Industrial-scale Prototype of cTES for Water Consumption Reduction and Power Block Efficiency Improvement - SOLWATT PROJECT

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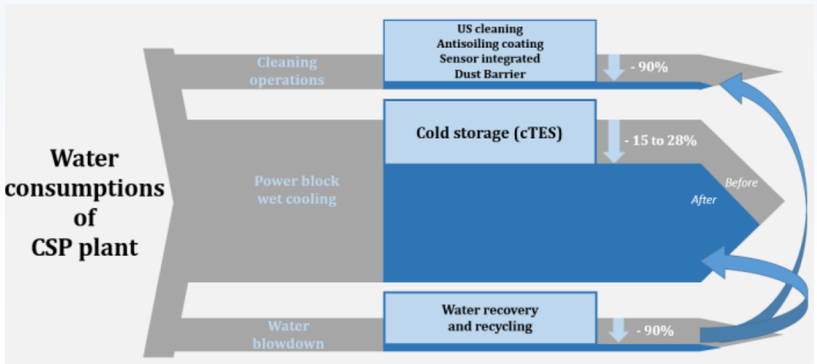
SOLWATT PROJECT



Objectives of water reduction of SOLWATT project

SOLWATT's objectives for reduction of water consumption:
- **90% for cleaning**
- **15% to 28% for condenser cooling**
- **90% for recovery and recycling water**

Then, a total reduction of water consumption by:
- **35 % for a wet cooled CSP plant**
- **90 % for a dry cooled CSP plant**

"The overall purpose of the SOLWATT 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."

WASCOP (2015-2019) — TRL<5

COOLING
- Water/rock thermocline
- Air/rock thermocline
- Hybrid cooling (wet/dry)
- Versatile cooling (dry with spray)

CLEANING
- Dust barrier
- Anti-soiling/self cleaning coating for abosrber
- Anti-soiling/self cleaning coating for reflector
- Soiling characterization devices
- Innovative cleaning systems

Upscale and test in La Africana

SOLWATT (2018-2022) — TRL→7

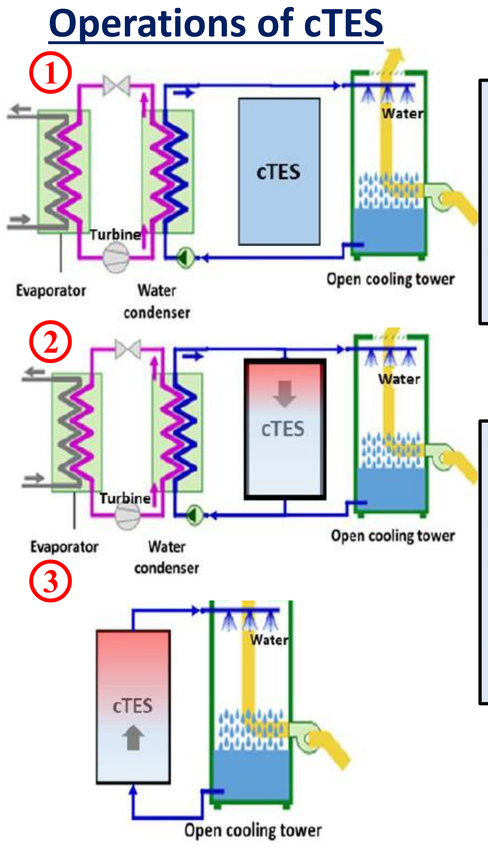
COOLING
- Water thermocline 1000 m³

CLEANING
- Dust barrier
- Anti-soiling/self cleaning coating for abosrber
- Anti-soiling/self cleaning coating for reflector
- Ultrasonic cleaner
- Soiling sensor

WATER RECOVERY

cTES for optimized condenser cooling

Operations of cTES



1. **Moderate to high ambient temperatures:** NO USE of cTES
2. **Too high ambient temperatures:** Partial storage of condenser heat in the cTES
3. **Nocturnal operation:** Discharge of the cTES

- **Water consumption reduction in a wet cooled plant**
- **Increase of performances in a dry cooled CSP**
- **Easily implemented in existing plant or built into new plant**
- **Low CAPEX: excavated pond rather than aboveground tank**

cTES main tasks in SOLWATT

Main objective of SOLWATT project for cooling part is the validation at industrial-scale of the relevancy of the cTES concept

- **Detailed design for the cTES prototype**
- **cTES engineering for installation and exploitation on La Africana CSP power plant**
- **Development of cTES control laws for optimal operations**
  - **Expert laws**
  - **Predictive control strategy based on MILP approach**
- **cTES construction**
- **cTES exploitation**
  - **Results analysis**
  - **Numerical model validation**
- **Study/optimization of related components (fluid distribution, membrane etc…)**
- **Estimation of benefits related to cTES depending on cooling configuration (dry or wet) and power plant locations**
- **…**

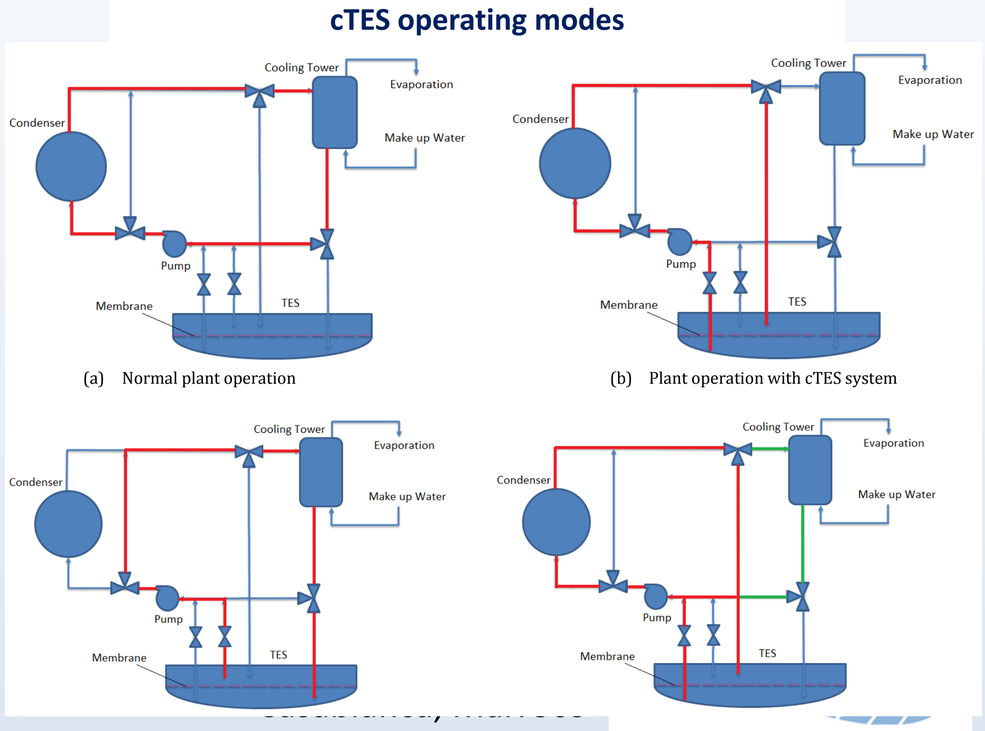
cTES Prototype in La Africana CSP power plant

Example of Pit-storage for district heating (http://sunstore4.eu/understand/gallery)

- **1000 m³ water thermocline cTES**
- **Pit-storage configuration**
- **cTES in parallel with the existing wet cooling tower**
- **Membrane at the water/air interface to reduce heat transfer and water loss**
- **Flexible membrane to separate hot and cold water?**
- **cTES prototype large enough to allow representative characterization at real-scale and small enough to not interfere with the power plant cooling system**

Power plant name	**La Africana**
Country	**Spain (Posodas, near Sevilla)**
Owners	**Ortiz/TSK/Magtel**
Technology	**Parabolic trough**
Turbine capacity	**50 MW gross**
Cooling system	**Open wet cooling tower**
Start year	**2012**

cTES operating modes



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