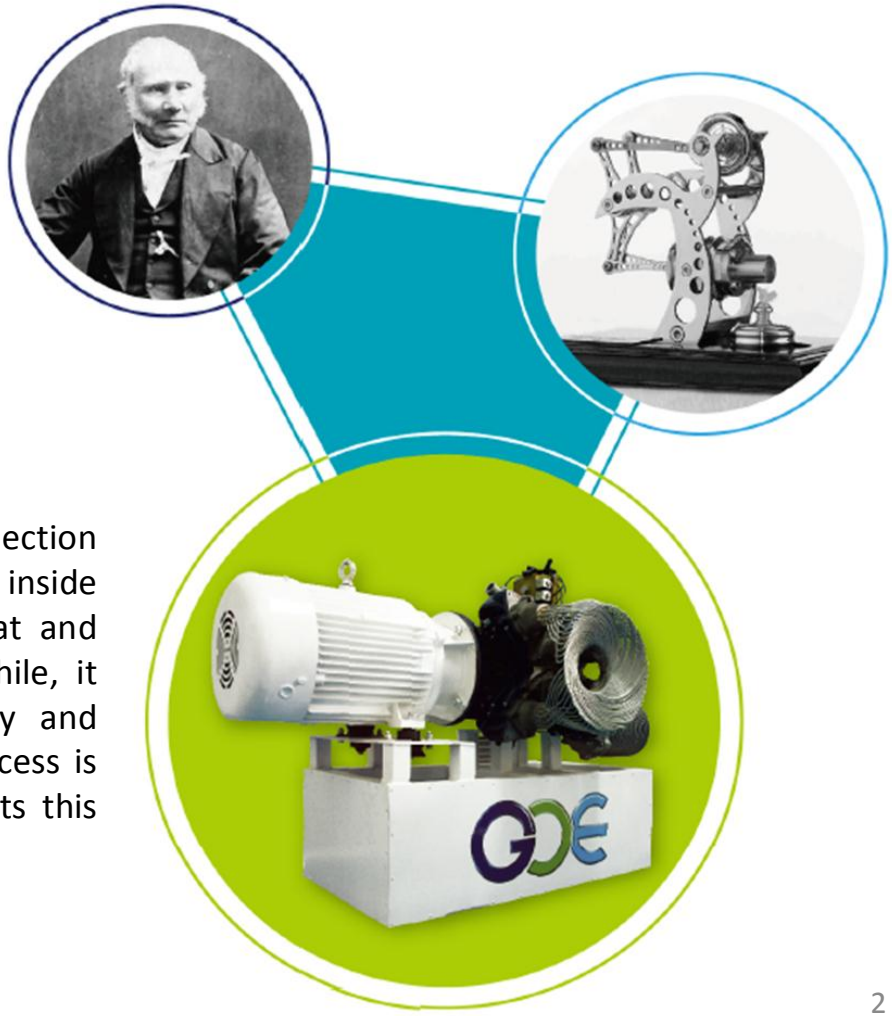
TWR Dish Stirling
Solar Thermal Power Generation System

TWR Holding Group

Introduction of Stirling Products

The History of Stirling Engine

In 1816, Robert Stirling who was a Physicist in Britain invented a closed-cycle Regenerative external combustion heat Engine, and thus all such engines are Generically named “Stirling Engine”.



Working Principle

An external heat source is used to heat up the heat collection subsystem outside the Stirling engine. The inertia gas inside the heat collection subsystem expands from the heat and pushes the piston to move as a power gas, meanwhile, it enters the cooler where it is cooled down quickly and produces power via cold compression. Such cyclic process is repeated and the Stirling engine continuously conducts this reciprocating motion to produce power.

Various Heat Sources Enabling Stirling Engine to Produce Power

- Solar Energy (including solar thermal energy, molten salt thermal energy, etc.).
- Gaseous Energy (including natural gas, coal gas, hydrogen, biogas, methane gas, associated gas, coal-bed methane, etc.).
- Fuel Oil (including diesel, gasoline, heavy oil, etc.).
- Hot-gas Energy (hot air, reaction heat from chemical enterprise, etc.).
- Exhaust Gas (exhaust gas from waste incineration, furnace exhaust, etc.).
- Thermal Energy of Thermal Storage Medium (including biomass hot oil, heat transfer oil, graphite, ceramic particle, etc.).
- Nuclear Energy (various nuclear fuels, thorium, etc.).

Dish Stirling Solar Thermal Power Generation System

25 kW Solar Type Stirling Engine

Solar Reflectors

Dish Solar Concentration Tracker System

Product Characteristics

- Excellent light gathering concentration ratio above 1.200.
- Efficient Conversion: solar to electricity conversion rate up to 33%.
- Direct conversion from solar to power with very little water consumption.
- Applicable to various landscapes from sloping fields of 30 degrees to hilly slopes.
- Applicable to either centralized grid-connected power plant or off-grid distributed power plant.
- Able to satisfy various demands from independent operation of single unit 25 kW system to clustered power plants in medium and large scales.

Applications

01

To build large-scale solar thermal power plant.

02

To build distributed power stations applicable for oil fields, remote mountain areas without or deficient in electric power, border outpost, pastoral area, etc.

03

To provide off-grid and grid-connected electric power for single household, individual office building, broadcast station and microwave station.

04

To build centralized or distributed heating system.

Technical Indicators and Main Parameters

Dish Concentration Tracker System (25 kW)	
Dish Radius	6280 mm
Specular Reflectivity	93%
Projected Area	92 m^2
Land Area	4 m^2
Required Annual Average DNI	≥2000
Operating Temperature	(-25° --- 40°)
Tracking Mode/Accuracy	Dual-axis tracking of elevation and azimuth angle/ 1 mrad
Tracking Range	Azimuth Angle: 0° - 360° / Elevation Angle: -10°-90°

Technical Indicators and Main Parameters

Parameters of Stirling Engine (25 kW)	
Rated Output Power	25 kW
Engine Speed	1500 rpm
Working Gas	Helium or Hydrogen
Input Energy	≥ 90 kW
Length	1300 mm
Width	1120 mm
Height	1800 mm
Weight of Engine	925 kg
Cooling System	Closed Cycle
Cooling Medium	Liquid Coolant

Project Case Showcasing

Zhang Jiakou

Zhang Jiagang

Ordos

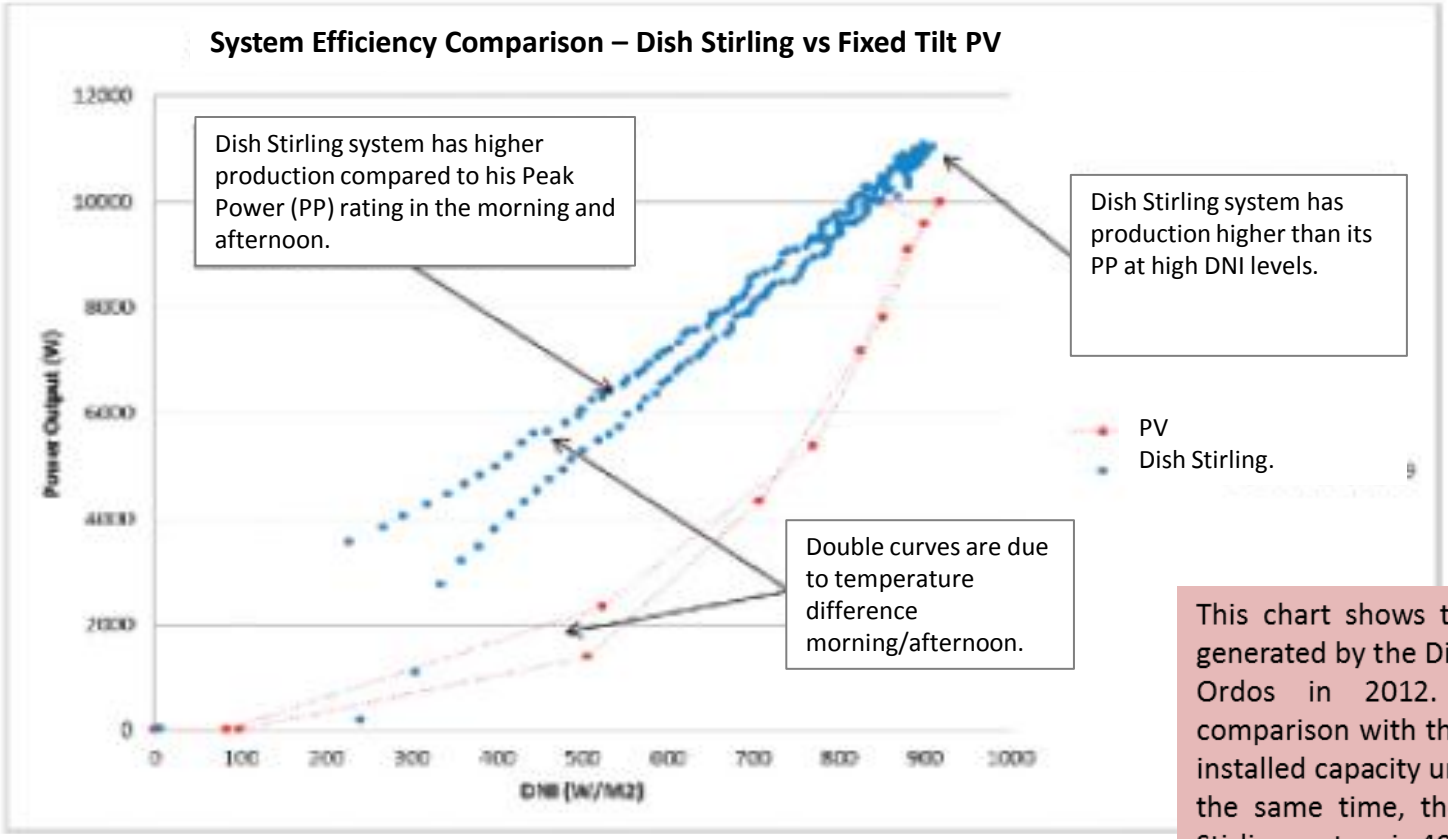
Advantages

Competitive Advantages of Dish Stirling Power Generation System over Other Solar Power Generation Systems

Technology	Generating Efficiency	Required Landscape for Installation	Maintenance	Environmental Protection	Land Area	Whether capable of 24 h power generation with thermal storage or not	Functions
Dish Stirling	28 - 33 %	Both flat land and land with some slope	Easy	Good	Small	Yes	Combined Heat and Power
Parabolic Trough	16 - 20 %	Flat Land	Difficult	Good	Moderate	Yes	Combined Heat and Power
Power Tower	18 - 22 %	Flat Land	Difficult	Good	Moderate	Yes	Combined Heat and Power
Photovoltaic	15 - 18 %	Both flat land and land with some slope	Easy	Bad	Much	No	Power Generation

System Efficiency Comparison

Our observations show that Dish Stirling Power / DNI produces significantly more kWh for the same Peak Power Rating than an equivalent size PV installation.



This chart shows the quality of the power generated by the Dish Stirling Power Plant at Ordos in 2012. Based on the data comparison with the PV system of the same installed capacity under the same location at the same time, the power output of Dish Stirling system is 40% higher.

Characteristics

Ease of Maintenance

As each Dish Stirling system can operate independently as a modular unit, the operation of the other units will not be affected if any of them encounters any functional failure. Therefore, it is much simpler than parabolic trough and power tower system.

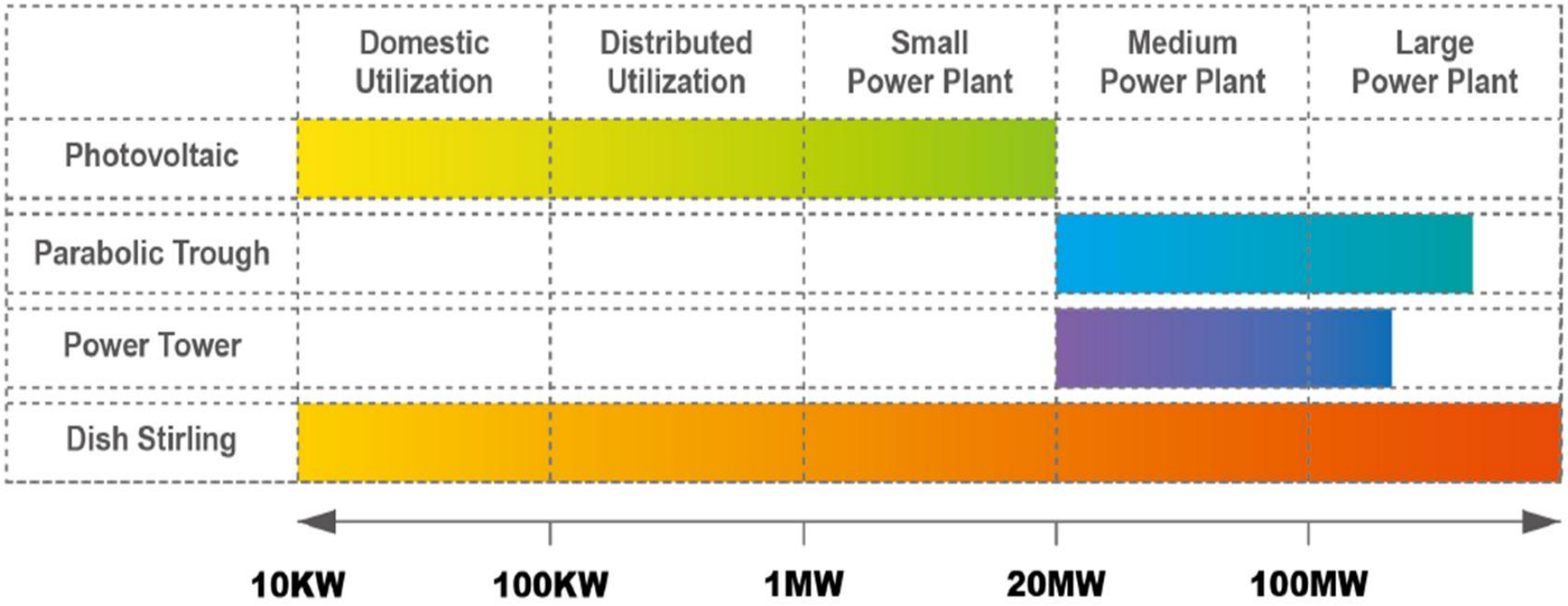
Environmental Protection

Power generation technologies like Dish Stirling, parabolic trough and power tower adopt a tracker system to follow up the track of the sun which has no effect on ecology of the vegetation and crops on the installation site, however, PV system is fixed without any movement once installed throughout the year, therefore, the vegetation on site often get withered due to lack of exposure to the sunlight.

Land Area

If taking a power plant of 20 MW as an example, the land area of dish solar Stirling is 480 Mu (320.000 m^2, requisition land), while solar PV will cover a land up to 800 Mu (533.333 m^2, requisition land).

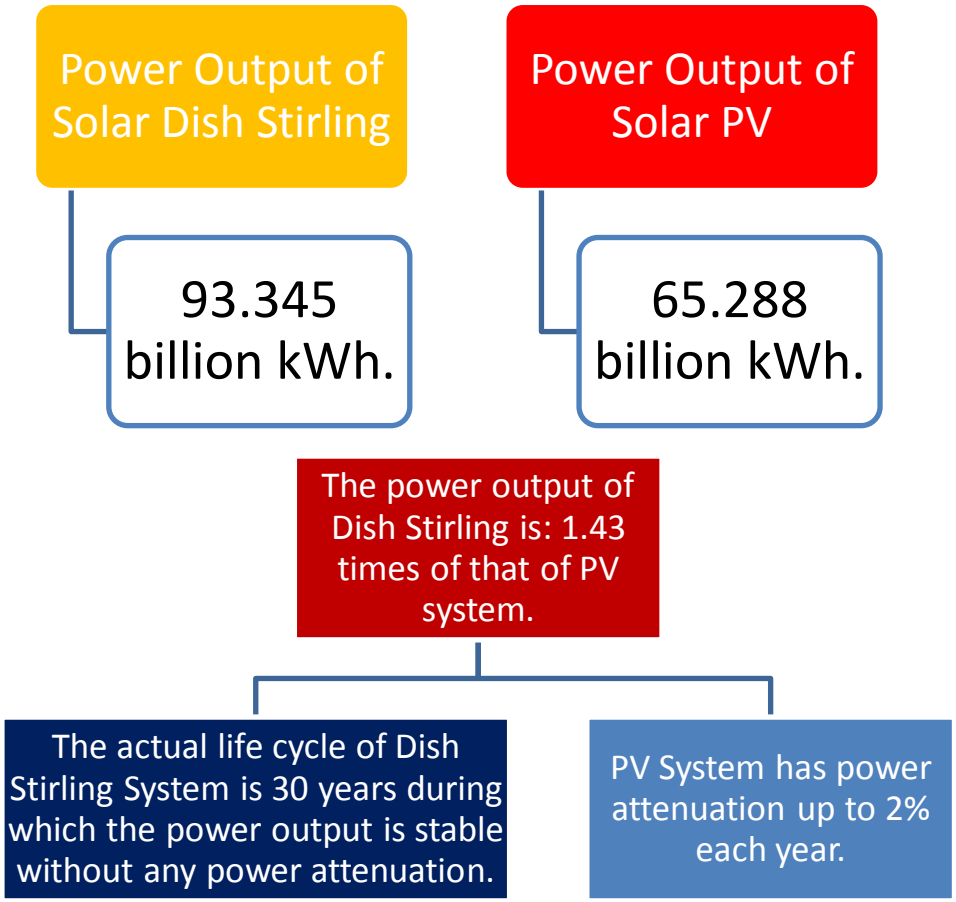
Applications



Analysis of Power Generation Cost

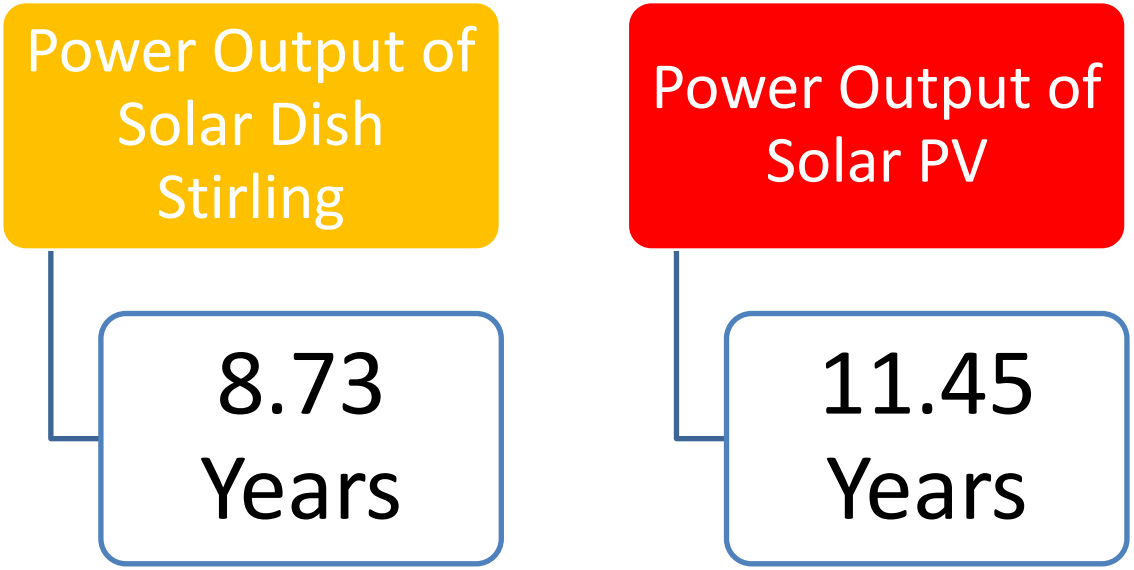
Economic analysis and comparison between Dish Solar Thermal Power Generation System and Solar Photovoltaic Power Generation System (a power plant of 20 MW as example).

Comparison of Power Output within the Life Cycle (on a basis of 25 years for the time being).



Investment and Payback Period

Economic analysis and comparison between Dish Solar Thermal Power Generation System and Solar Photovoltaic Power Generation System (a power plant of 20 MW as example).



TWR Holding Group

Is committed to put all effort to make this project happen, commitment founded by our slogan,

"People Helping People“

We appreciate your valuable time

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