PS10 Solar Power Tower

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Overview

- Magnitudes , Cost & Technologies
- Project use & Social and Economic Benefits
- Why is it Green Project
- Innovations Compared to Common practice
- Technological ,Social Problems and Policy Challenges

Magnitudes

- Location: Seville, Spain
  15 mile to the west
  of Seville Spain
- Construction:
  From July 1, 2001 to December [illegible], 2005.
- Open: March 20 ,2007
- Tower high : 377 ft ,40-story
- Area : 150 acres : Y=1005 meter
  X= 945 meters

Magnitudes

- Megawatts: 11 MW currently

  Powers 6,000 Spanish homes
- Produce : 24.3 GWh per year
- Useful life : 24 years

Funded & Management

- Owner : Solucar, Abengoa
- Total Cost: $ 45.5 million
- Co- Funded by :
  - $6.5 millions come from European Commission under 5th Framework Programmed
  - $2.2 millions come from Andalusia Regional Government

.

Further Explanation

Plataforma Solar de Sanlúcar la Mayor,PSSM

- Megawatts will increase to 300 MW by 2013
  - Energy Cover 180,000 homes .The whole city of Seville
  - PS 20 Solar Tower (opened Jan 14 ,2009)

Technical Issues
Primary Components(1)

- Glass-metal heliostats,

  624 movable mirror, each surface 1,290 ft^2

  Total area equivalent of 17 American Football

- Tower
  - Solar receiver

    4 vertical panels 18ft*39ft
  - Steam turbine

Primary Components(2)

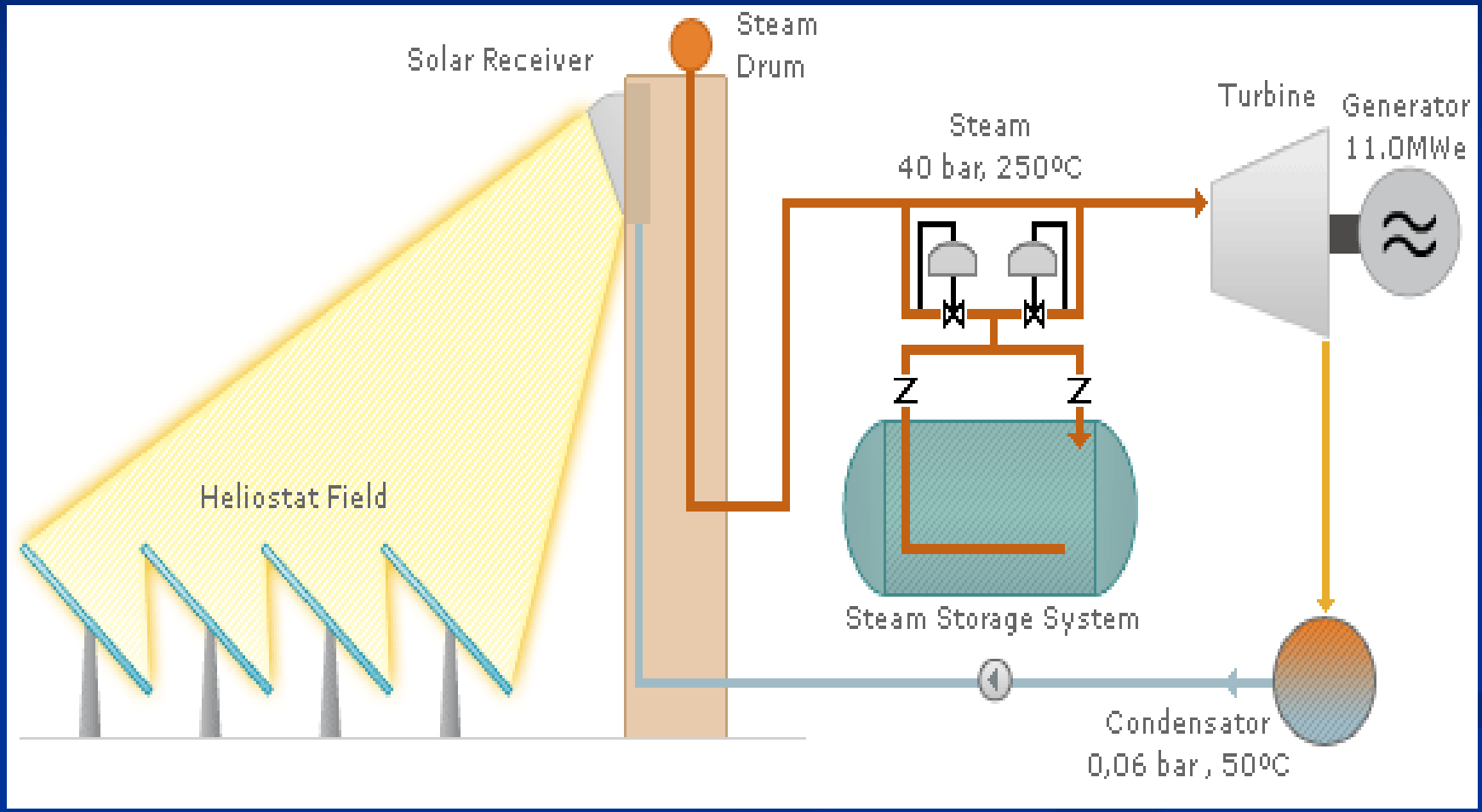
- Water thermal storage system
  - 4 tanks that are sequentially operated in order of their charge status
  - capacity 20 MWh equivalent to 50 minutes of 50% load operation
  - When energy is needed to cover a transient period, the energy is recovered from the saturated water at 20 bar to run the turbine at 50% load

Concentrating Solar Power (CSP)

- Heliostats concentrates the Sun's rays to receiver
- The receiver transfers received heat to an operating fluid.

  40 bar 250ºC saturated steam
- The steam is sent to the turbine
- The turbine drives a generator. To Producing electricity

How it Work


Solar Receiver
Steam
Drum
Turbine
Generator
11,0MWe
Steam
40 bar, 250ºC
Heliostat Field
Steam Storage System
Condensator
0,06 bar , 50ºC

Project Use

- Providing power to the Sanlucar la Mayor substation

  It share the 66 kv line with Sevilla PV plant , a large ,low concentration system photovoltaic plant

Social & Environmental Benefits

- Created many new jobs
  - 1000 temporary jobs during construction
  - 300 service and maintenance jobs
- Educates local people

  For all of their installations, Abengoa Solar educated local temporary staff so that can add value to the local
- Environmental Benefits
  - Reduces local air pollution
    Save 18,000 tones of carbon emissions every year
  - Offsets greenhouse gases
  - Conserves energy

Economic Benefits

- Under feed-in tariff policy , rate 0.43/kwh
- Abengoa earn 0.78 millions from sales the solar energy to the grid in 2007
- Operating cash flow 1.4 millions in 2007.

  LOST Money ? NO
- Company stock increase 11.5% per year
- Abergoa make lots of contract with other countries to build solar power plan

CSP Green Project(1/3)

- Economic sustainability
  - Reduce the dependency on fossil fuels
  - The risk of future electricity cost escalation
  - Reduce the solar electricity cost can deliver competitively price electricity today and in the future
- Environmental sustainability
  - Reduction of greenhouse gases and other pollutants
  - Most material can be recycled and used again for further plants

CSP Green Project(2/3)

- Social sustainability
  - Supply electricity like any convention power plan
  - Large Electricity grid Can help to stabilize the political and economic relation between the countries
  - Reduce the risks of conflicts related to energy, water and climate change

Example :**TREC**

CSP Green Project(3/3)

Solar Energy Potential

Each square meter of mirror

- Produces…

  up to 500 kWH of electricity per year

- Avoiding…

  12 tons of carbon dioxide emissions

- Saving ..

  3.0 tons of fossil fuel over its 30 year lifetime

Advantages and Disadvantage

- Advantage
  - Concentrating all of the sunlight to one location to get very high temperatures
  - Less energy loss as higher temperatures are converted to electricity more efficiently than lower temperatures
- Disadvantage
  - Requires more foundations and positioning motors for heliostats needs

Problems

Compare to other types of electricity generation

- Large areas of land are required
- Technology requires storage for stable power output
- Cost of such energy is about three time higher than conventional of power generation as with all technologies

(Note: cost should drop as it develop over time)

Policy Challenges

- March, 2004 Renewable Electricity Generation Law for solar thermal electricity generation in Spain.
  1. Solar premium was raised 50% from $0.17/kWh to$ 0.24kWh
  2. Support of gas was allowed with the restriction of keeping its consumption (in energetic units) under 15%of the amount of electricity produced
- Result
  - change the design
  - more technology
  - cost increase

Technical Problems

- Controlling the heliostat field
  - If there are problems with heliostat control it could be very dangerous.

    Example, the receiver could end up damaged if a group of heliostats was not proper focused
  - In order to function properly, heliostats must be cleaned
  - Wind poses another difficult for heliostats
  - If wing> 22.5 mph the heliostats are set vertically to avoid structural damage
  - If wing > 87 mph it could result in the loss of structural integrity

Conclusions

- Solar power plays an important in the world's power demands
- At present solar power tower play a minimal role in power generation.
- We like to see large-scale solar power plan in the future.

Thank you very much