

Exploring the Determinants of Biogas Generation Potential in California

Web address for GitHub repository

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1 Rationale and Research Questions

Methane's global warming potential is estimated to be over 25 times as potent as that of Carbon Dioxide. The UNECE estimates that over a 20 year period, this ratio increases to 84-86 times. Methane is generated from various sources, including (but not limited to) wastewater treatment, animal manure, landfills, industrial organic waste.

The NREL estimates that California has the highest biogas generation potential in the US. According to the American Biogas Council, California can power nearly 200,000 homes if this biogas is utilized appropriately.

We therefore set to find out more about biogas generation potential in California:

Firstly, was biogas generation potential correlated with densely populated areas? That is, could biogas be channeled to nearby use cases frequently?

Secondly, are there additional factors to consider?

2 Dataset Information

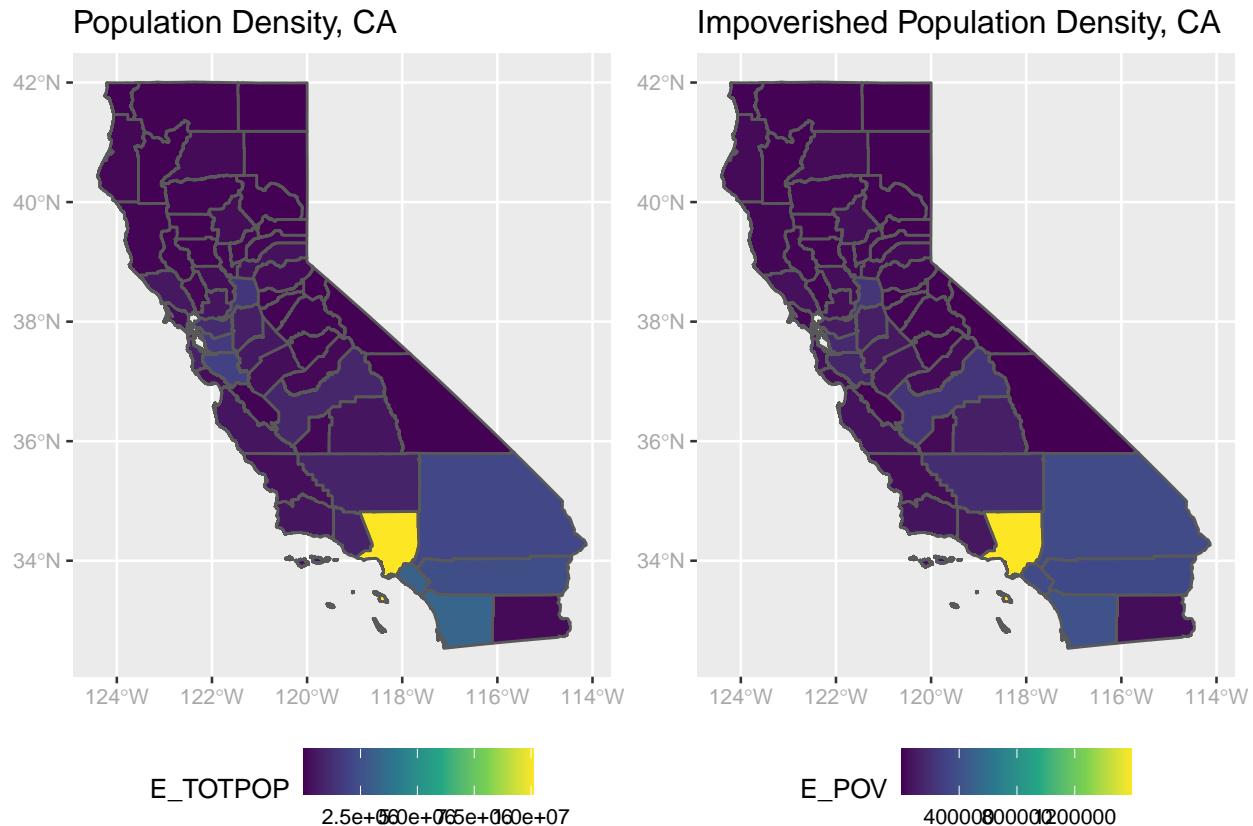
We drew upon two datasets:

1. The National Renewable Energy Laboratory's dataset on methane generation potential in the United States of America. This considered all US States' CH₄ generation potential in metric tons across the following sources: landfills, industrial organic waste, animal manure, and wastewater, aggregated into Total CH₄ potential. This data is sourced from 2009-2012.
2. The CDC and ATSDR's social vulnerability index, from which we obtained county-wide population data, and details on impoverished populations. This data is sourced from 2017-2018.

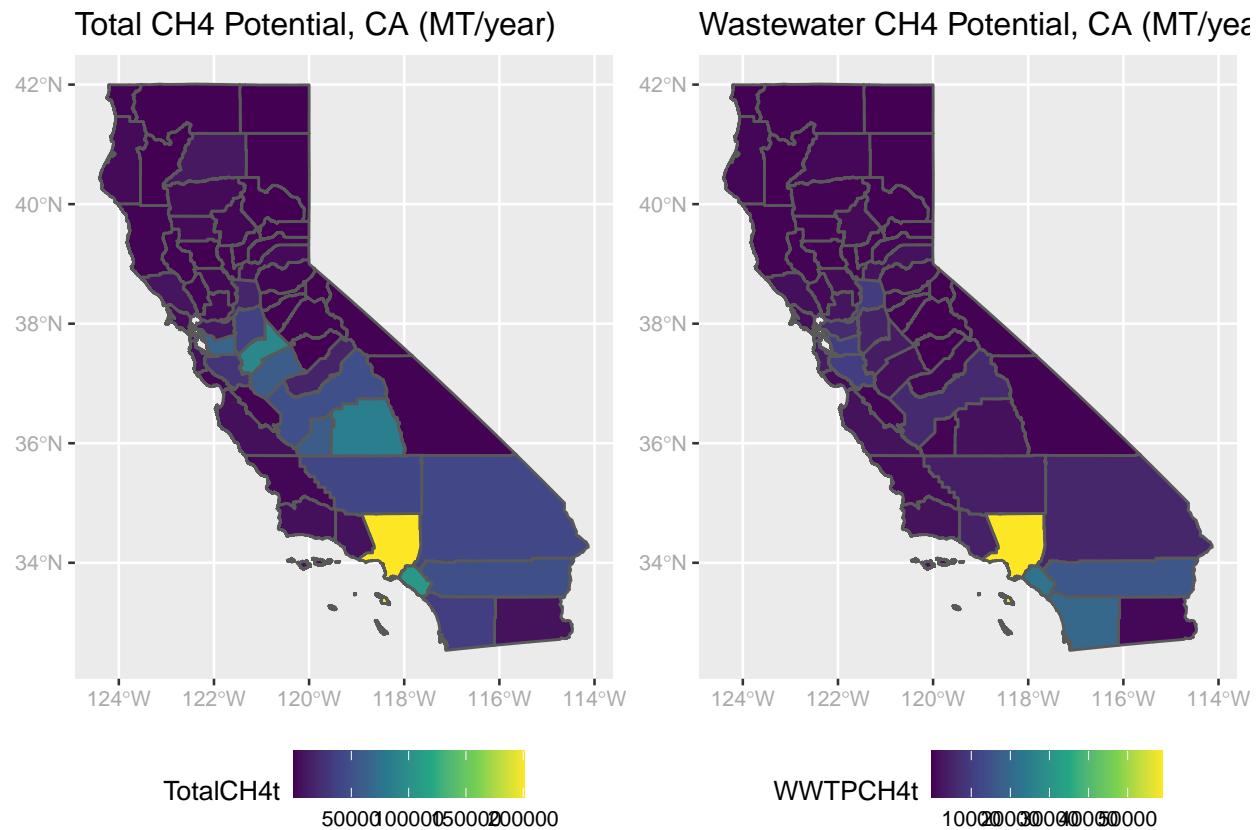
3 Exploratory Analysis

We wrangled and joined both datasets to have a unified, county-wise dataframe that included data on methane generation potential, population and poverty. We started our analysis with a visual assessment of spatial data, to determine if any trends immediately emerged.

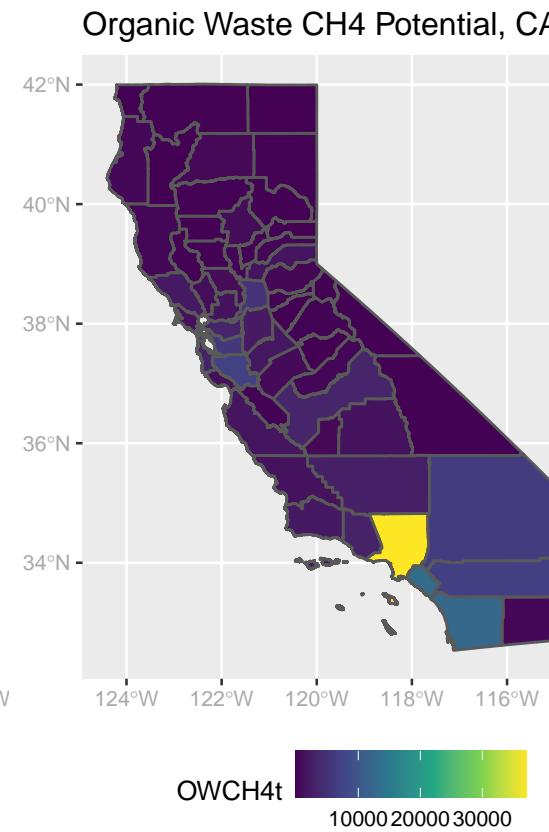
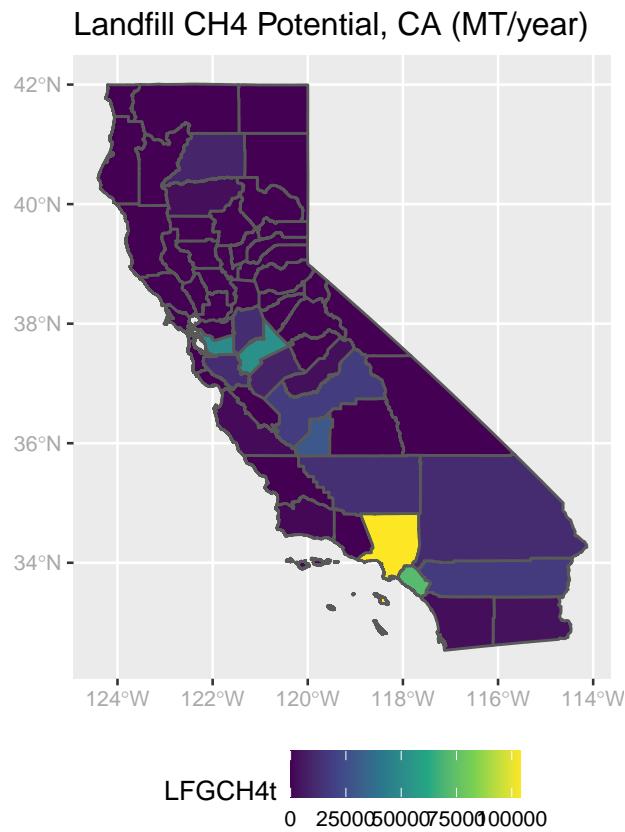
Visually, the most populated area of California, given by the county shaded yellow, Los Angeles, has the highest CH₄ generation potential. The density of impoverished population appears to be similarly distributed.



Total CH₄ generation potential is greatest at the most densely populated areas. This trend appears to continue with wastewater derived methane.



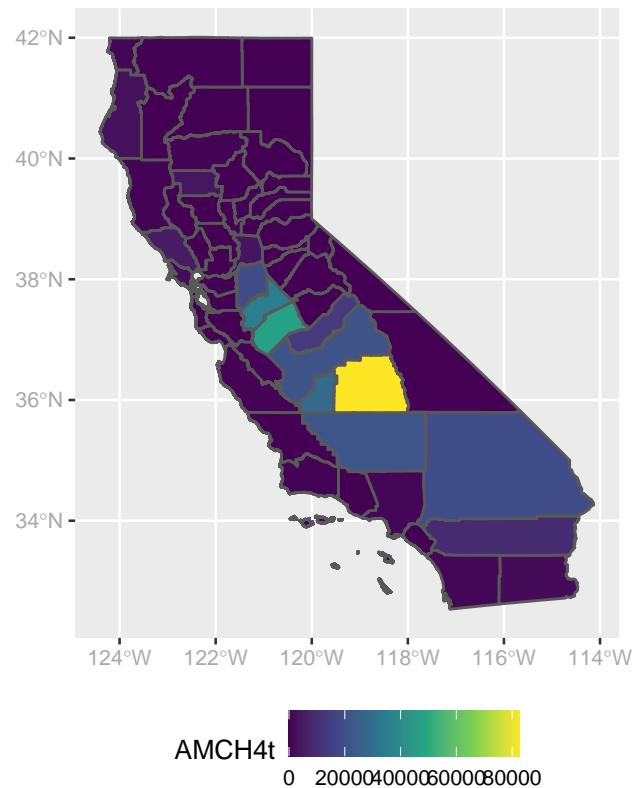
Industrial Organic waste, like wastewater, is highly correlated with population. With landfill-based methane, some counties in central CA, which do not appear to have a high population, have comparatively high methane generation potential. There may be some non-population re-



lated factors in play.

The trend with animal-manure derived CH₄ however substantially differs from the previous cases. Population does not appear to be a decisive factor.

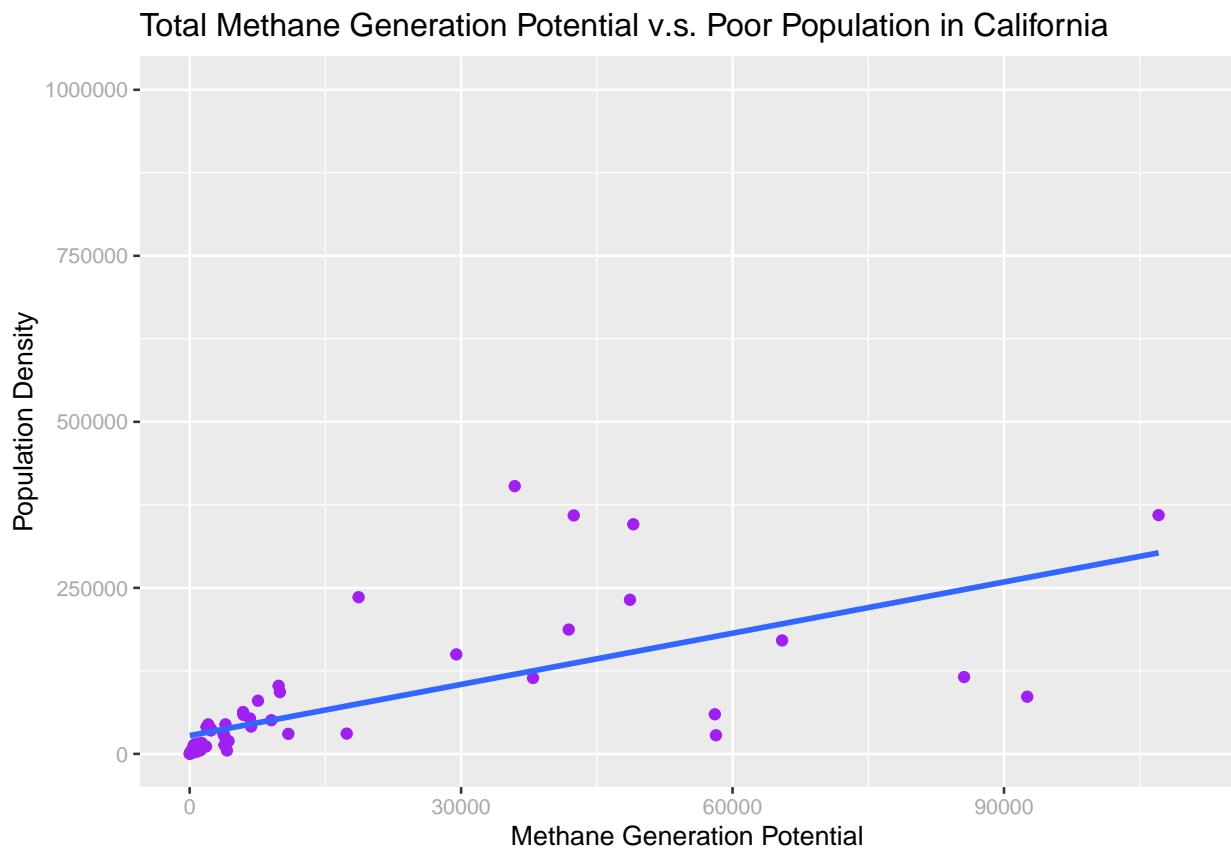
Animal Manure Derived CH₄ Potential, CA (MT per year)



4 Analysis

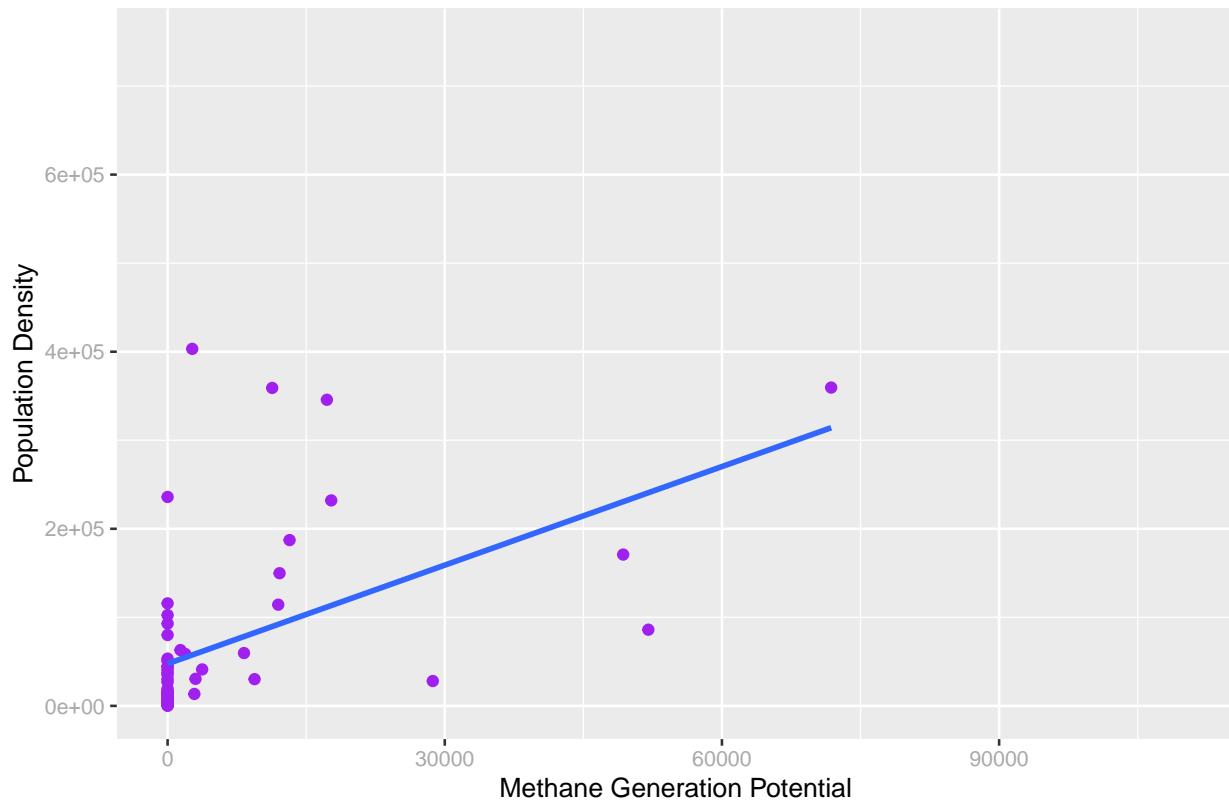
- 4.1 Question 1: <insert specific question here and add additional subsections for additional questions below, if needed>
- 4.2 Question 2: Is there a relationship between methane generation potential and impoverished populations?

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## `geom_smooth()` using formula 'y ~ x'  
## Warning: Removed 1 rows containing non-finite values (stat_smooth).  
## Warning: Removed 1 rows containing missing values (geom_point).
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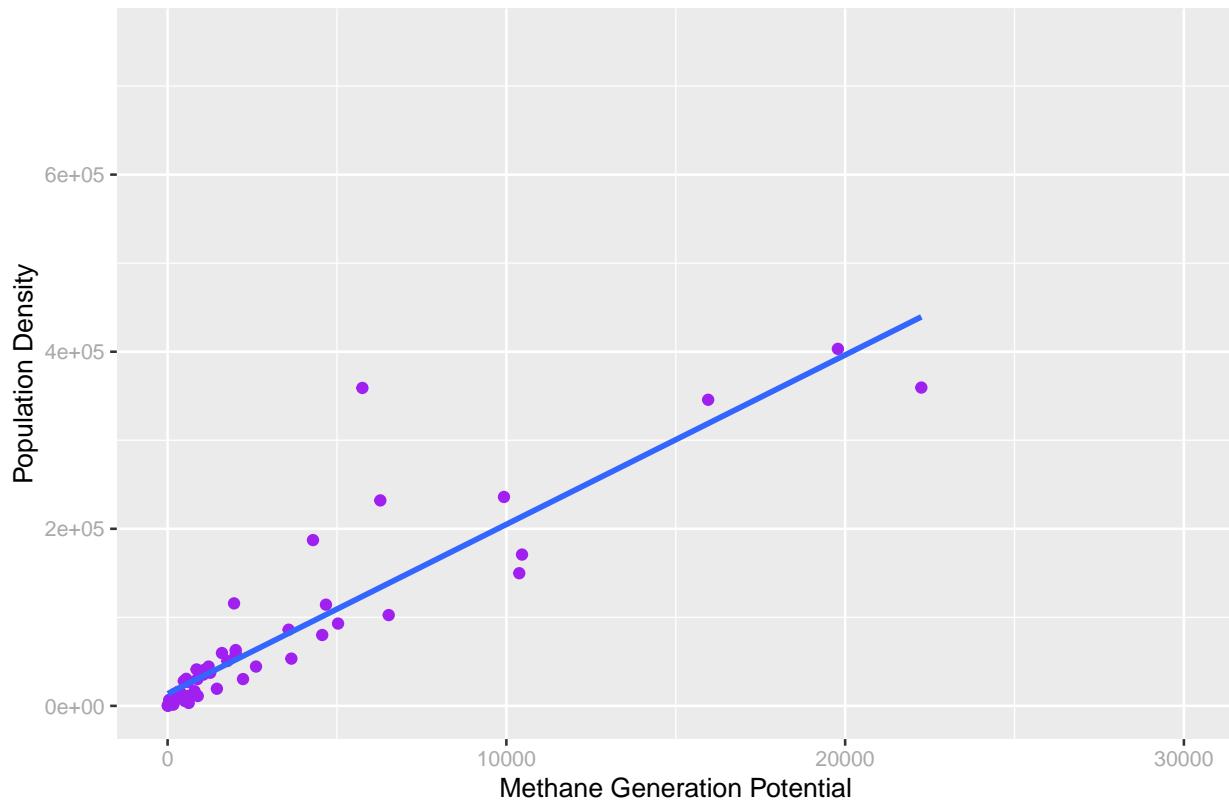


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Landfill CH4 Generation Potential v.s. Poor Population in California

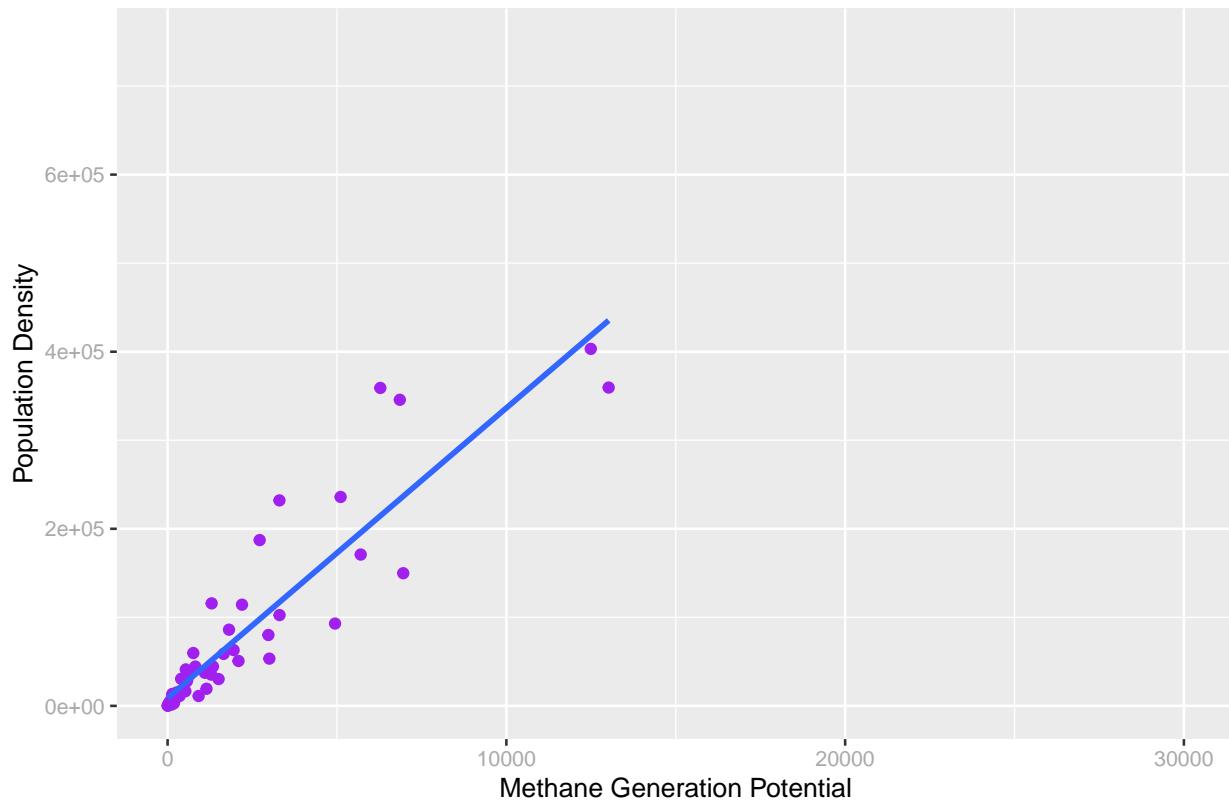


Wastewater CH4 Potential v.s. Poor Population in California

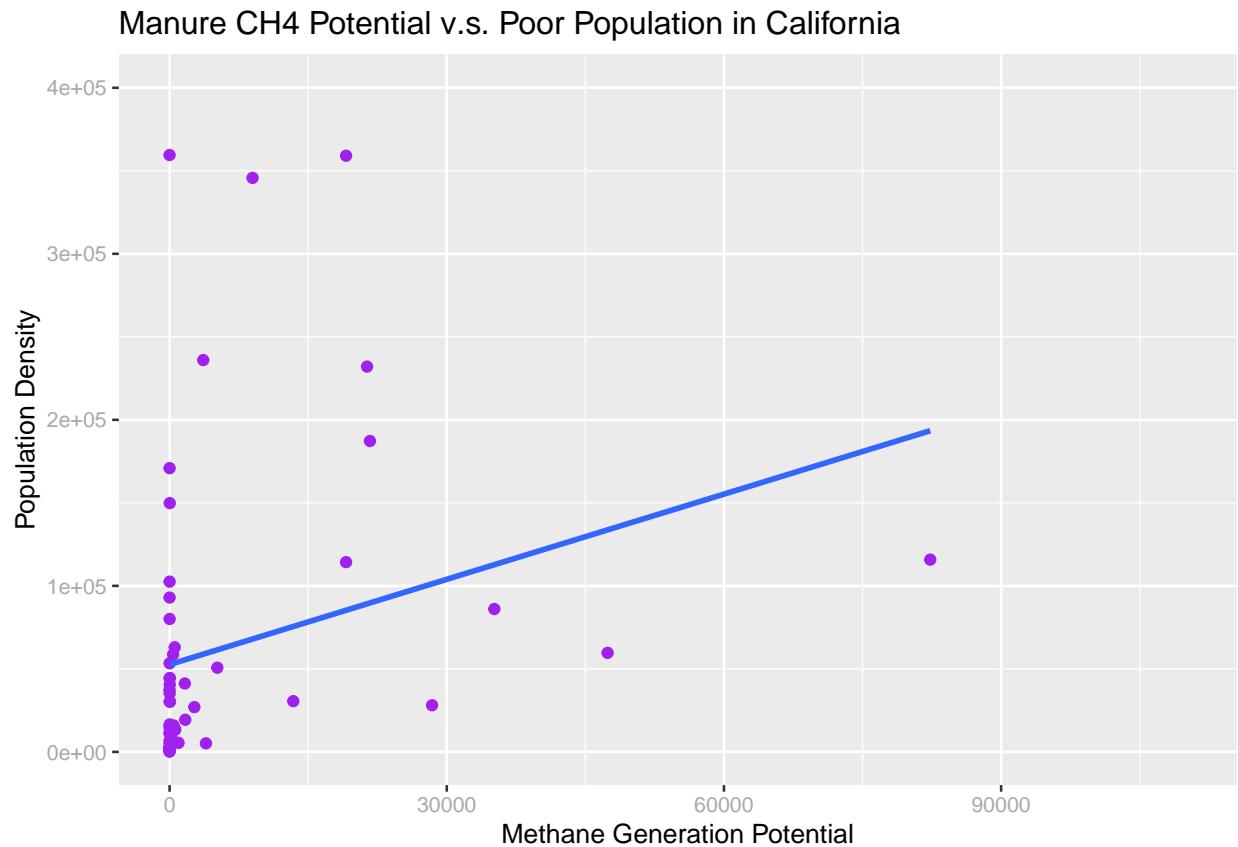


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Organic Waste CH4 Potential v.s. Poor Population in California



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## Warning: Removed 2 rows containing missing values (geom_point).
```



5 Summary and Conclusions

6 References

<add references here if relevant, otherwise delete this section>