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Research Notes

Reducing Greenhouse Emissions from Optimizing Urban Transit Networks

Evaluate the potential benefit of design and operational approaches for reducing the environmental impacts of urban transit systems.

Planning
Policy
Programming

APRIL 2015

Project Title:
Potential Greenhouse Gas Emissions Reductions from Optimizing Urban Transit Networks icles

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WHAT IS THE NEED?

The public transportation sector in the U.S. annually emits approximately 13 million metric tons of the greenhouse gas carbon dioxide. Recent investments in the transit sector to address greenhouse gas emissions have concentrated on purchasing lower emission replacement vehicles. There has been little focus on the potential for operational improvements to reduce greenhouse gas reductions. Transit system design modifications such as reducing the frequency of service or increasing the distance between transit lines have not been evaluated. Previous research by the Principal and Co-Principal Investigators has shown that a greenhouse gas emission reduction can occur by reducing the level of service to transit customers. However, elastic demand was not considered in this research. Elastic transit demand may lead to situations when reducing levels of transit service results in a city-wide increase in greenhouse gas emissions because travelers switch from relatively clean transit to polluting vehicles such as single-occupancy automobiles. There is a need to develop policies more likely to achieve the greenhouse gas emissions reduction set by Assembly Bill 32.

WHAT ARE WE DOING?

The research will be conducted in three tasks: a concise literature review, model extensions, and a case study. These tasks will be done concurrently.

We will develop a concise literature review on the state of the art in Emissions from Public Transportation and Transit Network design. A literature review performed during preliminary research which focused on emissions from public transportation and public transportation network design will be expanded and updated to insure completeness up-to-date models and data. Additionally literature on transit travel time elasticities will be included to obtain realistic values for a US city context.

We will extend out models by incorporating elastic demand, to allow for the possibility of transit users shifting to the auto mode in the face of level-of-

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service reductions. Curves showing the relationships between greenhouse gas emissions and user travel time will be developed for a range of hypothetical cities, of varying sizes, demand densities, and elasticities, and for four different trunk technologies (bus, bus rapid transit, light rail transit, and heavy rail transit). This will be done for both versions of the problem formulation: transit agency emissions constraint, and city-wide emissions constraint

We will apply our methodology to the MUNI bus network in San Francisco as a case study. The objective will be to demonstrate the applicability of our proposed approach to a realistic setting. We believe that having a concrete application to complement our models is likely to enhance the credibility of our work with practitioners. Data for agency and user costs and emissions for San Francisco (and other cities in the US) have already been collected, but will be updated if newer data are available. The objectives of the case study are:

1. To quantify the agency and user costs and greenhouse gas emissions for the current Muni system, and where it falls relative to the Pareto frontier;

2. To quantify the potential for system cost reductions for San Francisco if the system were designed optimally to minimize costs; and

3. To quantify how the answer to (2) might change if greenhouse gas emissions constraints are introduced, for both the idealistic and elastic demand cases.

WHAT IS OUR GOAL?

The goal of the research is to investigate two different policy scenarios that are consistent with greenhouse gas emissions reduction called for in Assembly Bill 32. In the first scenario transit operators are required to reduce their greenhouse gas emissions, while in the second scenario cities are required to reduce their greenhouse gas emissions from the transportation network as a whole. The research will identify which of these two policies is more likely to lead to the desired results and move cities closer to achieving the greenhouse gas emissions reduction set by AB 32 while avoiding the unintended results of lowering greenhouse gas emissions from transit only to accrue an overall increase in greenhouse gas emissions.

WHAT IS THE BENEFIT?

Our research will inform policy for cities and communities that plan to take advantage of the flexible metrics allowed by California Senate Bill 743. The work will highlight the advantages and potential pitfalls associated with changing from a Level of Service standard to a Vehicle Miles Traveled criterion in evaluating transit projects or operational changes. The case study for the San Francisco MUNI will quantify reductions in societal costs and greenhouse gas emissions if the system design and operations were optimized. The research will help communities reduce greenhouse gas emissions while maintaining viable efficient transit systems. Our research will identify whether reducing greenhouse gas emissions from transit systems alone or from reducing greenhouse gas emissions on a city-wide basis will move cities closer to achieving the targets set by Assembly Bill 32.

WHAT IS THE PROGRESS TO DATE?

This project is just beginning and no milestones have been completed.

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