

# Past and present challenges on R&D for Concentrating Solar Thermal Technologies addressed from the perspective of the PSA

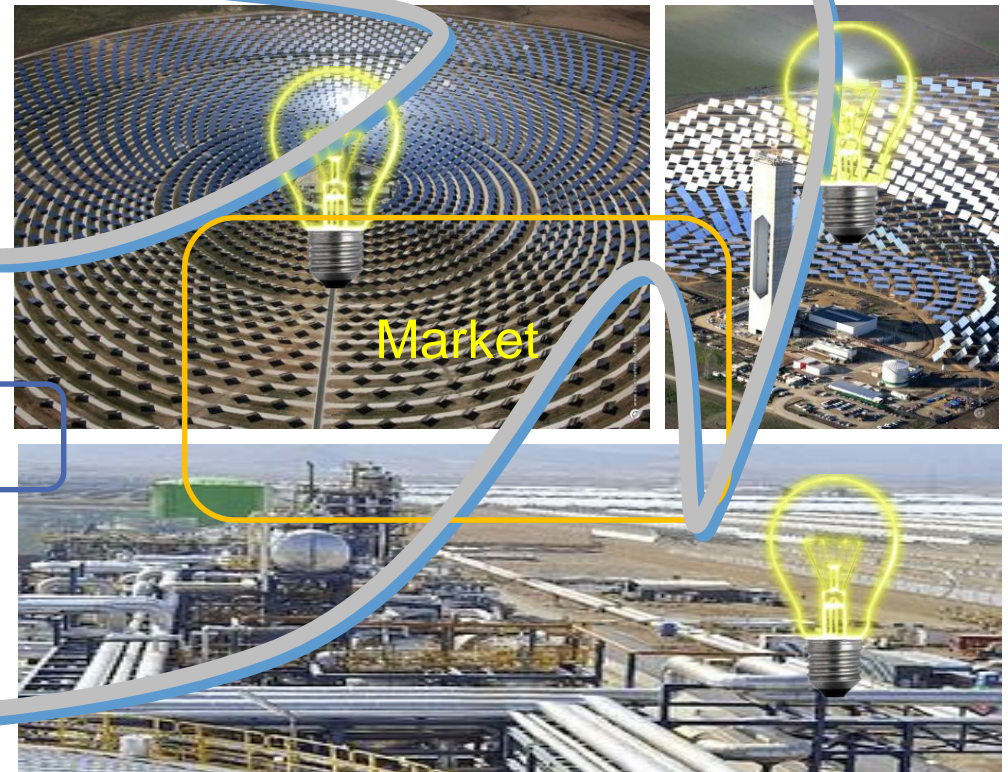
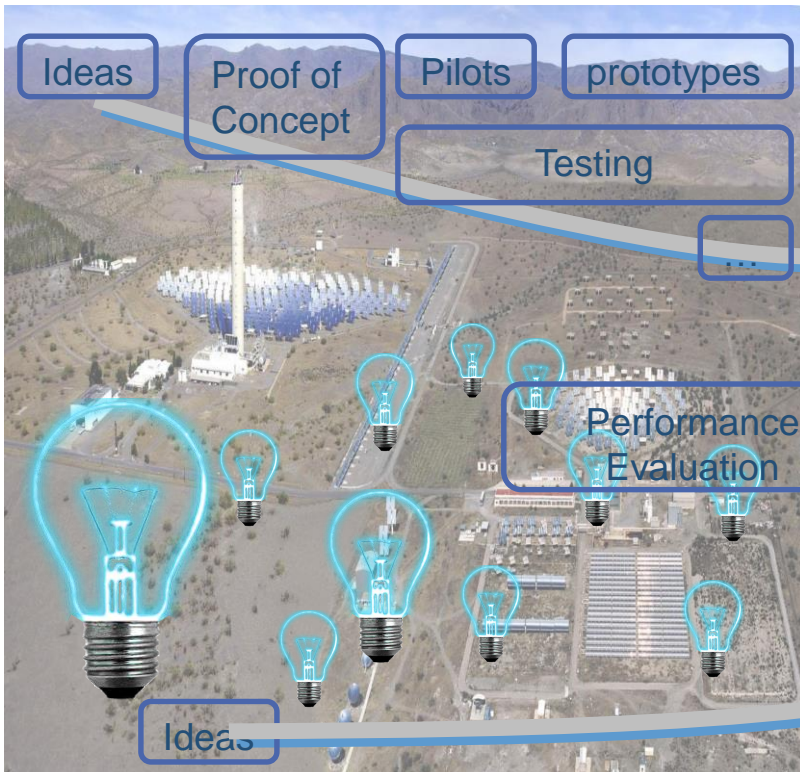
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*“who has a question has a quest” ... (to find the answer)*

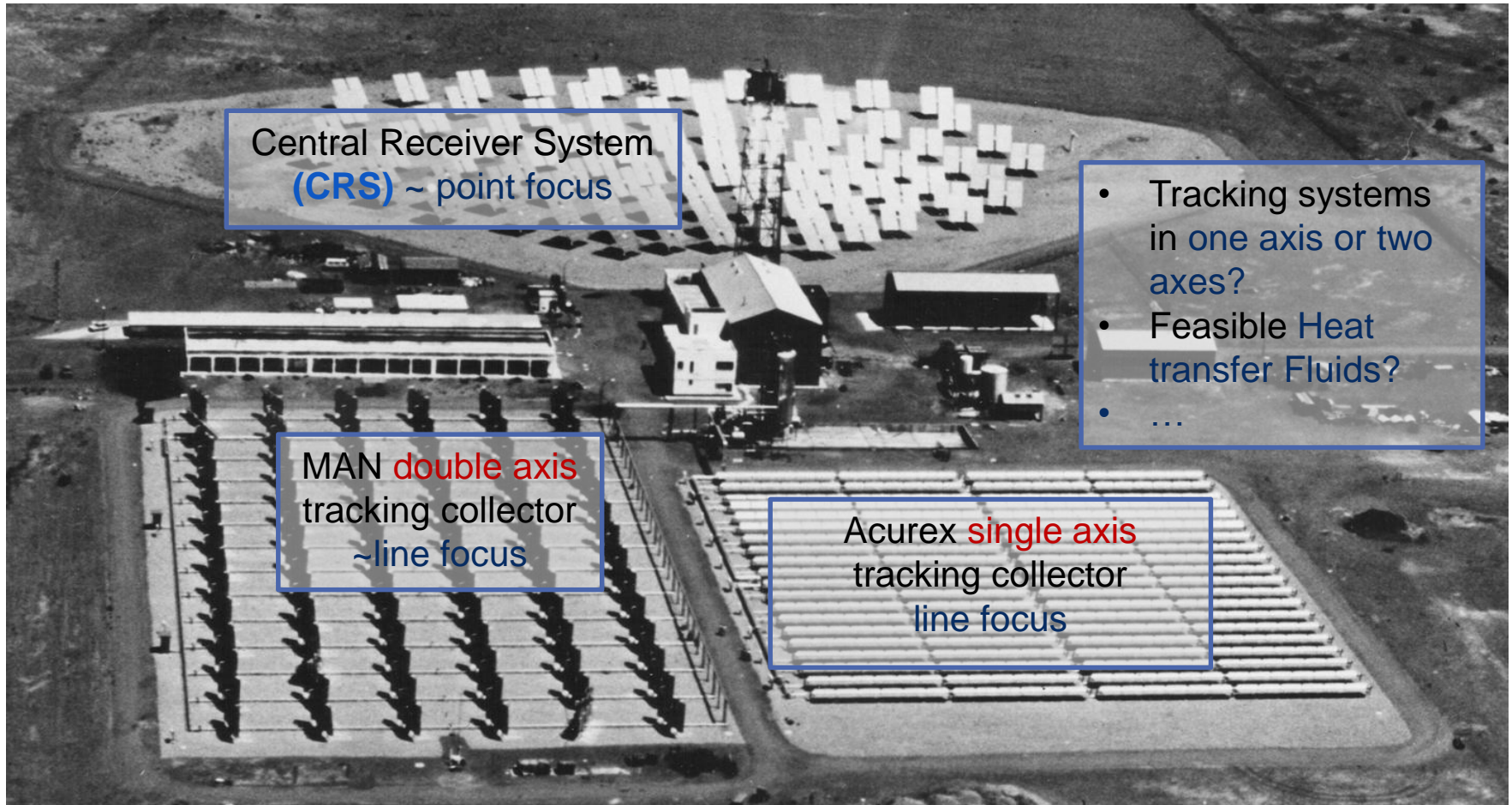
# From Idea(s) to Market

Born in the early 80s, during these 35 years, the Plataforma Solar de Almería (PSA), has participated in the different steps that lead "from idea to market" of a variety of concentrating solar thermal technologies.

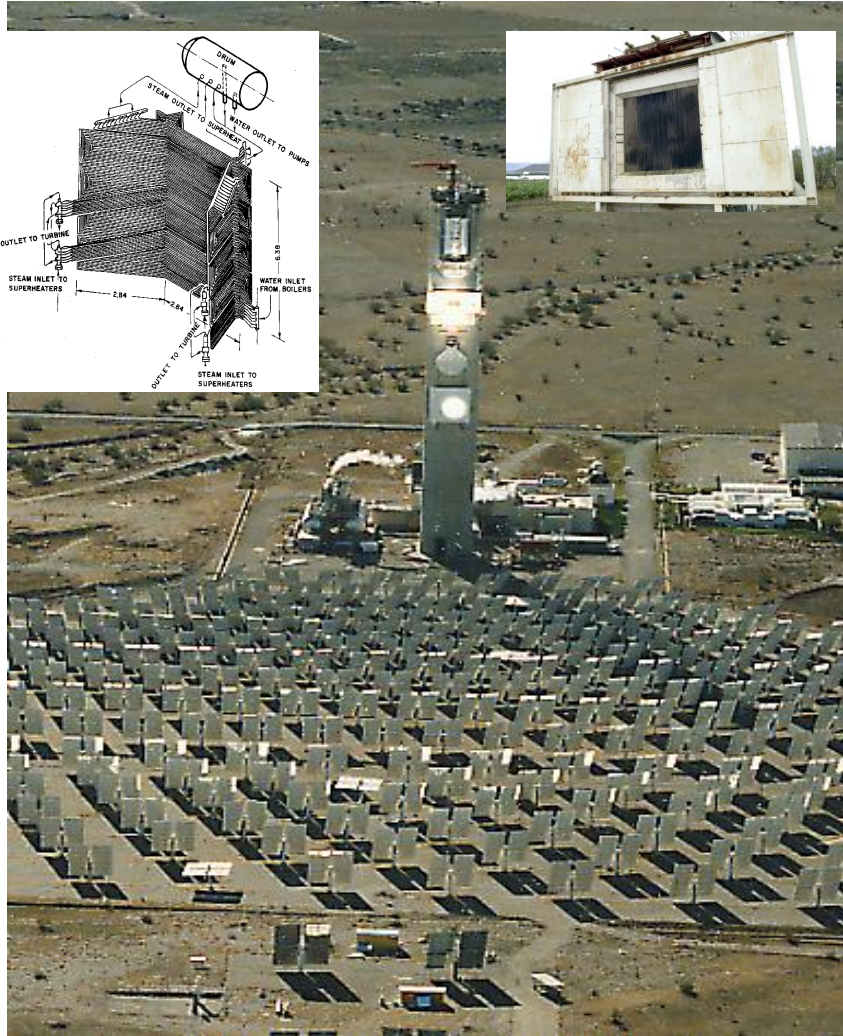



# First Ideas & Questions: Line focus or Point focus?

e.g.: IEA-SSPS Project in 1977-1983

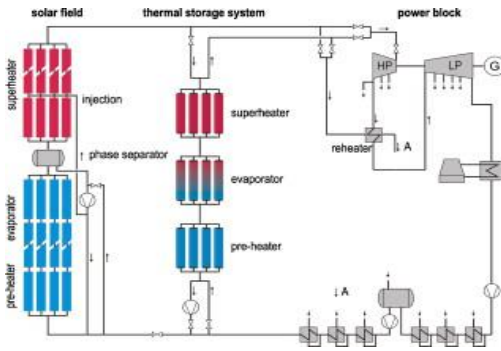


# First Ideas & Questions: What heat transfer fluid to choose? (main focus on CRS)




- Molten metals (SSPS-CRS, 1981-83)
- Water/Steam & Molten salts TES (CESA-1, 1977-84) ...(PS10, 2000-5)-> PS10&PS20 
- Air in tubes (GAST project, 1981-1986)... (SOLHYCO, 2006-10)
- Atmospheric Air –Volumetric (PHOEBUS-TSA, ...SOLAIR, 1986-2004)
- Pressurized Air-volumetric (...REFOS,SOLGATE, ...1994-2005)
- Molten salts (SOLAR TRES, 2003-2008)-> GEMASOLAR 
- ...

# Following Ideas & Questions: How to innovate the (PT ) SEGS technology?



R&D on:

- Improved collectors (Eurotrough, 1998-2005...  Senertrough, 2007..)
- Advances in absorbers / receivers (1996-2010)
- Simplified schemes (e.g. DISS Direct Steam generation Systems, 1996-2001)
- Chipper concentrators (e.g. FRESDEMO, 2007) ...

I&Q: Modularity versus size?



1992-97, ...

# Following Ideas & Questions: Feasible solutions of Solar Energy Storage (~searching dispatchability)?

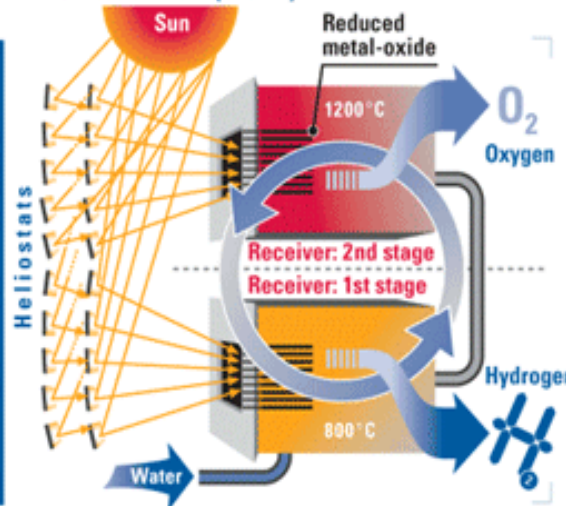


Thermal Storage Plant with Molten Salts

- Thermal Energy Storage
  - Molten salts (CESA-1, 1977-83), (SOLAR TRES, 2005-8),... (ANDASOL, 2003-8)
  - Thermal Oil
  - Water/steam HTF (DISTOR, OPTS...)
- Chemical Storage of Solar Energy:
  - Solar fuels (Methane reforming, ASTERIX, 1990), Hydrogen production using solar concentration via Water Splitting ...HIDROSOL I, II, 3D,,2005-2017)



## Direct Solar Hydrogen Production at the "Plataforma Solar de Almeria" (PSA)



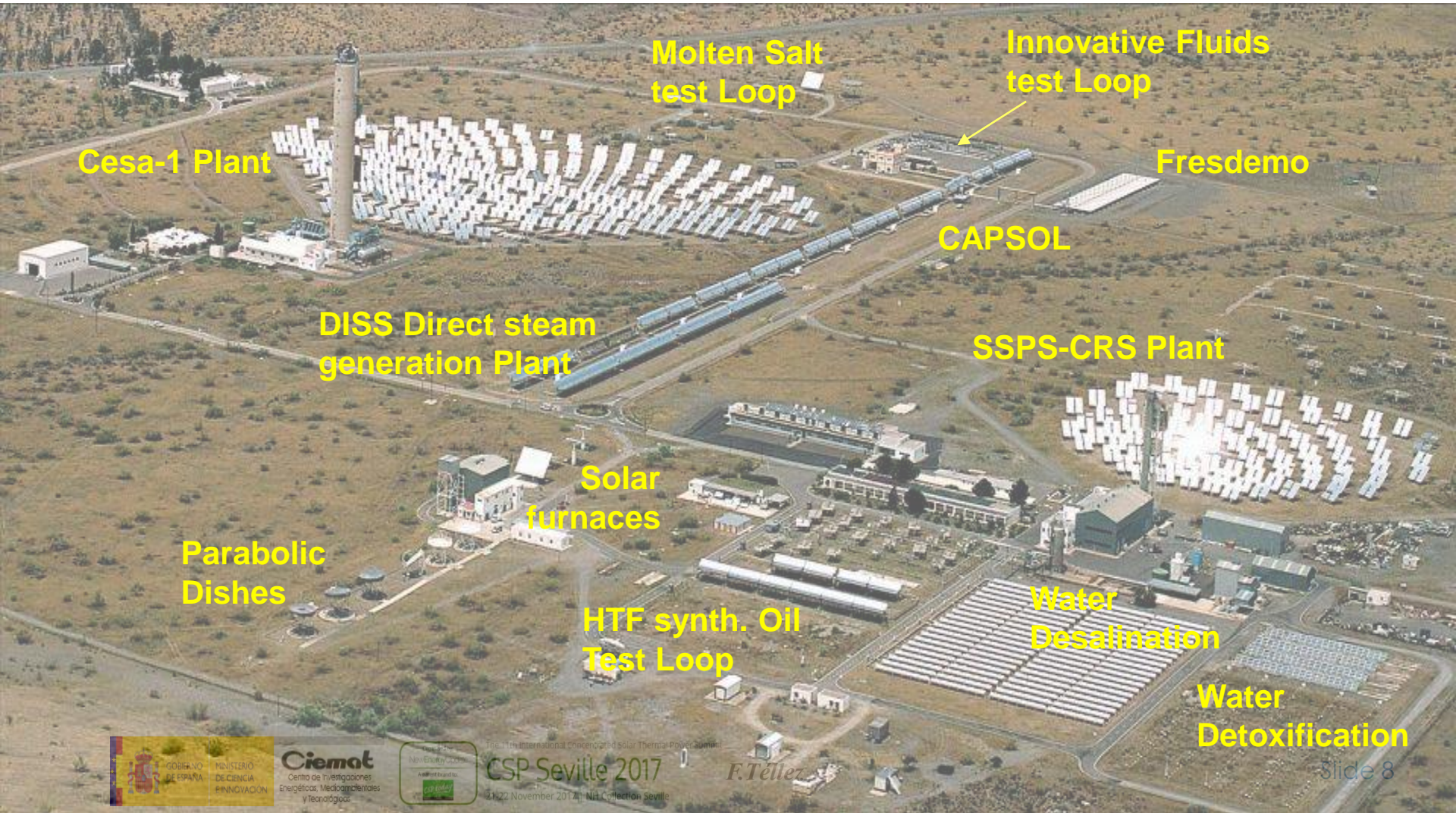
# First Ideas & Questions: Other applications of Concentrating Solar Technologies for fuel saving?



- Materials treatment,
- Water Detoxification
- Desalination (MED-STD Project 1987),...
- Solar thermal co-generation of electricity and desalinated water (CSP+D)
- ...

# PSA's TEST FACILITIES

Currently, the PSA is mainly profiled as result of the afforded questions and projects. It is a Large Scientific and Technical Installation that includes that R&D in most of the concentrating typologies and applications of Solar Concentration (~120 staff)







# Current Ideas and Questions: New drivers and contexts

**New contexts** (and references for new developments):

- **Urgent energy transition** that needs the values that "can" bring the solar concentration:
  - Renewable energy,
  - high dispatchability,
  - high local value,
  - reduced life cycle...
- **Delocalized commercial deployment** (Europe, USA, MENA, South Africa, ... China ...)
- **About 5 GWe** of CSP plants deployed, feeding the "**learning curve**" in all the phases of the value chain
- ...

**(but) Similar R&D&I challenges:**

**Many of the initial questions** (initiated during the 70's and 80's) do not have a definitive answer and **are still on the desk:**

- The question of **line focus vs. point focus is not showing a clear winner** for the next deployments.
- The **question of costs** (although shows a significant reduction) is still showing a **wide variety** and **requires additional reductions**
- The question of **alternative applications** for solar concentration is rethinking the solar **heat for industrial processes** as alternative /complement to the CSP. (e.g. Solar Desalination identified a **R&D priority,...**)



# Current Ideas and Questions: better cost/efficiency STE components ?

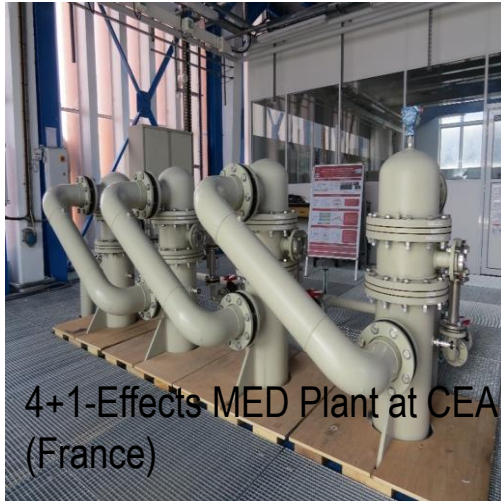


Current challenges requires additional Ideas ...

- To improve the **overall optical performance** of **Concentrators** (by rigidity under wind and/or high temperature weather conditions in solar tracking; cleaning of reflectors; ease of alignment and installation, ...) and lowering its costs.
- To find new **heat transfer fluids** (HTF) that allow for advanced system designs with **higher conversion efficiency**, more environmentally friendly, better stability...
- Improve **Receivers** with better optical and thermal properties, guaranteed **durability** (at high temperatures and under oxidizing conditions ) for the plan lifespan...
- Develop **Thermal heat storage** solutions at **reduced costs**
- ....



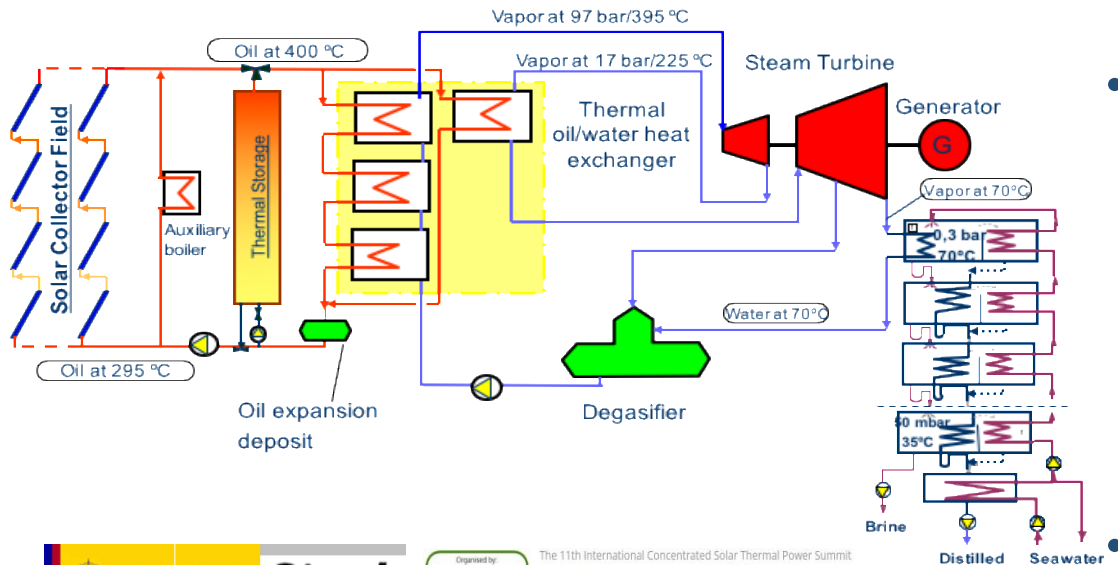
# Current Ideas and Questions: Are Solar Concentrators mature for additional market applications?



4+1-Effects MED Plant at CEA (France)



- **Desalinated water** is emerging as a necessity both **to expand** the regions where CSP technologies may be feasible and to meet human needs.



- Schemes of **CSP+Desalination** (at competitive costs) seems a very appropriate idea to deploy in **the GCC region**



# Emerging Ideas and Questions: How to promote the implementation of solar concentration technologies?

- Highlighting the **values** of CSP to **favor the penetration of other renewables**, produce on demand, generate local value, ...
- **-> Hybridization** of CSH & CSP with other technologies from renewable and non-renewable sources
- Feasibility studies for decision makers (e.g. Identifying barriers and taking advantage of new contexts -> **MUSTEC Project**, 2017-20)
- ...



In the light of the EU 2030 **Climate and Energy framework**, the **MUSTEC project** aims to **explore and propose concrete solutions to overcome the various issues that hinder the current and future deployment of CSP projects capable of supplying renewable electricity on demand from Southern to Central and Northern European countries.**



# Current Ideas and Questions: Need for Standards & Performance Diagnostic tools

e.g. Monitoring of incident solar flux?

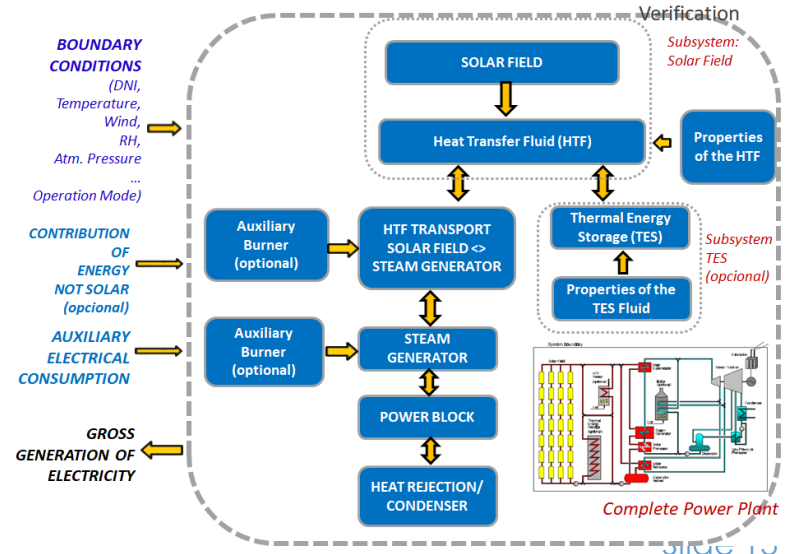


Unmanned aerial vehicle (UAV) for concentrator characterization?

- The necessary implementation of **standardized acceptance tests** that accelerate confidence in technology
- The implementation of in-situ diagnostics on the behavior of solar subsystems

• ...

e.g. Blocks diagram of a PT-CSP Plant with interfaces for Performance Verification





**THANK YOU  
FOR YOUR  
ATTENTION!**

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