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Solar Usage Effectiveness in Different Environments

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Abstract: A vital part of a sustainable future is renewable energy, and one such renewable energy is solar power. In this project we examined how and if solar power could be implemented successfully in three different urban environments: Buffalo, Shanghai, and Belo Horizonte. We chose instructively different cities from around the world: Buffalo, our local city and reference standard, Shanghai, a modern and heavily populated city in China, and Belo Horizonte, a smaller city in Brazil. We investigated the degree to which private and government programs guided the transition to solar power. We suspected our investigation would demonstrate difficulties in that transition, primarily taking the form of resident opposition and technological issues with the panels. For each city considered economic, geographic, demographic, and social impact data.

Belo Horizonte BRAZIL

Belo Horizonte , Brazil , already is considered a model city for food security ,sustainability and quality of life. This city is widely considered as the solar energy capital of Brazil with its almost 3000 installations of solar water systems. Minas Gerais , the city where Belo Horizonte is located , has a very large potential for Solar power generation either thermal or Photovoltaic , reaching a annual direct solar irradiation of 2700 KWh/m2 in the summer , and with an annual basis of 2200 to 2400 KWh/m2 .

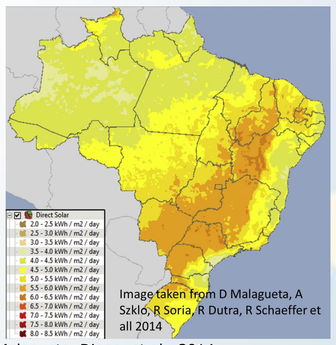


Image taken from D Malagueta, A Szklo, R Soria, R Dutra, R Schaeffer et all 2014

Malagueta, Diego, et al. 2014

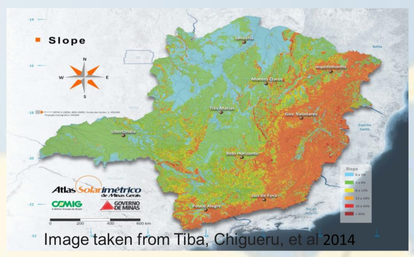


Image taken from Tiba, Chigueru, et al 2014

Tiba, Chigueru, et al. 2014

Geographic Factors:

- Belo Horizonte has very abundant flat spots with general slopes of less than 3%, being perfect to the application of solar energy systems in terms of energy.
- While the city itself is 100 percent urban, it forms the core of the Belo Horizonte Metropolitan Region, which comprises urban and rural areas with a total population of more than 5.7 million.
- The region corresponding to Belo Horizonte, has a low density of environmental protected areas.

Government Programs:

- There are many government policies to directly or indirectly promote the solar energy technologies such as the program " Minha casa, minha Vida " (My home , my life) and a program of incentive for alternative energy (PROINFA).
- The Government has developed educational programs to spread Solar power technology through the city of Belo Horizonte and Brazil.

Social Impact:

- The implantation of solar energy in sites located on Belo Horizonte has greatly affected the quality of life in small communities by promoting employment and better conditions of rural and poor communities.
- Electrical lighting has promoted a great impact in education by allowing children to study in the evening, as well enhancing their learning conditions during the day in their schools.

Conclusions:

Solar energy for water heating is by far one of the most widespread application of solar energy in Brazil and in Belo Horizonte. The amount of energy produced is capable of supplying a grown market. However, a big problem is still a need for more aggressive public awareness on the advantages of this technology to further developments.

Buffalo UNITED STATES

Buffalo provides an example of how solar power can be implemented and successful in a local and familiar environment. As well as its locality, Buffalo's climate provides an example of how to implement solar harvesting in environments that are less than ideal.

Geographic Factors:

- Buffalo avg sunny days per year: 155/365
  National avg. :205/365
- Buffalo avg. snowfall per year: 82.4 in.
  National avg.: 25 in
- SolarCity is planning on using hydro-power from Niagara falls to power some of their solar plant

Government and Private Programs/Economic Factors:

- Governor Andrew Cuomo gave $750 million to SolarCity, a solar panel producer to arrive in Buffalo by 2016.
- PUSH Buffalo and Grow WNY advocate for more solar power.
- U.B. has installed their well-known Solar Strand.

Population Economic Factors:

- U.B. team of students designed and built a solar-powered home, demonstrating that solar homes could be built affordably.
- PUSH Green provides low-cost and subsidized installments of solar panels to homes of low-income people in Buffalo.


Osterhoudt, Christopher. *Model of GRoW Home*. 2014. Buffalo.


Solar Strand. 2012. University at Buffalo, Buffalo.

Social Impact

- The U.B. Solar Strand powers 700 on campus apartments.
- PUSH Buffalo has provided affordable and sustainable housing and are working to develop more solar-intensive housing.

Conclusions:

Buffalo has proven that Solar can be implemented in a city that is not ideal. New innovations, and substantial interest on the part of the public, have supported substantial progress in increasing solar harvesting in Buffalo.

Solar Dashboard. 2012. University at Buffalo Website, Buffalo.

Shanghai CHINA

Shanghai was chosen to look at more closely because Shanghai and China as a whole are very progressive in the movement towards a sustainable lifestyle. Shanghai has a very large population and an interesting layout as approximately 10% of people live in a rural setting.

Government and Private Programs/Economic Factors:

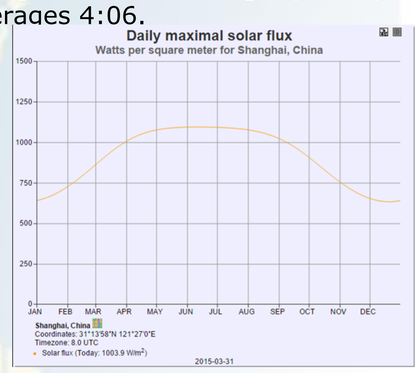
- Chinese and Shanghainese governments put together the Shanghai Manual as a blueprint for sustainable urban development for Shanghai and other cities.
- In 2009, the Chinese government announced the Golden Sun Initiative, where they set aside $3 billion to subsidize 50% of the cost of 275 different solar energy projects.

Geographic Factors:

- Shanghai is almost entirely flat due to being on the alluvial plain of the Yangtze River.
- Shanghai receives an average of 5:07 of sunlight per day, by comparison Buffalo averages 4:06.

Picture to Right: Solar flux is the measure of how much solar energy is radiated in a given area.

"Sunrise, Sunset, Daylight in a Graph." *Ptaff*. 31 Mar. 2015. Web. 31 Mar. 2015.



Demographical Factors:

- Shanghai's median household income is $38,928 vs. the US' median household income of $51,939. The average Shanghai household has $6,550 of disposable income annually.
- 89.3% (20.6 million) of all Shanghai citizens live in an urban setting, the other 10.7% (2.5 million) live in a rural environment.

Social Impact:

- The development of Solar energy in Shanghai prevented and controlled the serious air pollution by reducing carbon emissions from oil and gas.
- In the last 5 years, many new solar energy companies became established in Shanghai because of Shanghai Electric Group Co. This projects helped to create numerous jobs and decrease unemployment rate of Shanghai area.

Conclusions:

Shanghai and China have been leaders in the movement towards sustainable living. Shanghai has some key factors that have allowed it to succeed in the effort to convert to solar power. These factors include the flat terrain, and generous government subsidies. This conversion is much needed for China given its disastrous levels of air pollution.

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