Multifunctional Solar Updraft Tower

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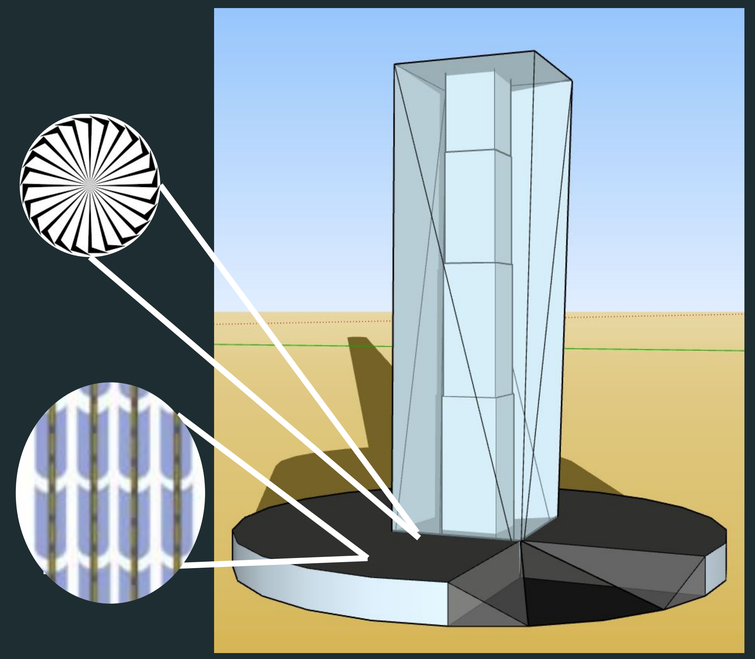
PROJECT DESCRIPTION

The purpose of the project is to design a building structure that incorporates an optimum environment for energy generation. Our design incorporates the solar updraft concept, which uses air movements to rotate turbines and generate energy. By optimizing the surface area of the structure, the sun is then used to heat the air causing it to move upward at an increasing velocity, therefore turning the turbines and generating energy. The structure will act as a multifunction facility, consisting of wind turbines for energy generation and occupiable space (i.e. research facility, storage).

DESIGN METHODS

- Be able to incorporate Green Infrastructure on the design and function of structure
- Be able to operate another function besides energy generation (office space, research laboratory, etc.)
- Be within height restrictions based on: location, base to core ratio
- Be able to decide a location with the most sun exposure to assure energy generation
- Be able to account for Seismic & Wind Loadings
- Be able to design with material strength in mind

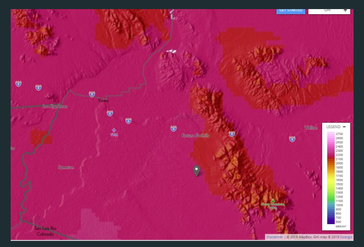
DESIGN SPECIFICATIONS



- Building Height
  - 700 ft.
- Concrete Core
  - 8-1 ratio to building height
  - 87.5 ft. wide
  - 40% of base width
- Building Base Width
  - 20 ft
- Extended Base
  - 700 ft. diameter
  - 1-1 ratio to building height

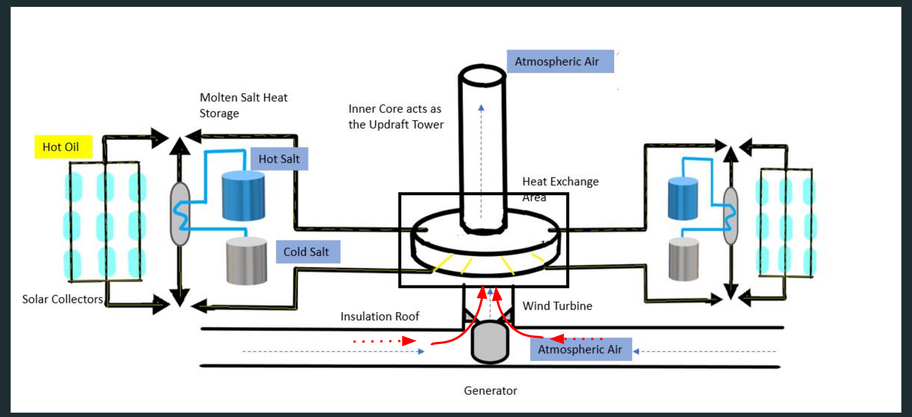
LOCATION

- Yuma, Arizona - located in the U.S.
- Global Horizontal Irradiance (GHI) is the total amount of shortwave radiation received from above by a surface horizontal to the ground [1].



- PV Out : 1888 kWh/kWp /year
- GHI: 2169 kWh/m^2 per year
- To be efficient GHI levels ≥ 1800 kWh/m^2 per year [2]

DESIGN SCHEMATICS



RENEWABLE ENERGY SYSTEM DESIGN

- Solar Updraft Tower
  - Harness the power of wind using turbines to produce electricity
  - High thermal energy needed to increase velocity
- Molten Salt
  - provides thermal energy to Heat Exchange chamber[3]
  - heats oil throughout night to address lack of sunlight

FUTURE DESIGN CONSIDERATIONS

- Possible Integration of renewable water distribution system
- Optimal inner core design for wind collector penetrations
- Eccentric design of building's outer skin

NEXT PHASE OBJECTIVES

- Finalize Structural Designs
- Complete System Design
- Complete Life Cycle Cost Analysis

1. Consulting, F. G. (2012, May 03). Differentiate between the DNI, DHI and GHI? Retrieved from https://firstgreenconsulting.wordpress.com/2012/04/26/differentiate-between-the-dni-dhi-and-ghi/
2. Solargis. (n.d.). Retrieved from https://globalsolaratlas.info/?c=34.829587,-117.413626,3&s=34.829587,-117.413626&m=sg:dni
3. Saengsaen, S., Thongkroy, C., Wechsatol, W., & Chantharasenawong, C. (2018, December 1). Design an Efficiency Assessment of Solar Thermal Updraft Tower with Molten alt as Heat Storage. Retrieved from https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=8624692&isnumber=8624673&tag=1