

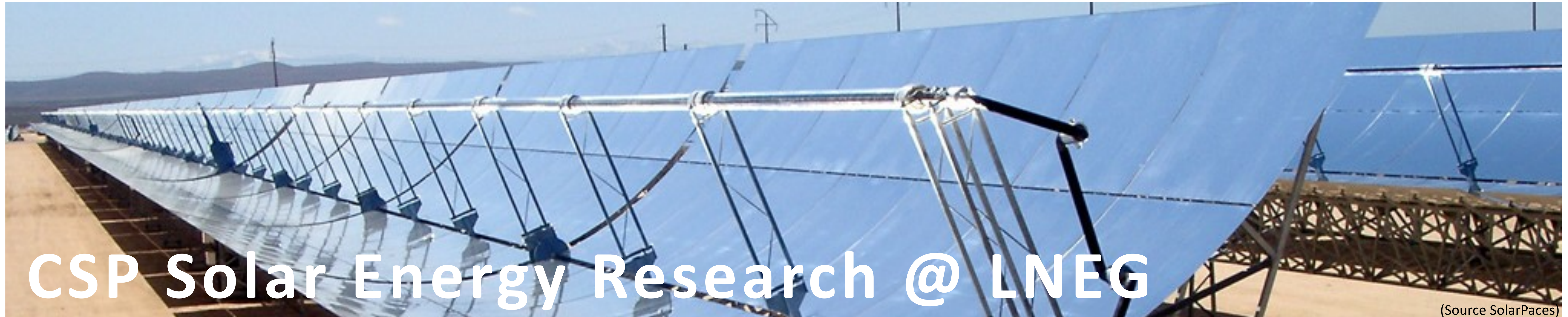


CSP Technology Developments and Cost Reduction

Innovative Heat Storage and Desalination Cogeneration Simulations

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(Source SolarPaces)

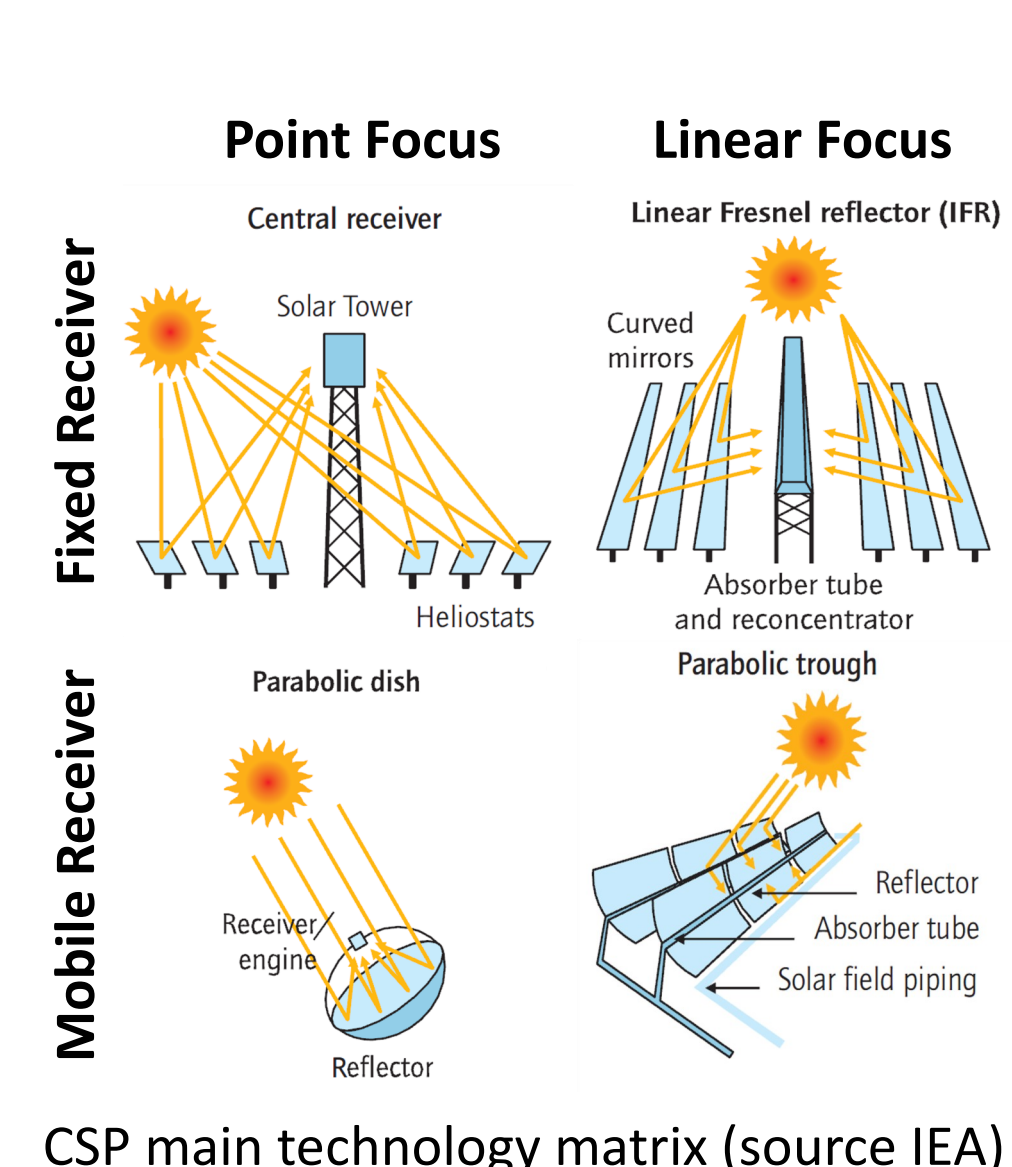
In Portugal 60% of its final energy consumption represents electricity or heat which can be produced by solar energy. It receives daily on average 14-17 MJ/m² (2200-3000 h/yr). Thus it is natural that one of LNEG's research focus is solar energy, studying PV and thermal technologies, in areas such as:

- Solar collector/field optics;
- Thermal energy storage;
- Solar collector performance and costs optimization;
- Solar collectors heat loss mitigation strategies;
- Solar air-conditioning;
- Process heat;
- Solar desalination;
- Solar detoxification;
- Concentrated solar power (CSP).

Concentrated Solar Power

CSP is a solar thermal power technology applicable for Peak, Intermediate and Base load (using heat storage).

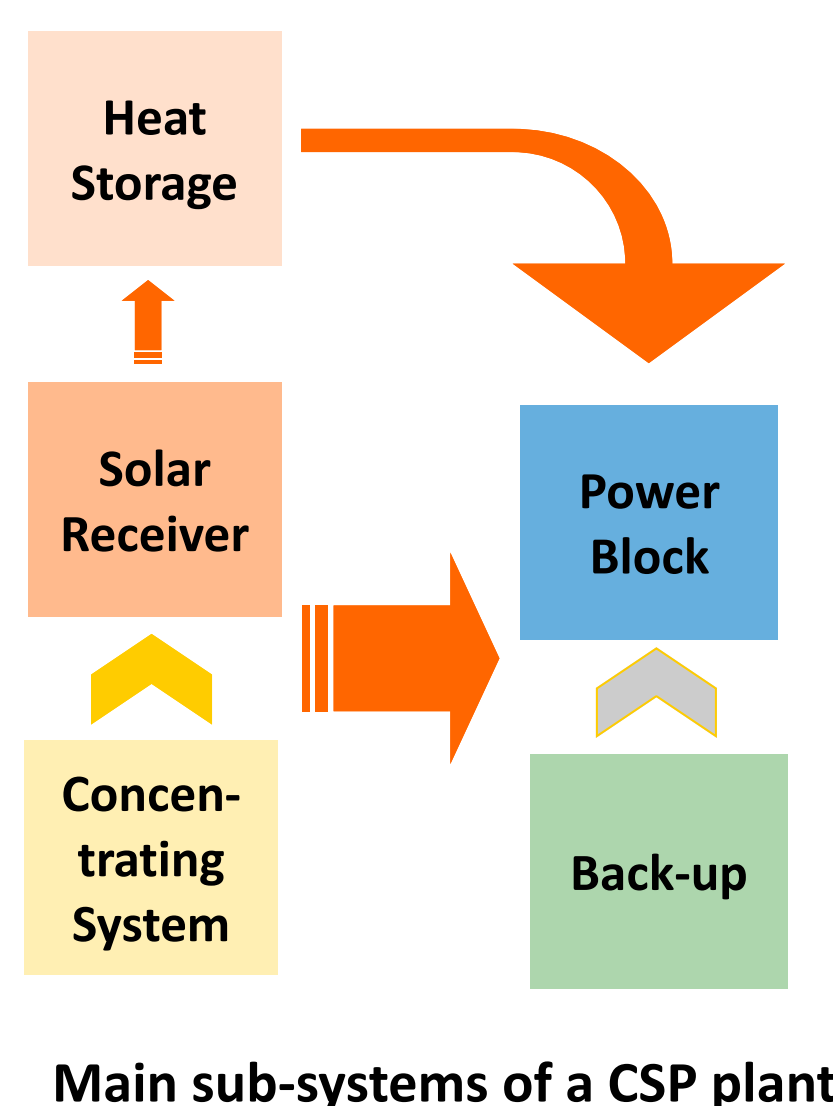
CSP can be divided in 4 main technologies. The principles behind plant design are similar (except for Parabolic dishes).



CSP main technology matrix (source IEA)

Poligeneration applications:

- Water desalination;
- Combined heat;
- Cold and power;
- Process heat;
- Hydrogen production;
- Solar fuels synthesis.



Main sub-systems of a CSP plant

CSP is a reliable, clean and highly dispatchable renewable power technology, easily hybridized with conventional techs and enhances grid flexibility.

Current costs

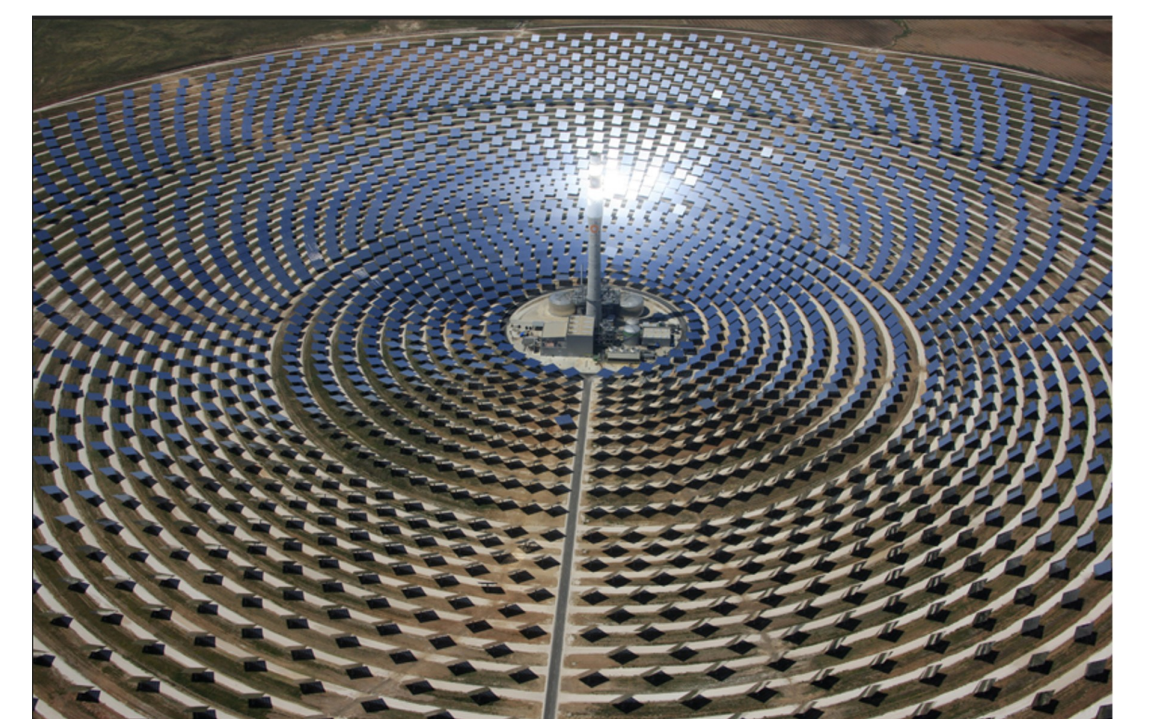
- Investment costs: 4,2 to 8,4 \$/W;
- Levelized electricity costs: 170 to 250 \$/MWh;
- Further R&D is needed in order to decrease these costs.

(Values from the International Energy Agency (IEA))

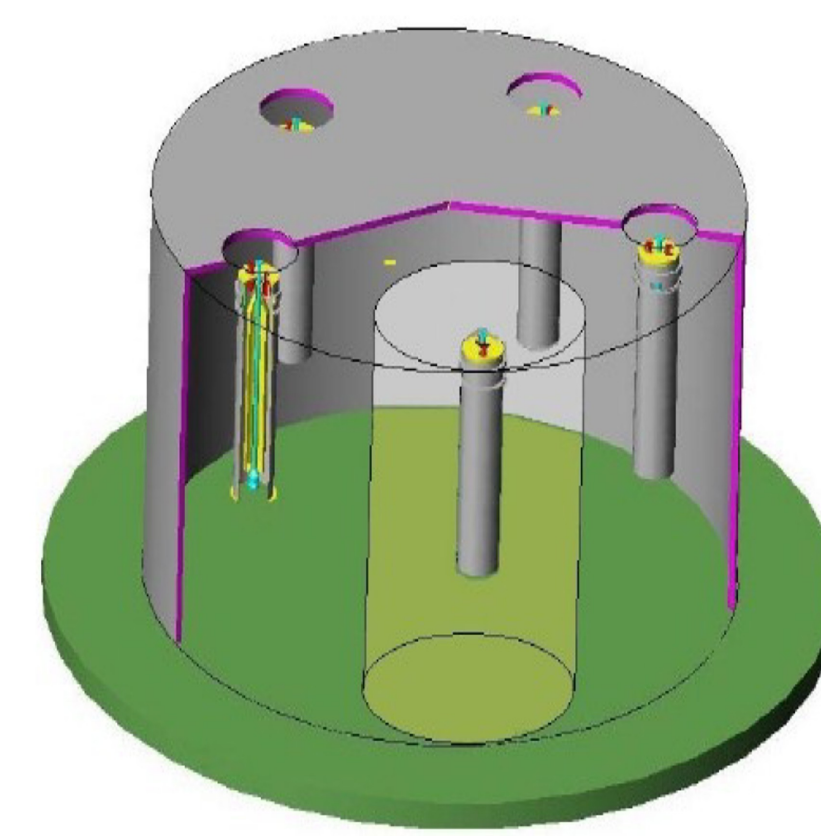
Ongoing Research Projects

Plant Modeling

Physical and empirical models development for parabolic trough and central receiver plants.



Gemasolar central receiver plant (source Torresol)



Single tank with integrated steam generator (source OPTS)

Heat Storage Model

Model development for an innovative single tank thermocline thermal energy storage:

- Using molten salts at 550°C;
- With integrated steam generator concept developed under FP7s OPTS.

Both models will be validated with:

- Experimental data from operational commercial plant;
- Data from a small-scale thermal energy storage.

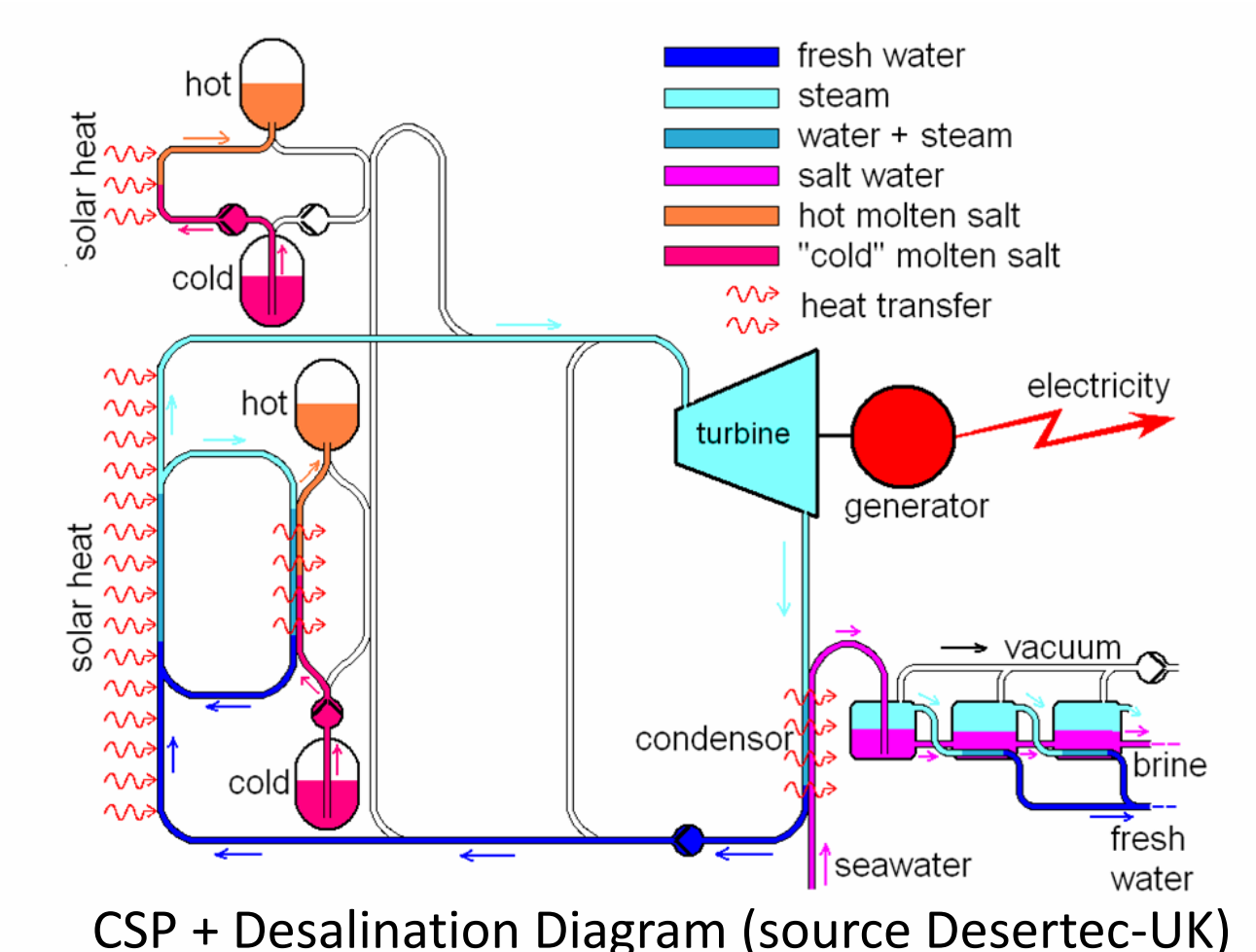
After experimental validation both plant and heat storage models will be integrated.

Electricity + Water Cogeneration (CSP+D)

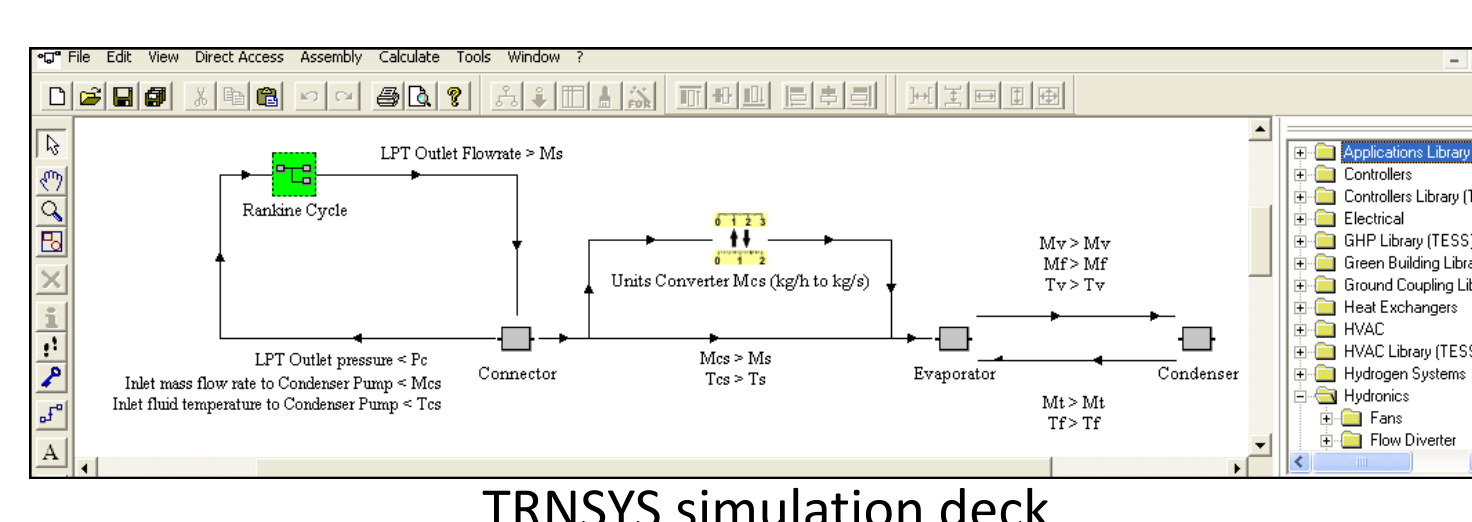
Develop a model to determine how feasible is to have a CSP plant powering a Desalination unit, using:

- Evaporation (Thermal) or,
- Reverse Osmosis (Mechanical)

Then adapt the work to NREL CSP Solar Advisor Model (SAM).



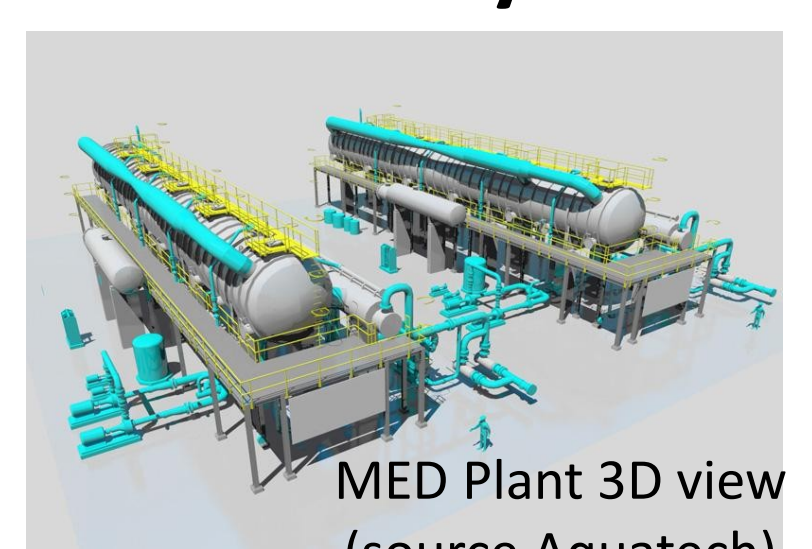
CSP + Desalination Diagram (source Desertec-UK)



TRNSYS simulation deck

Programming in TRNSYS: Modular transient systems simulation program. New components were built for the desalination systems.

Till the end of the year, a Multi Effect Desalination (MED) system will be modeled, and connected to the CSP plant models from SAM made by NREL.



MED Plant 3D view (source Aquatech)