Solar Energy Implementation Proposal to Meet all of the Nation's Energy Needs

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Background

Most of the world's energy is generated through the burning of fossil fuels such as oil, natural gas, and coal. In 2012, these three fossil fuels made up 87% of the world's energy consumption. Although there may be controversy over the exact impact, there is no arguing that current means of generating energy from burning fossil fuels is causing harm to both the environment and the human population. Pollution from energy consumption has been linked to an increase in average global temperature, which can in turn result in more extreme weather events such as heat waves, droughts, floods and hurricanes. In addition, it can decrease agricultural productivity. With rising temperatures comes in increase in sea level, which has resulted in the loss of thousands of miles of shoreline. Furthermore, pollution forms smog, a perpetual smoky fog that hovers above metropolitan areas and can result in major health impacts.

So, what can be done to combat all these harmful results of energy pollution?

Every single hour, the sun provides Earth with enough energy to meet worldwide demand for an entire year. Despite this, solar energy currently only produces 10% of global energy demand. Since this energy is coming from the sun, it is infinitely renewable, and it 100% clean energy with absolutely no negative impact on the environment. In addition, the Solar Rights Act of 1978 allows all homeowners to use solar energy despite homeowners associations' regulations, and the U.S. government even provides incentives like tax credits in order to promote solar energy use. With these tax incentives, solar energy is an economically beneficial choice as it generally will pay for itself within five to ten years, eliminating decades of costly electricity bills.

Solar energy is the logical solution to finite costly fossil fuels that are degrading nature and harming people's health. GIS should be used to identify locations that would prove the most profitable for solar energy farms, to provide the U.S. with clean, renewable energy.

Literature Review

It has been determined that the earth received approximately 1,366 watts of direct solar energy every square meter. Meanwhile, the total surface area needed to satisfy the global need for energy would require only 366,375 square kilometers. Figure 1 shows a proposal using these calculations.

Figure 1 demonstrates that in the scheme of things, the surface area required for solar panels would be practically statistically insignificant. However, the figure identifies only one or two areas per continent where a solar panel should be considered, which would potentially prove inefficient when attempting to distribute all the energy. I believe that to power at least the U.S.,

multiple solar fields should be constructed so that citizens are not grossly affected by transportation costs.

Solar panels can be installed in many different locations. The Department of Energy's National Renewable Energy Laboratory determined that 90% of U.S. power could be supplied by abandoned industrial sites. Further studies by NREL indicated that if all cities installed solar energy to just 7% of their buildings, all of the U.S.'s energy needs could be met. NREL constructed a map shown in Figure 3 depicting areas of the U.S. that obtain the most solar photovoltaic resource potential and would thus be the most efficient areas for capturing the sun's energy.

The Energy Information Administration advocates deserts, as implanting solar fields on 4% of the world's deserts would meet all of the world's needs for electricity. Concentrix Solar argues that land use can have multiple purposes, meaning that land doesn't have to be dedicated to just solar panels. Figure 2 demonstrates one of Concentrix Solars' solar plants installed in a grazing field for sheep, opening up a whole new realm of potential locations for solar panel sites.

To determine ideal locations for solar panels, one must consider the ideal conditions for solar panels. Solar panels are more efficient when they are colder, indicating that higher altitudes are better. For a most consistent and uniform absorption of the sun's rays, solar fields should be a fairly flat and level surface.

Hypotheses

My proposal seeks to identify 5 prime locations in the U.S. for the installation of solar fields that would together meet all the U.S.'s demand for energy. The proposal will investigate whether it would be more efficient to have many individual installations on property, or several large solar fields.

Data

Required Data in Digital Form:

- Concentration of energy use throughout U.S.: shown as thematic U.S. map with color range indicating energy use for each U.S. county
- Individual buildings in the U.S: shown as shape files like roads
- Thematic map of federally owned land vs. private land
- Slope map of U.S. to target minimal slope
- Altitude map of U.S. to target higher altitudes
- Map of annual concentration of solar energy beamed from sun throughout U.S.

Further Data Required:

- Whether cloud cover will vary greatly seasonally must be incorporated into analysis. Variance in cloud cover must be graphed to target areas with minimal cloud cover and with minimal variance
- The ease of installing solar panels in vacated or occupied areas must be determined to create a map with ranked ideal areas
- Cost of installing individual solar panels on buildings vs. cost of large solar fields

Methods

The proposal will outline the 5 best means of providing solar energy throughout the U.S. Cost effectiveness will prove critical. There are two main methods to be considered – installing solar panels on individual buildings, or creating solar fields. The cost of both must be considered. However, ideal locations for both individual panels and entire solar fields must be analyzed. The proposal will first identify large area's that obtain the most annual solar energy, have the flattest area, and are at the highest altitude. Additional criteria to be assessed will be whether there are areas of land in use that can accommodate solar fields and whether the land is federally or privately owned, as these will influence the ease with which construction can occur. For individual solar panels, a weakness with meeting these criteria will be attempting to compare their efficiency with the ease of which homeowners can install solar energy technology. A house may be an ideal location for solar energy, but it may be much more difficult for the homeowners to purchase or install the technology. To overcome this, there must be an analysis done of how much homeowners are willing to pay for solar technology versus the cost, and how much the government would be able to incentivize them. If the government were to be in charge of constructing several large solar fields, as I believe they should be, a thorough cost analysis would have to be performed weighing the costs and benefits of these approaches.

Anticipated Results

I believe that it will be less costly to incentivize homeowners to purchase their own solar panels. This would eventually save them a large amount of money and could power the entire nation, if enough panels were adopted. However, I think it would be more efficient to simply install several large solar fields in southwestern U.S. deserts that receive the highest amount of energy from the sun annually.

Policy Applications

With increasing prices of fossil fuel methods and the resulting pollution, this is already an incentive to all to use clean solar energy. However, policy applications would be different based on the final outcome of this proposal. If the result were to install solar panels on more homes, this could be approached in several ways. For instance, the government could pass into law a regulation forcing all newly constructed homes to have solar panels. Another way to approach this would be to increase incentives for homeowners or businesses to have solar panels. If the government were to undertake this project, it could increase taxes in an effort to fund it. In addition, all industries that emitted over a certain limit of emissions should be held accountable, and should be forced to help fund the project.

Budget

The budget for the total project would depend on the outcome of the proposal. However, for simply determining the best locations for solar energy technology, the budget would be as follows:

GIS Software (1 year): $1,000

Total wages for workers gathering information (1 year): $400,000

Institutional overhead: $160,400

Total: $561,400

Timeframe

All months require full time work weeks.

Month #	
1	Determining ideal locations for solar fields
2	Determining ease and cost of building solar fields
3	Determining ideal locations for individual solar panels
4–11	Determining ease and cost of building individual solar panels
12	Determine most cost-effective means of providing solar energy to the U.S.

Total time required for project: 1 year

Figures

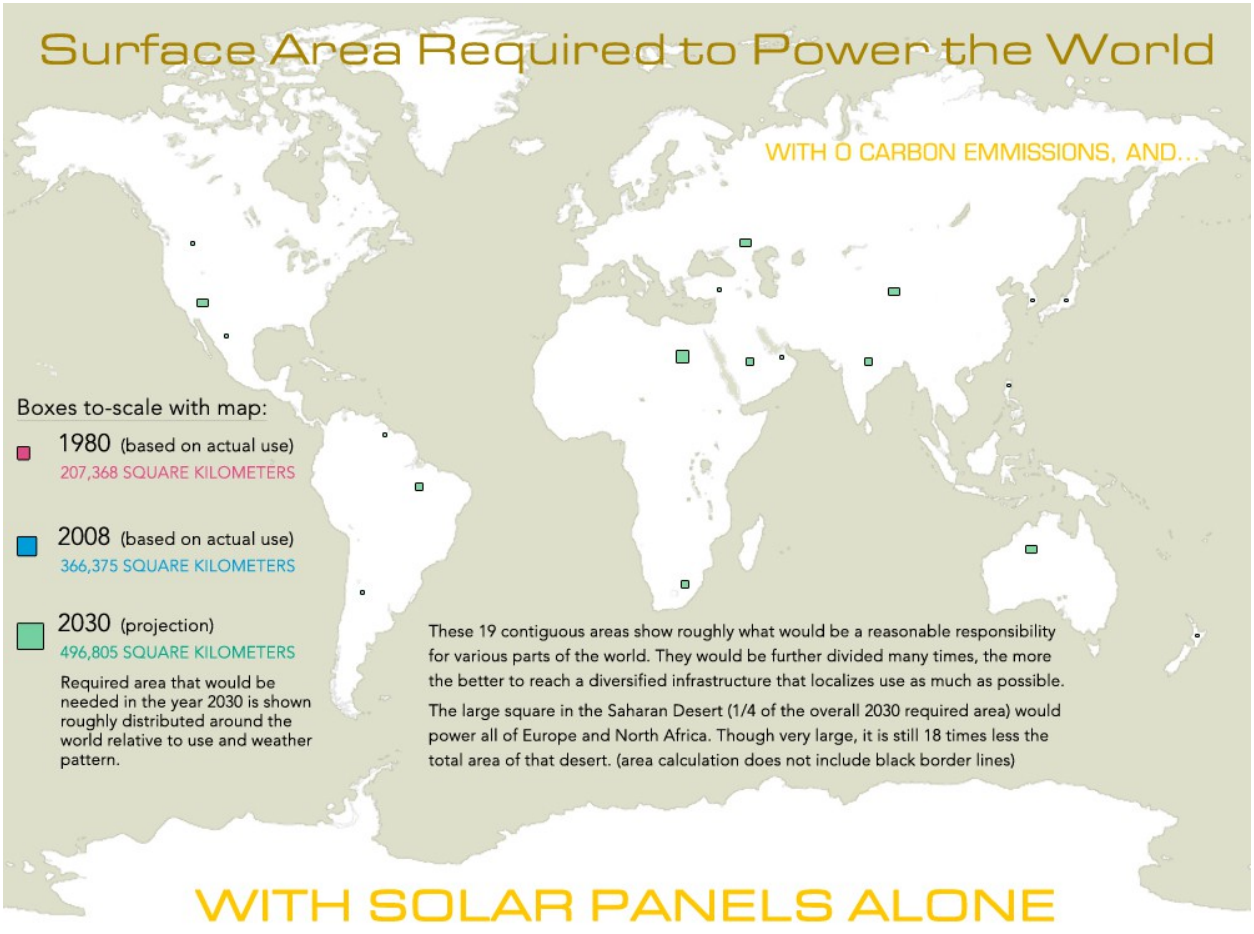

Figure 1. Surface area required to satisfy global energy demand with solar energy

Figure 2. Concentrix Solar’s affirmation that solar fields can be compatible to other land uses.

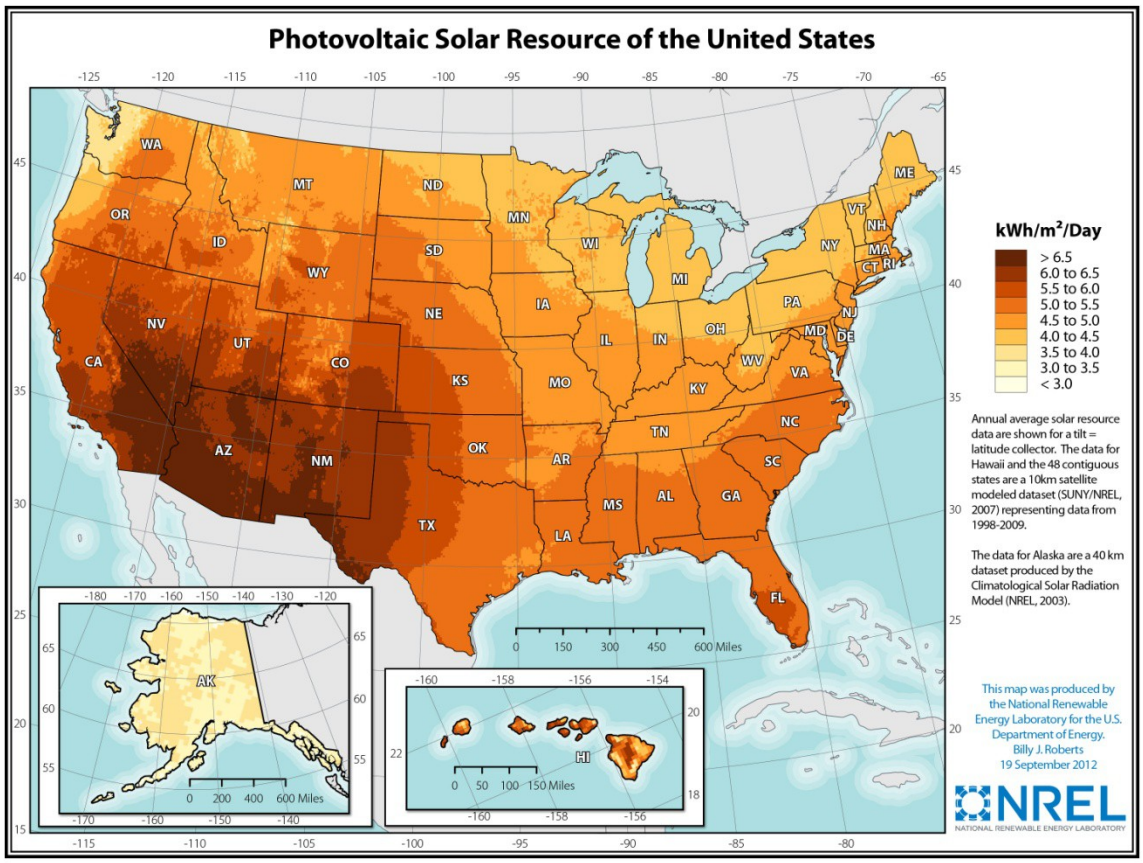

Figure 3. Concentration of solar energy in the U.S.

Works Cited

http://dailyfusion.net

http://environment.nationalgeographic.com

http://mediamatters.org

http://www.dsireusa.org

http://www.instituteforenergyresearch.org

http://www.justenergy.com