Research Proposal: Vancouver Sustainable Transportation

Introduction

Vancouver is a city wanting to become a leader in sustainable development, and aims to become one of the "greenest cities in the world" [1]. Some of Vancouver's initiatives to meet its greenest city goal was implementing "green transportation" [1]. Green transportation includes sustainable means of travel such as public transit, bike, and by foot [1]. To analyze the effects of green transportation in Vancouver we use concepts from the study of computational social science (CSS). CSS is a fairly new field of study which merges sub-disciplines of social phenomena with computer models, and simulations [2]. R. Chang, et al say, computer "modeling approaches now can predict the behavior of socio-technical systems, such as human interactions and mobility, that were previously not studied with one-time snapshots of data" [3]. With new concepts of CSS I would like to propose the following review: a need exists to quantify green transportation effects on the environment compared to private fossil fuel transportation modes in Vancouver.

Problem Description

Vancouver has implemented the "Greenest City 2020 Action Plan" (GCAP) in 2011 to move towards a sustainable city [1]. The GCAP states "cities are responsible for three-quarters of global greenhouse gas emissions. Globally, cities are

acknowledging that averting the worst impacts of climate change will require cutting greenhouse gases by at least 80% by 2050" [1]. Green Transportation aimed to make 50% of transportation in Vancouver by "foot, bike, and public transit" which was achieved, however we will quantify the effects made on the environment [1].

The GCAP contains many elements of transitioning towards more sustainable methods of transportation, but it may not be enough to slow climate change. To measure the effects of green transportation in Vancouver, 46 open-source datasets exist on opendata.vancouver.ca, and will be used to analyze the mobility of people in Vancouver.

Before open-source datasets, it was difficult to find data, and much more expensive if data was captured by a single researcher. Now there is a plethora of open-source datasets available for analysis. R. Chang et al state that these new forms of data "opens up the study of a range of geospatial and spatio-temporal contexts that involve the spatial movement of consumers in stores, medical patients in their homes and workplaces, delivery vehicles and public transit buses" [3]. Similar to the R. Chang et al study, we can use the datasets to study the geospatial transportation of a population in Vancouver.

Data collection can be conducted with global positioning systems (GPS) to complement open-source datasets. GPS data can be collected by mobile devices (which typically have one identifiable user) sent through a cellular networks and/or through navigation apps such as Google Maps [3]. Previous GPS data studies include

discovering positions and movements in a region when applied to corresponding geographic data, and finding frequent travel paths in a region without any corresponding geographic data [3].

Objectives

To review the effects of green transportation in Vancouver I propose the following objectives:

1. Compile datasets on different green transportation methods available in Vancouver.
2. Create greenhouse gas emission rates from transportation to quantify green transportation emissions vs. private fossil fuel based transportation emissions.
3. Compile GPS data to determine if people are transitioning to green transportation modes.

Using the public open-data datasets we are able to test the goals of the GCAP in various scenarios. With the public bike lane datasets we can map the feasibility of traveling from one point in the city to another, finding locations with bike racks, and compare the data to other transportation modes. An "electric vehicle charging stations" dataset can be used to analyze the feasibility electric vehicles over fossil fuel based vehicles. Since 2016, Vancouver has a public bike share service with public datasets for further analysis on mobibikes.ca [4]. All of these proposed datasets can be used to find which areas of Vancouver are accessible by green transportation.

Each green transportation dataset will be used to determine greenhouse gas emission rates for each mode. Emission rates can be further broken down into per trip

emissions, and ride-share & public transit services can be converted to an emission per user basis. Rates can be applied to population census datasets also found on open-data.vancouver.ca [5]. Census data will determine the population of Vancouver sub-regions, and determine information like classification of residents as working class, or students etc. Census data will allow for correlations between the population, and mobility of residents such as when and how they are traveling. With the data and correlations, each green transportation method, and emission rates can be accessed with a great level of precision.

Once transportation methods and emission rates are compiled, we can determine what methods of transportation are being used, and examine if the results of the GCAP are working. The City of Vancouver publishes bike volume data monthly, using automated bike counters set up on public bikeways [6]. Translink provides an open API for access to data associated with public transit. The public Mobi bike-share dataset contains lots of data such as total uses per pickup point and length of each distinct rental [4]. This data can help determine increases and decreases in total green transportation use, but alone they can not correlate distinct users per sub-region to their preferred method of travel.

GPS data from mobile phones can help infer distinct residents per location to a preferred method of travel. H. Yuan et al studied if GPS data could be used to infer frequent paths of travelers commuting if a fixed location. H. Yuan et al state, "recorded data includes longitude, latitude, height, timestamp and so forth, in which the first two are critical [... in] human mobility discovering [... where] we try to trim the trajectory into

frequent path and fixed territory for a traveler" [7]. Once a frequent path is found for users, we can correlate the path with the locations of each mode of transportation, and the speed that they are traveling to infer which mode of transportation they are using (with some probability). Linking a user's GPS data with transportation mode data will help determine if a user is using green transportation modes, and infer an emission rate per person in each sub-region.

SIgnificance

Canada's average warming is double the average of global warming which brings relevance to our proposed review of Vancouver's green transportation practices [8]. Vancouver influences the practices of neighboring municipalities, as well as Vancouver's general influence over other cities in Canada. Vancouver has made impactful moves to fight climate change, but an external review must be conducted given Vancouver's vast influence, and the irreversible changes of climate change. Our proposed review will meet the following objectives: (1) Compile datasets on different green transportation methods available in Vancouver; (2) Create greenhouse gas emission rates from transportation to quantify green transportation emissions vs. private fossil fuel based transportation emissions; (3) Compile GPS data to determine if people are transitioning to green transportation modes. Our research will be compiled in a formal report, and presented to SFU, and members of the Vancouver City Council.

References

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