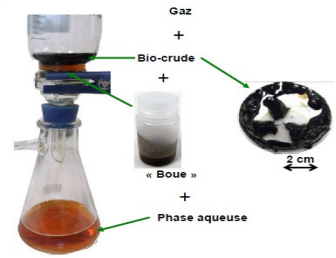
CEA – DTBH : Department of Hydrogen, Biomass and Thermal Technologies
FRANCE



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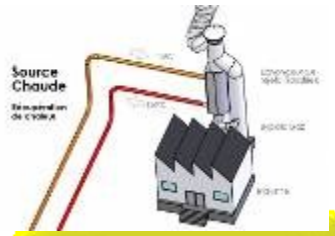
INSTITUT NATIONAL
DE L'ENERGIE SOLAIRE

GLOBAL STRATEGY



Processes optimization

Thermal effluents valorization

Renewable energies
- Biomass
- Solar for heat production
- CSP

Energy storage

Energy conversion

networks
heat / cold / chemistry / gas

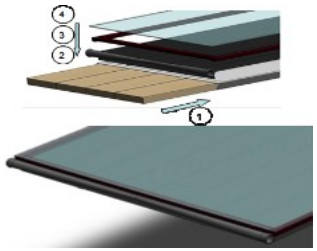
Industry

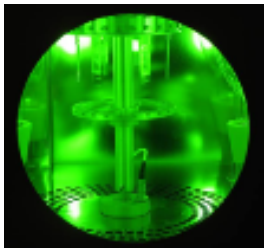
Housing

Energy
- Heating
- Cooling / Ice
- Electricity
- Desalination
- Chemistry

SOLAR THERMAL ACTIVITY

Polymeric Solar Thermal Collector

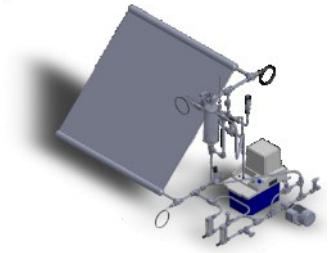


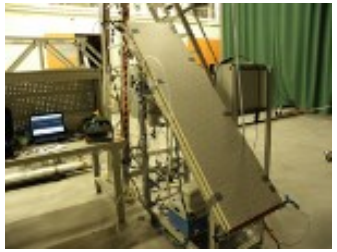


Development of a low cost solar collector for south countries :

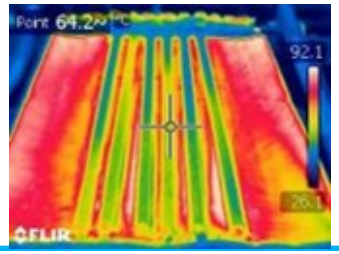
- Hot water production
- Desalination

✓ 1 patent
✓ Prototype in 2013
✓ Collaboration with MAScIR (Morocco)





High temperature solar thermal collector



Development of a multi-channel heat pipe solar panel for a temperature range from 80°C to 120°C :

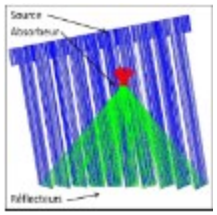
- District heating network
- Industrial process

✓ 2 patents
✓ 1 publication
✓ prototype (100 kW) in operation

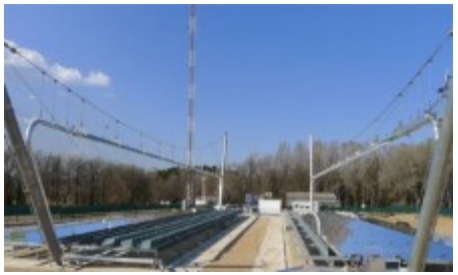
0°C 50°C Temperature 100°C 200°C

SOLAR THERMAL ACTIVITY

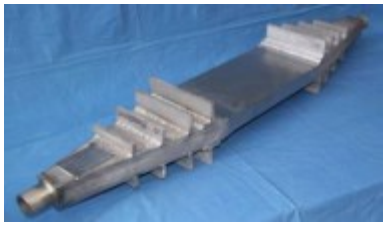
Water / oil Fresnel receivers



Development of solar field and storage system
- ✓ 10 patents
- ✓ 2 publications
- ✓ 1 prototype in operation

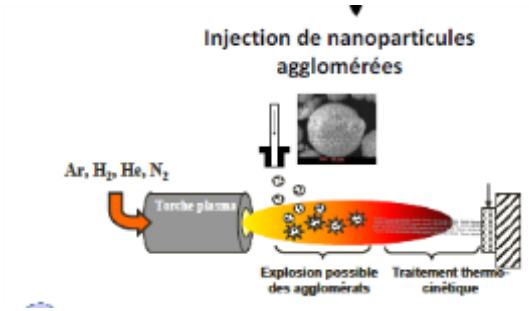


High T° compact solar receiver

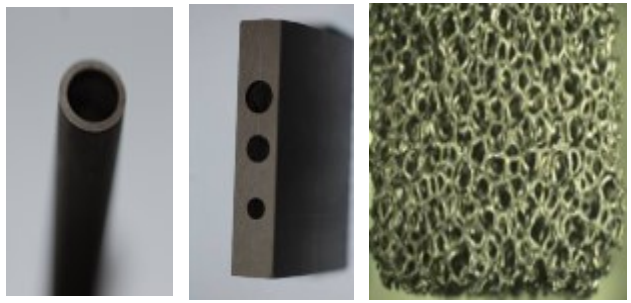


Development of high temperature receiver (750°C)
- ✓ 2 patents
- ✓ 2 publications

Very high temperature solar receiver



Development of materials for very high temperature receiver (600-1000°C)

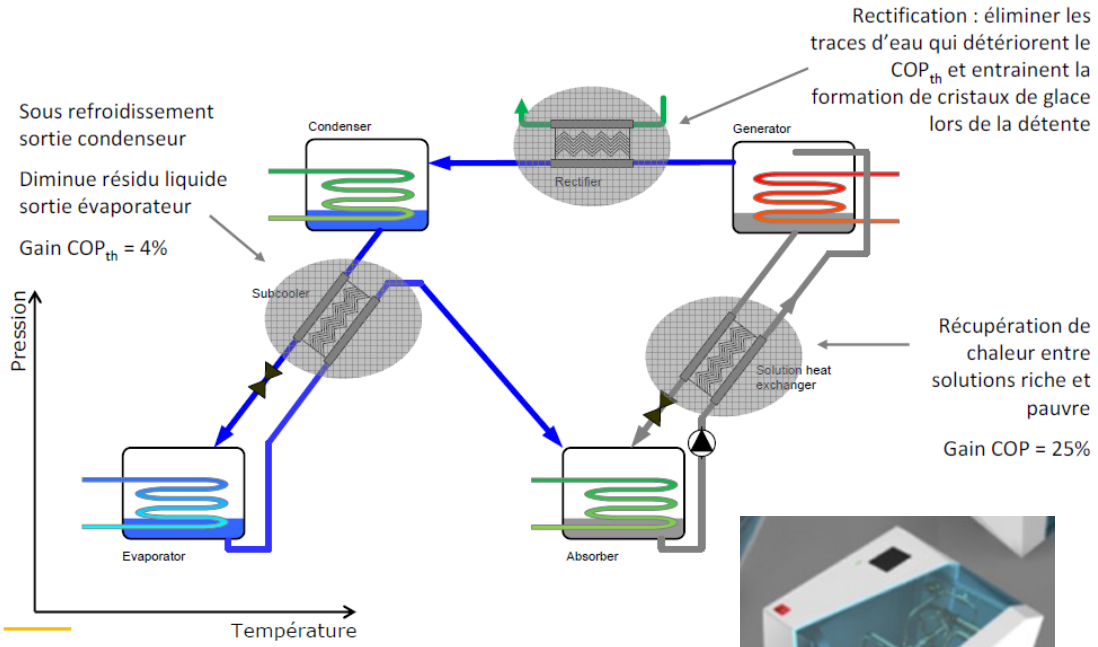


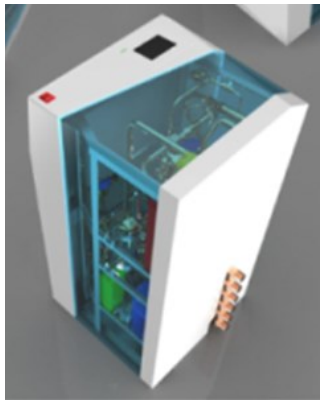
300°C 500°C 800°C 1000°C

Temperature

Absorption systems :

- Cycle and components size optimization : cost reduction
- Working fluid capacity reduction (ammonia)





Two applications :

- Housing < 5 kW
- Industry > 50 kW

Results

- ✓ Publications : 3
- ✓ patents: 3
- ✓ Prototype (5 kW) in 2012
- ✓ First commercial system built and tested in 2013

Electricity production from low temperature heat

ORC cycles modeling :

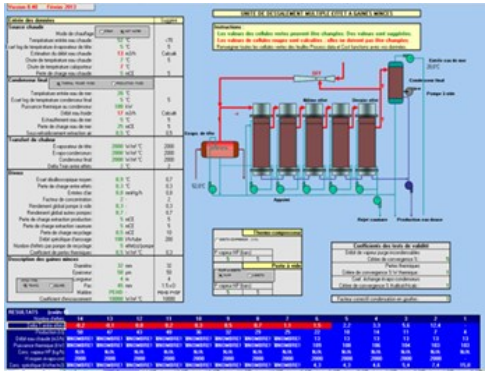
- Thermodynamic cycles performances / design modeling (EES)
- Components models (exchangers, pump, turbine)
- Dynamic models (Dymola)

Experimental system development :

- Tanscritical bench for pump and exchangers charactérization (< 200°C – 10 kWth)
- ORC prototype for low temperature effluents (<200°C – 150 kWth)
- Stirling engine characterization (<200°C – 10 kWth)
- 50 kWe ORC monitoring

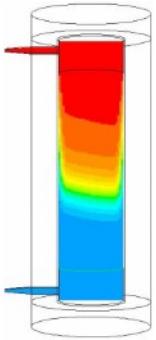
Sea water desalination and effluents concentration

- Thermal effluents valorization (50-100°C)
- Fresh water production through thermal heating (humidification or evaporation)



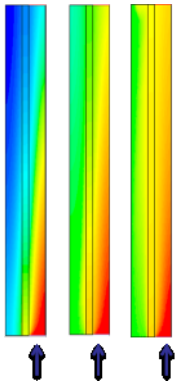
Multi stage evaporation cycle :
Fresh water production capacity: 1-10 000 m^3/j
Hot fluid temperature : 50-80°C
Proof of concept under construction
Results :
✓ Publications : 1
✓ patents: 3

THERMAL STORAGE



2010-2012
Design and tests
Volume : 3 m3
Temperature : 100-300°C

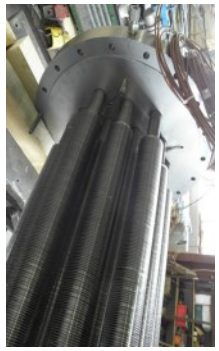
2012-2014
Validation
Volume : 30 m3
Temperature : 100-300°C

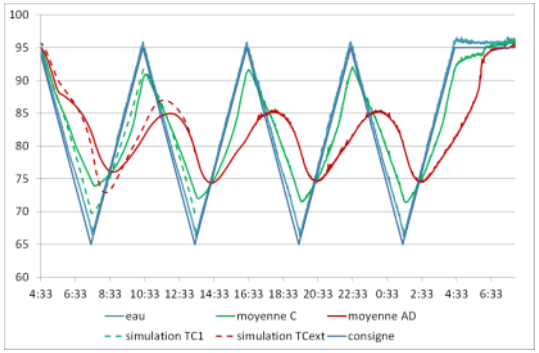


2010-2011 : Single-tube
Temperature : 50°C

2012 : Multitube
Temperature : 80°C

2014 : Prototype
Temperature 300°C





Sensible heat thermal energy storage

Energy density: 50-100 kWh/m3

- ✓ 3 patents
- ✓ 2 publications

Phase change materials storage

Energy density: 100-300 kWh/m3

- ✓ 2 patents
- ✓ 1 publication

Ageing studies for solar thermal energy

- **Indoor ageing means**
  - Temperature ageing chambers
  - Temperature / humidity
  - Salin mist chamber
  - Irradiation : suntest and UV
  - Sand blaster chamber
  - Cleaning test bench

- **Outdoor natural ageing sites**
  - CEA INES (France)
  - CEA Cadarache (France - mediterranean climate)
  - Rabat (Morocco - seaside site)
  - Ouarzazate (Morocco - desert site)
  - Corsica (France - seaside site)
  - Réunion (France – indian ocean island)

- **Characterization means**
  - Spectrophotometers labo (UV -> IR)
  - Portable reflectometer
  - Colorimeter