Utility Scale Solar: Why Minnesota, Why Now?

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Introduction

Current energy usage in the United States is not sustainable. Heavy reliance on depleting fossil fuels pushes the U.S to search for alternatives. Utility scale solar (USS) is one viable option to meeting our energy demands as a country. Certain states have taken the lead with USS development, while others have lagged behind. This study evaluated three states, California, Minnesota and Wisconsin to analyze four major USS development factors. Policy, physical characteristics, public support and infrastructure. Results are summarized based on factors influencing USS development highlighting significant differences between states and pointing out driving factors.

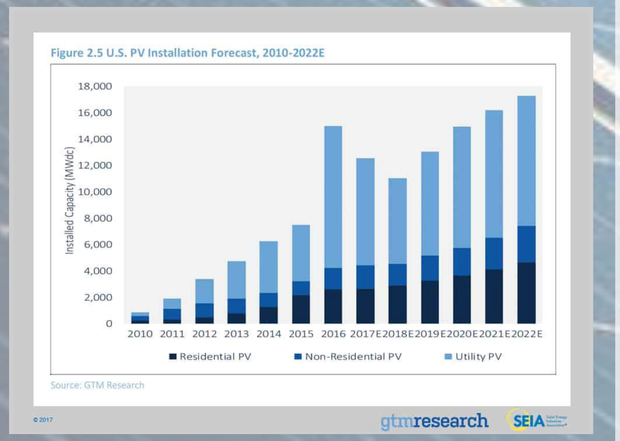

Figure 1. Current and future U.S. PV Installation

Methods

Each state was analyzed based off a set of factors that influence USS development. Within each of these four main groups, subgroups were explored to help rank states within the table. Policy and incentives included state and local policy and incentives. Physical characteristics included capacity factor (which is measuring installed wattage versus produced wattage), percentage of developable land compared to total land available, annual irradiance and average temperature. Public support was measured by quantitative data received from surveys conducted about solar support in each state. Infrastructure was analyzed by studying the electrical grids within each state and determining the ability of each states electrical grid to support USS, noting any potential improvements

State	July 2017 Production (thousand MW hours)	State Policy	Developable Land (%)	Annual Irradiance (kWh/m²/day)	Average Temperature (°F)	Public Support	Infrastructure
California	2,197	Strong	19.7	6.5-7.0	55	Strong	Strong and Improving
Minnesota	97	Strong	60.2	3.5-4.0	42	Average	Average and Improving
Wisconsin	Less than 3	Weak	39.4	3.5-4.0	44	Weak possibly Improving	Weak and Not Improving

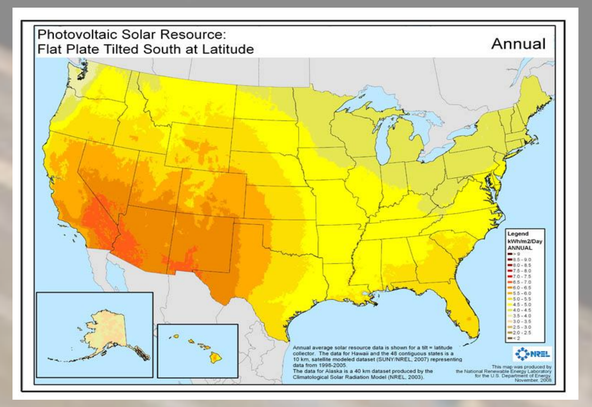

Figure 2. United States annual irradiance levels based on a kWh/m²/day scale

California

Policy (Strong)
- California's Renewable Portfolio Standard (RPS) requires 33% of their energy produced from renewable energy by 2020

Public Support (Strong)
- Multiple solar support groups in the state
- Over 85% of Californian's supporting solar

Infrastructure (Strong and Improving)
- Large amount of USS currently supported by California's grid
- Proposals by utilities asking for funds to improve the grid, with the intention of it supporting more renewable energy

Annual irradiance and Temperature
- Supports solar growth with high kWh/m²/day values
- High average temperatures could prove to be problematic due to line sag potential

Developable Land
- Low % of developable land could prove to be problematic

Minnesota

Policy (Strong)
- RPS requires Minnesota utilities to have 25% of retail electricity sales be generated or procured using eligible renewable sources by 2025
- Community Solar Garden law

Public Support (Average)
- Small scale surveys showing citizen support, large scale data still lacking
- Prominent solar groups such as MnSEIA and the Great Plains Institute

Infrastructure (Average and Improving)
- Grid is in a 20th century state
- Great Plains Institute creating the e21 Initiative to improve the grid to a 21st century grid

Annual Irradiance and Temperature
- Low irradiance levels prove troublesome
- Low average temperatures reduce line sag, improving transmission

Developable Land
- High % of developable land provides opportunity for growth

Wisconsin

Policy (Weak)
- RPS goal of 10%, which was met, but no further RPS has been developed since
- Lacking in PSC support

Public Support (Weak possibly Improving)
- 2008 study found public entities lacking in support
- Current, non-investor owned utility USS development shows signs of increased support

Infrastructure (Weak and Not Improving)
- Heavily reliant on non-renewables and rural distribution techniques
- Utilities fighting against renewable energy

Annual Irradiance and Temperature
- Low average temperatures improve transmission and reduce line sag
- Irradiance levels similar to Minnesota negatively support growth

Developable Land
- Average % of developable land, providing some opportunity for growth

Discussion

California
- Strong rankings in policy, public support and infrastructure contribute significantly
- High average temperatures and a low developable land % show small negative impacts

Minnesota
- Strong policy ranking, coupled with average rankings in public support and improving infrastructure are driving factors
- Additional factors include high % of developable land and low average temperatures
- Low irradiance is the only negative impact on USS development in Minnesota

Wisconsin
- Weak rankings in policy, public support and infrastructure have hindered USS development
- Low irradiance negatively impacts development
- Possible improvements into the future due to potential increase in public support and average % of developable land

Conclusion

Policy and infrastructure prove to be two constant driving factors for USS production regardless of average temperatures, irradiance or % of developable land. Pursuing strong RPS programs and a 21st century grid layout are useful tools and will continue to be into the future. Public support has shown signs of promoting growth, but further research is still needed. Correlations between strong RPS programs, infrastructure, and USS development were found.

Acknowledgements

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Further References

Figure 1: https://cleantechnica.com/2015/03/11/us-pv-installations-predicted-pass-8-gw-gtm-seia/
Figure 2: National Renewable Energy Laboratory. "Photovoltaic Solar Resources: Flat Plate Tilted South at Latitude." 2008.