Importance of Solar & Renewable Energy in United States: Modeling, Prediction, & Management

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Introduction

The global fossil fuels supply is estimated to run out in the next 50-100 years. In order to develop a sustainable future, the US must switch from fossil fuels to cleaner, more energy-efficient alternatives, such as solar and other renewable energies.

However, there are obstacles that hinder the transition to becoming a 100% renewable society in the US. We intend to focus on solar PV (photovoltaic) energy instead of thermal solar energy or other renewables to generate electricity.

The current state of the world:
- Fossil fuels overconsumption & pollution
- Overpopulation & resource scarcity
- Increasing global energy usage

Solar energy problems needed to be tackled:
- Expensive costs
- Time & maintenance
- Government policies & funding
- Location & land use
- Access to communities & long-distance transmission
- Storage capacity

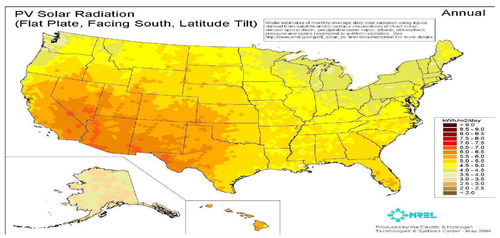

Figure 1. US Map Contains PV Solar Radiation (Flat Plate. Facing South, Latitude Tilt) [4]

Methods

Instead of a traditional lab and experiment set-up, our method of study was a scientific literature review. We examined case studies, scholarly articles and textbooks that were related to solar energy.

References

[1] Hoffacker M.K, Allen M.F, and Hernandez R.R, 2017.
[2] Pringle A.M, et al., 2017.
[3] Rodgers J., Wisland L., 2014
[4] Subramanian, R. Fazil, T., 2017.
[5] Wang S, Kim A.A, Reed D.A, 2016.
[6] Yang Z, Liu J., Baskaran S., Imhoff C.H, Holladay J.D, 2010.

Goal

To find solutions related to solar and renewable energy that will significantly cut down on pollution from and dependence on fossil fuels.

Solutions

The main solutions we found involved restructuring the current electrical grid and putting solar panels on inhabitable land or on water. Some other solutions we encountered included forecasting, aquavoltaics, agrivoltaics, developing improved solar cell materials, and increasing energy efficiency in solar panels.

Solar PV Cell

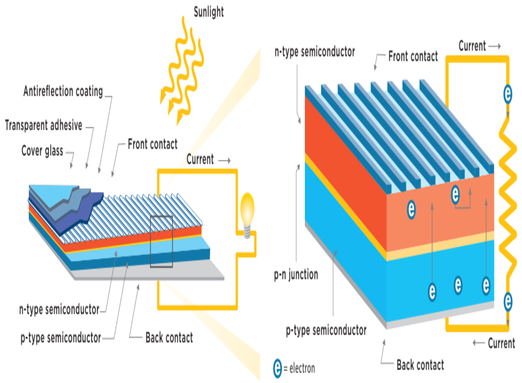

Figure 2. Key Components of PV Cell [3]

Land Reuse

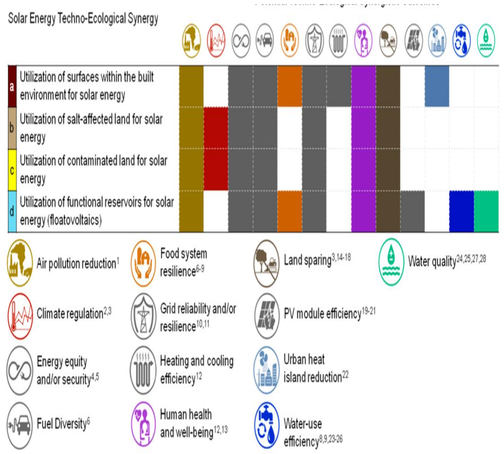

Figure 3. Land Economical Solar Energy Opportunities within the agricultural landscape, built environment, salt-affected soils, contaminated land, and reservoirs (floatovoltaics). Note: Contained sites are shown according to their actual land [1]

Smart & Solar Electrical Grid

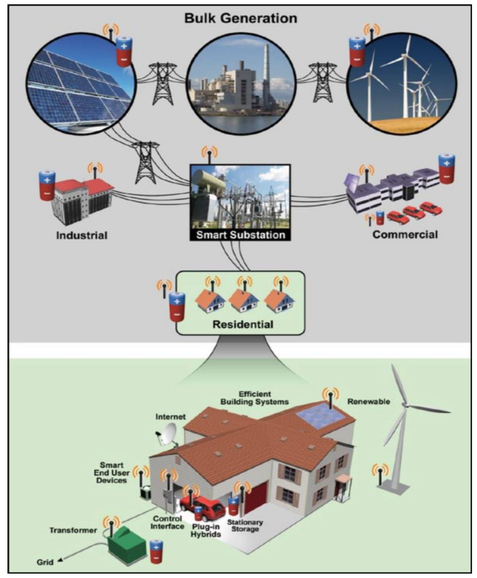

Figure 4. Schematic of the electricity storage for generation, transmission, distribution and end uses. A future smart grid is provided that integrates with intermittent renewable and plug-in hybrid vehicles, as an example of applications [6]

Floatovoltaics

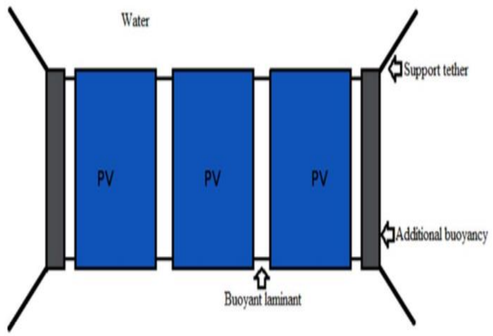

Figure 5. Aqua Voltaic Schematic of Floating Thin-Film PV [2]

Conclusion

We were already aware of many of the obstacles to creating cost-effective and efficient solar energy solutions. Each solution provided both justifiable advantages and disadvantages, which explains why none of them are currently fully integrated into society yet.

Furthermore, we did not realize how one small variable or limitation could negatively and significantly interfere with solar energy progress for each research proposal. We have a renewed sense of urgency to push for energy conservation and renewable energy development because of our realizations from this study.

Realizations:
- Cooperation and collaboration for large-scale development is needed
  - ex: updating grid systems
- Energy conservation among citizens should be pressed further
  - via spreading awareness, increased advertising and policy change
- Society is making too slow of progress to adjust to the increasing global energy usage

Remaining difficult limitations to overcome:
- Solar cell efficiency limits by nature
- Government policy
- Land disputes & availability
- Lack of funding
- Solutions must not compensate for one aspect of the environment for another

Further Information

During the summer semester, we hope to go more in depth into creating our own engineering project to help solve the issues regarding solar energy.

In the future, we also hope to work with the Institute for Sustainable, Energy, and Environment and Illinois Applied Research Institute at UIUC for future projects.

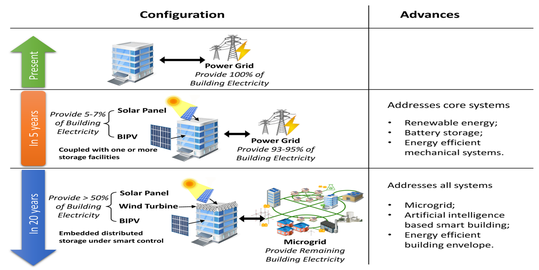

Figure 6. Design Plan of the Building's Future 20 Years Later [5]

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