Kraftanlagen
München

KAM's CSP Technology – an Economic and Highly Flexible Solution, Designed for Full Market Integration

The Concentrated Power of the Sun

Kraftanlagen München's (KAM) Concentrated Solar Power (CSP) solution is a simple, economic, and sustainable choice for many applications, markets, and locations. Our services cover the entire life-cycle of a CSP plant, including project development and market integration.

The name Kraftanlagen has stood for efficient plant technology and qualified power plant construction for more than 90 years. As a versatile service provider for industry and the energy sector, we are utilising state-of-the-art processes and technologies. We are offering custom, sustainable solutions and thereby contribute to the type of increased energy efficiency that is key to the success of the energy transformation.

Towards a carbon-free energy supply
We are convinced that power generation will abandon fossil fuels in the long run. Concentrated Solar Power (CSP) with an open volumetric receiver is an environmentally friendly technology towards achieving this goal. As one of Europe's leading companies in the field of engineering and constructing thermal power plants, we are committed to serve our customers with a robust, realiable and easy to operate CSP solution.

CSP: one concept, many applications
The core of CSP is a renewable heat source. CSP may therefore be hybridized easily with conventional thermal power generation, thereby combining a low carbon footprint with minimum overall system cost. As regions with large solar resources often coincide with low sweet water resources, a particularly attractive option is thermal desalination of seawater with the CSP plant's waste heat. KAM's economic integration of thermal energy storage further enhances the values of such applications: Expensive components like steam cycle or desalination equipment can be designed for average load rather than matching the high peak solar generation.

Strong partnership in research and development
Together with our partner DLR, Germany's national aeronautics and space research centre, we have developed our CSP technology for more than a decade and are demonstrating and continuously improving it at the Jülich solar tower power plant.

Range of services
As general contractor, we offer complete project management of costs, schedules, and quality for planning, procurement, construction, commissioning and maintenance of the plant. Together with our parent company Alpiq, we cover the entire value chain, complementing our services with further elements, including project development, energy marketing and trading.

Jülich Demonstration Power Plant

General contractor for engineering, supply and construction

Electrical output:	1.5 MW
Hot air temperature:	680 °C
Storage capacity:	1.5 h
Steam parameters:	27 bar, 485 °C

KAM test facility for research and development of CSP components

This Is How it Works

Solar thermal power plant with open volumetric receiver (OVR)

Concentrator system

The solar thermal power plant with an OVR comprises a concentrator system, an air cycle, a water/steam cycle and a cooling system. The concentrator system consists of a field of mirrors (heliostats), which track the sun on two axes. The heliostats concentrate the solar radiation onto a receiver located at the top of a tower.

Energy conversion

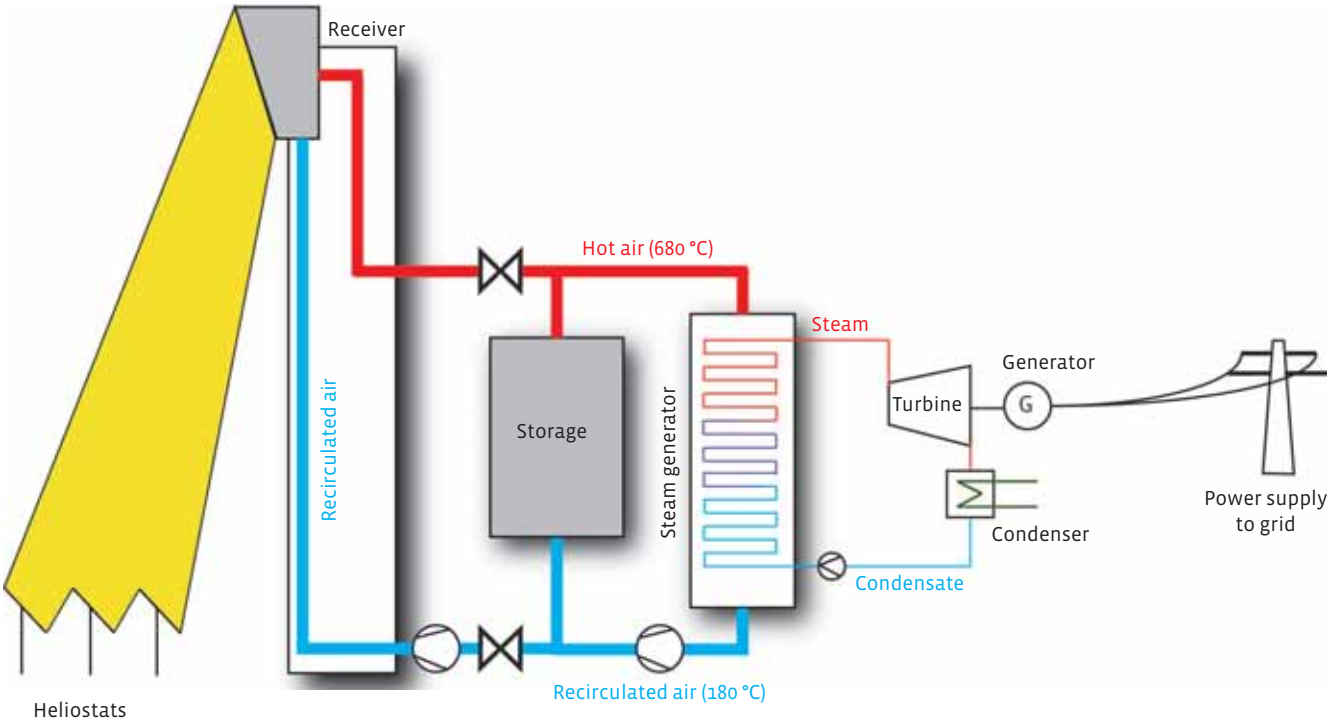
Solar radiation is absorbed at the front of the receiver, generating temperatures of up to 1,000 °C. Air drawn in from the atmosphere cools the receiver and heats up to approximately 680 °C. This air is used to "fire" a conventional steam power process.

Thermal storage module

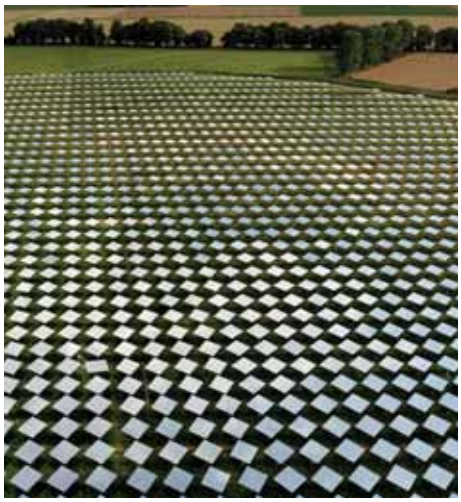
A thermal storage module decouples the time of power generation from the capture of solar energy. This allows for the plant to be equipped with a smaller power block, which is operated continuously.

Water/steam cycle

Superheated steam is generated in a heat recovery steam generator. Due to the high process temperatures, the steam parameters are in a range usually found in conventional power plants. This means that field-tested high efficiency components can be used in the power plant section.



Our Key Components

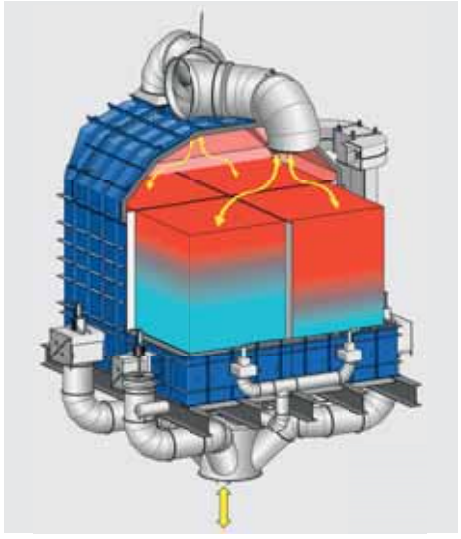


Heliostats

A large number of mirrors, the heliostats, track the movement of the sun and reflect the concentrated sunlight onto the receiver.
A heliostat consits of a 14 m² mirror with a metal support structure, its post and foundation, two actuators, and a control unit connecting it to the heliostat field's SCADA system. Thanks to a sophisticated manufacturing process in which metal works tolerances are compensated during the mounting of the mirror on its steel frame and a self-learning calibration algorithm, KAM's own heliostat technology facilitates both low-cost volume production and very high optical precision.

Open Volumetric Receiver

The receiver surface consists of modular high temperature-resistant ceramic monoliths with an open honeycomb structure.
They absorbe the concentrated solar radiation from the heliostat field not only on their surface, but also deep inside the structure. Environmental air is drawn in through the absorber and heats up as it passes through, reaching the highest temperatures inside the absorber. Behind the absorber modules, the hot air is directed to a steam generator and/or a thermal storage module. Overall efficiency is increased by recirculating air to the receiver and feeding its energy back into the hot air cycle.



Solid State Thermal Storage Module

The storage is an industrially tested, commercially available fixed-bed regenerator with a storage mass of ceramic honeycombs.
It is operated at atmospheric pressure, resulting in thin walls with excellent thermal cycling behaviour. It may be designed to any capacity from a buffer for periods of cloudiness up to 24-hour plant operation. When charging, hot air flows through the module from the top, heating up the ceramic bed material before leaving the storage at the bottom. When discharging, air flows through the module in the opposite direction, recovering the stored heat. The scalable module features a large energy density due to the wide temperature spread between charging and discharging.

Advantages of Our Technology

The tower design with an OVR enables the integration of a simple, reliable thermal storage module, ensuring that power generation can be adapted to the demands of mid- to base load power and grid stabilization. The absence of heat exchangers and the solid state storage medium result in low equipment cost, negligible operating risks, and minimum operations and maintenance cost.

The plant can easily be hybridized with other conventional or renewable heat sources to raise overall efficiency and flexibility. This can be achieved by integration of gas turbine exhaust gas into the hot air cycle or the usage of hot (solar) air for the superheating of live steam from a waste-to-energy or biomass plant.

Since the high steam parameters achieved are similar to those of conventional power plants, conventional components can be used, also providing high levels of efficiency. KAM's CSP technology is rigorously designed for longevity, reliability and availability. The whole process is environmentally sustainable: only air and water are used as operating media.

Further advantages:

Flexibility in all ranges from peak load to base load operation
- affordable, large fail-safe storage
- high capacity factors
- excellent adaptability to requirements of grid infrastructure
- power generation independent of solar heat generation
- rapid start-up and cooldown
- excellent part load behaviour

Long life expectancy
- modular set-up of highly stressed parts, large safety margins
- components with limited life expectancy make up only a small portion of investment costs, therefore few reinvestments necessary
- most parts may be serviced or replaced during operation (e.g., mirrors), receiver can be serviced at night, while plant uses storage for electricity production

High operational safety
- decoupling of solar heat generation and electrical power
- short-term variations in solar radiation have no effect on power generation
- large safety margins for highly stressed parts
- excellent thermal cycling behaviour
- unpressurized, simple and robust air system
- major components based on conventional power plant technology
- no significant risk for plant and personnel in case of shutdowns
- potential for high degree of automation

Low cost of operation
- short mean times to repair (MTTR)
- very limited auxiliary power consumption during night-time and shutdown
- cleaning and maintenance of heliostat field require neither expensive machinery nor personnel with special training

KAM's CSP technology with its usage of air as heat transfer medium is well-suited for many other CSP applications, namely hybridization with other thermal power plants, high-temperature process heat (e.g., for chemical processes), solar augmentation, and enhanced oil recovery.

Particularly interesting is the combination of CSP with thermal seawater desalination, because regions with large solar resources often coincide with low sweet water resources. All around, our technology is an attractive, economic, and sustainable choice for many applications, markets, and locations.

Kraftanlagen München References

Kladno K7 Lignite Power Plant (Czech Republic)

Turnkey contractor for engineering, supply and construction of the complete K7 lignite-fired power plant unit on the site of the existing plant.

Customer:	Alpiq Generation (CZ) s.r.o.
Thermal furnace output:	326 MW
Electrical output:	135 MW
Thermal output:	105 MW

Olkiluoto 3 Nuclear Power Plant (Finland)

Engineering, supply, prefabrication and installation of the IP/LP piping systems for the water/steam cycle, the auxiliary systems and turbine piping.

Customer:	Siemens AG Power Generation, Erlangen
Total length of piping:	approx. 31,000 m
Nominal diameters:	DN 6 to DN 1,600
Welds:	approx. 27,000
Pipe supports:	approx. 11,000

Al Shuweihat S1 Combined-Cycle Power Plant (United Arab Emirates)

Supply, installation and commissioning of the complete ventilation, air conditioning and cooling systems for the gas and steam turbine halls as well as for the switchgear building, including control systems and cabling.

Customer:	Siemens AG Power Generation , Offenbach
Volume of air in steam turbine halls:	4 x 102,000 m^3/h
Volume of air in gas turbine halls:	15 x 82,000 m^3/h
Volume of air in switchgear building:	3 x 25,000 m^3/h
	3 x 18,000 m^3/h

Product Areas of the Kraftanlagen München Group

Energy and Power Plant Technology
Decentralised Energy Supply
Underground Piping Construction
Nuclear Technology
Industrial Plants and Installation
Utility Services
Engineering and Consulting
Production and Welding Technology

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