Chelsey Kim
Analysis of the association between variables in the AHSC Round 5 dataset and cost-effectiveness

Introduction: The California Air Resources Board is the clean air agency in the government of California with a mission to protect the public from the harmful effects of air pollution. To do this, they develop and fund programs that actively fight climate change. The Affordable Housing and Sustainable Communities Program (AHSC) is a part of the California Climate Investments within the Strategic Growth Council (SGC) agency. The AHSC creates affordable housing that is accessible to nearby jobs and key destinations by walking, biking, and public transit. AHSC Program funds are allocated through a points system created by SGC. Research on the variables that play a factor in the point scoring is important to study to ensure that the system is fair to projects and allows future projects to see the most optimal ways to reduce their carbon emissions. The research questions and hypotheses being studied include the following. What is the association of the cost-effectiveness and the Project Area Types? Cities tend to have infostructures that make public transit easier to incorporate, while rural areas have more limitations; therefore, there will be differences in the cost-effectiveness between the different project areas types. What is the association between how much of the total GHG emission reduction is due to transit GHG emission reduction and the cost-efficiency? According to the United States Environmental Protection Agency, transportation generates the largest share of greenhouse gas emissions; therefore, there will be a positive correlation between the Total MTCO2e/$ and the Transit GHG Emission Reductions as % of Total.

Methods: The data set is a summary of the Round 5 projects that were granted funding from AHSC in 2018-2019. The variables that were analyzed are Project Area Type, the Total MTCO2e/$ (cost-effectiveness), and Transit GHG Emission Reductions as % of Total. The Project Area Type is divided into three categories: Transit Oriented Development (TOD) Project Areas, Integrated Connectivity Project (ICP) Project Areas, and Rural Innovation (RIPA) Project Areas. Refer to the Affordable Housing and Sustainable Communities Program Round 5 2018-2019 Program Guidelines pages 7-8 to see Project Area Type definitions. The Total GHG Emission Reductions (MTCO2e) is determined by the AHSC Benefits Calculator Tool. The Cost efficiency of estimated GHG reductions per AHSC dollar is calculated by the Total Project GHG Reductions divided by the amount of AHSC dollar requested. These two categories make up the GHG Reductions Scoring, each having a maximum of 15 points. The Transit GHG Emission Reductions (MTCO2e) is the amount of carbon emission that is reduced by Transit. The Transit GHG Emission Reductions as % of Total is the Transit GHG Emission Reduction divided by the Total GHG Emission Reductions. The Kruskal-Wallis test was used to compare the Total MTCO2e/$ for the three Project Area Types. A linear regression model was used to see the correlation between the Total MTCO2e/$ and Transit GHG Emission Reductions as a percentage of the Total.

Results: Each test statistic was compared to an 0.05 alpha level of significance. The project's cost effectiveness (MTCO2e/$) and the Project Area Type is not statistically significant (p=0.2643, see table 2 in Appendix A). The project's cost effectiveness (MTCO2e/$) and the Transit Green House Gas Emission Reduction is statistically significant (p=<.001, see table 3 in Appendix A).

Discussion: The association between cost-effectiveness and the Project Area Types do not support my hypothesis. The Project Area Type a project is in does not influence the amount of carbon emission that is reduced. The association between the Transit GHG Emission Reductions as % of Total and the cost-efficiency supports my hypothesis. Because transportation generates the largest share of GHG emissions, the more that is reduced the higher the cost-effectiveness. Also, creating access to sustainable transportation may be cheaper than other projects. The correlation between the two is strong (0.738, see table 3 in Appendix A) and the residuals followed linearity. A limitation to the study is the small sample size (N=47) and the lack of prior research. More research should be done within the transit components, to see what specific projects are the most cost-effective. In conclusion, knowing that the Transit GHG Emission Reductions as % of the Total and the cost-efficiency have such a strong positive correlation will encourage projects to focus on reducing carbon emissions through transit—the most cost-effective way to reduce carbon emissions.

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Appendix A: Tables with descriptive statistics, tests of association, and p-values

Table 1: Descriptive statistics and tests of association between the Total MTCO2e/$, Project Area Type, and the Transit GHG Emission Reductions in the AHSC Round 5 Summary dataset. N=47.

	Overall	p-value
	N = 47	
Total MTCO2e/$	0.001022 (0.000597)	
Transit GHG Emission Reduction	15820.96 (16022.6)	
Project Area Type		
ICP	23 (48.936%)	0.2643
RIPA	10 (21.277%)	
TOD	14 (29.787%)	
Transit GHG Emission Reduction Percentage	52.82% (32.87%)	<.001

Table 2. Kruskal-Wallis Test between the Total MTCO2e/$ and Project Area Type in the AHSC Round 5 Summary dataset. N=47.

Chi-Squared	Df	p-value
2.6611	2	0.2643

Table 3. Linear regression results of Total MTCO2e/$ regressed on Transit GHG Emission Reduction Percentage in in the AHSC Round 5 Summary dataset. N=47.

	Total MTCO2e/$	95% Confidence Interval		p-value
		Lower	Upper	
Transit GHG Emission Reduction Percentage	0.0013	9.720	0.002	<0.001
Constant	0.0003	8.532	0.0005	0.008
Observations	47			
R^2	0.5342			
F Statistic	53.75			<0.001
Correlation	0.738	0.572	0.846	<0.001

Appendix B: Bi-variate Plots of the Total MTCO2e/$ (cost-effectiveness), Project Area Type, and the Transit GHG Emission Reductions as % of Total in the AHSC Round 5 Summary dataset. N=47.

Figure 1. The Project Area Types ICP, RIPA, and TOD are not associated with the Total MTCO2e. N=47.

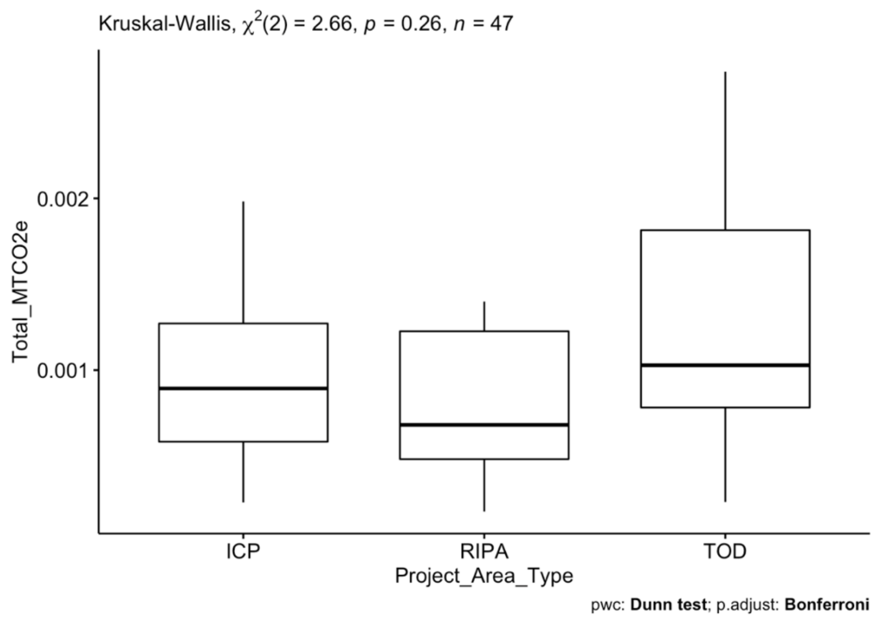

Figure 2. Total MTCO2e/$ and the Transit GHG Emission Reductions as % of Total. N=47.