

Solar Capabilities and Efficient Solar Implementation

Austin Cassidy
University of Miami

ABSTRACT

Although the United States is the world's second largest consumer of energy, only approximately 5% of our total energy generation is produced through solar despite having some of the world's most significant solar capabilities. This project aims to answer the questions of which states are the most efficient for producing solar energy, which states could benefit the most from implementing solar technology by reducing fossil fuel dependence, and if the current distribution of solar power plants is congruent with areas efficient for solar energy generation. Through the use of ArcGIS, the findings indicated that the states which would potentially benefit the most from solar implementation would be Texas and California as both states were among the most efficient for solar energy generation and fossil fuel dependence. Additionally, nine of the ten states with the most significant solar capabilities were located in the Southwest and included states such as Nevada, New Mexico and Arizona. However, fossil fuel dependence followed less of a singular regional pattern. Among the top ten fossil fuel dependent states, five were located in the rust belt and three others located along the Gulf of Mexico. Additionally, findings indicated that the distribution of solar power plants was not consistent with areas which were efficient for solar power generation.

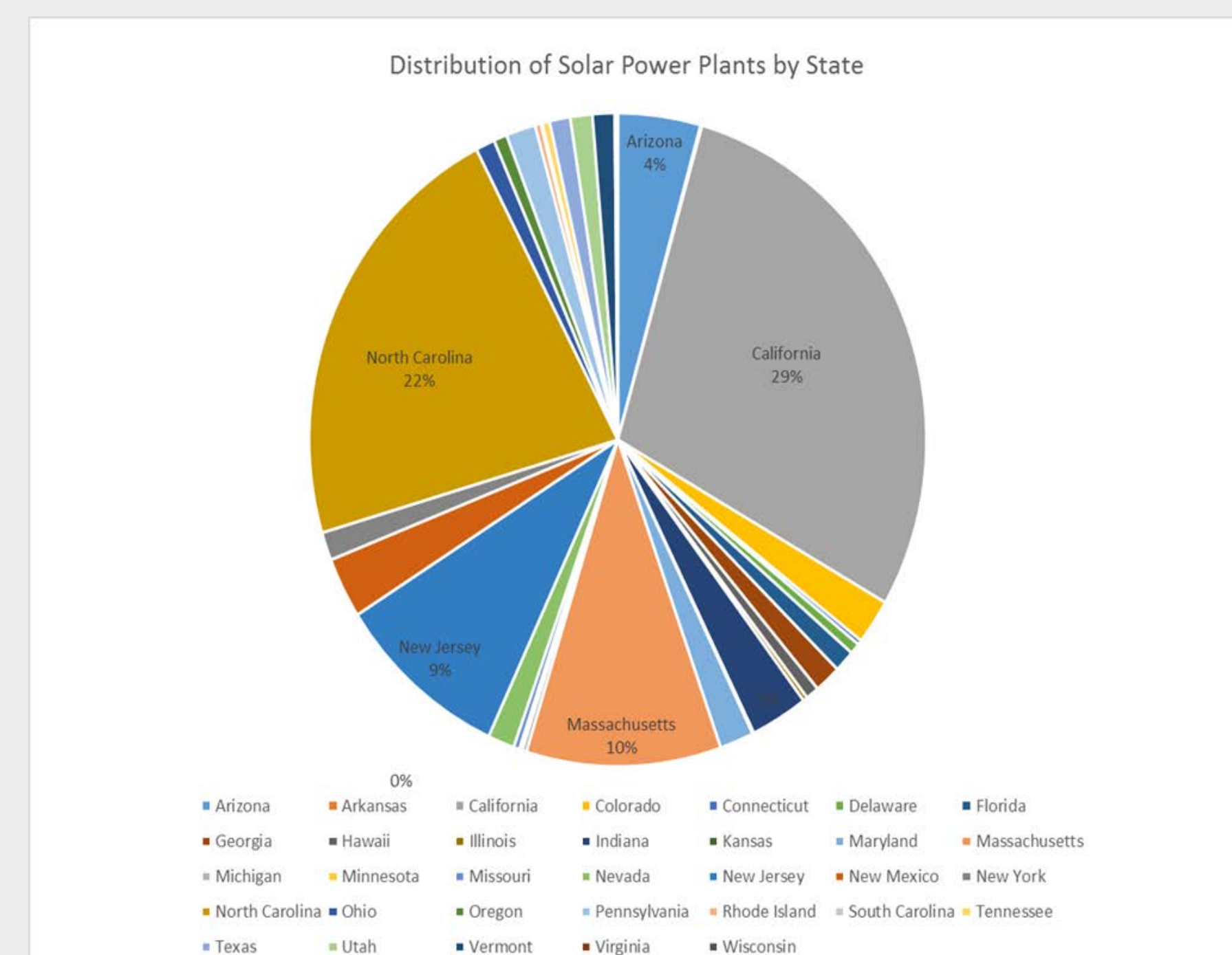
Austin Cassidy
University of Miami
Austincassidy@miami.edu

INTRODUCTION

Solar energy is among one of the least utilized sources of renewable energy in the United States, however, the U.S. is abundant in areas ideal for solar energy generation. Additionally, the cost to implement solar is falling rapidly with a more than 50% drop in the average price of solar panels in the past five years. (Solar Energy) Likewise, the efficiency of solar panels is increasing quickly and current estimates indicate that with present day solar technology, the entire US energy consumption needs could hypothetically be met by a solar field half the size of the Mojave Desert. In other words, this would be approximately 0.6% of the total area of the United States whereas farmland is more than 30% of the total area of the US (Naam, Ramez). Additionally, certain areas and regions in the U.S. are significantly more efficient in regards to solar energy capabilities and thus would be able to generate more electricity in a smaller area. Furthermore, the usage of fossil fuels and renewable energy varies tremendously by state. For example, Vermont generates over 99.7% of its electricity from renewables whereas Florida, which is nicknamed "The Sunshine State" generates less than 2.2% of its electricity from renewables, of which less than 1% is from solar (U.S. Department of Energy). Therefore, particular states may prove to be great candidates for solar energy production whereas other states, which may already generate large amounts of energy from renewables and are located in less than ideal solar regions may prove to be less ideal for solar energy generation.

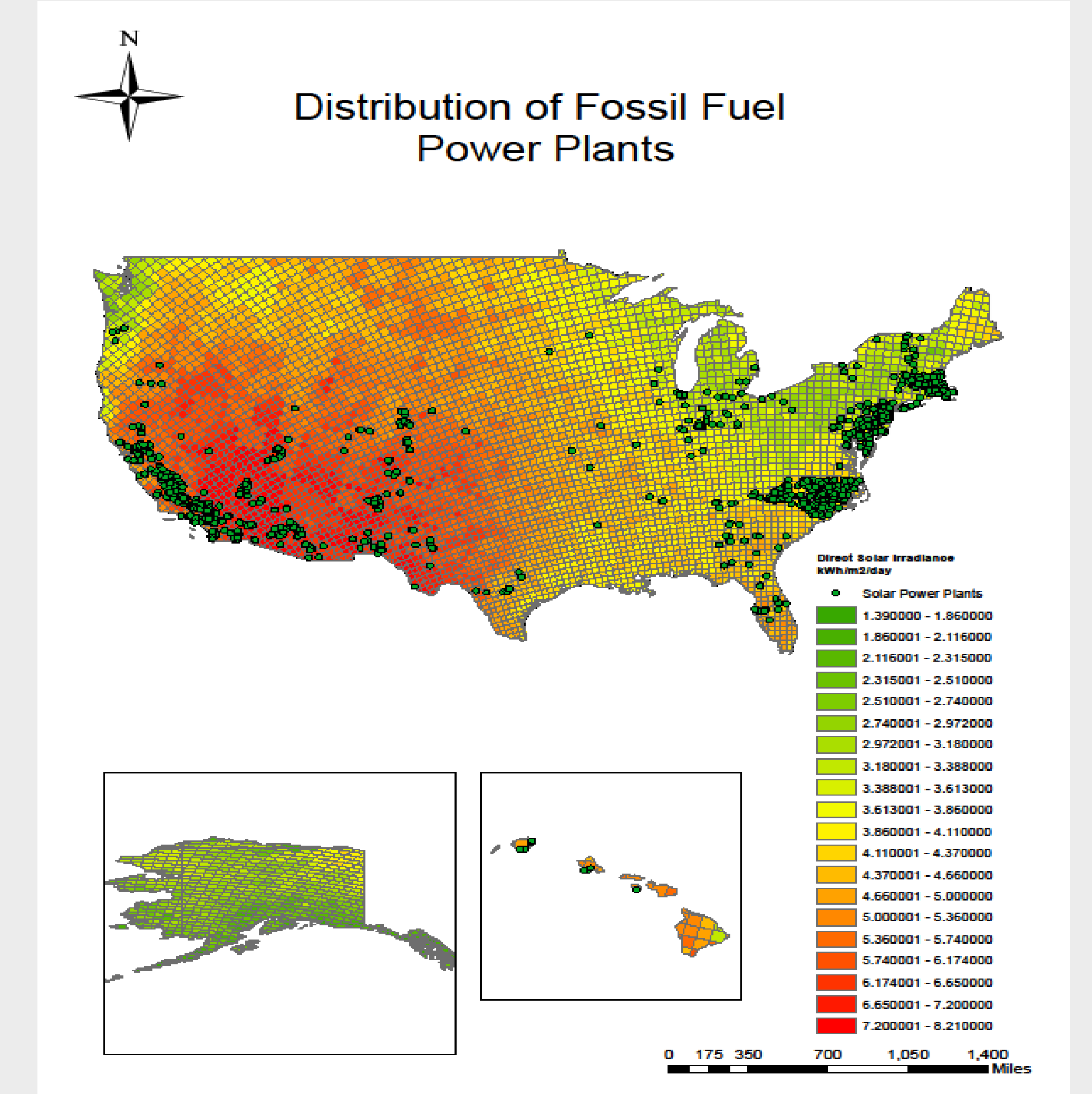
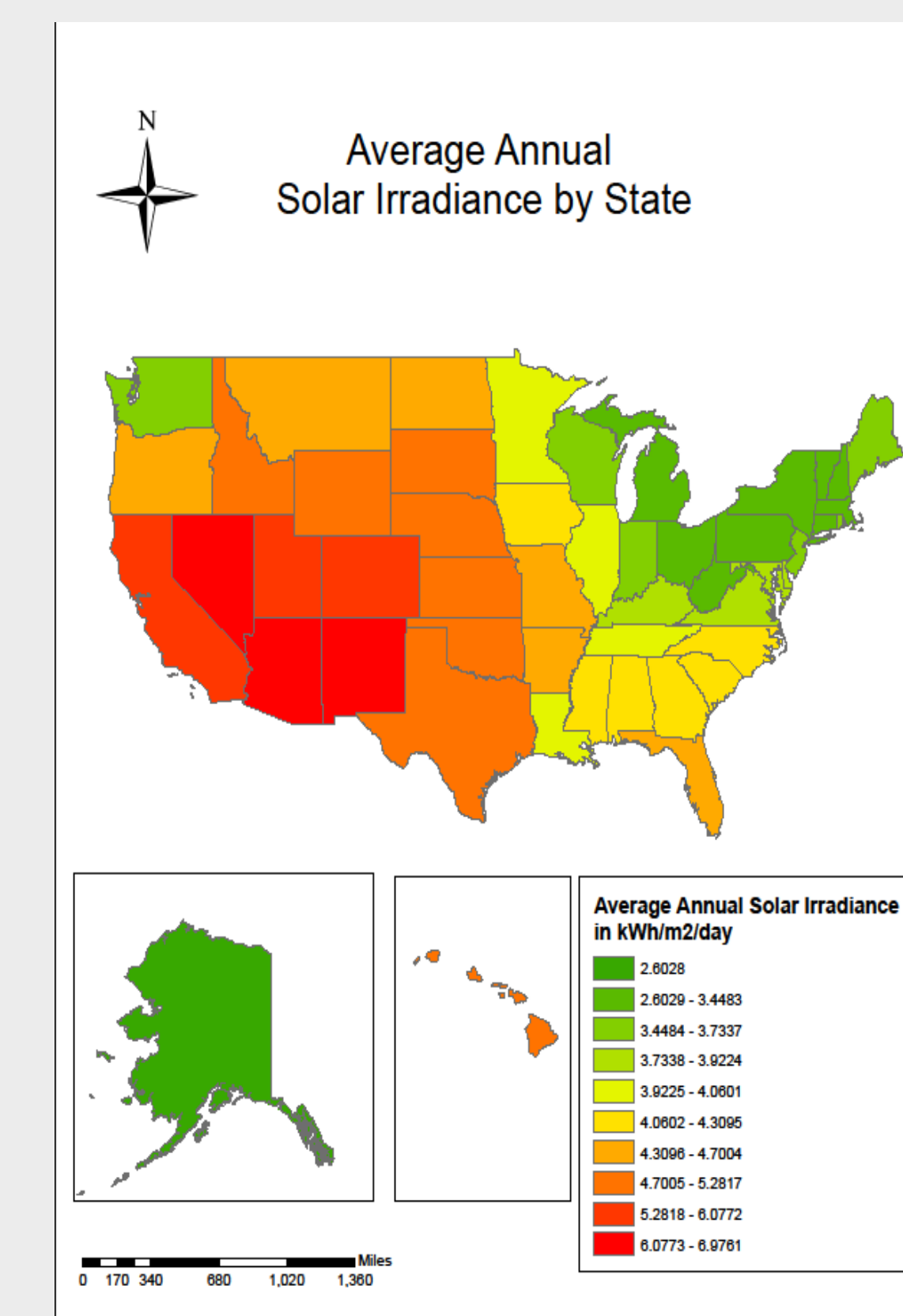
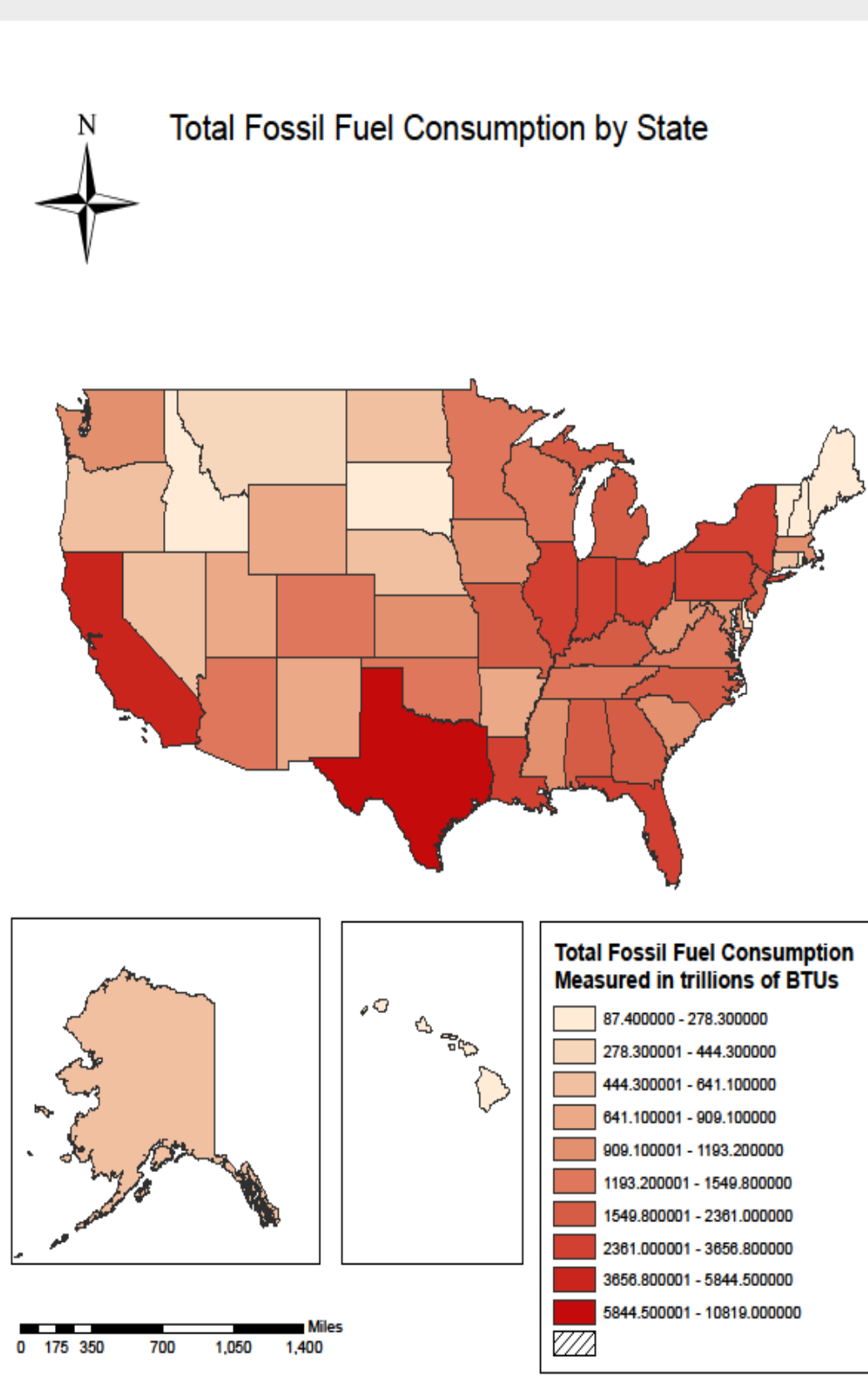
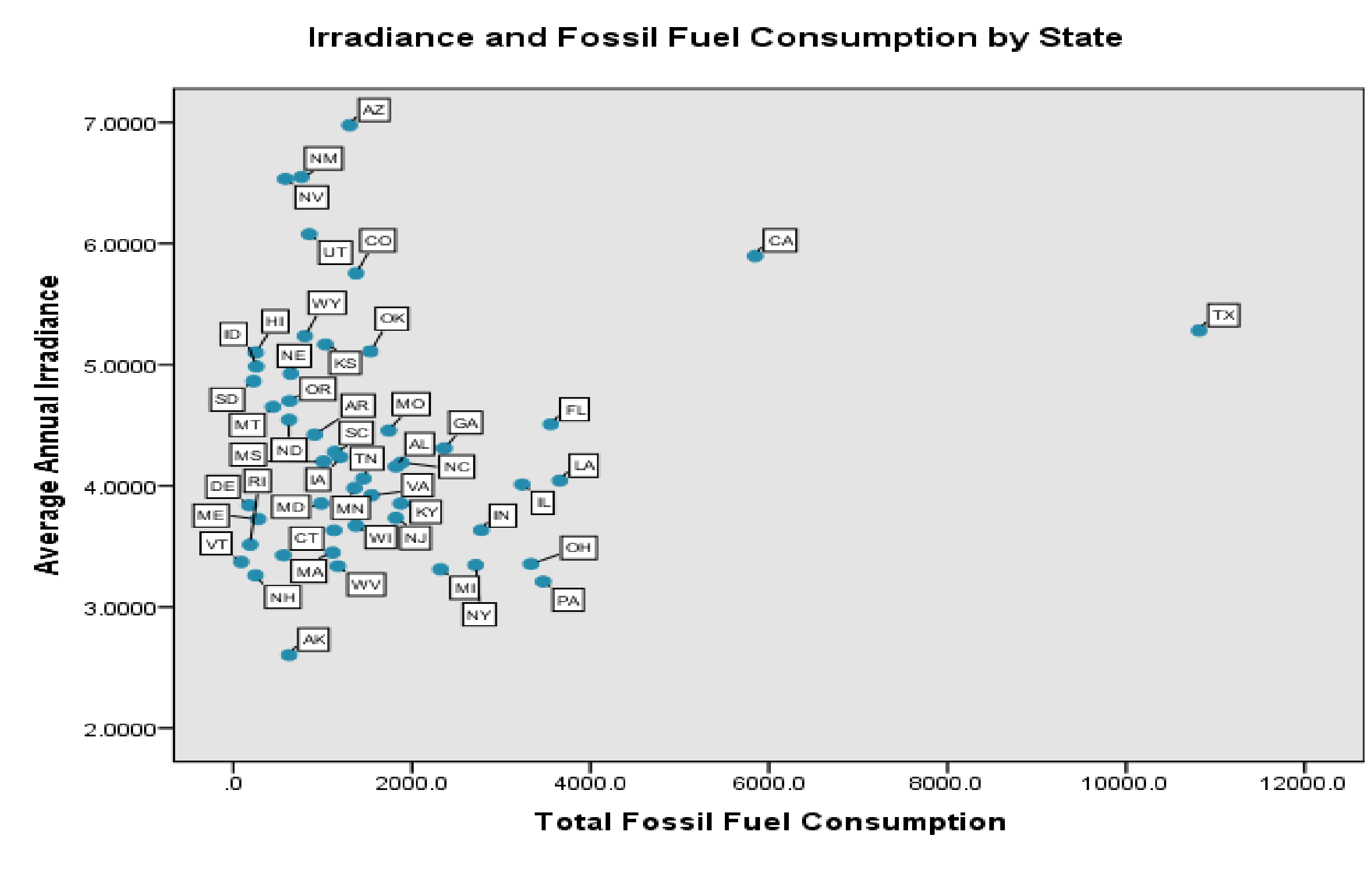
METHODS AND MATERIALS

- GIS data from the U.S. Energy Information Administration and the National Renewable Energy Laboratory was used in this project.
- Tools such as feature to point conversion, spatial joins, clipping, summarizing, search by attribute, joining table attributes, and conversion tools such as excel to table and table to excel were used in this project.
- Shapefiles and feature classes from EIA and NREL were used.



RESULTS

Results indicated that the states with the most optimal conditions for solar are largely located in the Southwest United States and in order of average annual solar irradiance levels, are Arizona, New Mexico, Nevada, Utah, California, Texas, Wyoming, Kansas, and Hawaii. Results indicated that the states which consume the most fossil fuels are Texas, California, Louisiana, Florida, Pennsylvania, Ohio, Illinois, New York, and Georgia. From these results, two states, Texas and California, were in both categories and thus are the most optimal for solar energy generation when fossil fuel consumption and solar capabilities are both taken into account. Additionally, results indicated that the current distribution of solar power plants is not particularly congruent with the areas which have the highest efficiency in the United States. The state with the largest share of solar power plants was in fact California, a state high in fossil fuel consumption and abundant in solar capabilities, however, the three leading states, North Carolina, Massachusetts, and New Jersey are all located in areas that were not the most efficient in generating solar electricity.



CONCLUSIONS

Results from this project conclude that Texas and California are the two states most optimal for wide scale solar implementation as both states are among the largest consumers of fossil fuels and have the greatest solar capabilities.

Additionally, this projects suggests that the United States should aim to locate more solar power plants in areas most efficient for solar energy generation whereas currently, the majority of solar power plants are located outside of the Southwest, the region most suitable for solar.

This project also concludes that the states most efficient for solar energy generation are almost all located in one region, the Southwest. Whereas the states consuming the most fossil fuels are not in one single region and instead are located in the rust belt and along the Gulf Coast.

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