

Solar & Thermal Storage



**Your solution provider for dispatchable
low carbon energy**



Dispatchable energy thanks to thermal storage:

Key to the green revolution

As the World is shifting from fossil fuels to renewable energy, higher shares of variable renewable energy appear every year and with it comes the need to manage them, as well as being able to generate green energy on demand: a need for **dispatchability**.

An answer to this challenge is Thermal Energy Storage (TES): the temporary storage of energy by heating or cooling a storage medium so that the stored energy can be used later for power generation or heating/cooling industrial needs. TES can facilitate the introduction of higher shares of renewables and contribute to the decarbonization of key sectors such as power, industry, district heating or cooling, cold-chain applications and buildings. In 2020, around 234 GWh of TES was present across the globe and is expected to experience a **three-fold growth by 2030**, reaching 800 GWh (*).

The power sector has already adopted TES on a commercial scale with **Concentrated Solar Power (CSP) Plants**. A CSP plant can indeed store energy in the form of heat using molten salts: a low-cost, flame-proof, and non-polluting fluid made of sodium nitrate and potassium nitrate. In 2020, molten salt storage capacity of over 21 GWh was installed worldwide. (*) Electrical heater systems are also currently considered, allowing electricity (usually from renewable sources such as PV) to directly heat to the molten salts ("Power to X" technology).

In the future, high efficiency TES technologies such as next generation molten salt, solid particles and supercritical CO₂ cycles will gain a foothold.

(*) IRENA (2020), *Innovation Outlook: Thermal Energy Storage*, International Renewable Energy Agency, Abu Dhabi.)



Credit: Abengoa, Khi Solar One project, South Africa

Solar Towers

The most efficient CSP technology today is the solar tower, which consists of an array of tracking flat mirrors (heliostats) that reflect and concentrate sunlight on a Solar Receiver: a high technology heat exchanger, allowing the heat-transfer medium (water, molten salt or solid particles) to reach the highest temperatures (and therefore the highest

plant efficiencies) of all CSP technologies: currently 565°C for molten salts, soon more than 800°C thanks to solid particle technology. John Cockerill is proud to have become a world reference supplier for this kind of receivers and supplied some of the most prestigious CSP plants in the world.

Our vision

We are rising to the challenge of the green revolution by using our extensive experience in CSP industry to be one of the world leading companies for Thermal Energy Storage solutions for renewable and dispatchable power and heat projects, from small to large scale, on and off-grid, on a worldwide basis.

We aim to be a partner for multi-energy renewable power plants, finding the perfect balance between the existing and future renewable sources to maximize the power plant efficiency, on a technical and economical level.

We propose our unique engineering, sourcing, and project management expertise over the complete project cycle, ranging from feasibility and engineering studies, equipment supply and long-term maintenance, for future and existing solar plants as well as research and development projects.



Technical expertise for extreme engineering



Credit: Abengoa/Acciona/Cerro Dominador, Cerro Dominador project, Chile

John Cockerill used his extensive and multi-century old expertise as a thermal and mechanical expert to master the many technical challenges that the solar receivers are facing while harvesting the intense solar energy flux.

- Integrity, efficiency, quality and lifetime through the best design and the highest quality materials.
- Operation safety with a thermo-mechanical monitoring software composed of highly precise infrared cameras.
- Easy maintenance using a tailor-made maintenance crane installed at the top of the solar receiver.

These efficient and innovative designs are recognized worldwide and allowed John Cockerill to be chosen as a trusted supplier for many prestigious large scale CSP projects around the globe.

Warranty & Services

Global Solutions for CSP and Steam Generators

Domains of expertise

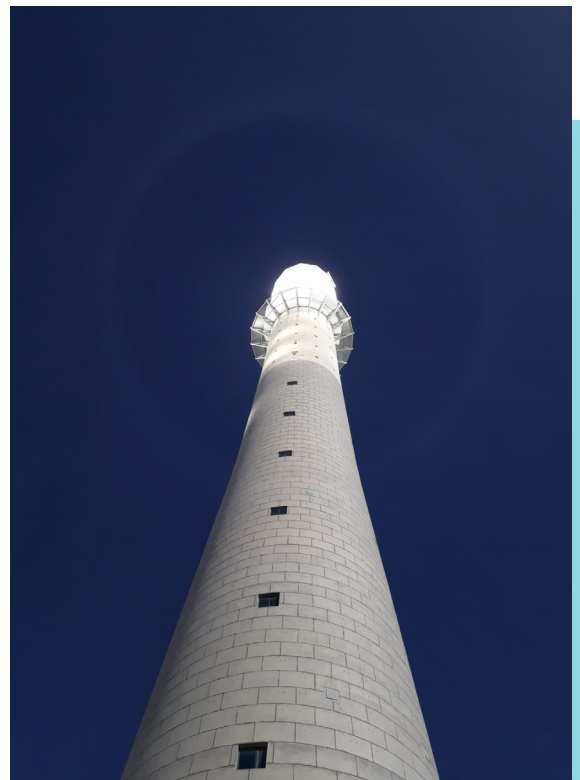
- Water/Steam solar receivers
- Molten salt solar receivers
- Molten salt steam generators

Our Solar & Thermal Storage Services teams can precisely work on:

- Heat Exchangers
- Steel Structure
- Casing, insulation
- Molten Salt, steam/water circuits
- Piping, flex calculation, supports
- Valves, PRVs, check valves,...
- Pumps
- Tanks, LP/IP/HP drums
- Expansion joints
- Erection, commissioning, revamping, repowering
- Inspections and assessments
- Monitoring
- Studies, trainings

Field of services

Our team can work on all type of CSP technologies or heat transfer fluid. From expertise, to studies, to on site works as well as supply or replacement of spare parts.



The steam generator:

Essential link

The Molten Salt Steam Generator (MSSG) is the essential link between the molten salt loop and the water/steam cycle, consisting of a group of heat exchangers transferring the heat from the hot molten salt to the water cycle of the power plant.

As CSP plants are oriented towards dispatchability, Molten Salt Steam Generators have to **constantly adapt their load to the electricity demand**, and therefore deal with frequent load change and daily start-ups.

To answer this specific and demanding range of operation and using his experience and knowledge from the solar receivers, John Cockerill has developed an **innovative design of heat exchangers** to offer the next generation of steam generators for CSP plants, with a focus on **flexibility, reliability and operating costs**.



World class supplier of CSP projects

- **2021: Redstone: Back To Africa.**
Molten salt solar receiver - 110 MW, 12h storage – South Africa
- **2018: Dubai Solar Park Phase IV: The world's tallest solar tower.**
Molten salt solar receiver - 100 MW, 15h storage – Dubai, UAE.
- **2017: Haixi Luneng. The only western solar receiver in China.**
Molten salt solar receiver - 50 MW, 12h storage – China
- **2014: Cerro Dominador: The first solar Tower in South America.**
Molten salt solar receiver - 110 MW, 17.5h storage - Chile
- **2012: Khi Solar One: The first solar Tower in Africa.**
Direct Steam solar receiver - 50 MW, 2h storage - South Africa



Constantly reaching for the stars

John Cockerill is proud of its achievements in CSP and is confidently looking towards the future, by working on **key research and development programs**.

Solar Gnext: future generation

This ambitious R&D program aims to design the next generation of solar receivers, and involves among others:

- A **dynamic corrosion test loop** “Dynacor”
- Testing of **new materials with high resistance** at high temperature (up to 850°C)
- Evaluation of **new molten salts and corrosion mitigation solutions** to reach an outlet salt temperature of 730°C
- Development of anticorrosion coating in molten salt at high temperature
- Development of an accurate lifetime prediction model including the corrosion effect.

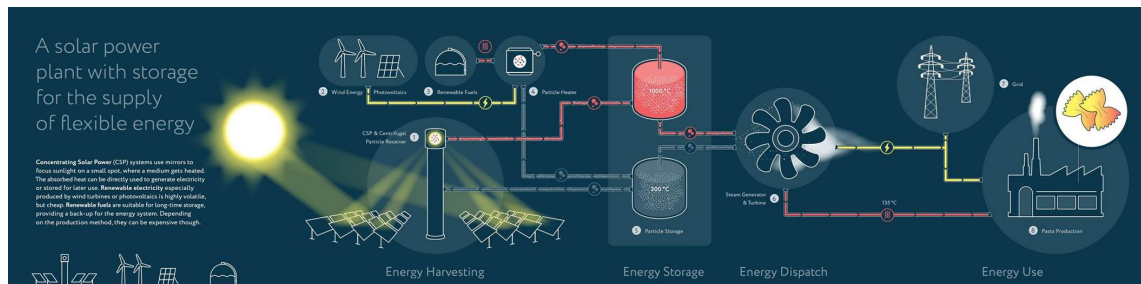


Credit: John Cockerill, Dynacor test loop, Belgium

HiFlex: turning on the heat

This EU funded project (H2020) will demonstrate a CSP prototype plant featuring solid particles as storage and heat transfer medium, allowing to reach the 1000 °C temperature limit, for maximum efficiency.

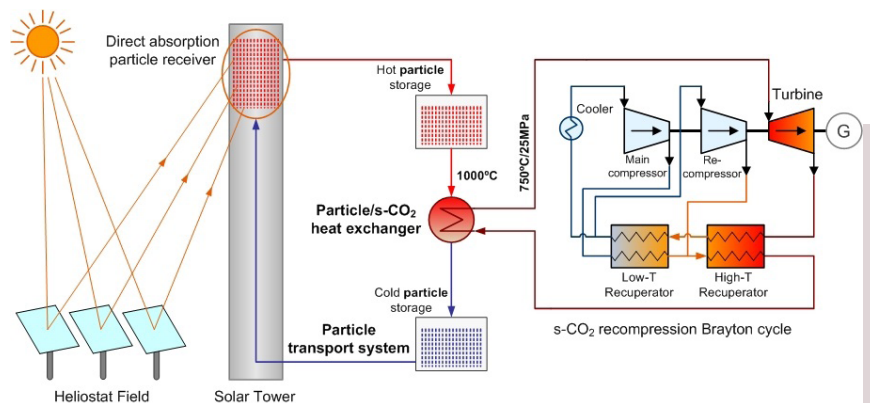
The HiFlex concept integrates a high level of flexibility, delivering dispatchable renewable electricity 24/7 to either industrial customers or the grid as well as supply process heat for many types of industrial plants. It will be tested at a pasta factory in Italy.



Credit: HiFlex project

CompassCO2: going supercritical

This research program creates the link between the very high temperature offered by solid particles solar towers and the ideal properties of supercritical CO₂ as a heat transfer media, allowing thermodynamical cycles such as Brayton cycles, to reach new levels of efficiency.



Credit: CompassCO2 project

The Power to Change the World



Credit: Cerro Dominador project, Chile

It is from the heart of its history stretching back more than 200 years that John Cockerill Energy draws its expertise in the production of steam, which has led to it being recognized worldwide on the market for the conception and supply of heat recuperation boilers. Resolutely turned towards the future, we proudly incarnate the bold spirit of an entrepreneur and we have extended our know-how in order to respond to the needs of our times, by developing innovative solutions to encourage access to energy, just like our founder in his own times.

It is from this knowledgeable mix of tradition and innovation that we draw our own energy. And it is across the whole world that John Cockerill Energy makes its mark through its technological know-how and its mastery of project management thanks to our Belgian, American, Canadian, Chinese and Mexican teams and our recuperation boiler licensees, Wuxi, S&T and Larsen & Toubro which respectively cover China, South Korea and India.

Share your renewable challenges with us!

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