence.

Today, our Company has a turnover of more than **USD 1000 million,** *which helps reinforce our position as a leading Technology Company with a strong international presence in Engineering and Industrial Construction.*

Market Diversification

Experience in more than 50 countries and projects currently under execution in 30 countries.



Sectors Diversification

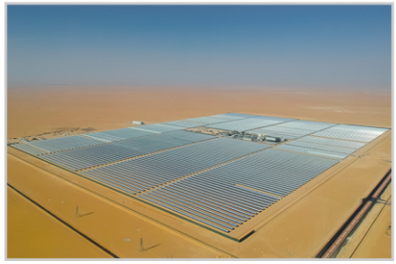
Conventional Power	Handling and Mining	Renewable Power	Industry	Electrical Infrastructures
30%	10%	35%	10%	15%

Renewable & Conventional Power

*In recent years, TSK has positioned itself as one of the main EPC contractors in the **Conventional** as well as **Renewable Energy Sectors**.*

***TSK** can call upon its extensive experience in the Engineering, Construction and Commissioning of Electricity Generating Power Plants with **Open Cycle and Combined Cycle, Cogeneration Technology, Wind Farms, Solar Thermal and Photovoltaic Plants, Geothermal Plants, Hydro Power Plants and Coal/Biomass Plants**, with involvement in projects of different types which in total surpass **15.000 MW**.*

Project:	*NOOR Midelt*
	800 MW Hybrid Solar Power Plant
Description:	*Technology: Hybrid CSP+ PV+ TES+ BESS*
	200 MW CSP (1XSIEMENS SST 700/900)
	600 MW PV polycrystalline
	Thermal Energy Storage & Battery Energy Storage System
Location:	*Midelt (Morocco)*
Client:	*EDF - Masdar*
Ending date:	*2023*



Project:	*Shagaya Renewable Energy Park*
	50 MW CSP Plant with TES
Description:	*Technology: 1xSIEMENS SST800*
	Scope of Work: EPC + O&M (6 years)
Location:	*Kuwait*
Client:	*Kuwait Institute for Scientific Research (KISR)*
Ending date:	*2018*

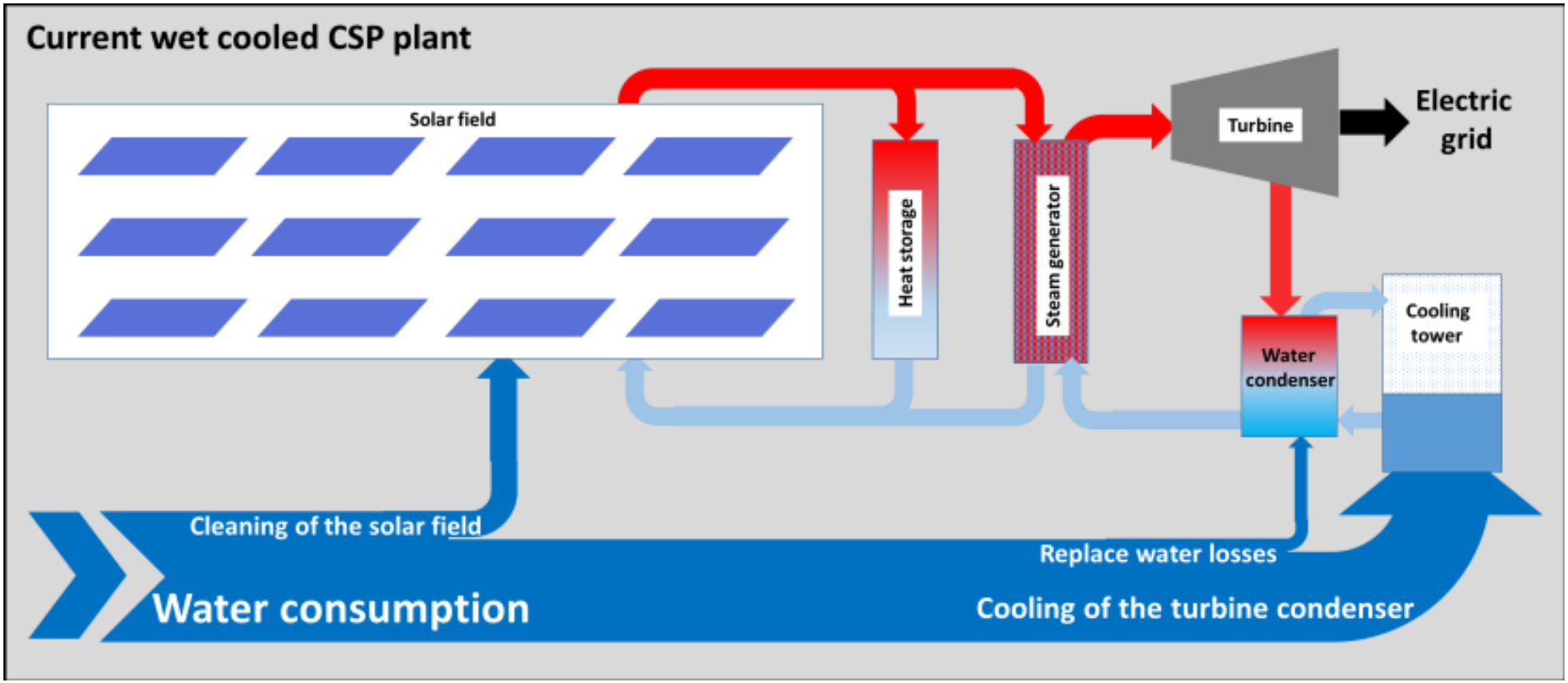
Project:	*NOOR I*
	160 MW CSP Plant with TES
Description:	*Technology: 1xSIEMENS SST 700*
	Scope of Work: EPC
Location:	*Ouarzazate (Morocco)*
Client:	*ACWA POWER*
Ending date:	*2016*

Project:	*BOKPOORT*
	50 MW CSP Plant with TES
Description:	*Technology: 1xSIEMENS SST 800*
	Scope of Work: EPC
Location:	*Northern Cape (South Africa)*
Client:	*ACWA POWER*
Ending date:	*2016*

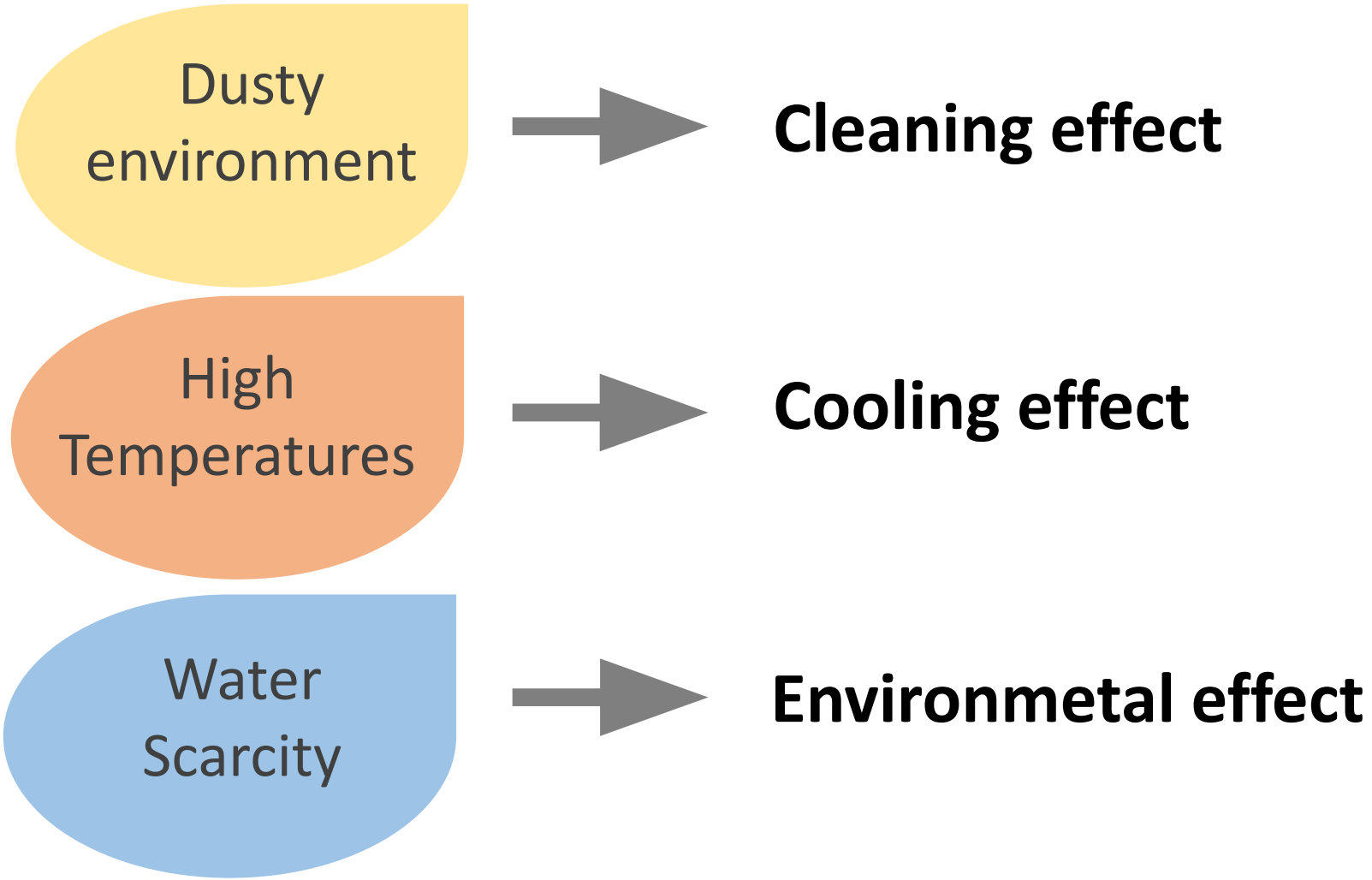
Project:	*LA AFRICANA*
	50 MW CSP with TES
Description:	*Technology: 1xSIEMENS SST 800*
	Scope of Work: EPC + O&M
Location:	*Córdoba (Spain)*
Client:	*La Africana Energía, S.L*
Ending date:	*2012*

Project:	*ANDASOL III*
	50 MW CSP with TES
Description:	*Technology: MAN DIESEL & TURBO dual casing reheat*
	Scope of Work: EPC Solar field and HTF System + O&M
Location:	*Granada (Spain)*
Client:	*Marquesado Solar*
Ending date:	*2011*

CSP plants need water



Future CSP plants will be constructed in **desertic areas**



SOLWARIS

Solving Water Isues for CSP Plants

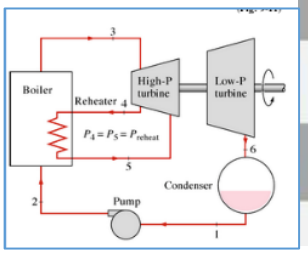
1 May 2018 → **30 April 2022**

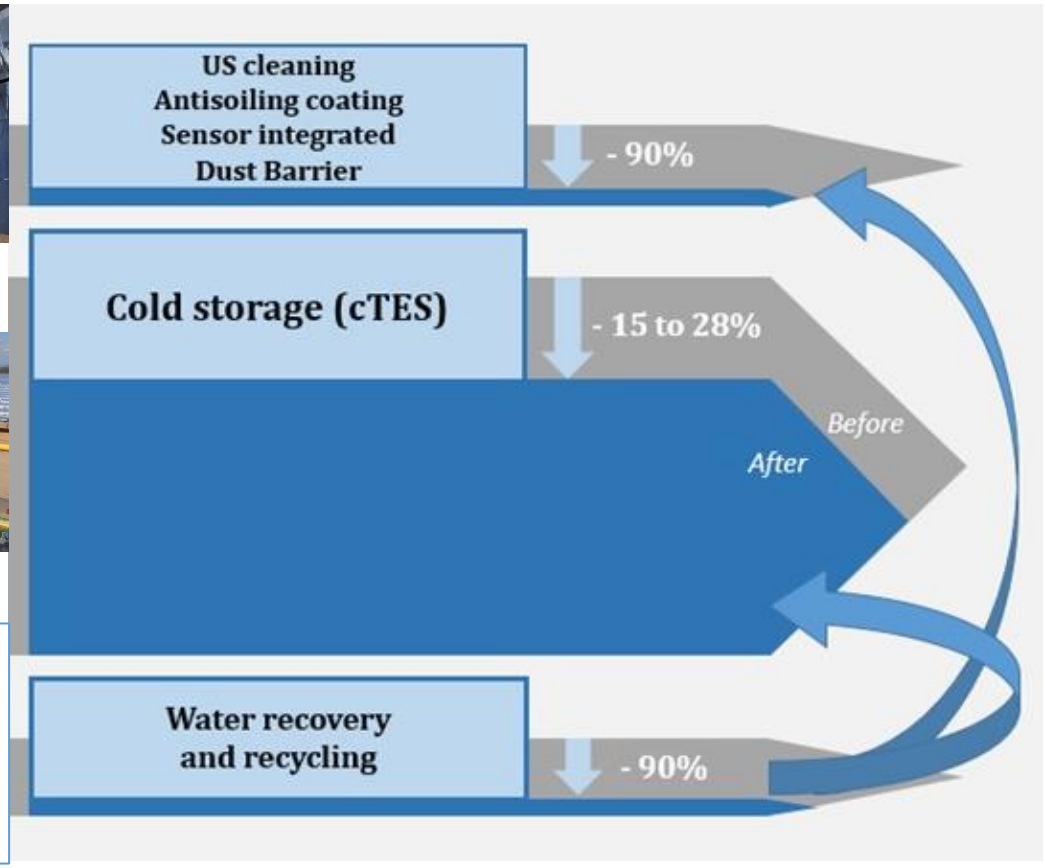
CIEMAT PSA · Cranfield University · TSK · BSC · BrightSource · INDETEC Tecnología Industrial · bertin TECHNOLOGIES · cea · AMIRES · RIOGLASS · FENIKS · IK4 TEKNIKER Research Alliance · DLR

TSK
Growth through innovation

SOLWARIS

The overall purpose of the SOLWARIS project is to upscale, implement and demonstrate cost-effective technologies and strategies that bring about a significant reduction of water of CSP plants while ensuring excellent performance of electrical power production.

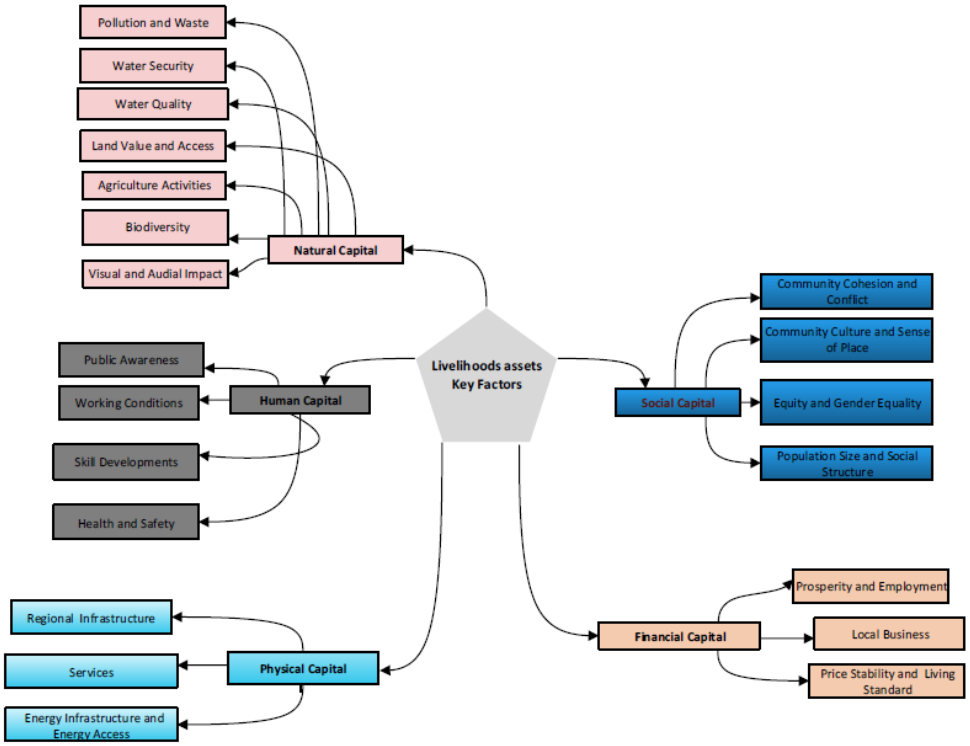




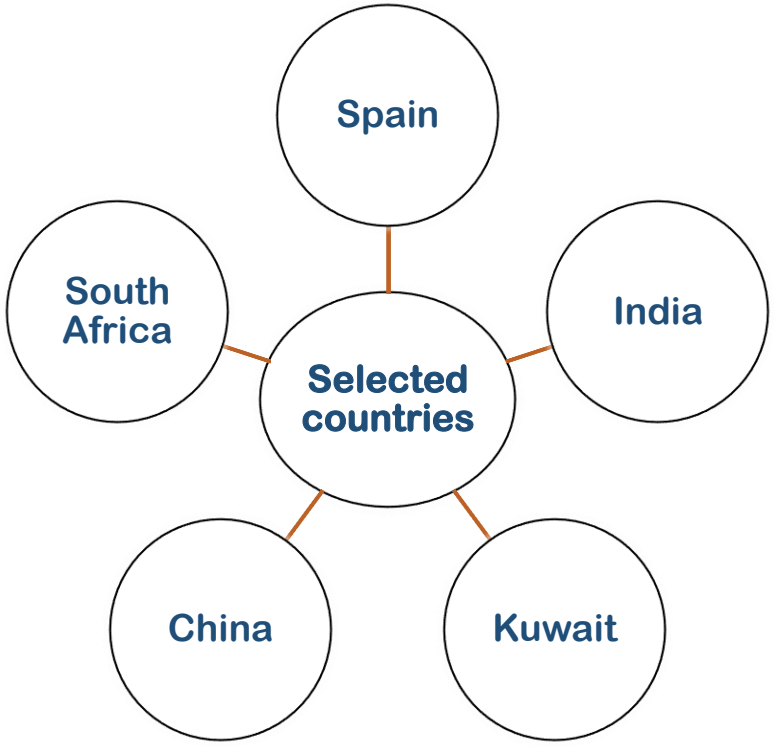
1

Study of the social, economic and environmental impacts of CSP plants on local communities

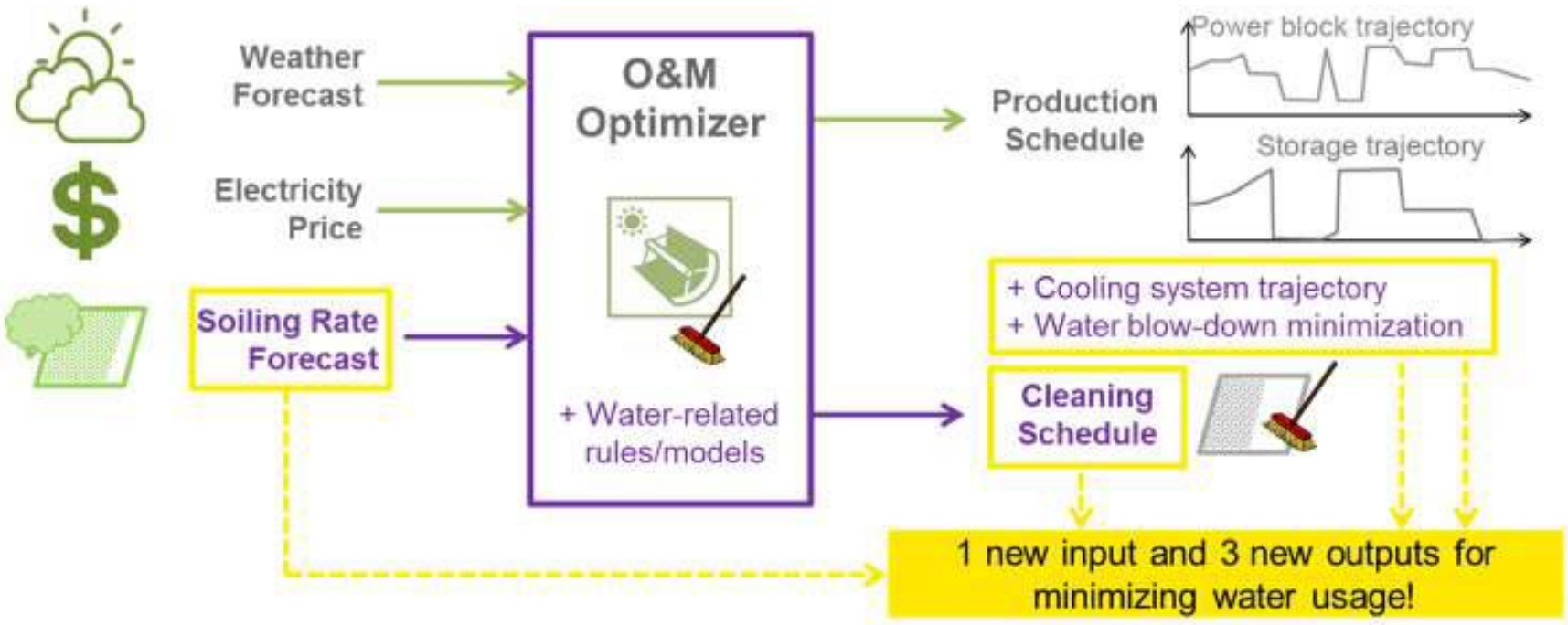
Livelihood assets Framework



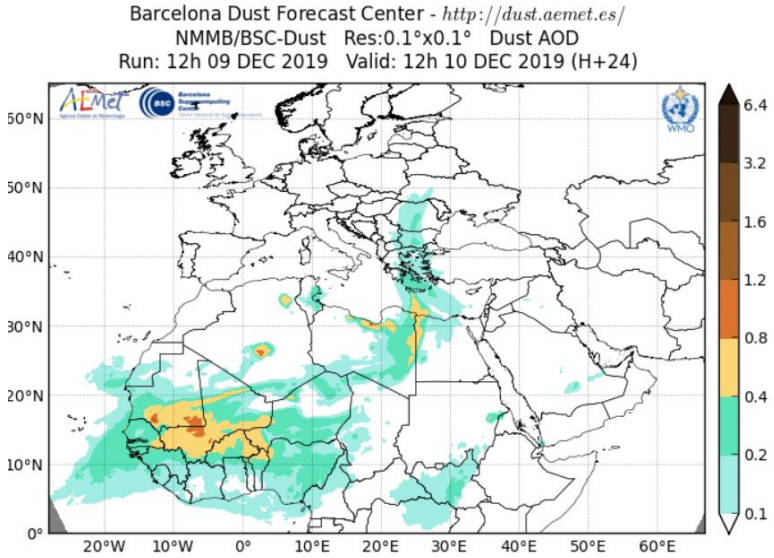
5 case studies

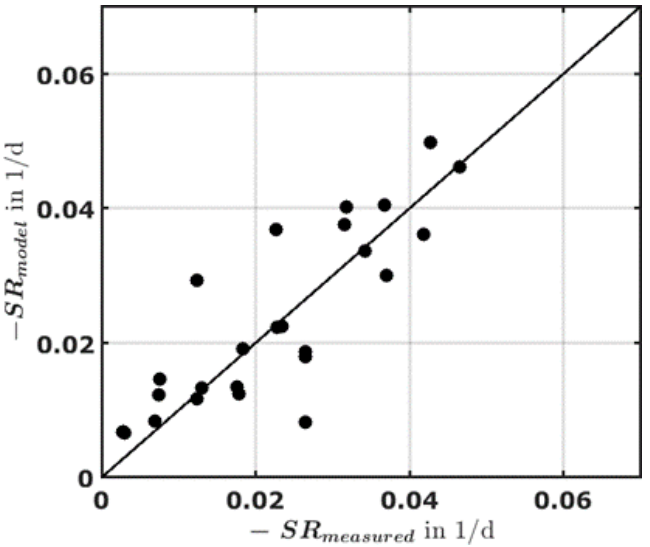


2 O&M Optimizer



3 Soiling rate forecast



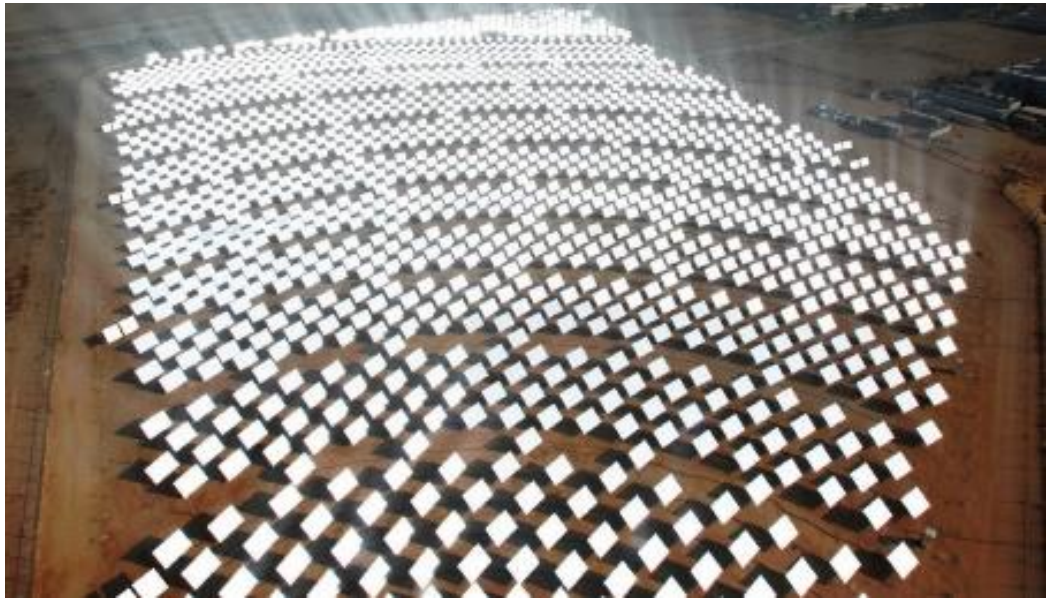


Soiling Rate

4 Ultrasonic Cleaning Device

Integration of an ultrasonic cleaning device on a robotic arm of a cleaning truck

5 Heliostat Cleaning Device



Device installed in each heliostat

Waterless cleaning

Powered by PV panels in the heliostat

Accelerated aging tests

6

Antisoiling coating for mirrors

Optimization of the application method

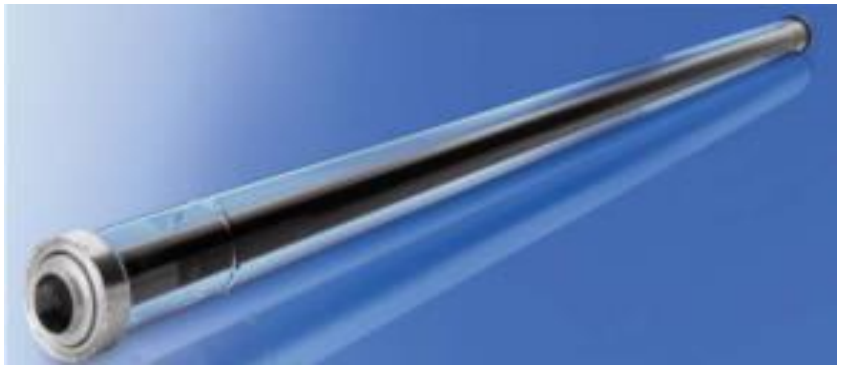
Accelerated aging tests

Improve the efficiency and durability of the coatings

Comparision between coated and uncoated mirrors

7

Antisoiling coating for receivers



Up-scale of deposition process to long glass tubes

Accelerated aging tests

Improve the efficiency and durability of the coatings

Comparision between coated and uncoated tubes

8

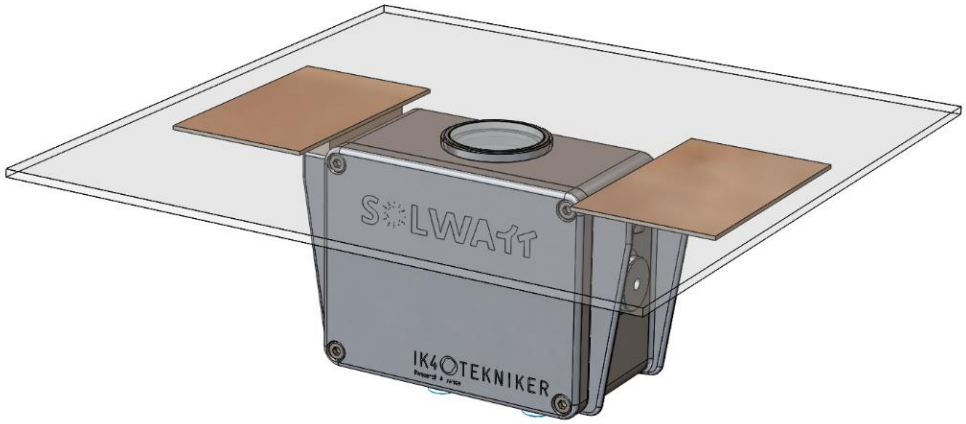
Dust barriers

CFD Analysis

Wind tunnel tests

9

Smart Mirrors



Integrated soiling sensor on mirrors

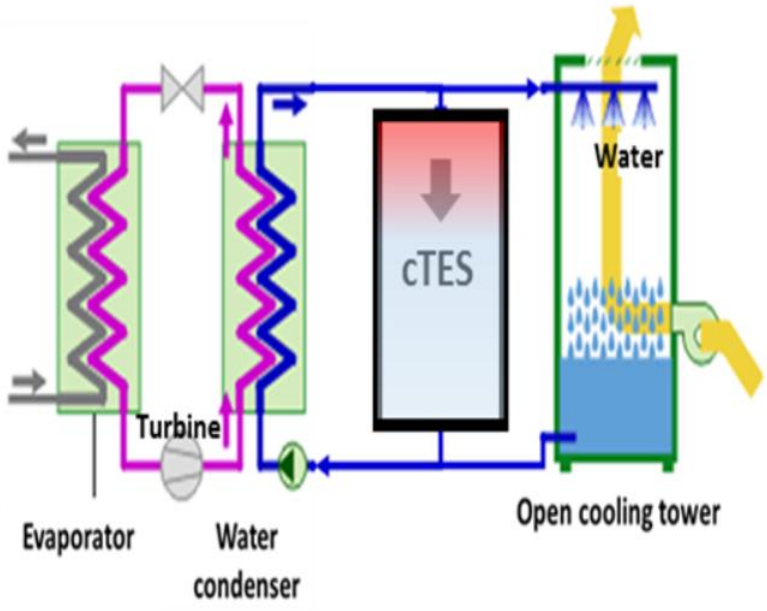
On-line measurements

10

cTES: cold Thermal Energy Storage

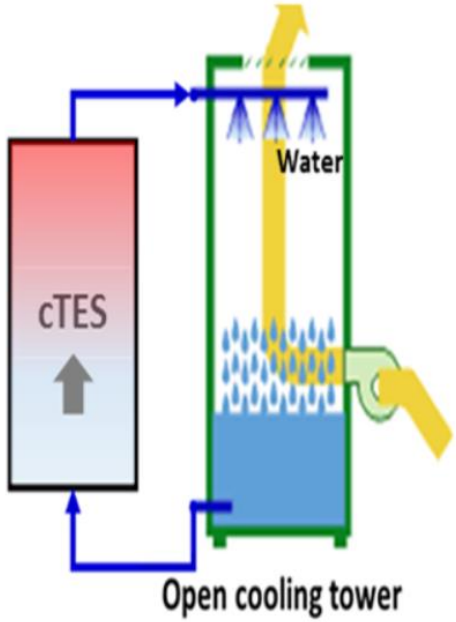
CHARGE mode

Partial storage of condenser heat in cTES



DISCHARGE mode

Release of the heat stored in the cooling tower



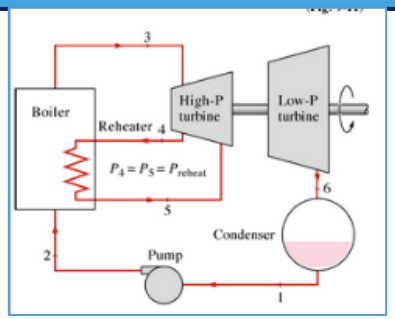
11

WRS: Water Recovery System

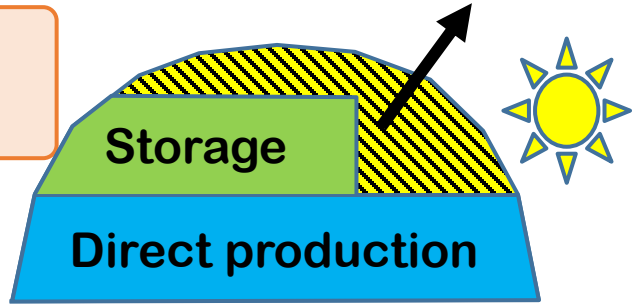
Cooling Tower Blowdown

Evaporation pond

Steam Cycle Blowdown



Water Recovery System



TSK
Growth through innovation

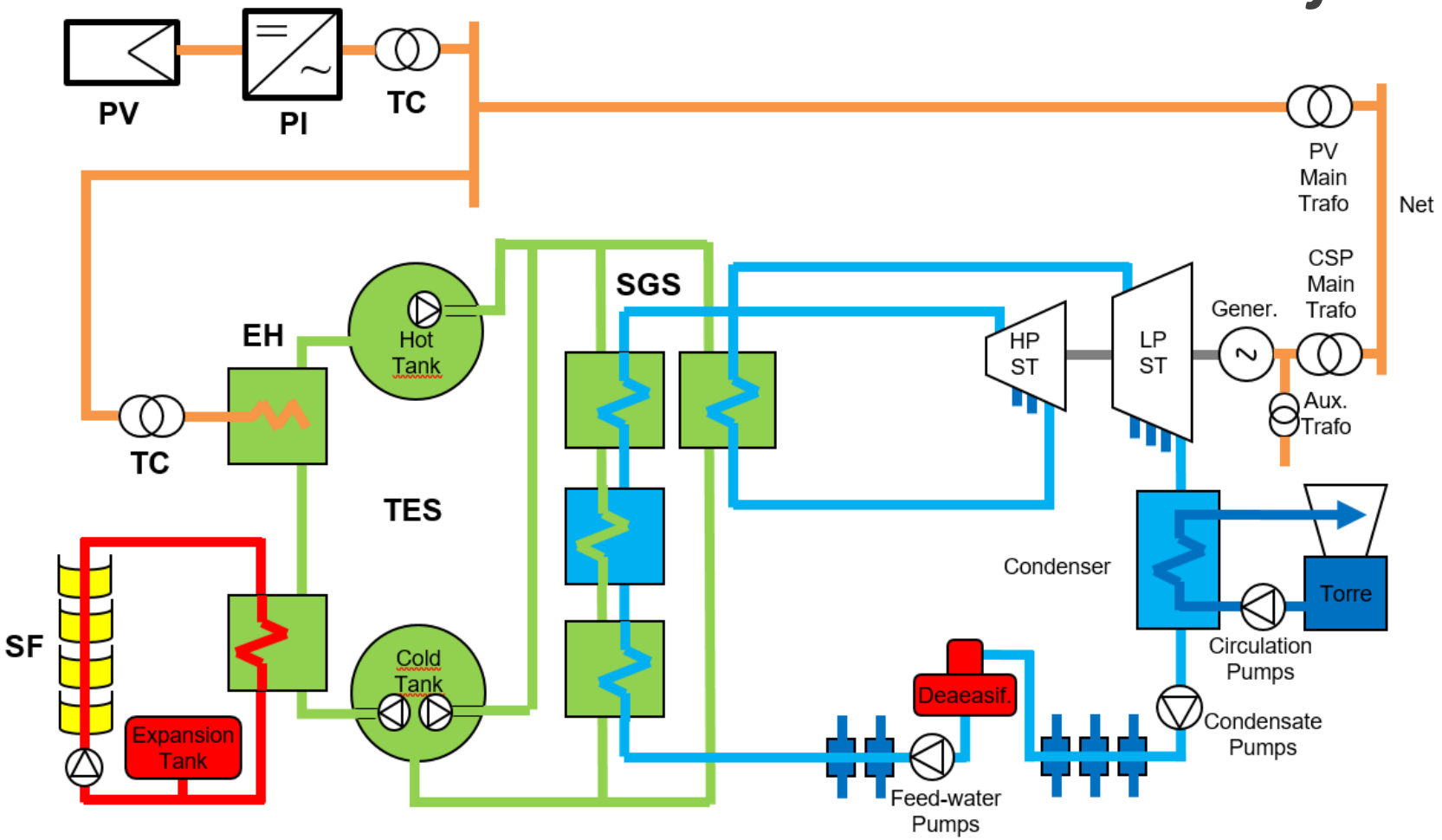
Integrated CSP-PV hybrid plant

	CSP	PV
+	• Dispatchable • Large storage capacities	• Low complexity • Low Price • Easily scalable
−	• High complexity • Dependent on economies of scale	• Storage not competitive • Volatile generation

TSK
Growth through innovation

Integrated CSP-PV hybrid plant

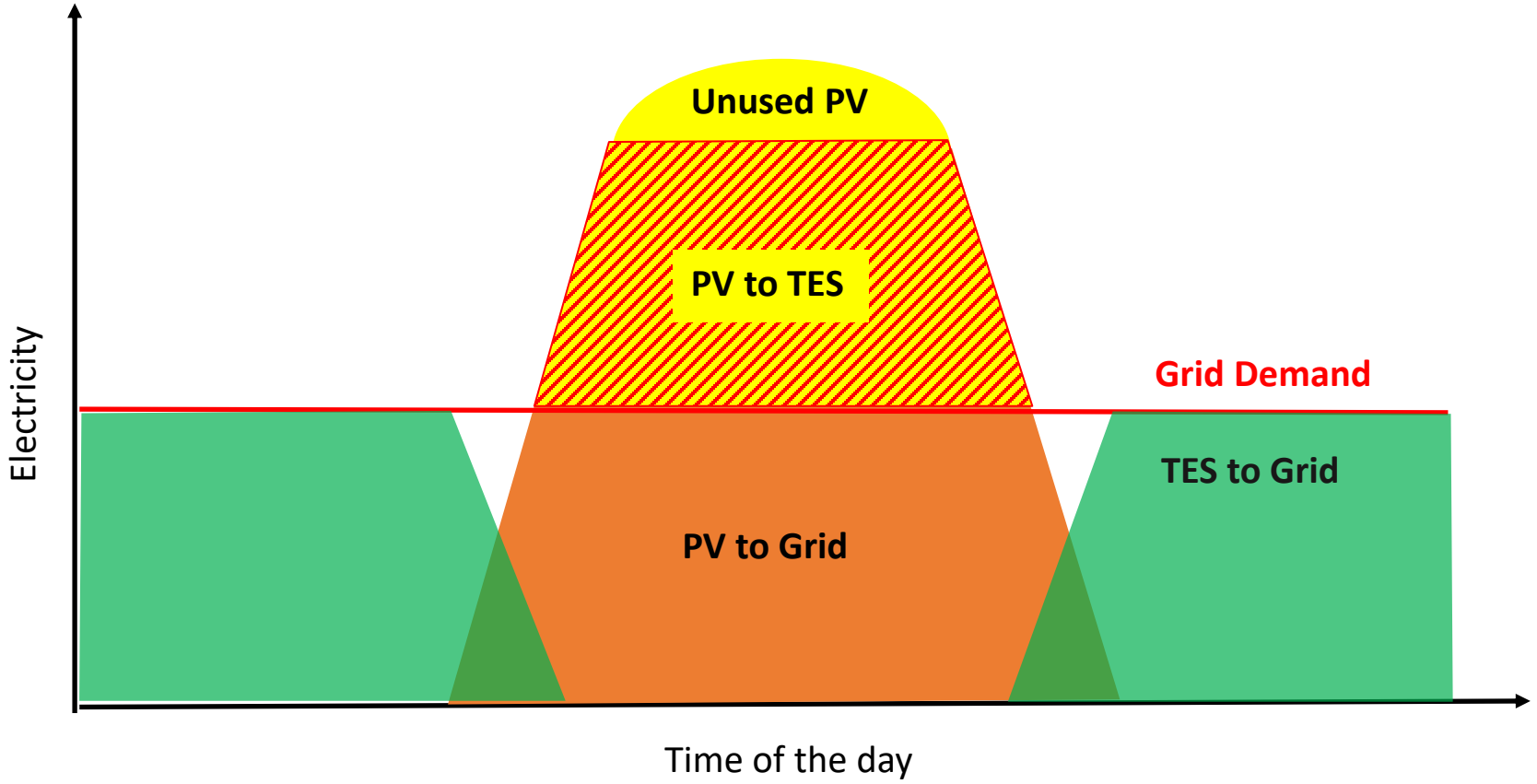
800 MW Noor Midelt Project



PV	**P**hoto**V**oltaic field
PI	**P**hotovoltaic **I**nverter
TC	**T**ransformation **C**entre
EH	**E**lectrical **H**eaters
SF	**S**olar **F**ield
TES	**T**hermal **E**nergy **S**torage
FH	**F**uel **H**eaters
SGS	**S**team **G**eneration **S**ystem

Integrated CSP-PV hybrid plant

Base Load



Benefits

- Lower electricity price
- Higher storage capacity
- Higher dispatchability
- Improvement of cycle efficiency

Thanks for your attention

Luis.millan@grupotsk.com

SOLWARIS project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement n°792103