## Application of Solar Tower Technology in Electricity Production in UAE

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## Situation

- Worldwide energy consumption is on a constant climb due to the fact of our reliance on electricity for almost everything as well as the increase in global population.
- In 2010, 100% of UAE's electricity demand was fulfilled through gas power plants which have huge negative impacts on the environment with 154 mega tons of carbon dioxide being expelled that year [1].
- UAE has excellent potential for harnessing solar energy to produce electricity.

## Project Idea

Build concentrated solar power plants that use solar towers to produce electricity.

## Problems

- Ability to generate electricity on demand and through the night time.
- Renewable energy power plants require very large areas to produce significant amount of electricity.
- Effective cooling method required in hot desert climate.
- Water is not an efficient fluid for concentrated solar plants due to its low specific heat capacity.

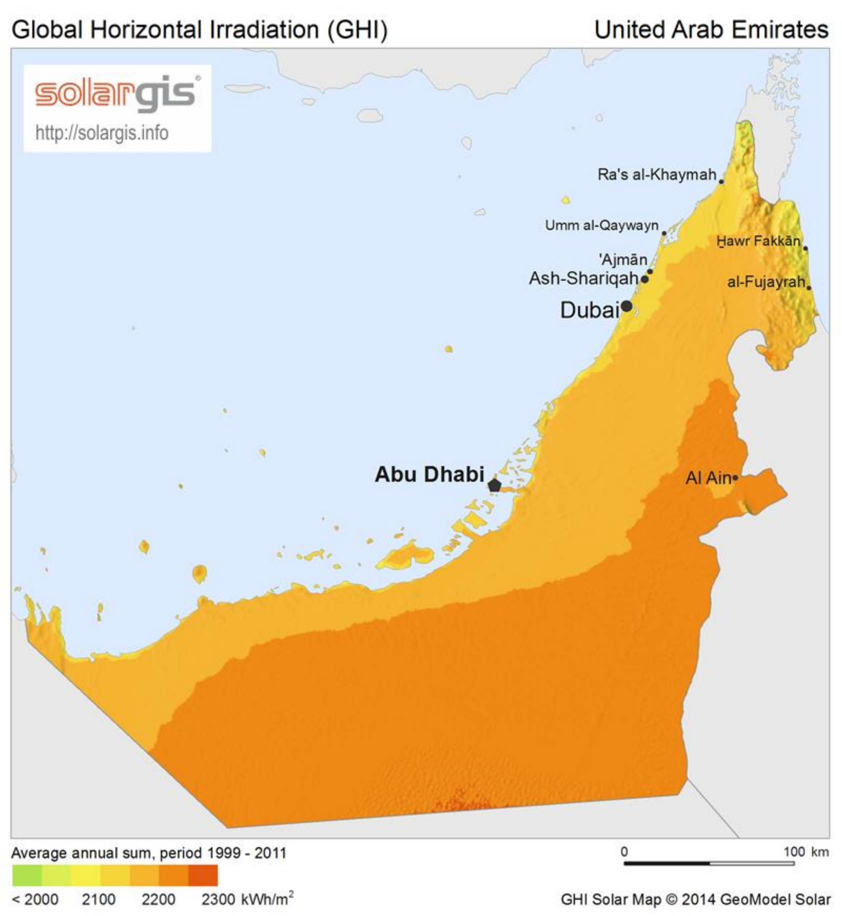


Figure 1: Solar power potential in UAE [2].

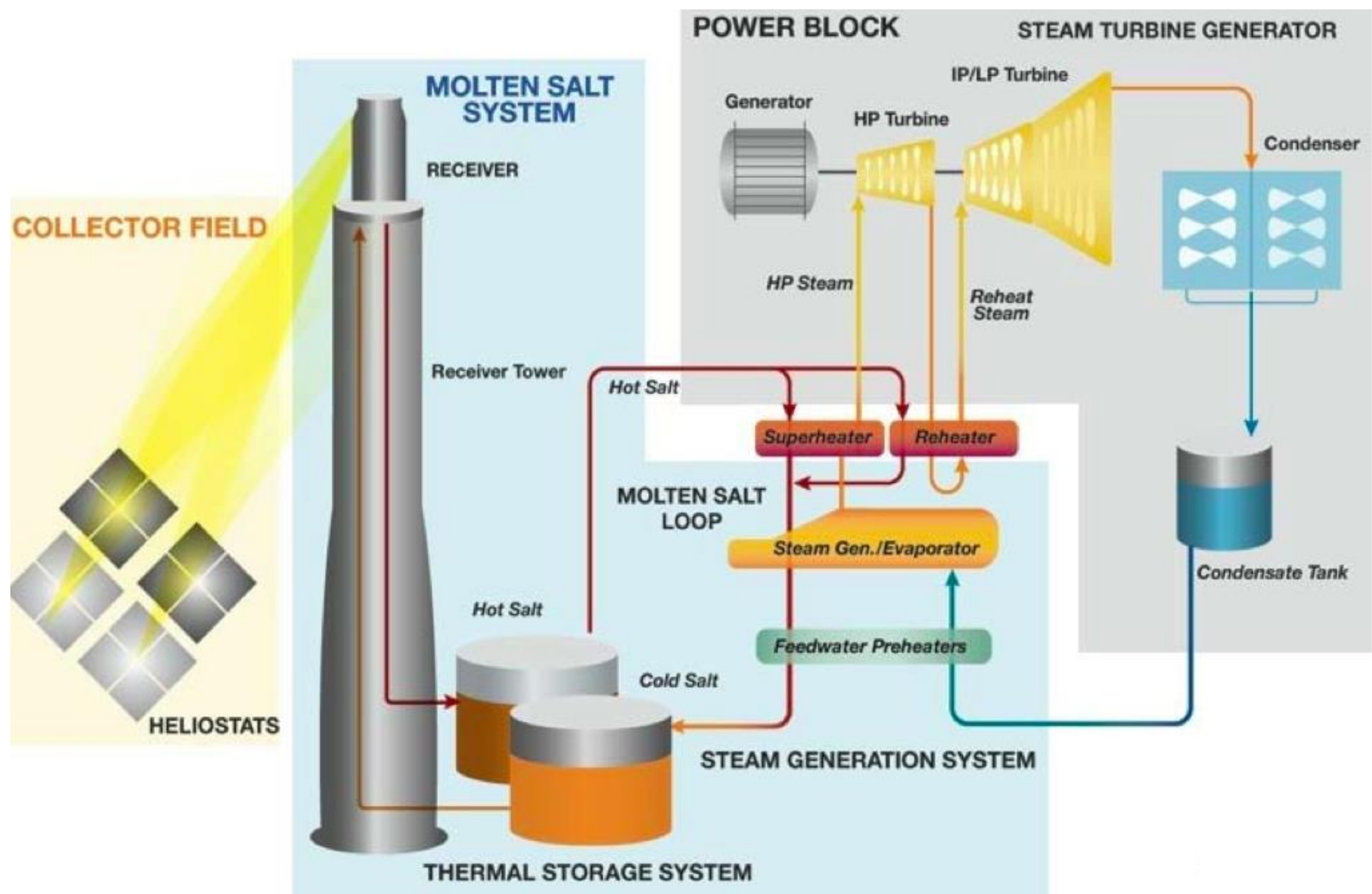


Figure 2: Schematic of Solar Reserve solar tower power plant in USA [3].

## Solutions

- Molten salt mixture (60% sodium nitrate, 40% potassium nitrate) is used as the heat transfer working fluid as well as the storage medium.
- All pipes, valves, and vessels for hot salt are constructed from stainless steel because of its corrosion resistance in the molten-salt environment, while the cold-salt system is made from mild carbon steel [4].
- Hot fluid can be pumped from the storage tank to the steam generator whenever more electricity is needed and through the night.
- Modified Rankine steam generator cycle reheats water between the high and low pressure turbines to maximize efficiency.
- Use wireless communication to control heliostats to reduce cables required as well as remote management of plant operation.

Figure 3: Solar tower power plant in Nevada, USA [5].

## Evaluation

- Power plant will operate with zero emissions.
- Nonflammable, nontoxic heat transfer fluid will operate at atmospheric pressure reducing risks of pressurized systems.
- Fluid is recirculated and reused in the system. If the plant is to shut down, the fluid can be used as a fertilizer [5].
- Startup cost is high especially with the large number of heliostats required.
- 24/7 high performance operation can be achieved.

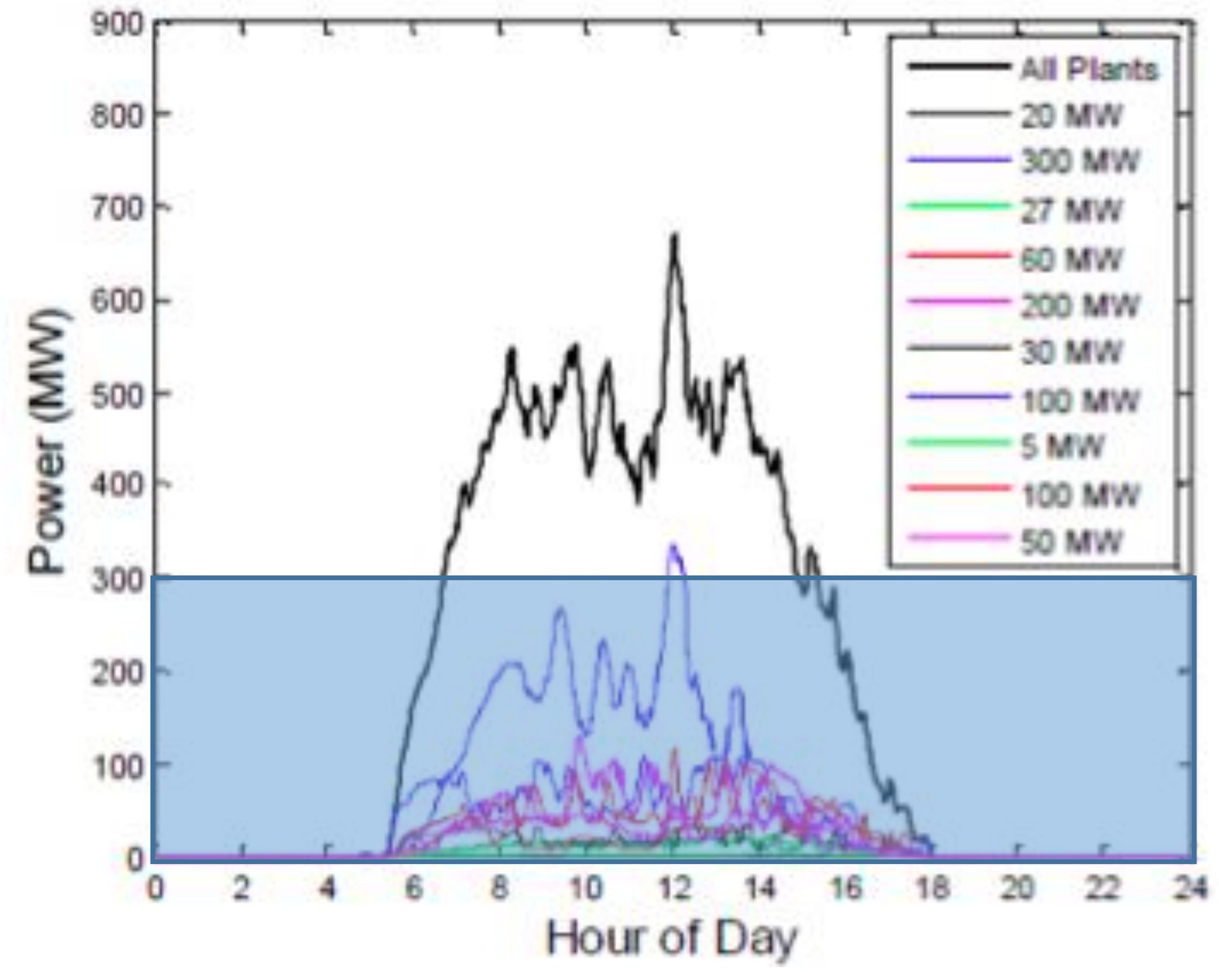


Figure 4: Performance comparison of photovoltaic and solar tower power plants [3].

## References

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[3]G. Parkinson, "How it works: Solar power towers with integrated storage", Renew Economy, 2016. [Online]. Available: http://reneweconomy.com.au/how-it-works-solar-power-towers-with-integrated-storage-78892/. [Accessed: 12- Nov- 2016].
[4]"What is a Solar Power Tower and How Do They Work?", AZO Cleantech, 2016. [Online]. Available: http://www.azocleantech.com/article.aspx?ArticleID=24. [Accessed: 12- Nov- 2016].
[5]"Molten Salt Energy Storage — SolarReserve", SolarReserve, 2016. [Online]. Available: http://www.solarreserve.com/en/technology/molten-salt-energy-storage. [Accessed: 12- Nov- 2016].