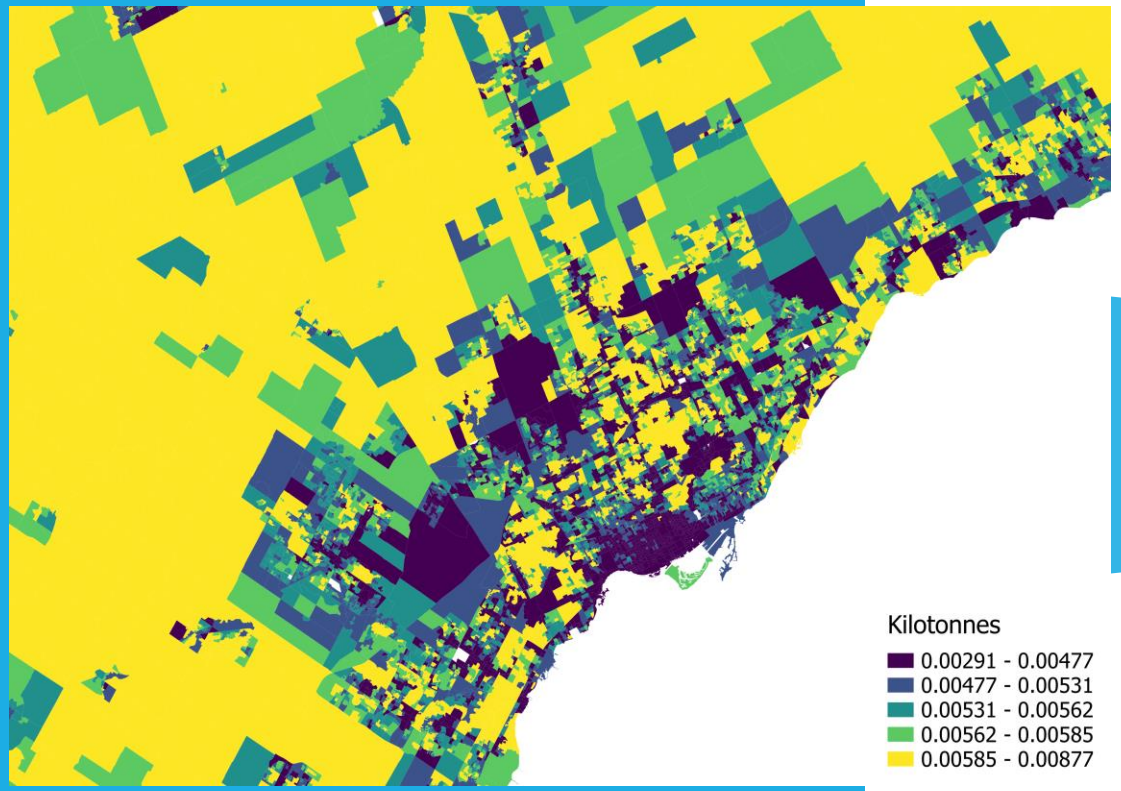
# CANADIAN URBAN INSTITUTE INTERNSHIP

EVER HUGHES

AMANDA NG

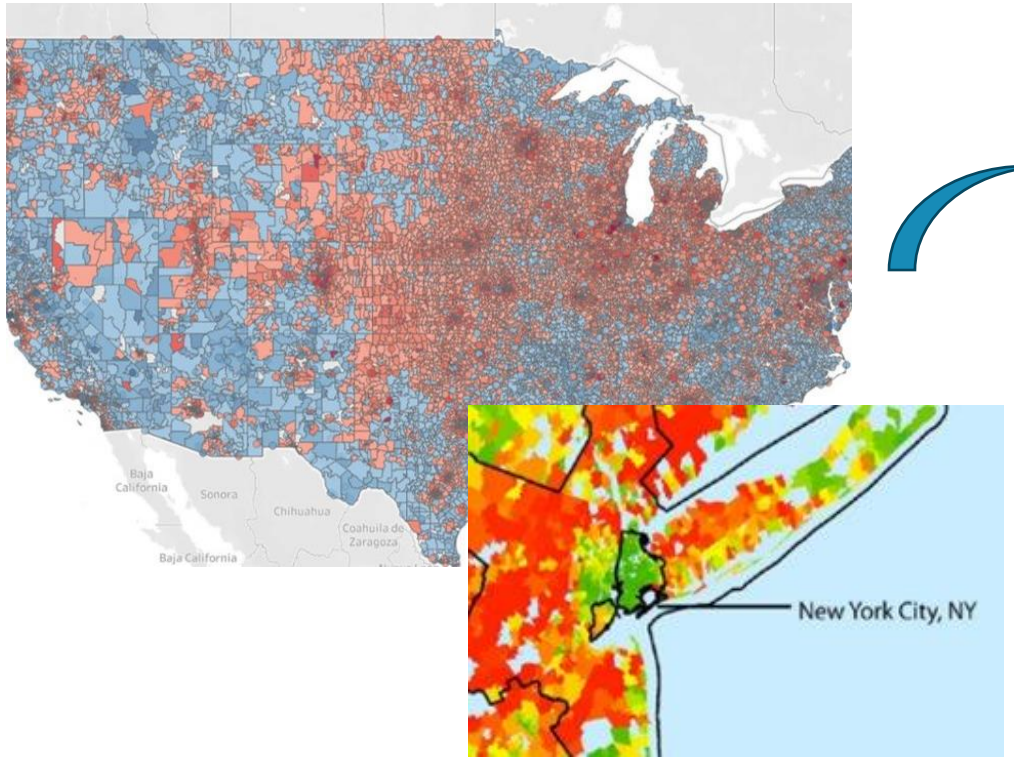
# MAIN PROJECT: HOUSEHOLD GREENHOUSE GAS (GHG) MAP




Modelling, mapping, and making sense of trends in the GHG emissions of household activity in Canada

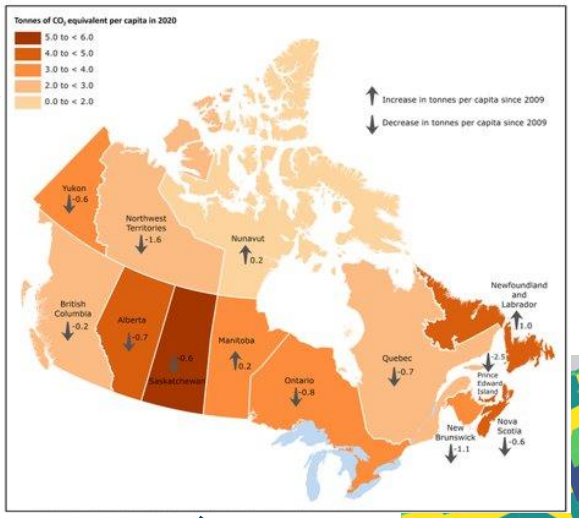
# BACKGROUND

## USA Household GHG model by UC Berkeley, 2013

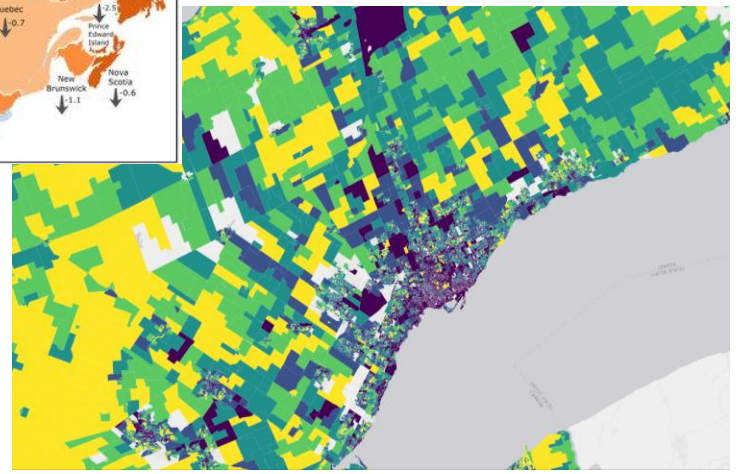


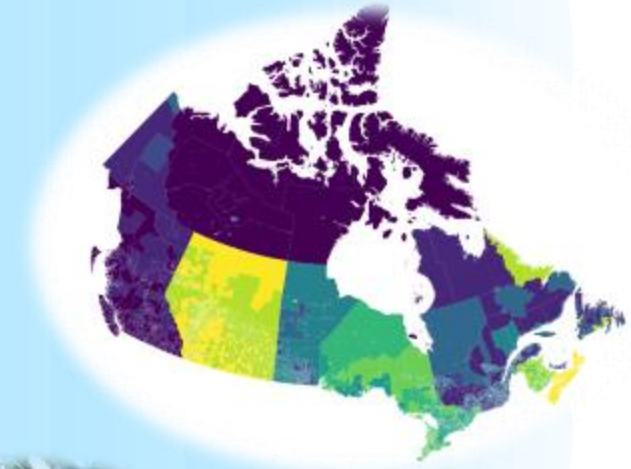

Finding: cities have **lower household GHG** than suburbs

## Canadian model of household GHG




Move from provincial GHG to DA level emissions





# Project Goals

- ❑ Create a nationwide map of household GHG emissions, specified at a local level
- ❑ Model the emissions based on urban form (ex. housing type) and demographic (ex. income, commute time) variables
- ❑ Create a situational tool to compare GHG based on housing composition

Overall aim: demonstrate environmental benefits of cities/urban living (in comparison to suburbs)

# MODEL PROCESS

## RESEARCH & PLANNING

- Review original paper
- Narrow scope
- Identify key variables
- Find data sources

## MODEL BUILDING, ANALYSIS

- Clean and merge datasets
- Build linear regression model in R
  - Try different predictor variables
  - Adjust training data
  - Compare coefficients, R^2 value
  - Identify inconsistencies, improve model

## MAPPING & REVISION

- Predict each DA's average household GHG based off model
- Map results in QGIS, check patterns
- Revise model

# Household GHG Emissions

**Energy consumption** (EC)

Electricity, natural gas

**Vehicle** use

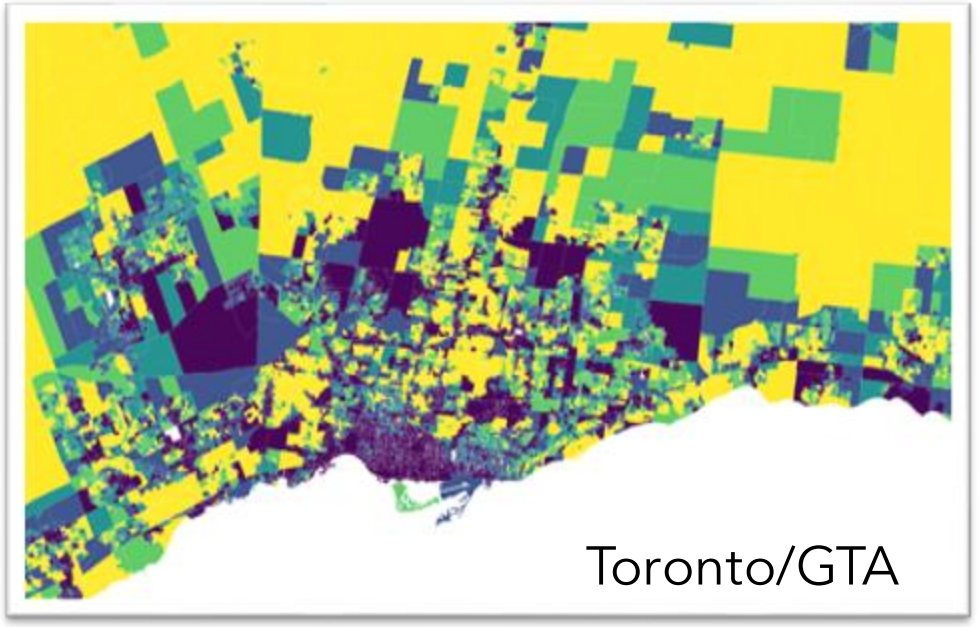
Motor fuels

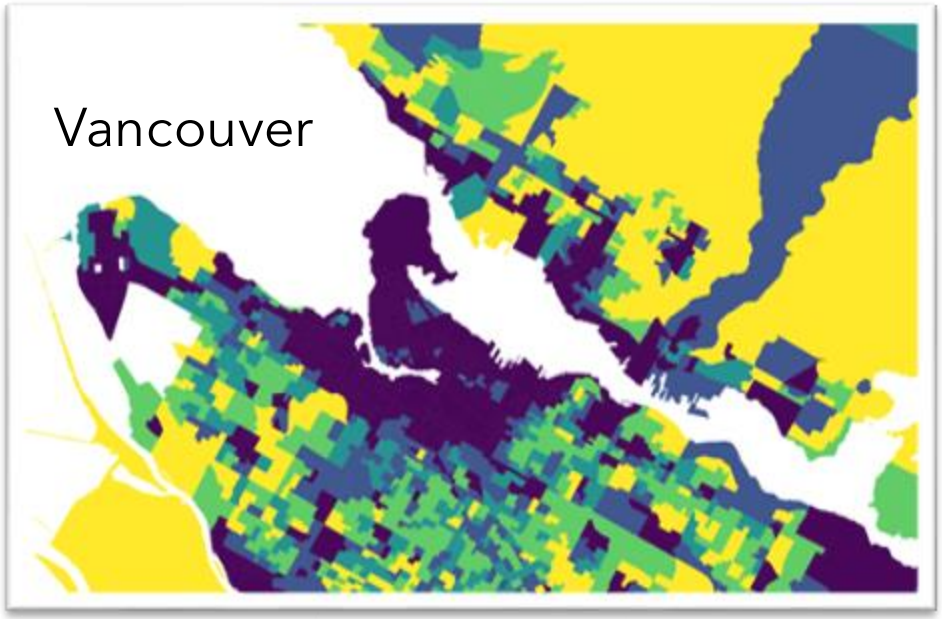
Model emissions by linear regression

## Model Equation:

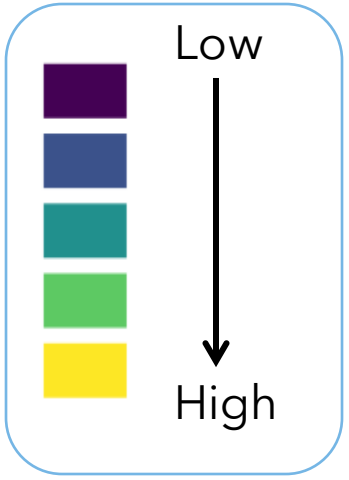
$$\text{Household GHG Emissions} = \beta_0 + \beta_1(\text{Income}) + \beta_2(\text{Population density}) + \beta_3(\text{Commute}) + \beta_4(\%\ \text{Houses}) + \beta_5(\%\ \text{Apartments}) + \beta_6(\#\ \text{vehicles}) + \beta_7(\text{Age of home}) + \beta_8(\text{Carbon intensity electricity}) + \beta_9(\text{Gas price}) + \beta_{10}(\text{Natural gas price})$$

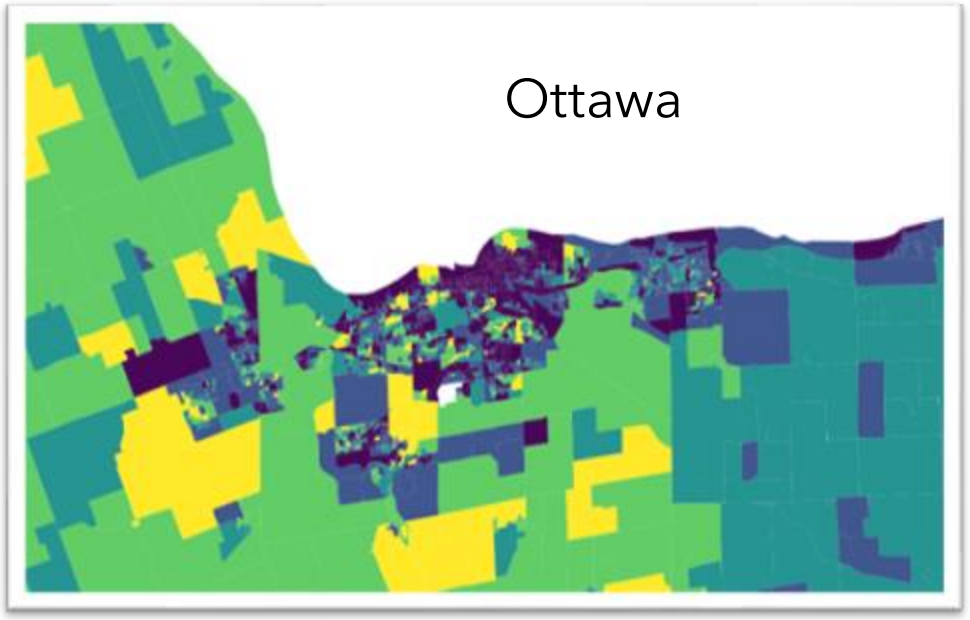
# MAPS



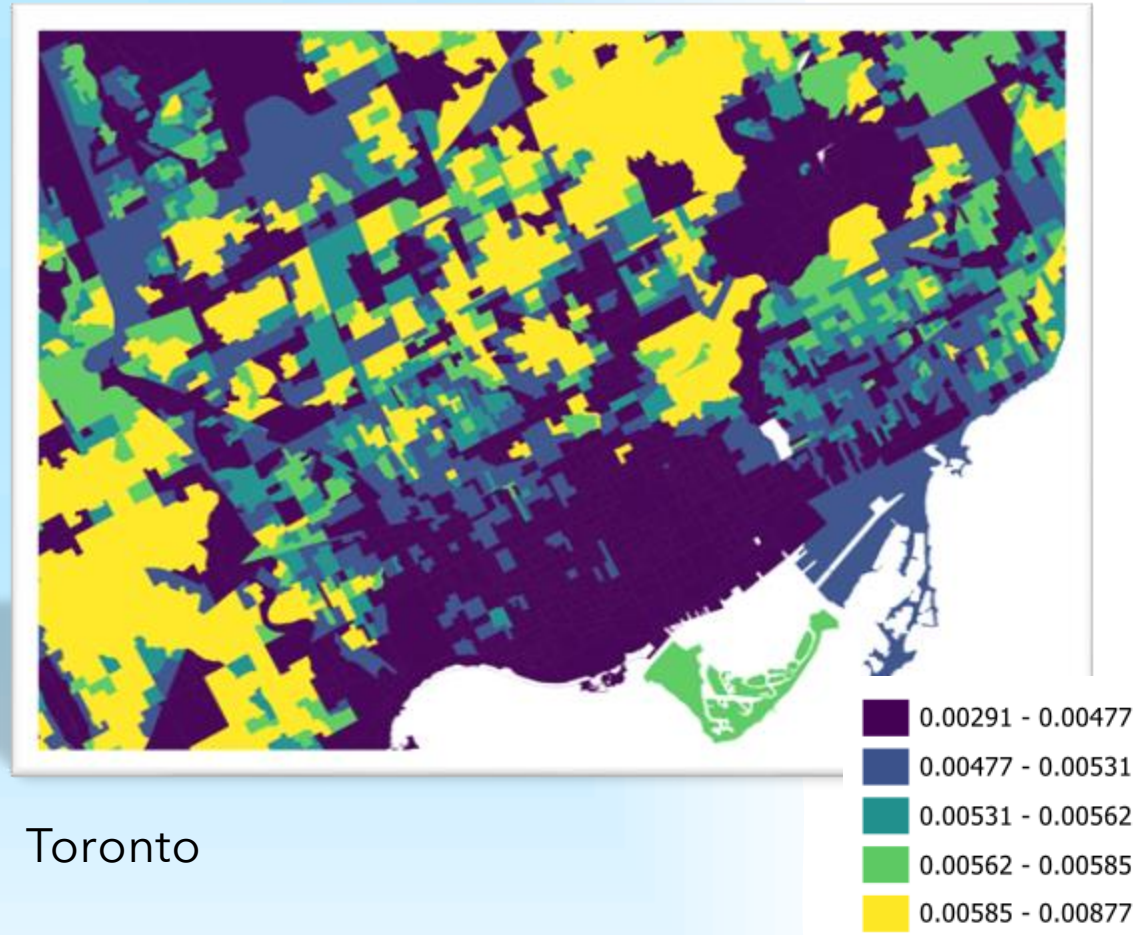




GHG Emissions
(Kilotonnes)




# Key Findings



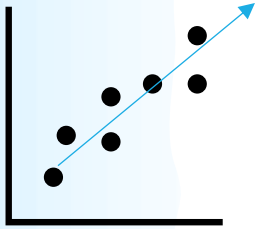

Toronto

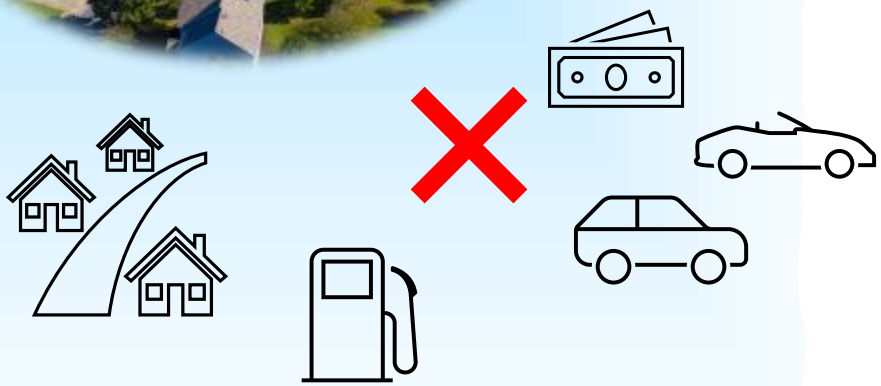
- Downtown areas : **lower household emissions**
  (smaller dwellings, public transit, etc.)
- Suburban areas : **higher household emissions**
  (larger homes, longer commute, etc.)
- **Ring of higher emissions** around city core

Vancouver

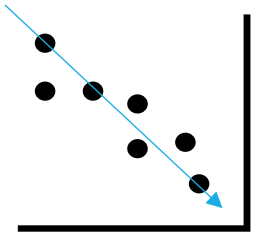
# Key Findings

- Income, commute time, % houses, # vehicles and home age are **positively correlated** with GHG





- % apartments and gas prices are **negatively correlated** with GHG



# Interactive tool

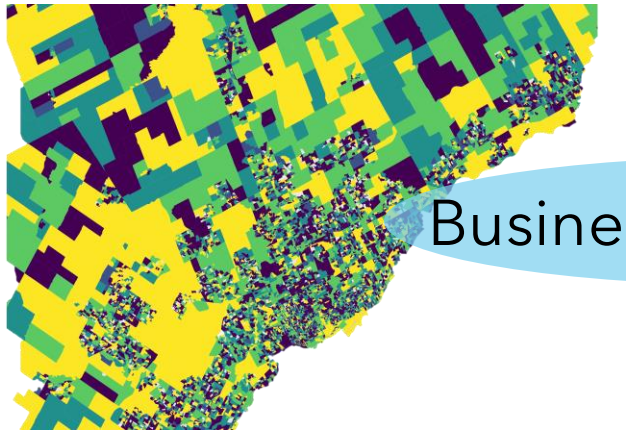
## Goal

Develop a tool to demonstrate how changes in housing type will affect GHG emissions per household

## How does it work?

1. Choose a location (i.e. DA number)
2. Extract original demographic values
3. Calculate original GHG emission
4. Modify housing data by:
    - Changing # houses
    - Changing # apartments
5. Calculate new GHG emission
6. Present difference in GHG emission due to direct changes in housing type

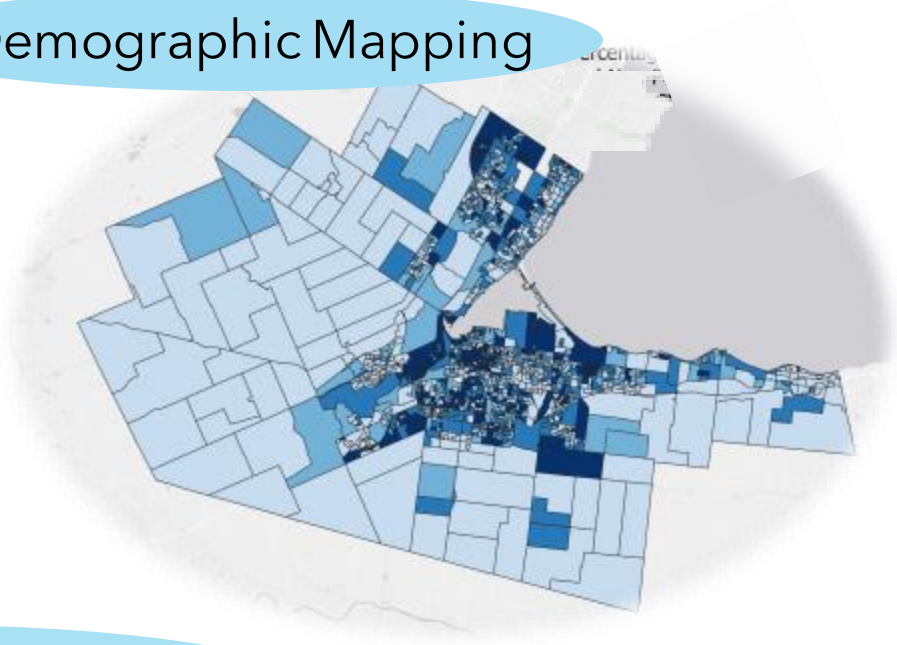
# ADDITIONAL PROJECTS



## Business GHG Emissions

## Demographic Mapping

- 250+ maps each of CMA data



## Local Business Index

- National dataset of businesses
- Distinguish chain vs. local
  - ➢ Frequency of name

0.22 Toronto

0 Local — 1 Chain

- Index of "localness"
  - Food vs retail

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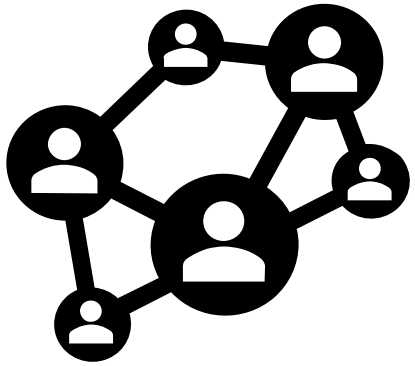
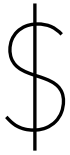


Social connection

- Multinomial logistic regression model
- Examine the relationships between urban form variables (independent variables) and social connection variables (dependent variables)

Local personal contacts
Sense of belonging

Income
Density
Housing type
Immigrants
Visible minorities
Education
Main mobility type



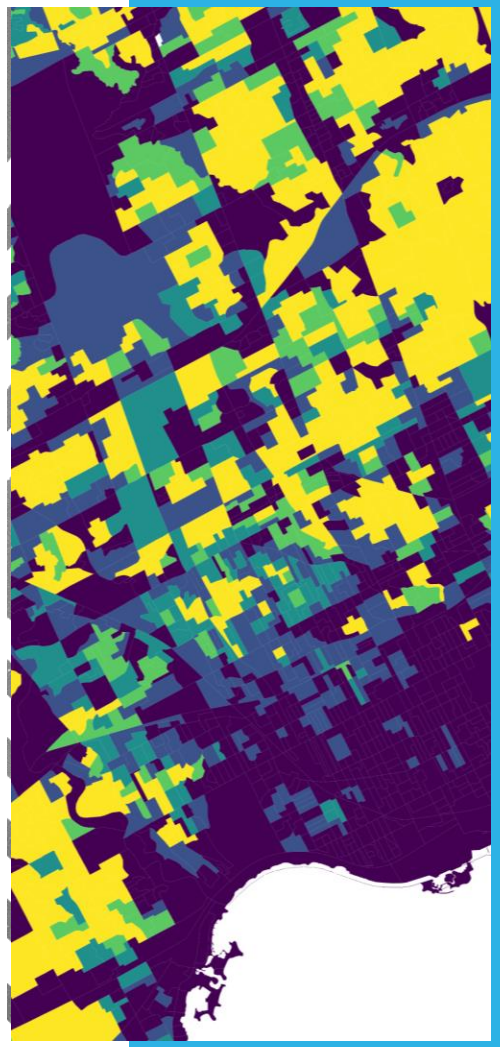
# TAKEAWAYS

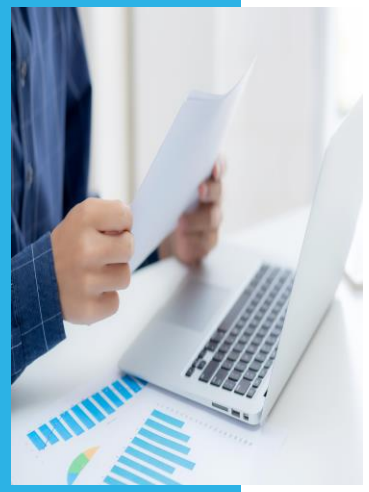
## EXPLORATION, EXPERIENCE, & ENRICHMENT

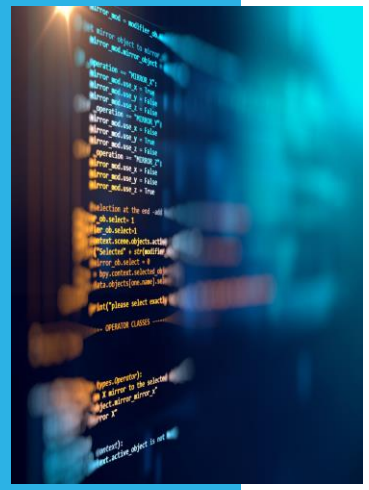
Data science skills
- Data cleaning, management, and analysis
- Programming in R
- Data visualization
- Regression analysis
- Excel, MS Office
- QGIS

Transferable skills
- Communication
- Organization
- Collaboration
- Critical thinking

Immersion in workplace
- Participated in meetings
- Presentations
- Observation
- Work-life balance








THANK YOU