SOLAR POWER FOR
CAIRO - EGYPT
FEB. 2014

ATOUN ENERGY

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The Thermal Storage System

ATOUN ENERGY

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CAIRO - EGYPT

Is Ideally Placed to Utilize Solar Energy

ATOUN ENERGY

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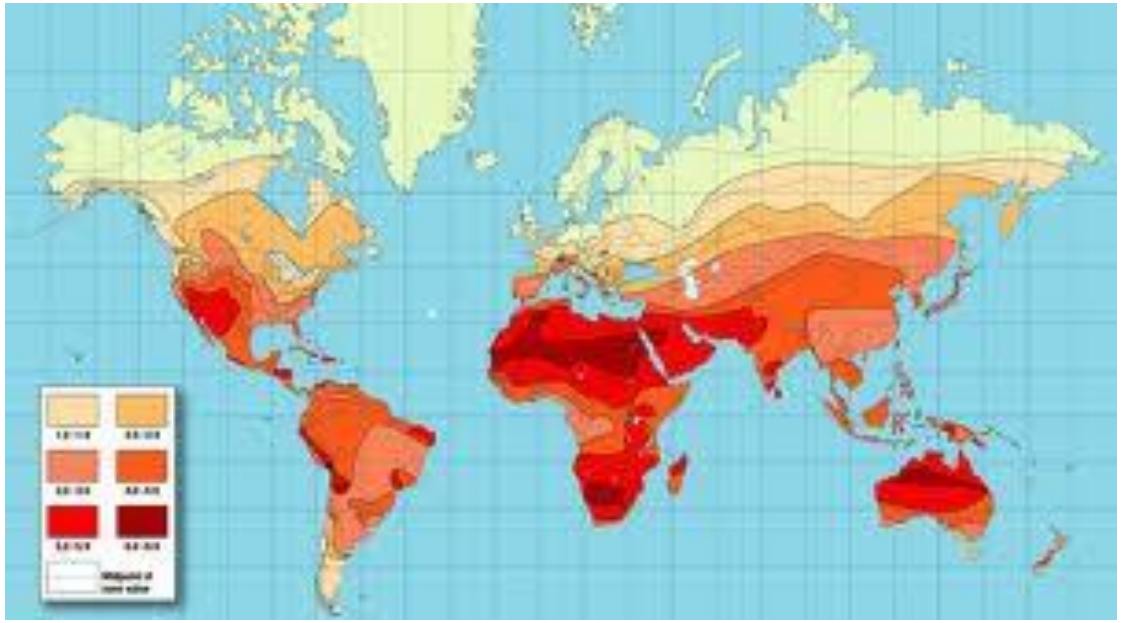
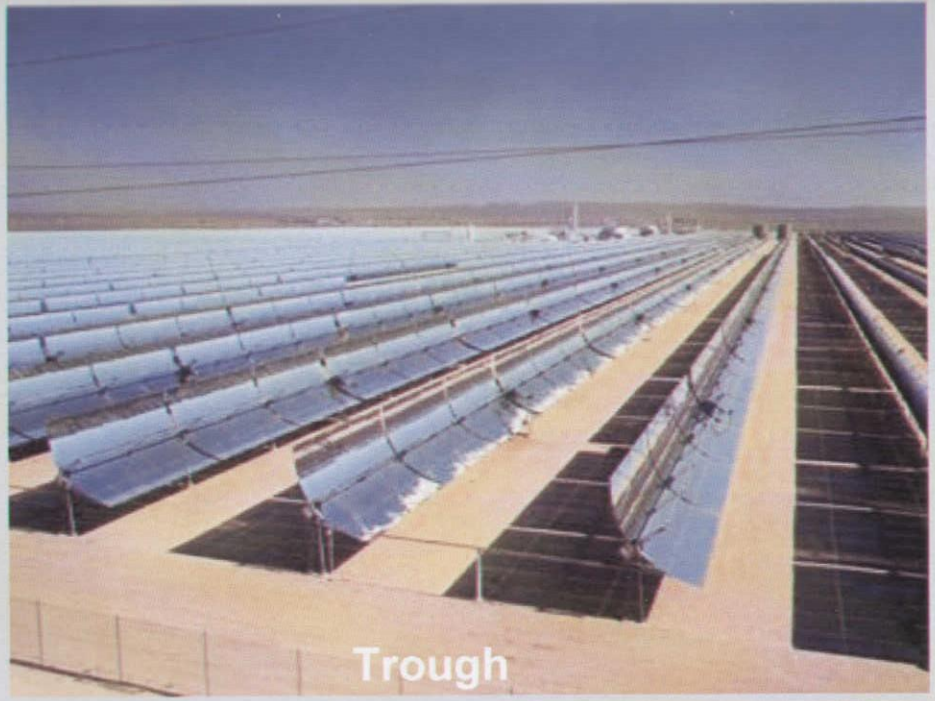
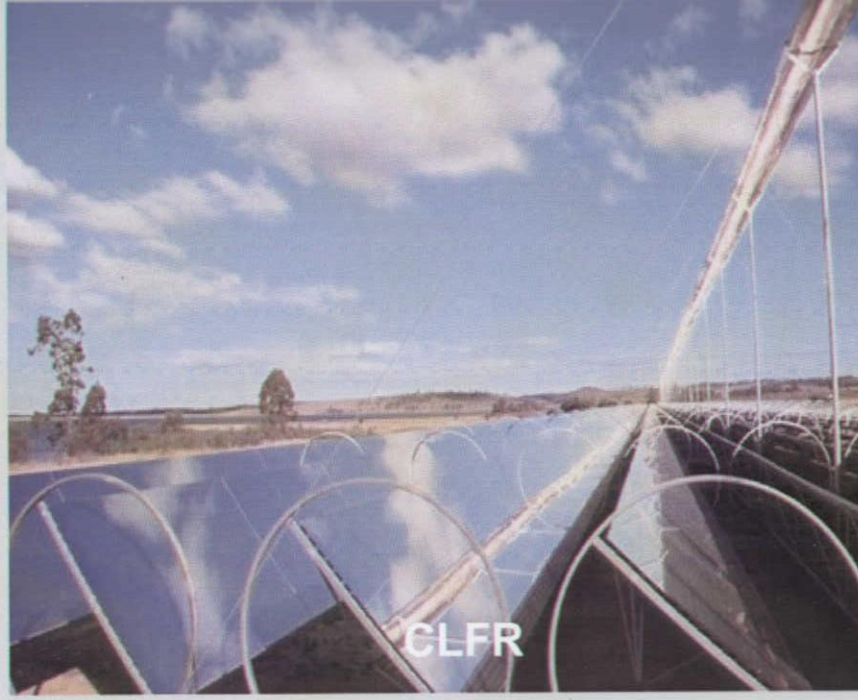
ATOUN ENERGY, suppliers and its associates

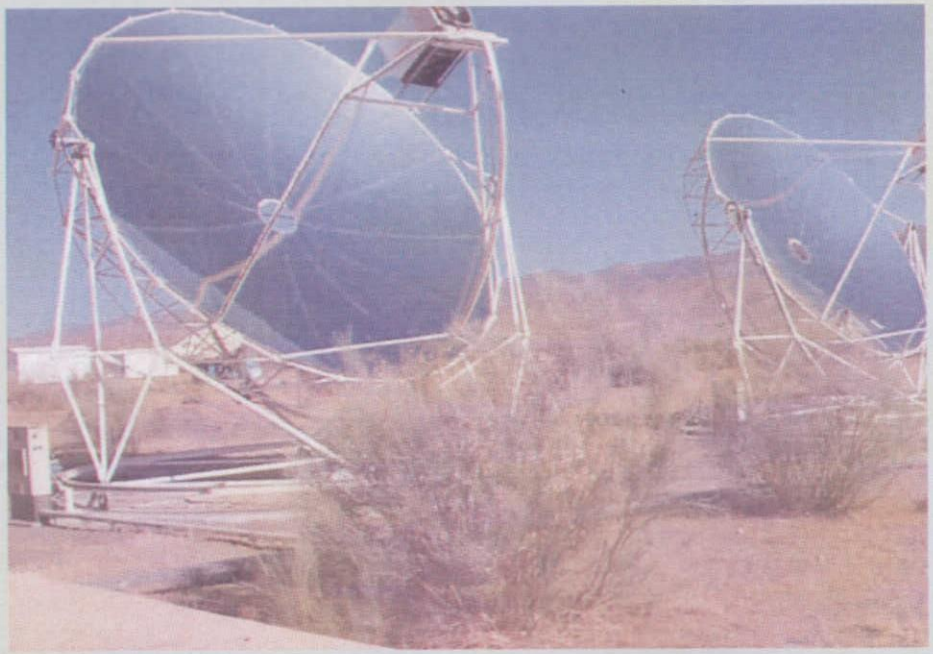
Are in an exclusive relationship to deliver projects using Graphite Heat Storage technology in Saudi Arabia, Middle Eastern countries, Africa and Europe







Linear Systems



CONCENTRATED SOLAR THERMAL (CST) SYSTEMS - Summary

- **Linear (Trough or Compact Linear Fresnel Reflector)**
  - **Relatively cheap but low temperature operation 250oC –300oC gives rise to inefficient generation and storage.**
- **Dish Engine**
  - **Small Scale Applications, engine/generator at focal point.**
- Solar Tower
  - **Major Engineering Structures but high temperatures achieved give more efficient generation and storage density potential.**

Why energy storage ?

- Electricity is one of the world's most widely used commodities.
- Absence of storage means the commodity must be used precisely when it is produced
- Electricity supply infrastructure must be provided and maintained to meet highest peaks, but these assets are then underutilised for much of the time.
- Electricity can not be directly stored cheaply, but can be stored in other forms and converted back (e.g. pumped hydro, flywheels, chemical etc.)
- Energy storage systems enable extension and enhancement of existing assets and technologies.
- Storage of energy will only work when reliability and costs are fully competitive with conventional solutions.

Background

- The system was developed over many years
- This system was set up to commercialise the storage technology in the power industry

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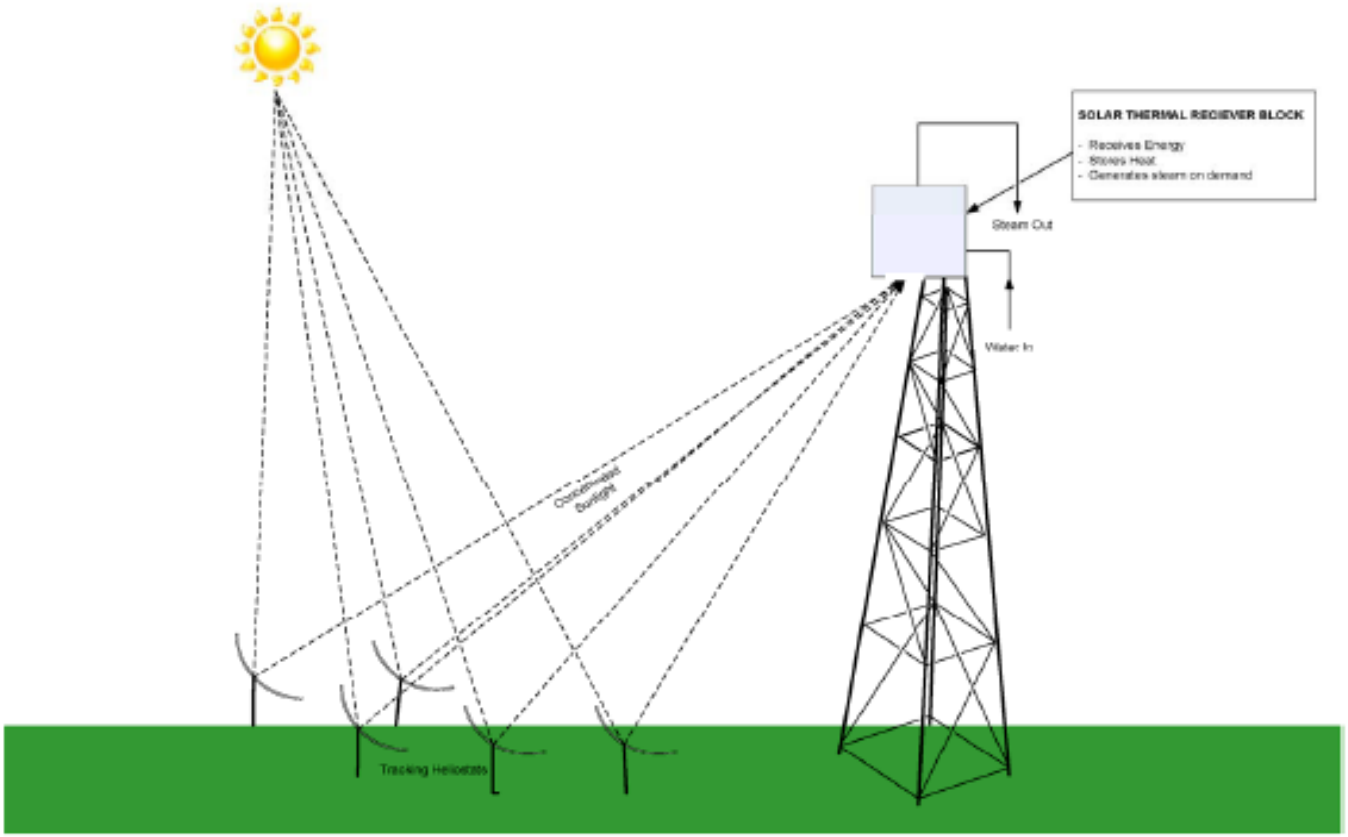
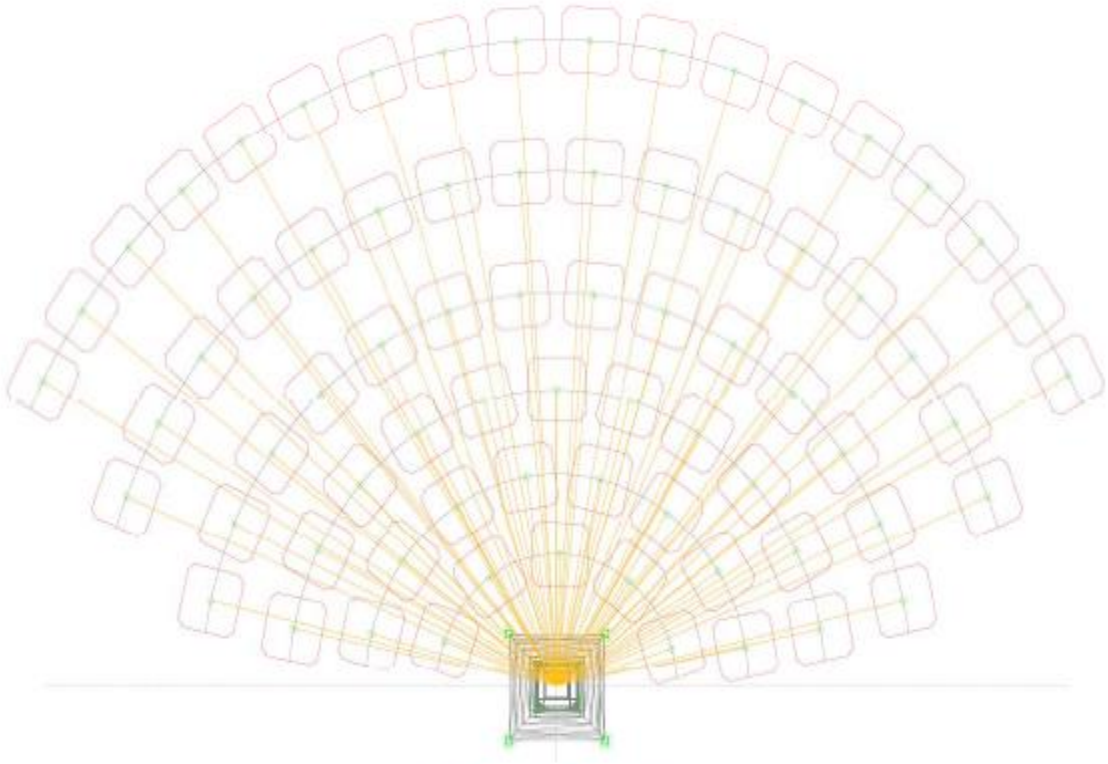
System we offer

- A low cost storing energy system, stores energy in the form of heat that has very low environmental and safety risks, is simple and familiar to install, operate and maintain, has location flexibility and ability to relocate and / or add modules to build higher capacity.

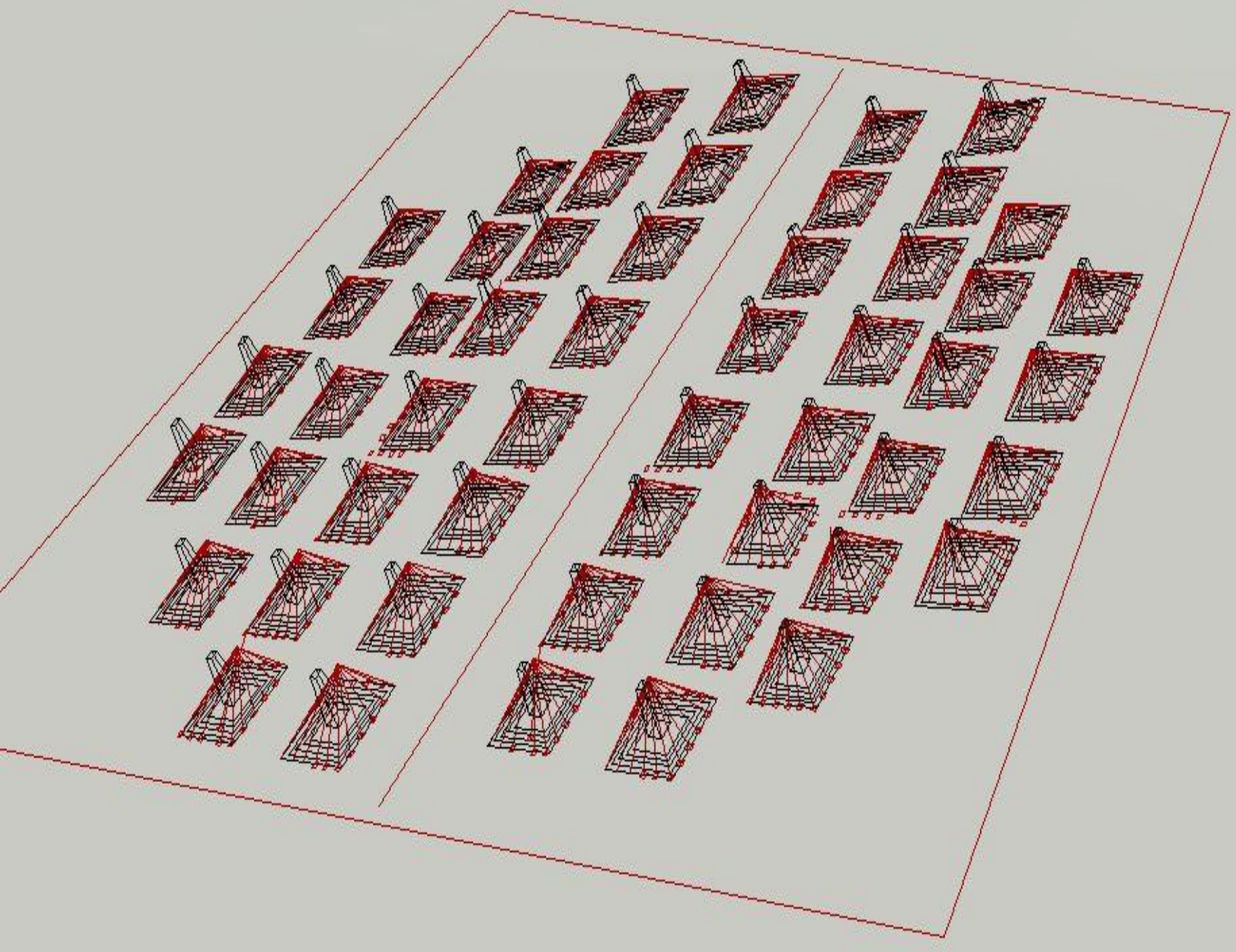
- Highly efficient toroidal heliostats in a multi tower (modular) array.

- The ability of high purity crystalline graphite to store high density thermal energy for extended periods.

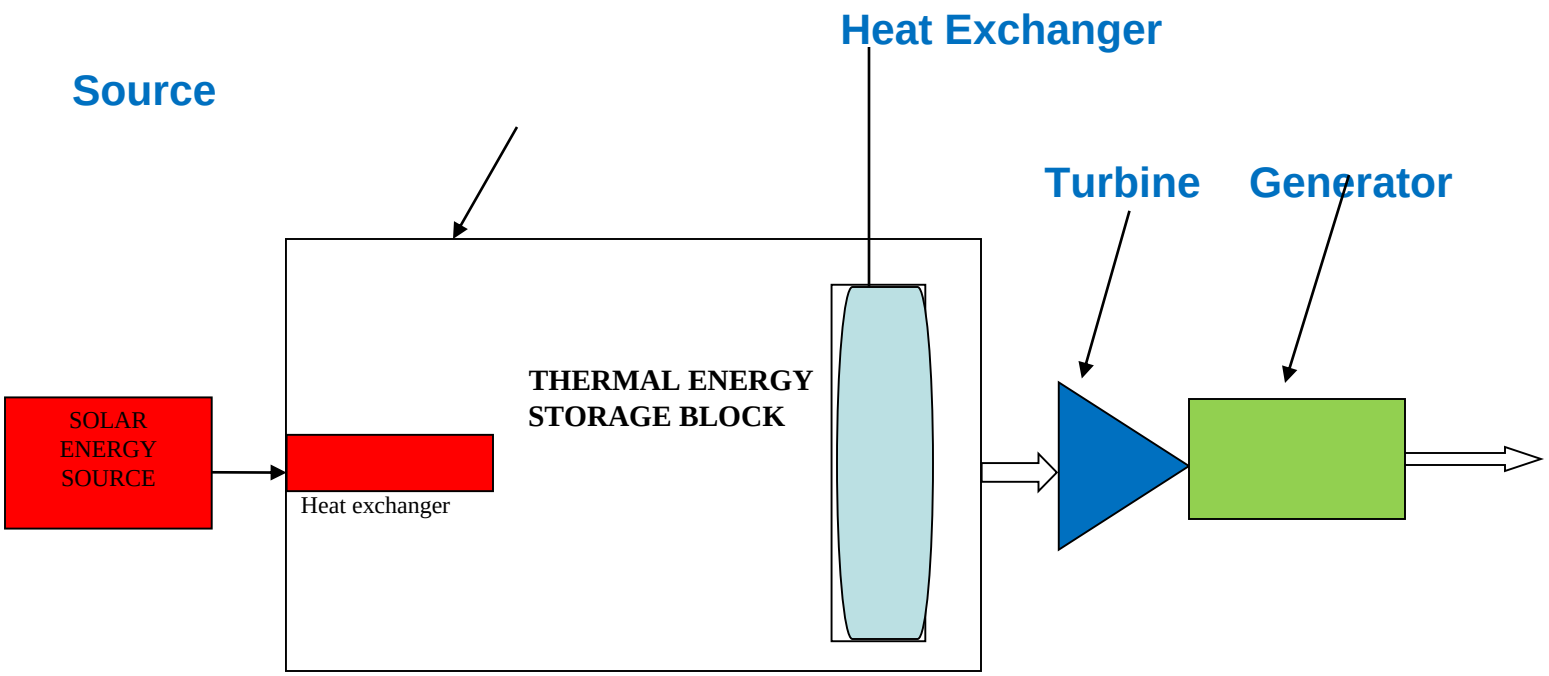

SOLAR THERMAL RECIEVER BLOCK
- Receives Energy
- Stores Heat
- Generates steam on demand
Steam Out
Water In
Concentrated Sunlight
Tracking Heliostats



Plan of Module



Simplified System



Technical Advantages

- Only technology in market that can be scaled from tens of KW to hundreds of MW
- Uses standard industrial components
- Environmentally benign
- The system we offer produces energy 24 hours a day while Photovoltaic produces energy 4 hours a day.

Reason to use high purity Graphite

- Unique combination of properties
  - High melting point (over 3000 c)
  - High specific heat (high capacity to hold heat energy)
  - High thermal conductivity
  - Low emissivity (does not radiate heat readily)
  - Thermally stable, does not expand , contract or break up with extreme heating or cooling cycles
  - Chemically stable and inert.

How does it work?

* Energy Input
  Solar heating using direct heat concentration

* Energy Output
  By heat exchangers containing a working fluid. Highly efficient heat exchange occurs because the heat exchangers are in contact with a highly conductive material.

Project Details

Power Output summer	50 MW
Hours of Operation	Summer 24 Hrs /Day
	Winter 24 Hrs /Day
Annual Power Output	323,000 MWh
No. of Modules	600
Area of Land Required	150 Ha

Insolation Data for ALKURAYMAT

Monthly Average Direct Normal Radiation (KWh/ m^2 /day)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg
4.95	5.55	6.50	7.85	8.51	9.58	9.35	8.75	7.41	6.14	4.99	4.58	7.02

Source: NASA Solar Energy Tables (22 years average)

Project Economics

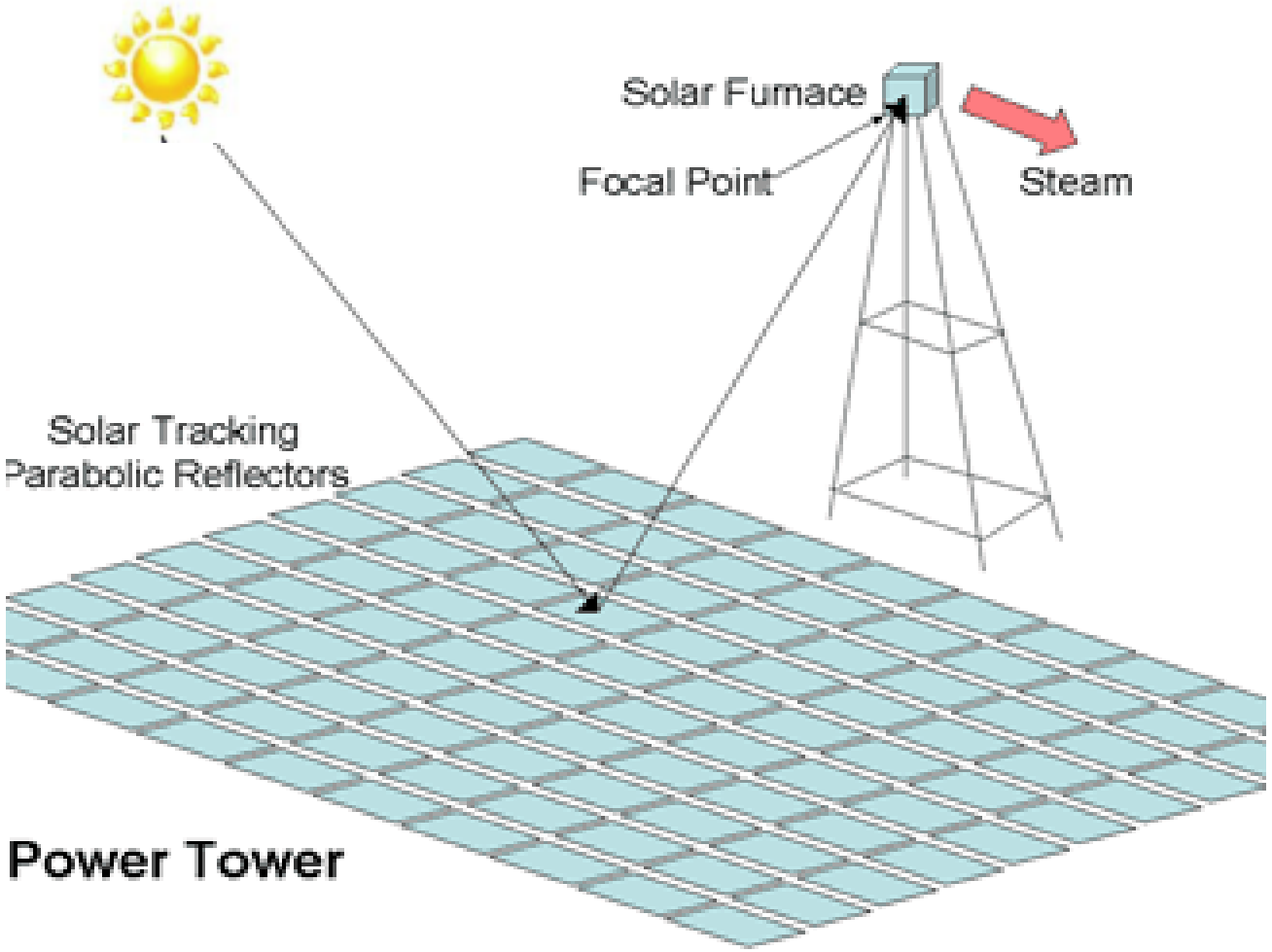
Capital cost $570 million

Installed cost per KWH $1.587

Production Cost of Electrical Energy:

Approx. $0.06/ KWH

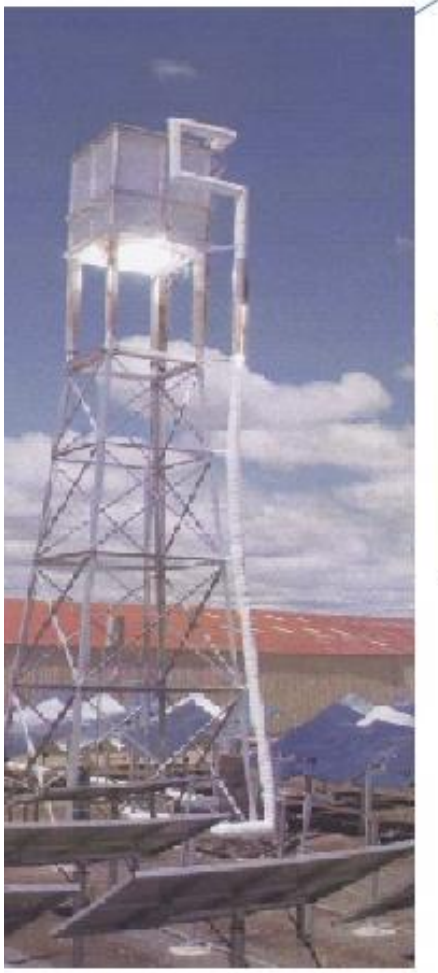
Cost of Electl. Energy after paying off the loans : $0.003/KWH


Solar Furnace
Focal Point
Steam
Solar Tracking
Parabolic Reflectors
Power Tower

10 Tonne Solar Heat Storage

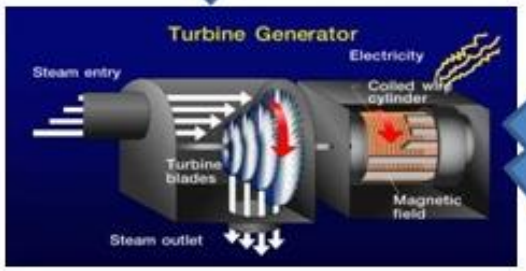
BOX SIZE: 2700 X 2700 X 2700 MM
WEIGHT : 14 TONNE
THERMAL STORAGE CAPACITY : 11.5 GJ
THERMAL OUTPUT CAPACITY: 1500 KW

STEAM GENERATION : PRESSURE 50 BAR A , 550 C°



HEAT STORAGE

STEAM



TURBINE + GENERATOR

E L E C T R I C I T Y

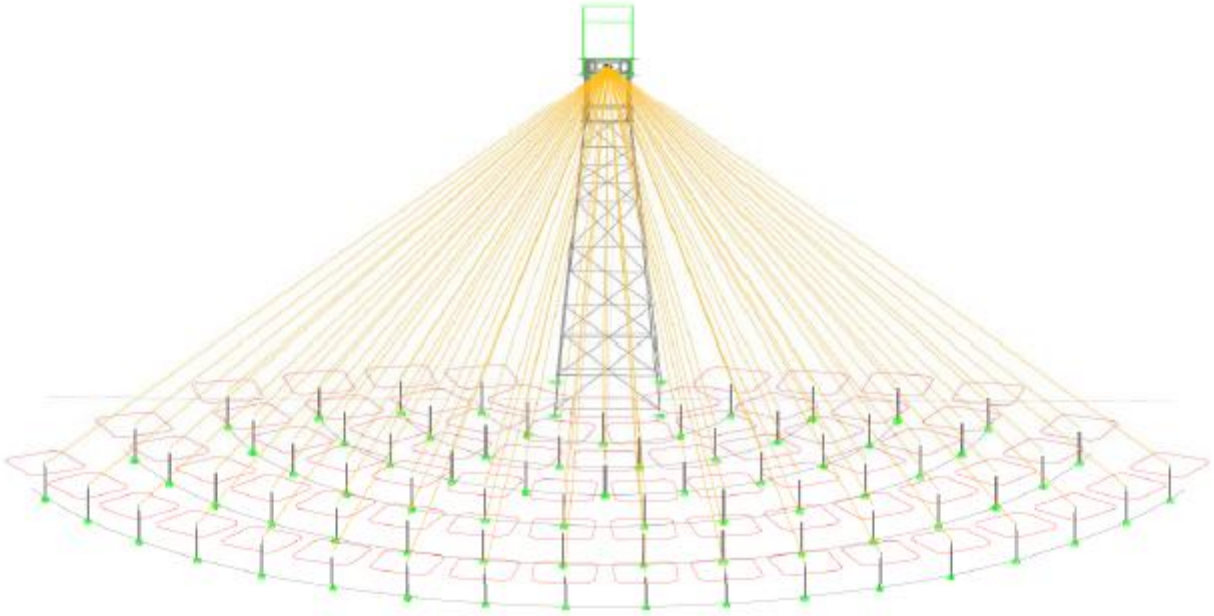
Our System

Each Module consists of:-

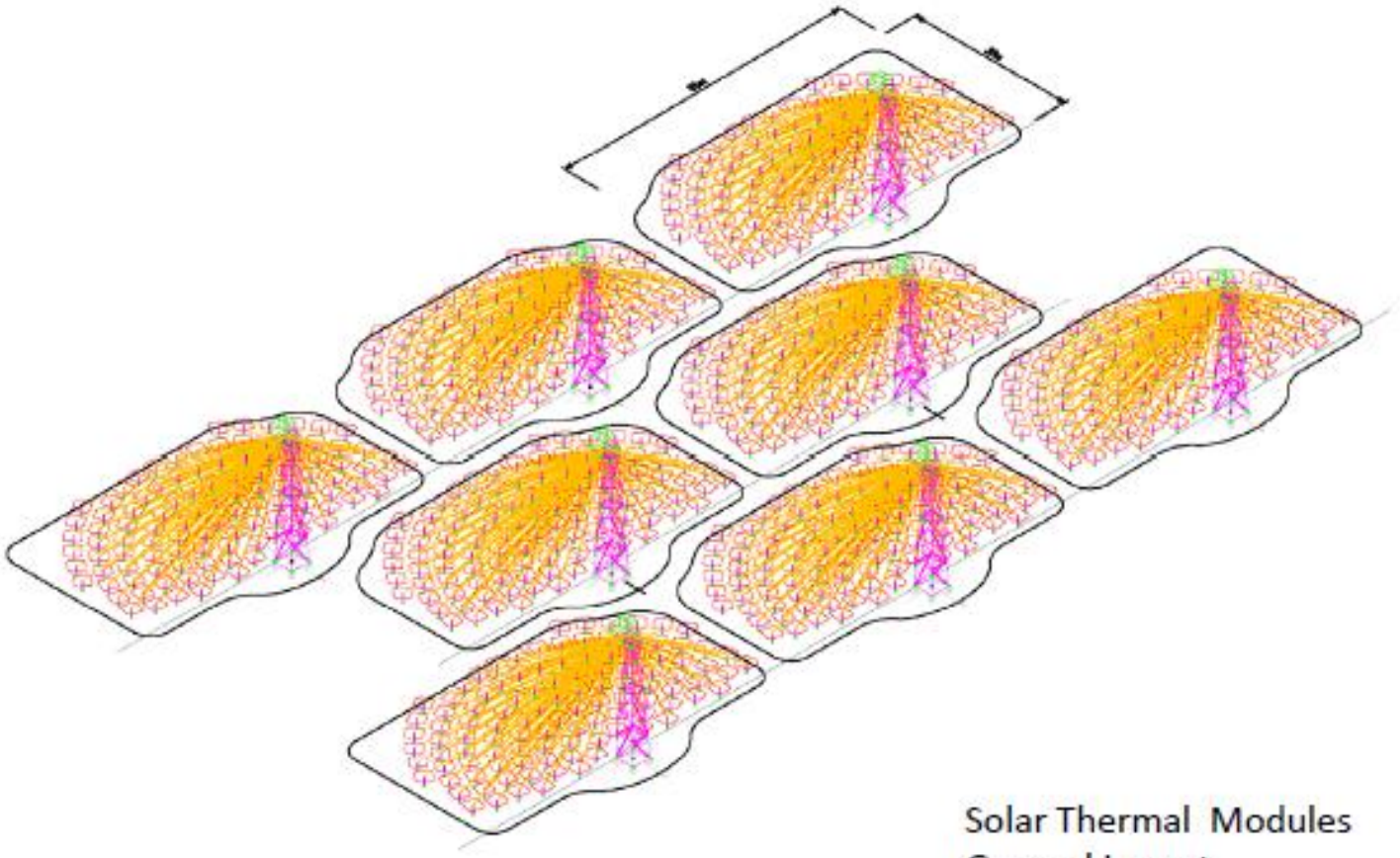
- **One solar thermal receiver on tower (24 m high)**
- **Approx. 100 heliostats (toroidal)**

and then

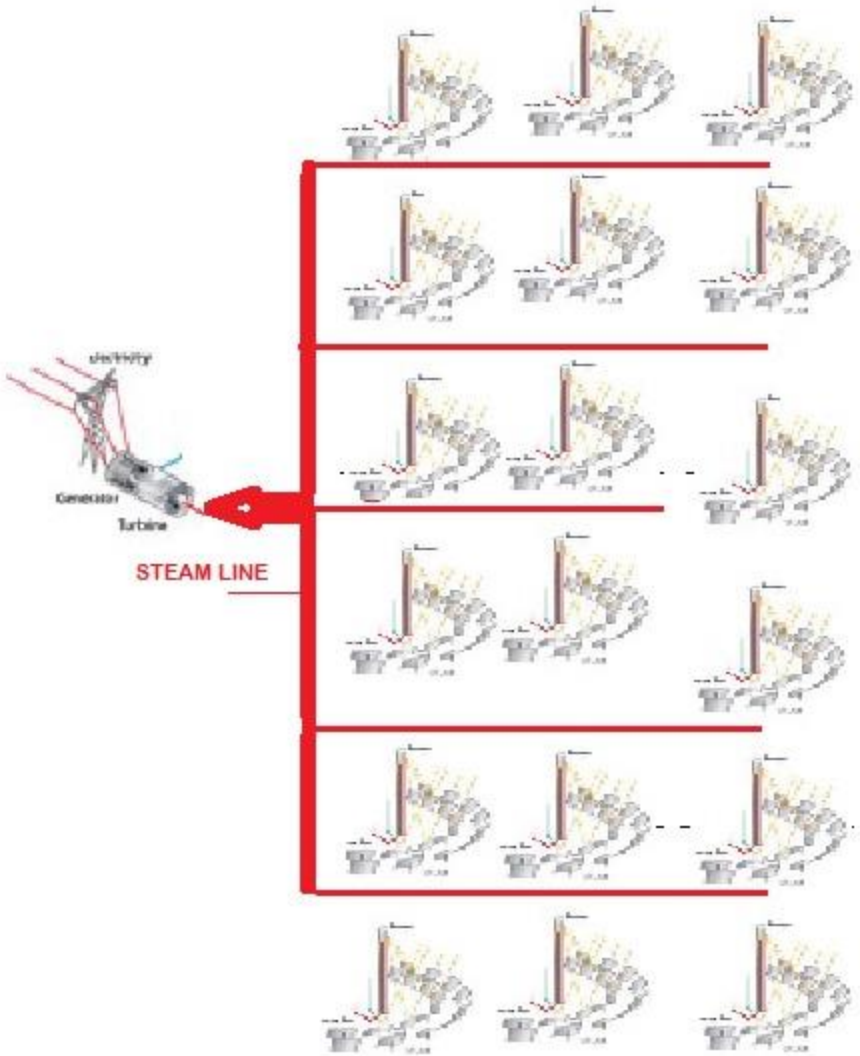
- **A conventional steam generation system to suit number of modules**



Perspective of Module



Solar Thermal Modules
General Layout


Turbine
STEAM LINE

Ref. No.: M-12.XXXX

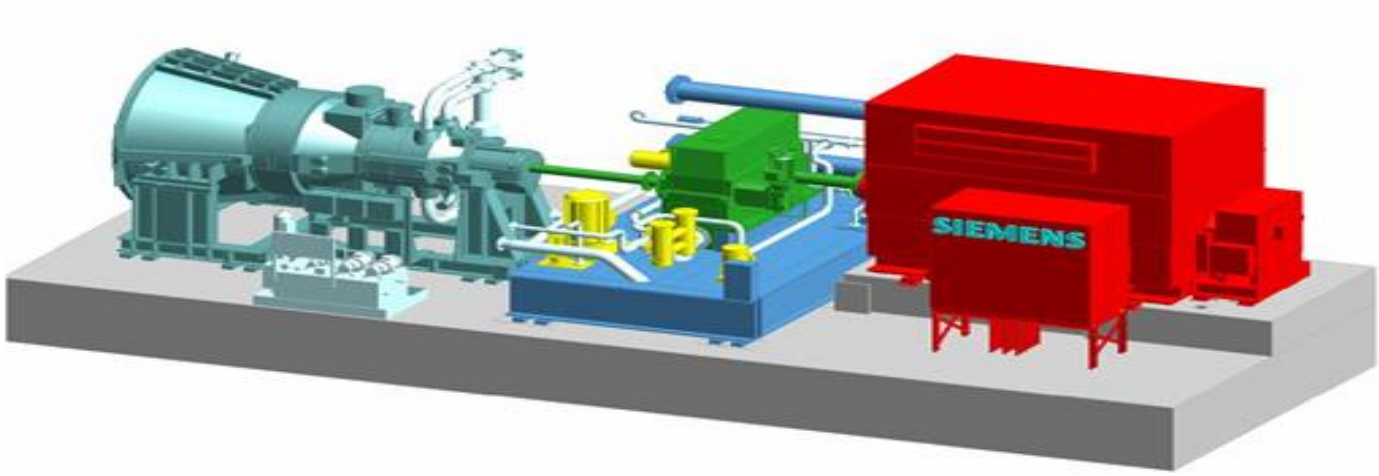
CUSTOMER: ATOUN ENERGY

PROJECT: 25 MW Solar Thermal

Technical Specification

This technical specification describes a turbo-set with 25,000 kW steam turbine

Revision: 0



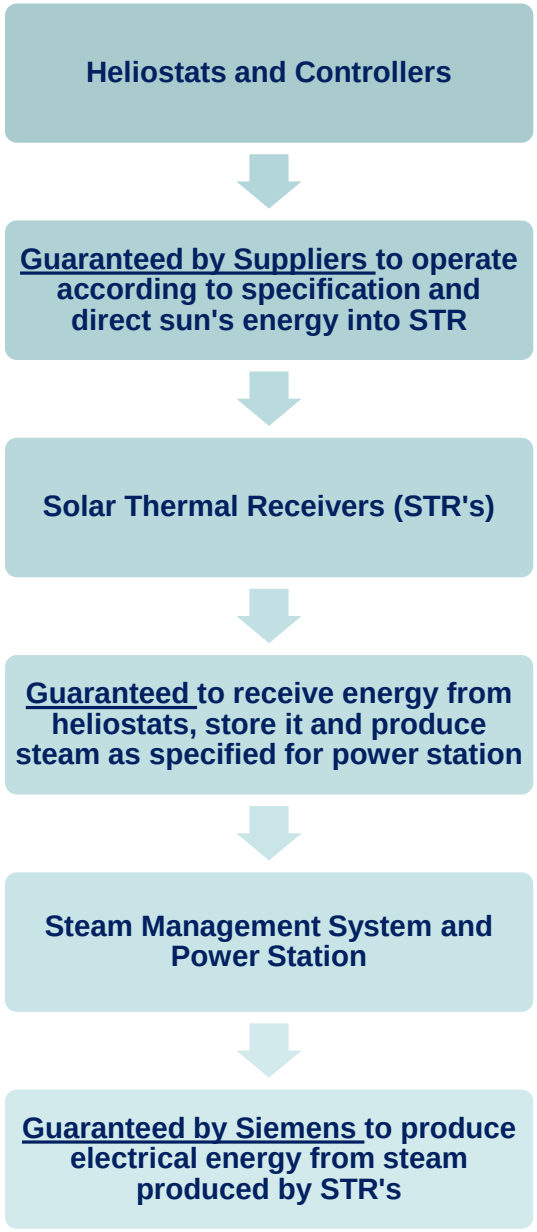
Performance Guarantees under Proposed Structure

- Acknowledging that the main concern of lenders is the assurance that the project will perform and deliver the energy on which the revenues are based.
- For this project, the boilers are the STR blocks on the towers, which have the solar energy from the heliostats as their heat source.
- Essentially, the project is a conventional thermal power station, with steam provided by multiple boilers (STR's) heated by the heliostats.
- The heliostat/controller suppliers guarantee that the solar energy will be delivered (as specified) to the STR's (Product Warranty).

Atoun guarantees that the STR's will firstly absorb and store the solar energy from the heliostats, and secondly, produce the required quality of steam as required for the steam system (Product Warranty).

The power station turnkey contractor then guarantees to manage the steam supply to produce electricity through the steam turbine generator.

The flow of performance guarantees is therefore structured as shown in Fig. 1. (see over)


Heliostats and Controllers
Guaranteed by Suppliers to operate according to specification and direct sun's energy into STR
Solar Thermal Receivers (STR's)
Guaranteed to receive energy from heliostats, store it and produce steam as specified for power station
Steam Management System and Power Station
Guaranteed by Siemens to produce electrical energy from steam produced by STR's