Surrey Electric Vehicle Project:

Data Analysis and Visualization for Surrey's Electric Vehicle (EV) Transformation Strategy

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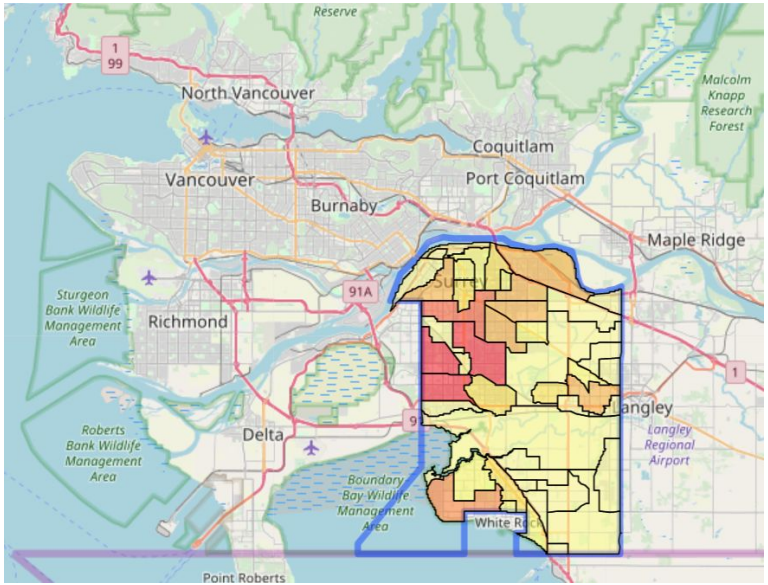
CITY OF SURREY
the future lives here.

Intro to Surrey & Project Background



- Surrey is the **2nd largest** city in Metro Van with a population of ~550,000
- Surrey grew **10.3%** from 2011-2016
  - 6.5% growth across Metro Van
- Expected to have over **800,000** residents by 2050

➡ The city's decisions now will have a big impact on regional sustainability

* Based on City of Surrey figures

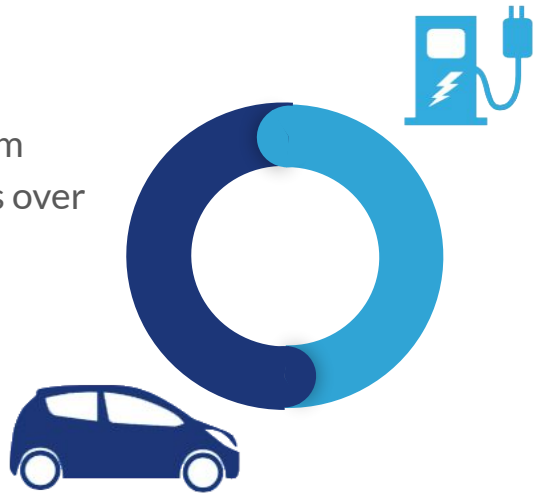
Intro to Surrey & Project Background

- Surrey wants to **grow sustainably** by:
  - Developing rapid transit corridors
  - Developing a zero waste strategy
  - Reduce greenhouse gas (GHG) emissions
- **Transit** is Surrey's largest source of GHGs*
- Surrey's Electric Vehicle (EV) Strategy with the goal of transitioning the whole vehicle stock to zero-emission vehicles by 2050

* Based on 2007 Community Energy & Emissions Plan

Why do EVs need a strategy?

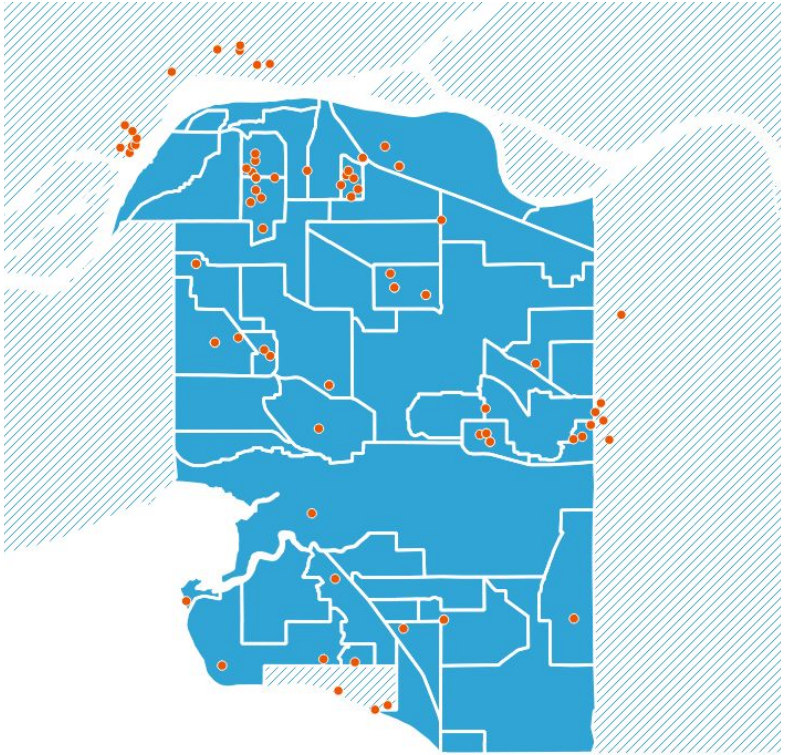
- Electric vehicles adoption faces a chicken-and-egg problem
- City funds early development and the private sector takes over in the long term
- Other challenges include:
  - Range anxiety/public perception
  - High entry price
  - Limited styles of car available



Current State of EV Adoption in Surrey

< 1%
of total vehicles

100%
of vehicles in market



2018

2050 Goal

70 Charging Sites

Our Role: Provide **insights** to guide the EV strategy development

Infrastructure

Where could the city strategically put future charging sites?

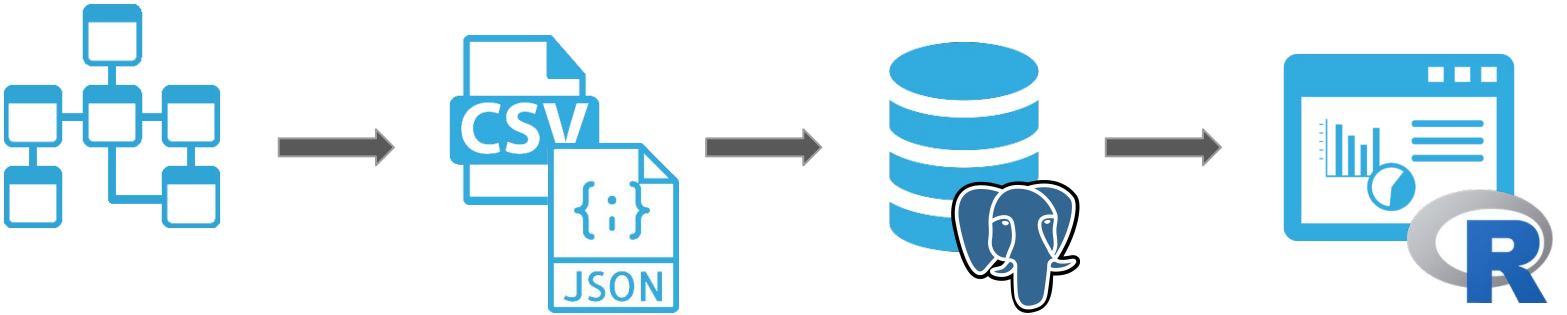
EVs

How many EVs are in Surrey and where are they located?

Consumers

Who/where are the current/potential EV consumers?

Our Approach



Design a Data Structure

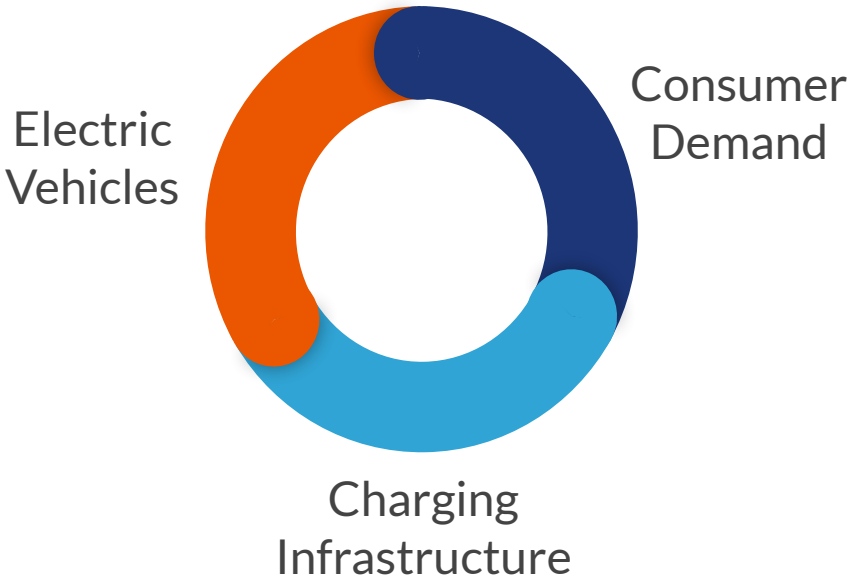
Process the Data

Build a Database

Create a Visualization Tool

Next Steps:
Analyze the Data

- Where are current and potential EV buyers?
- Where are the best locations for new charging infrastructure?



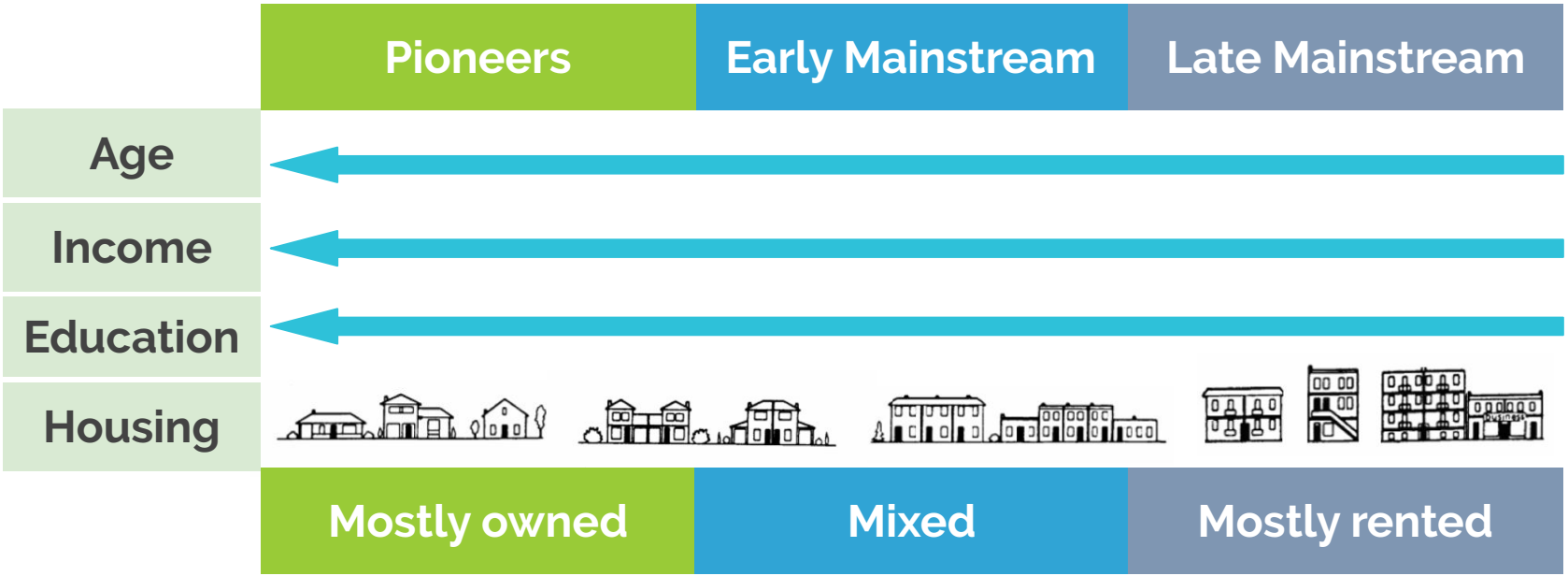
Literature Review: Classifying Potential EV Buyers

- The three categories of EV buyers:

  - Categories were defined based on:
    - vehicle ownership
    - land use
    - demographic information and sentiment analysis

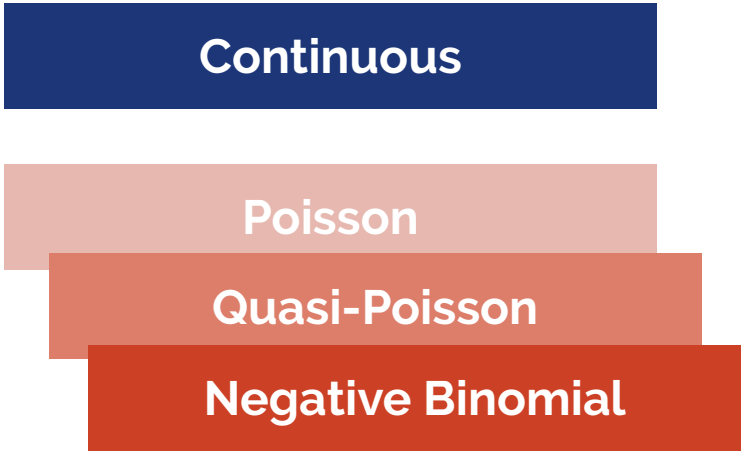
*Canadian Zero-Emissions Vehicle Survey: Metro Vancouver Analysis (Axsen et al, 2017).

Classifying EV Buyers: Demographic Differences



Statistical Modelling

1. Regression Models:
    a. Response: Electric vehicles
    b. Covariates:
        i. Special vehicle classes
        ii. Demographics
2. Hierarchical clustering
    a. Dendrograms
    b. Outlyingness factors



Motivation for Regression Count Models

1. A count approach targets those areas with **large EV stocks**
2. Interesting regression alternatives
3. Better data fits
4. Clustering coming from count variables **aligns profiles to existing literature**

Demographic factors coming from literature

+$100K

Detached houses

Bachelor's or higher

Owners

4+ persons

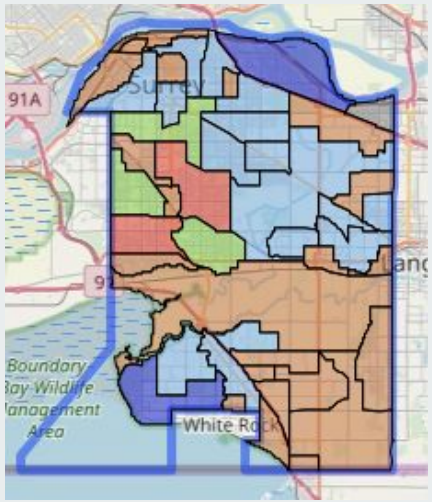
35 to 64 years old

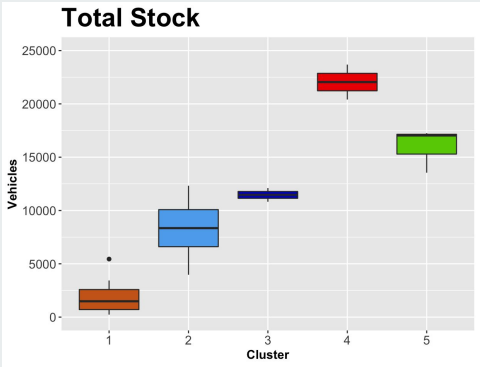
5 clusters instead of 3

Special vehicles (Hybrid and Luxury) and demographics as counts

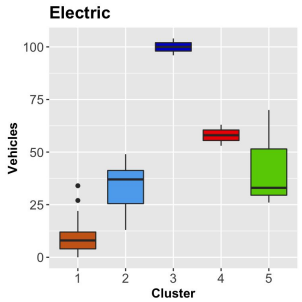
Clusters by Counts

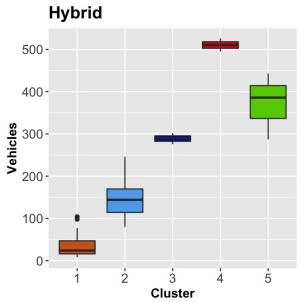
Literature Factors

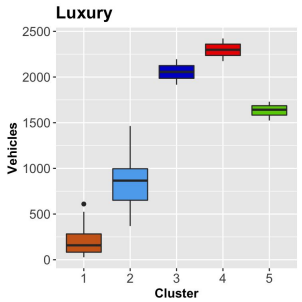




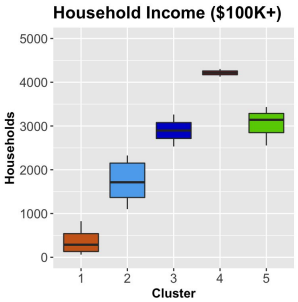
Special Vehicle Classes

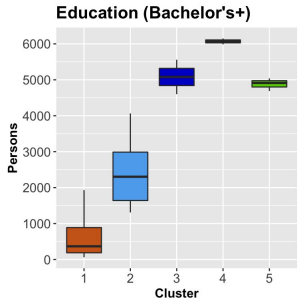






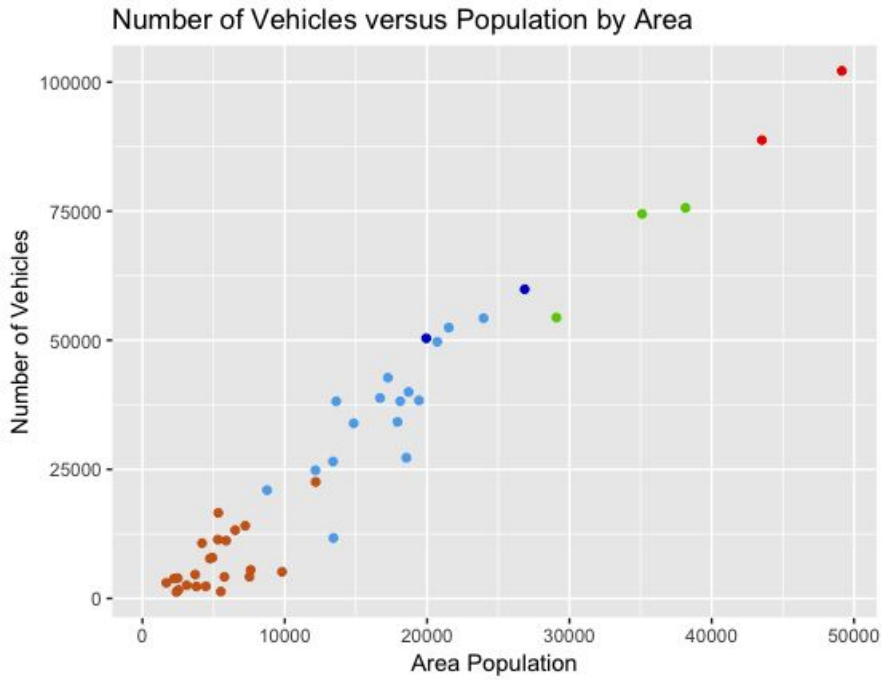
Key Demographics





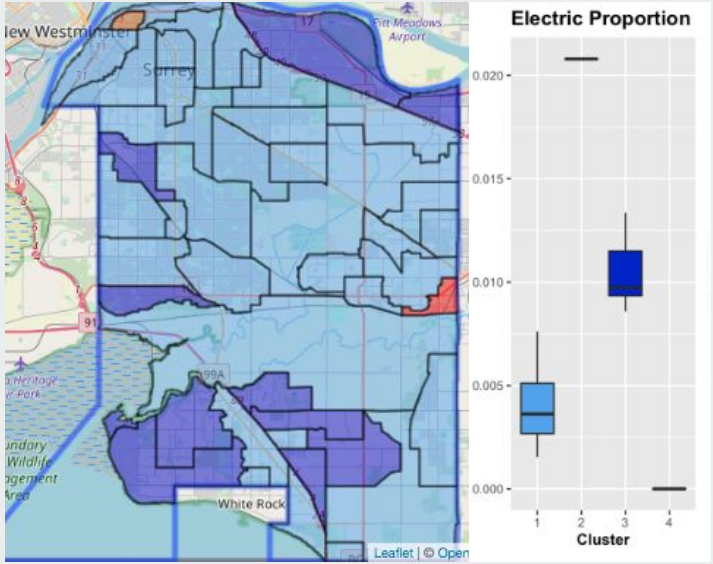
Motivation for Proportion Model

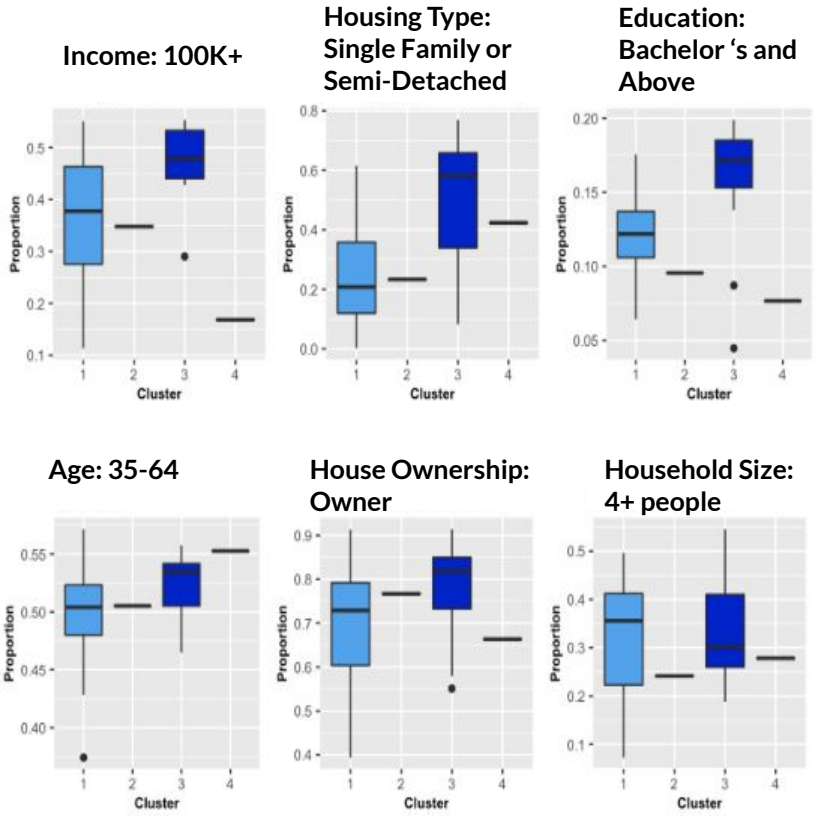
1. Counts are correlated with population
2. Demographic features should work regardless of population size
3. **Question to answer:** What makes an area have **high EV proportion?**



Cluster by EV Proportion

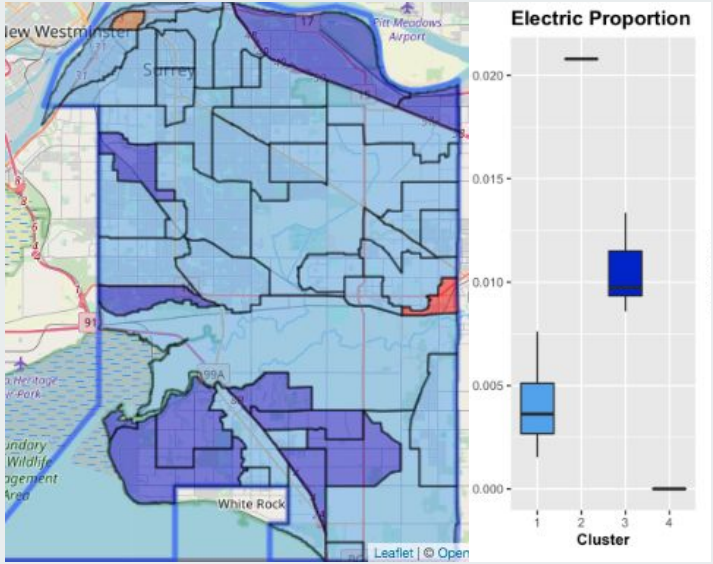
Literature Factors



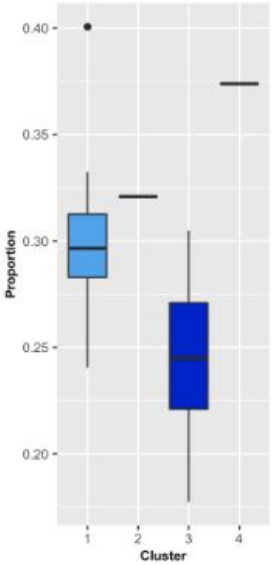


Cluster by EV Proportion

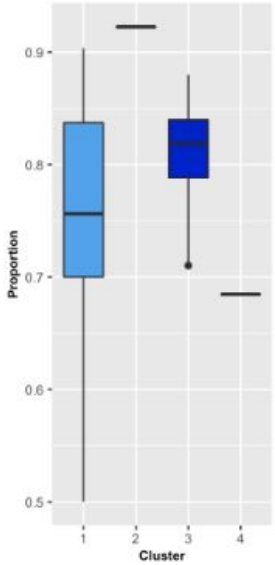
Interesting Factors not Covered in Literature



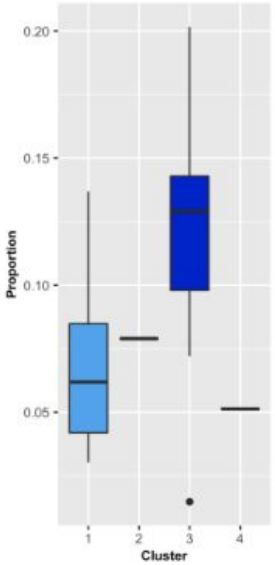
Commute Departure: 5am-7:59am



Commute Mode: Vehicle Driver

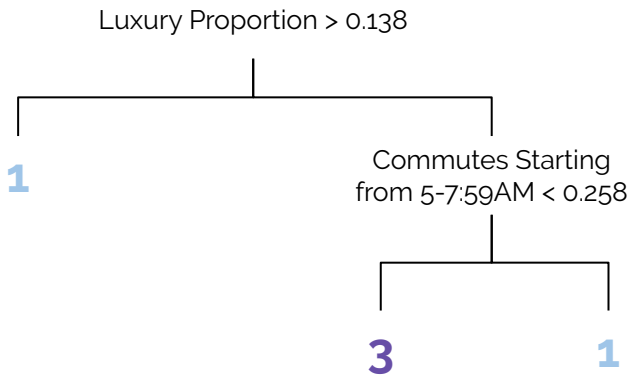


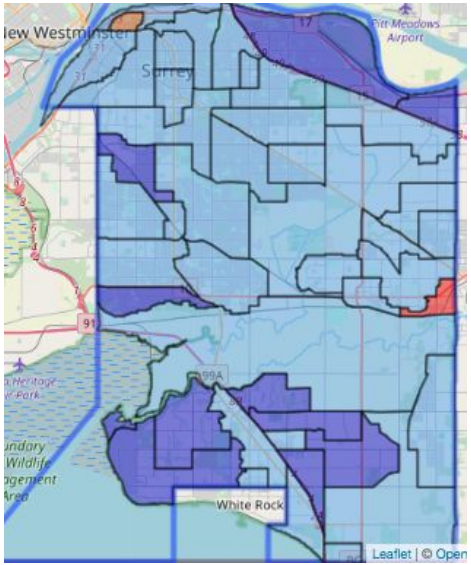
Workplace: Work from Home



Feeding Back to Feature Selection:

Interesting Factors not Covered in Literature

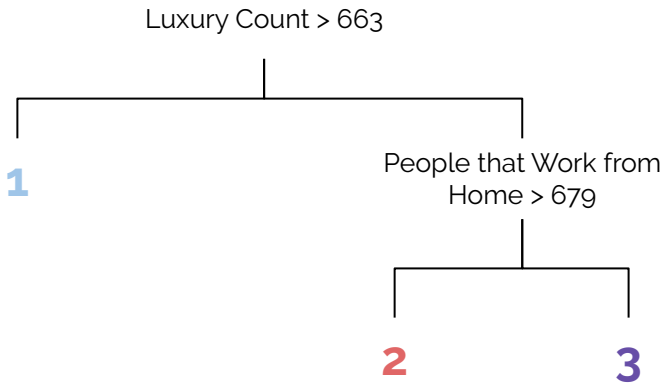


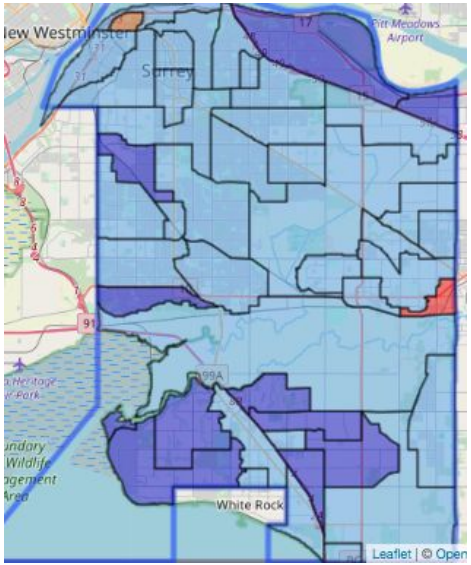


Assigning EV Proportion
Correct Classification: 89%

Feeding Back to Feature Selection:

Interesting Factors not Covered in Literature



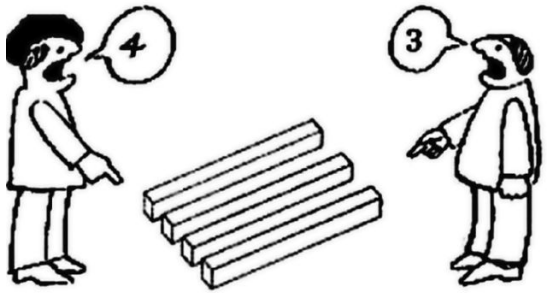


Assigning EV Count
Correct Classification: 89%

Count or Proportion: Two Lenses for Two Uses

- **Count model**:
  - Highlights areas with high population and decent EV adoption
  - These areas can be targeted to increase **total** EV sales

- **Proportion model**:
  - Suggest areas **overseen** by the count model
  - Good for targeting areas with less population but **higher** chances to adopt EV



NRCan Charging Site Proposal

- This fall, Surrey will be submitting a curbside charging site proposal to Natural Resources Canada
- Where should the chargers go?

What makes a good place for a charger?

- Where do people charge?
  - At home
  - At work
  - During activities like shopping, dining, or recreation
- The grant covers curbside chargers, so we'll focus on chargers away from homes

What makes a good place for a charger?

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  - At work
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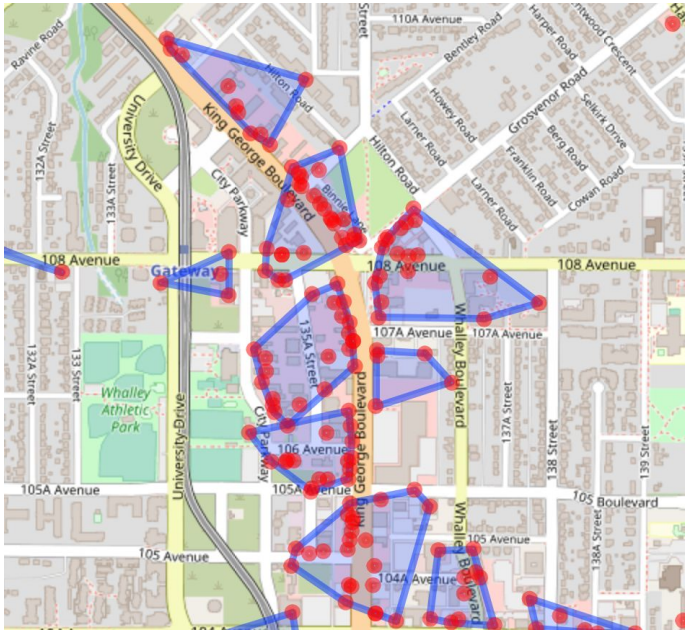
What makes a good place for a charger?

- **Important factors for chargers targeting employees:**
  - Business count
  - Traffic flow to areas in the AM

- **Important factors for chargers targeting shoppers/diners:**
  - Retail locations
  - Traffic flow to areas during the midday

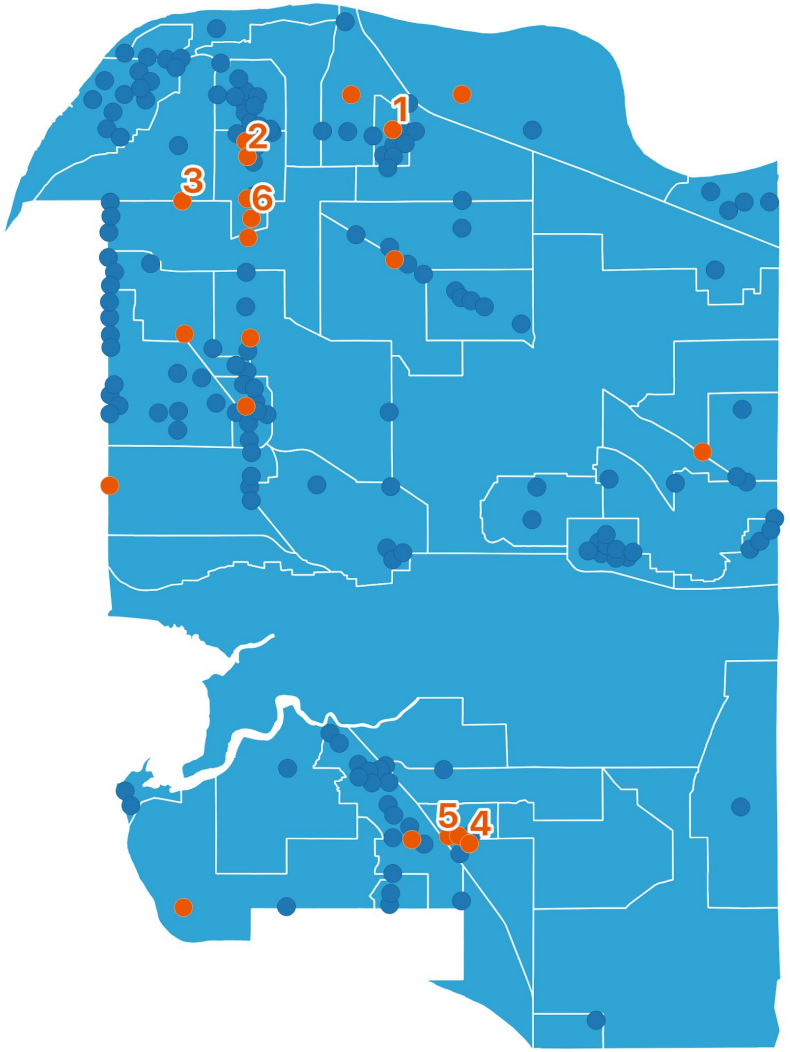
Destination Score Model

- Identify retail/business areas that could access a single charger
- Score each area based on the amount of traffic to the area
- Place chargers at sites with the best scores



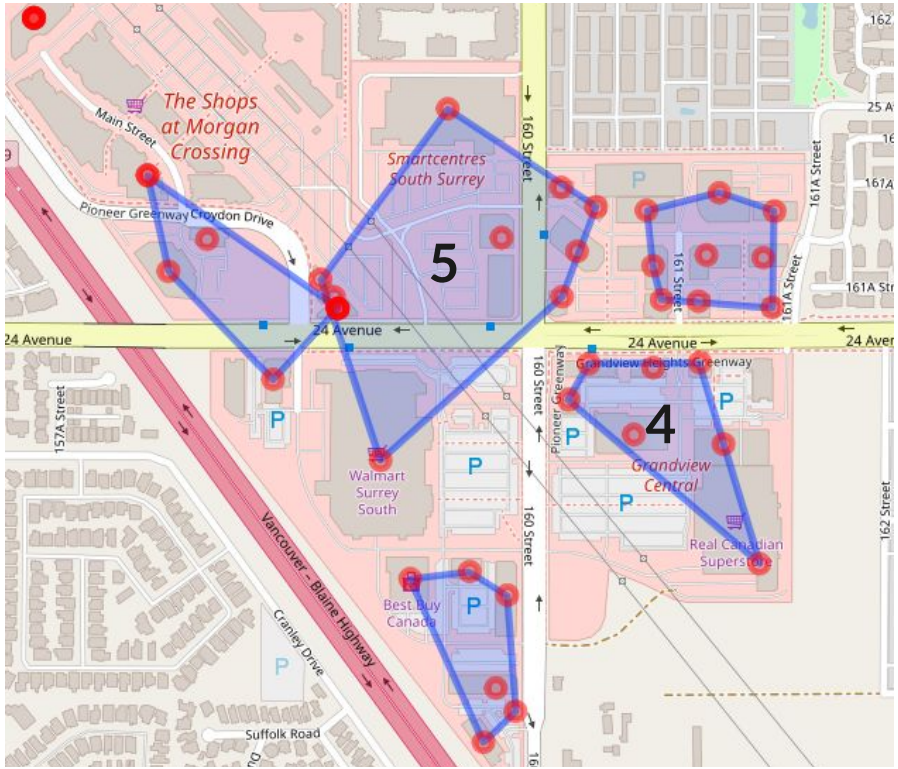
Retail Results -

1. Guildford Town Centre
2. Central Shopping Centre
3. Cedar Hills Shopping Centre
4. Morgan Crossing
5. Morgan Crossing
6. 72nd and King George Blvd.



Retail Results -

1. Guildford Town Centre
2. Central City Shopping Centre
3. Cedar Hills Shopping Centre
4. **Morgan Crossing**
5. **Morgan Crossing**
6. 72nd and King George Blvd.



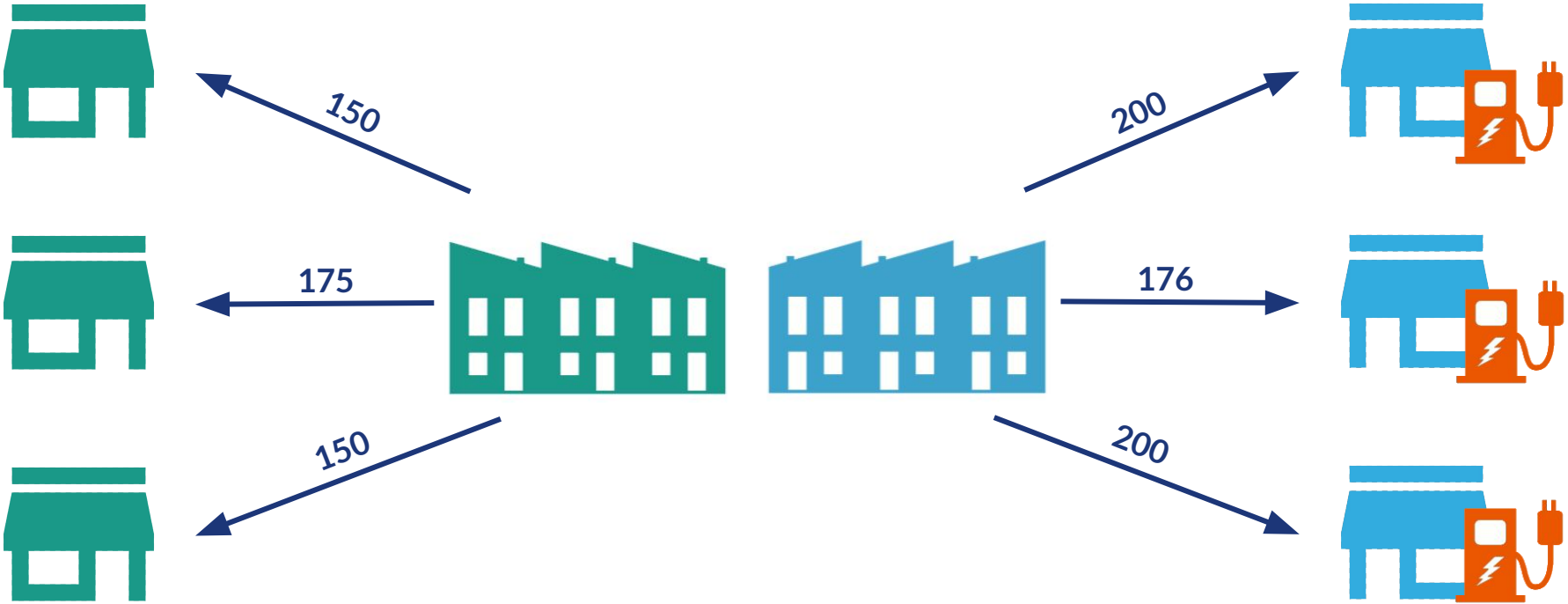
Morgan Crossing

Retail Results -

1. Guildford Town Centre
2. Central City Shopping Centre
3. Cedar Hills Shopping Centre
4. Morgan Crossing
5. Morgan Crossing
6. **72nd and King George Blvd.**

72nd and King George Blvd.

Uneven Access: Placing 3 Chargers



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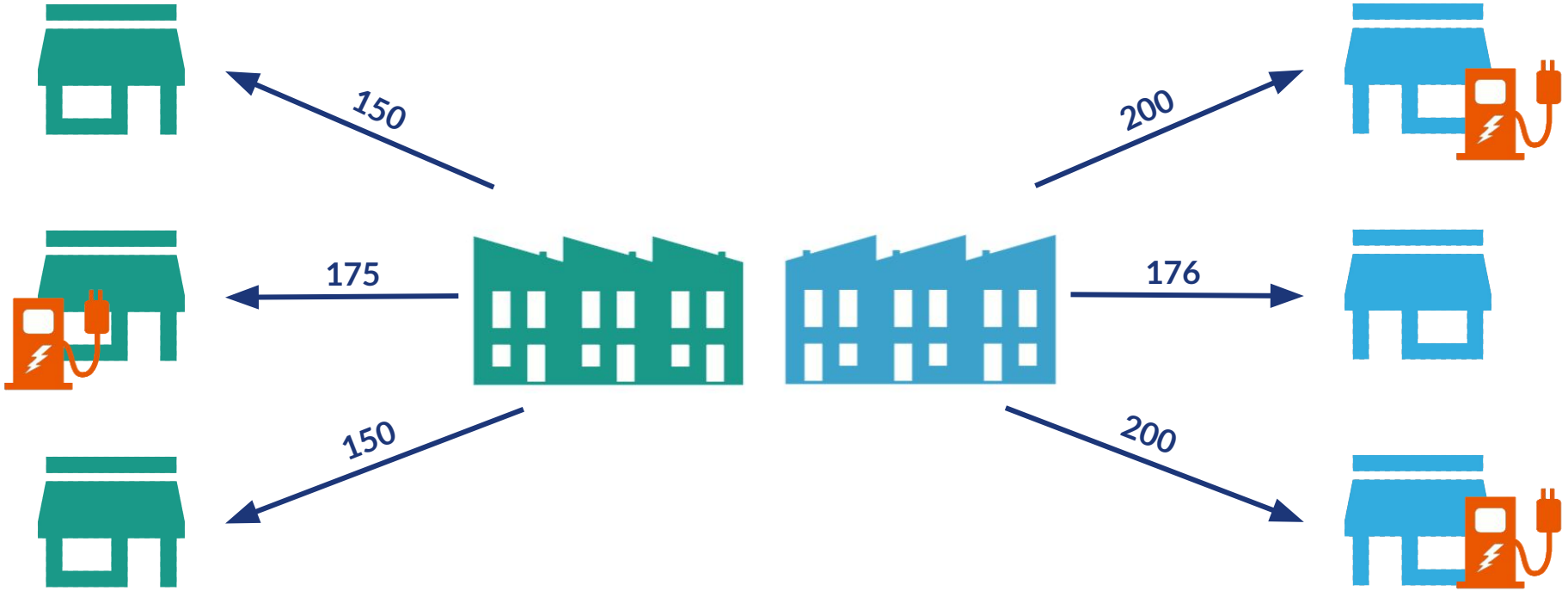
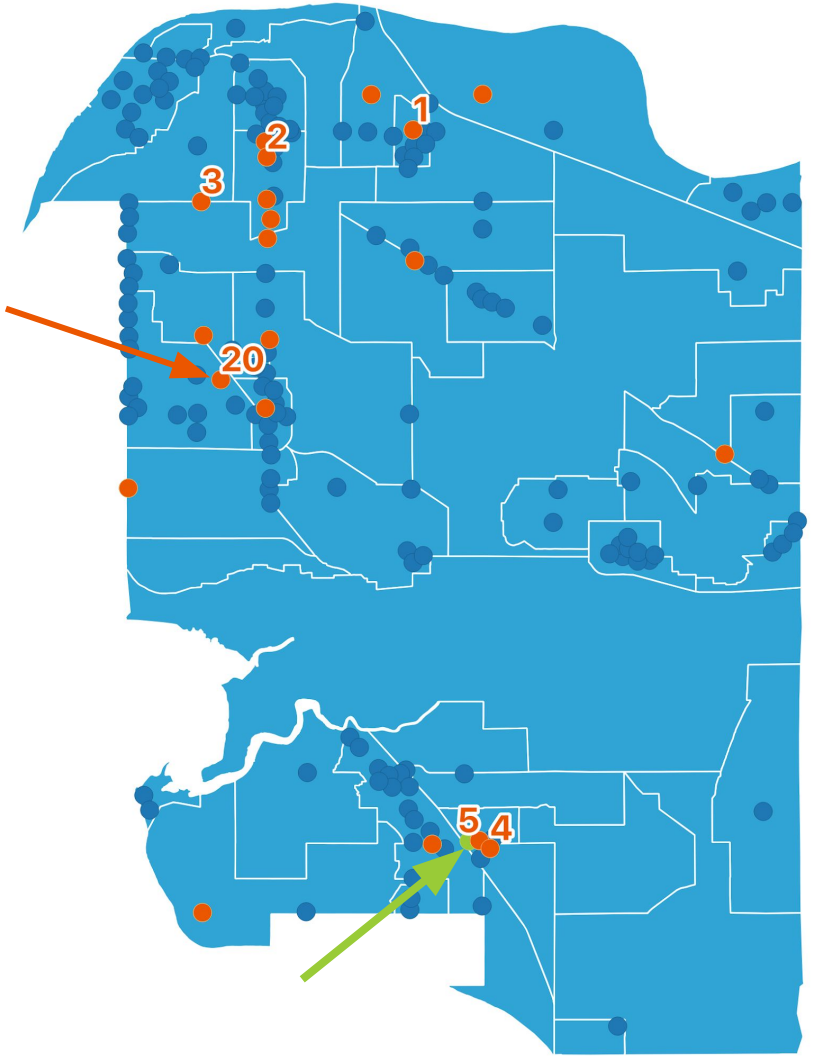


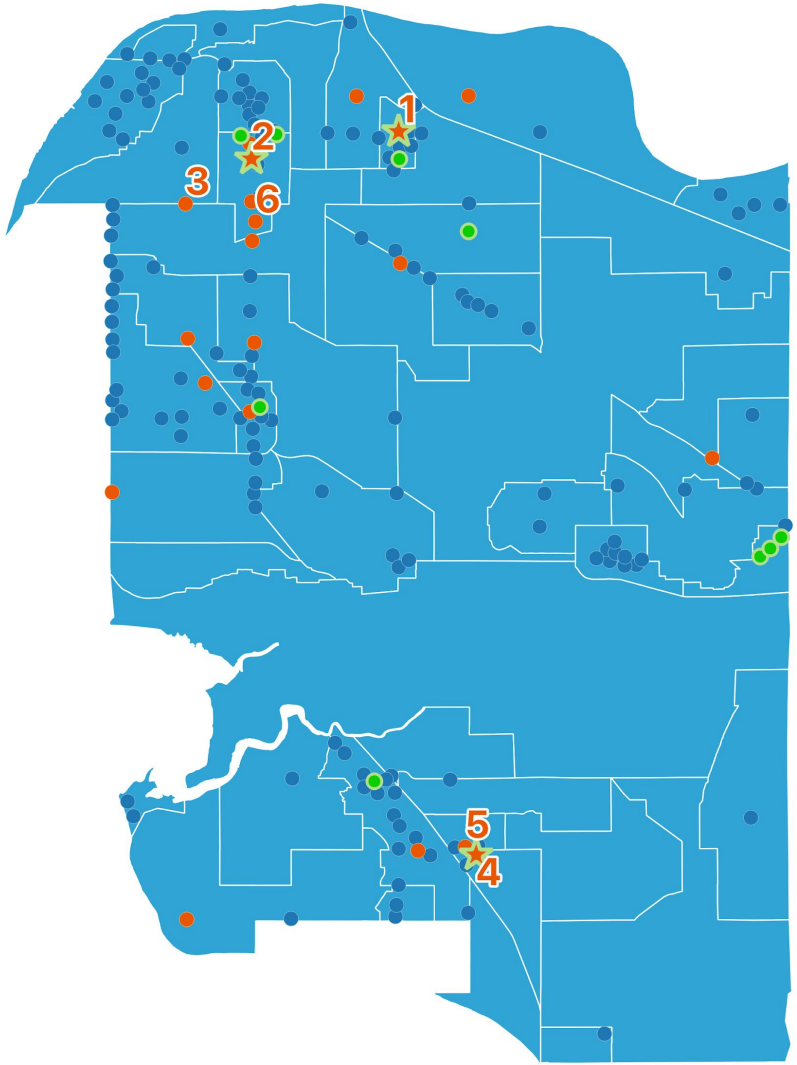
Updated Results -

- First 19 sites same as the first method
- Occurs because each origin only travels to a few destinations
- Emphasizes importance of distributing sites across Surrey

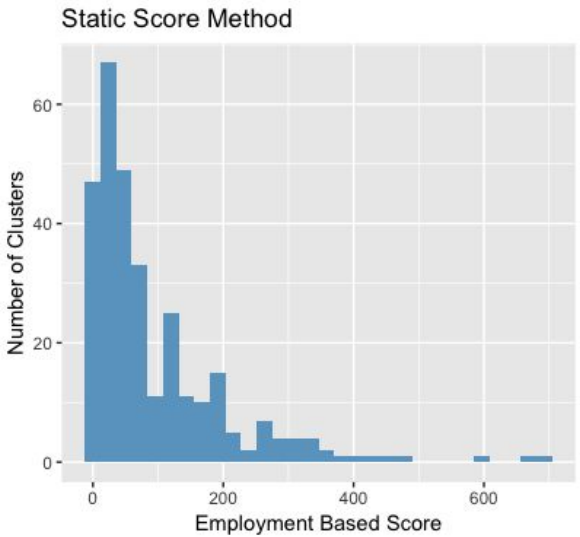


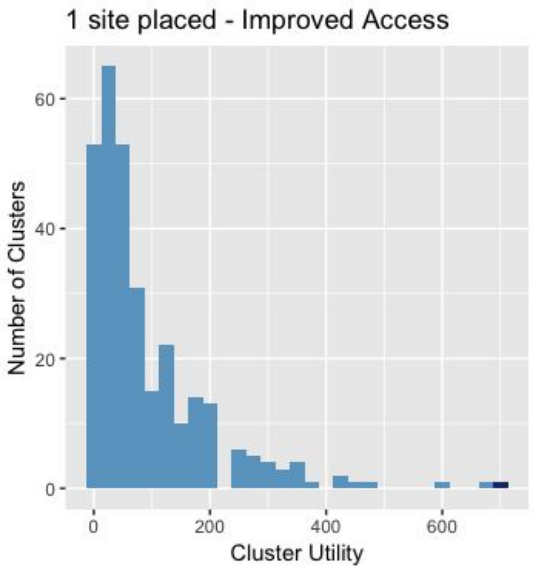
Updated Results with Existing Chargers -

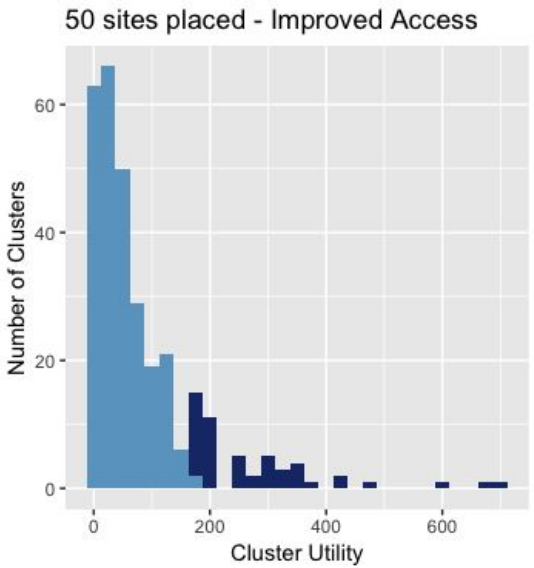
- Only 12 existing retail clusters contain a existing charging site (green)
- 3 of these clusters are in the top 6 locations ranked by our algorithm (red)



Using scores to choose *n*







Future Work

- **Consumer Classification:** Run on a wider range of features
- **Charging Site Placement:** Develop a better understanding of charging site capacity and utilization
- **App:** Add new datasets as they become available update features as EV strategy progresses

End of Presentation

Thank you for your attention

We are now open to questions