



Solar Thermal Power Plants From Vision to Realisation



FLAG SOL



Our everyday work is dedicated to putting global energy supply on a sustainable basis.

Flagsol has adopted a leading position worldwide in the market for solar-thermal power plants. Our high-quality services and innovative products for parabolic trough power plants have made us pioneers in this field – in Spain and Egypt, we provided the technology for each of these countries’ first parabolic trough plants.

The company’s roots date back to the construction of the world’s first parabolic trough power plants in the US in the 1980s. This experience has given us a competitive edge and we are committed to expanding this through numerous research and development projects.

We are continuously enhancing the technology. Our Skal-ET collector is approximately 10 percent more efficient than previous collectors. In addition, the new HeliOTrough collector allows us to further reduce the cost of solar thermal power plants significantly. The result is low-cost, climate-friendly and safe electricity production.

Business Model

Our core business comprises the construction of solar fields and turn-key parabolic trough power plants using our own first-class parabolic technology. Moreover, Flagsol GmbH offers consultancy services and various products and components of this technology. The business segments of project development, O&M management and equity investments in power plants are closely aligned with the plant construction business.

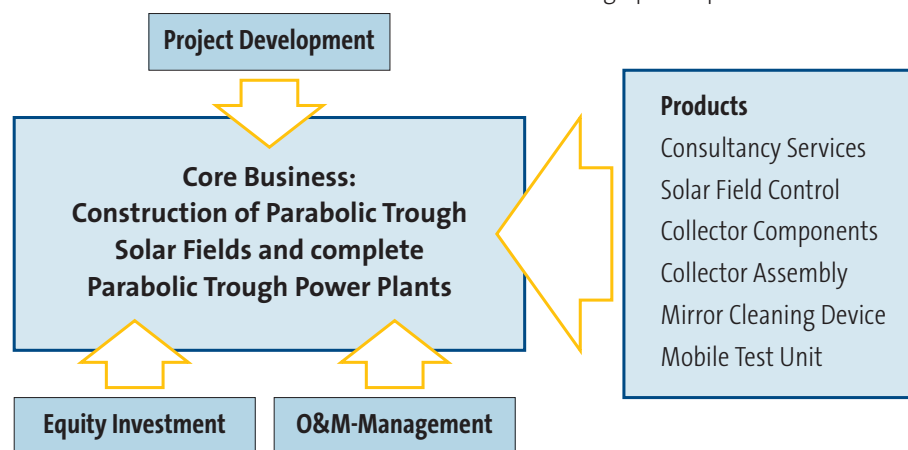
As a joint venture owned by Solar Millennium AG and Ferrostaal AG, Flagsol has access to the expertise of the two parent companies in both financing and construction of large industrial plants, especially in the sector of renewable energy.

Our Mission:

We create sustainable value by using our leading expertise in the development, construction and operation of environmentally friendly parabolic trough power plants.

Our Company Objective:

Technology and cost leadership are our main company objectives. We want to expand our position among the world’s top three companies for the development, construction and operation of parabolic trough power plants.



Flagsol is certified in accordance with ISO 9001. With this, we can guarantee:

- A high degree of customer orientation
- Adequate risk management
- Cost savings through efficient and lean processes and structures
- Highly motivated employees through optimal communication and information structures



A Milestone of Our Mission:

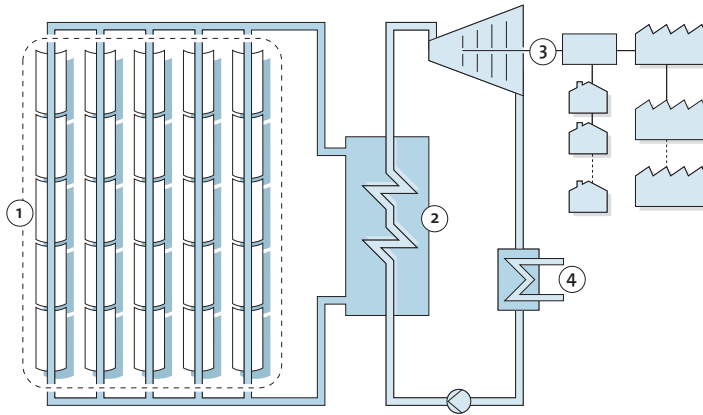
Flagsol is working with major, well-known enterprises to bring forward the DESERTEC concept. The goal is to cover 15% of Europe's electricity requirements in the long term using renewable energy from the desert areas of North Africa and the Middle East.



Parabolic Trough Power Plant

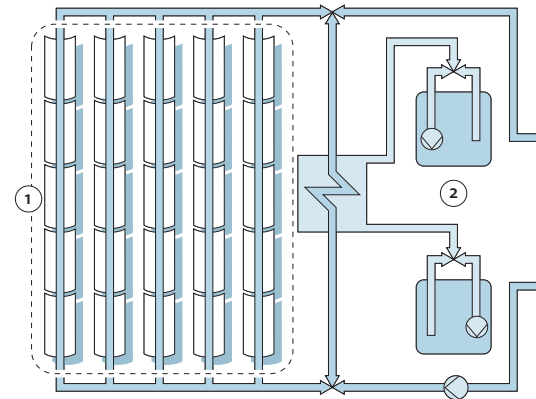


Parabolic Trough Power Plant with Thermal Storage



1. Solar field, 2. Heat exchanger,
3. Steam turbine and generator,
4. Condenser

Parabolic trough power plants without thermal storage are suitable above all in sunny countries with a high peak load requirement; i.e. high peak demand in the midday and afternoon hours.



1. Solar field, 2. Storage, 3. Heat exchanger,
4. Steam turbine and generator,
5. Condenser

Thermal molten salt storage allows for a significant increase in annual hours of operation and thus the electricity volume produced annually. It also makes reliable electricity production after sunset possible.

Parabolic Trough Power Plants

At a parabolic trough power plant, trough-shaped mirrors direct incidental solar radiation onto a pipe along the focal line of the collector. Its absorption heats a heat transfer fluid in the pipe, generating steam for the power block via heat exchangers. As with conventional power plants, the steam drives a turbine to generate electricity. By integrating thermal storage or hybrid operation, electricity can be supplied on demand, even after sunset. Solar thermal power plants are suitable for utility scale power generation with a 50 to 250 MW capacity.

Advantages of Parabolic Trough Power Plants

Efficient and Cost-effective

Parabolic trough power plants are the most efficient and cost-effective technology for converting solar energy into electricity on a power plant scale. Today, parabolic trough power plants are already an interesting option for covering peak load usage, even compared to conventional power plants.

Possibility of Storing Thermal Energy

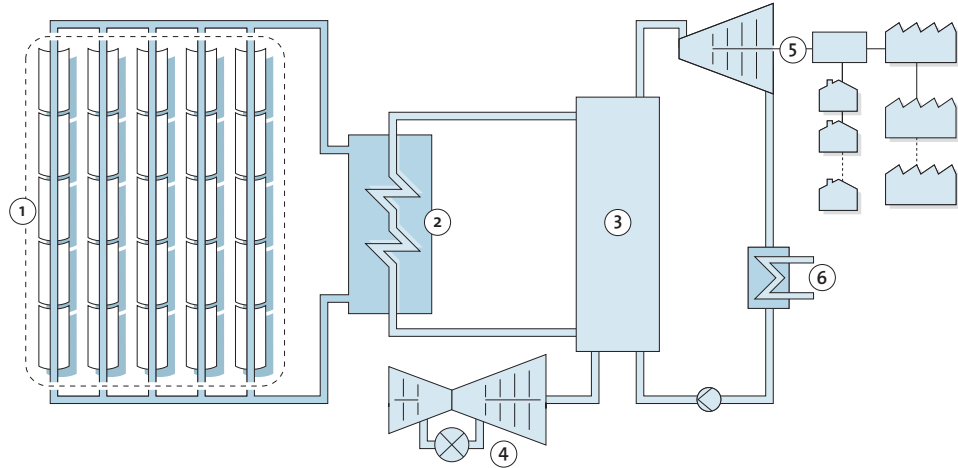
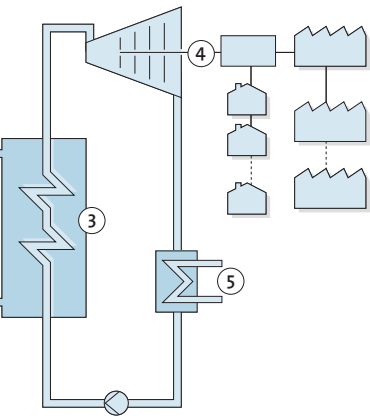
Parabolic trough power plants allow cost-effective and efficient storage of heat energy. Thermal storage even enables the power plants to deliver electricity at night, contributes substantially to grid stability and increases the reliability of supply for industry and households.



Storage



Hybrid Power Plant



- 1. Solar field, 2. Heat exchanger, 3. Heat Recovery Steam Generator,
- 4. Gas turbine and generator, 5. Steam turbine and generator, 6. Condenser

At a hybrid power plant, the thermal energy from solar fields is combined with an additional source of energy to generate electricity; for example, a gas-steam power plant. This allows for steady, 24-hour operation.

Nearly Unlimited Number of Location Options

On a worldwide scale, there is an abundance of vast deserts and semi-arid regions. Less than three percent of the Sahara desert would suffice to meet the world's energy demand with parabolic trough power plants

Particularly Flexible Implementation

Hybrid power plants can combine solar energy with other forms of power generation, such as natural gas or biogas. This means that parabolic trough power plants can reliably generate electricity on demand 24 hours a day

Proven Technology

Parabolic trough power plants have proven their efficiency over a number of years. In California, nine such power plants have been generating environmentally friendly electricity in commercial operation for approximately 25 years. These power plants are an impressive demonstration of the reliability and sustainability of the technical components. Flagsol is constantly improving this technology.





Andasol 1 + Andasol 2 – Two 50 MW Parabolic Trough Power Plants with Storage, Spain

Subcontractor for engineering (basic & detailed design), construction and commissioning supervision of solar field and HTF-system; supply of solar field control system.



Andasol 3 – 50 MW Parabolic Trough Power Plant with Storage, Spain

Engineering, procurement, construction and commissioning supervision of solar field, HTF-system, thermal energy storage and power block (in consortium).



Ibersol – 50 MW Parabolic Trough Power Plant with Storage, Spain

Engineering, procurement, construction and commissioning supervision of solar field, HTF-system, thermal energy storage and power block (in consortium).



Kuraymat – 150 MW Integrated Solar Combined Cycle System, Egypt

Engineering, supply, construction & commissioning supervision as well as operation & maintenance of the solar field.

Skal-ET – Improved Parabolic Trough Collector Design

Demonstration loop at Kramer Junction in operation since 2003. Commercial operation demonstrated an approx. 10 percent performance increase (Project supported by the German Federal Ministry for Environment).

Scope of Flagsol: Engineering, supply, construction and testing of 4,360 m² of parabolic trough collectors; supply of solar field control system.





R&D – Heat Transfer Medium

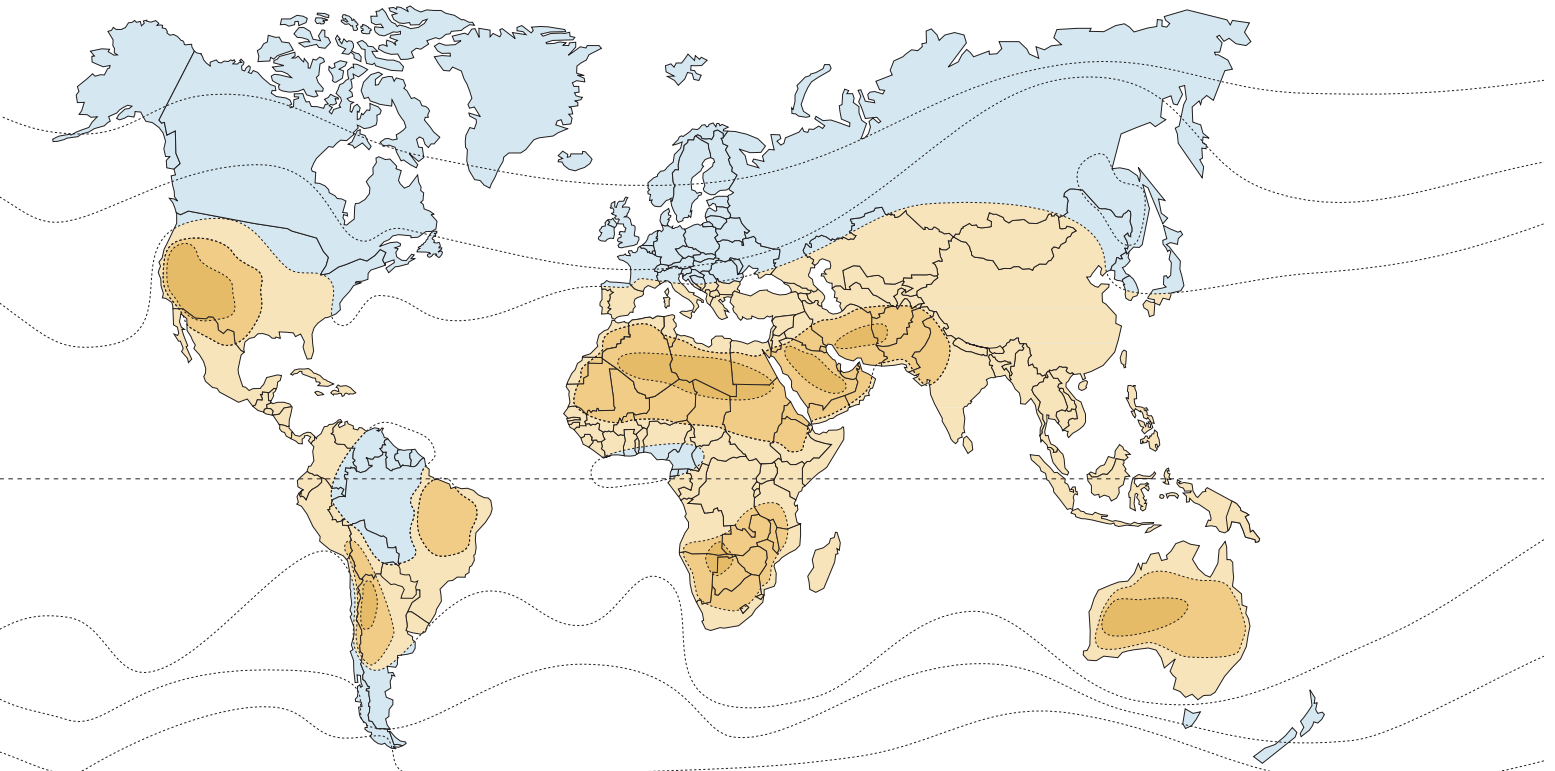
Testing of alternatives to current heat transfer fluids in the absorber pipes of parabolic trough power plants. R&D on the direct evaporation of water (replacing the oil cycle in the solar field) and molten salt (eliminating the oil/salt heat exchanger). Participation in research and development programs, for example together with Schott Solar and the German Aerospace Center (DLR).

**HelioTrough – New Collector Generation
Developed by Flagsol**

Demonstration loop at Kramer Junction in operation since end of 2009. Proof of the highest collector efficiency, setting new standards in specific cost reduction with parabolic trough collectors. (Project supported by the German Federal Ministry for Environment and the US Department of Energy).

Feasibility Studies

Feasibility studies, particularly in China, the US and Golf area for the construction of solar-thermal plants for supplying electricity or for the industrial use of thermal energy, e.g. steam generation in order to enhance oil recovery.



Suitability for solar thermal power plants: ■ excellent ■ good ■ suitable



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