MUNICIPAL POLICIES TO REDUCE GHG EMISSIONS: HOW DO WE KNOW THEY HAVE AN EFFECT?

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INTRODUCTION

CEKAP
Community Energy Knowledge - Action Partnership

SFU
FACULTY
OF
ENVIRONMENT

AGENDA

Overview of analytical tools for planning

CIMS: an energy-economy tool

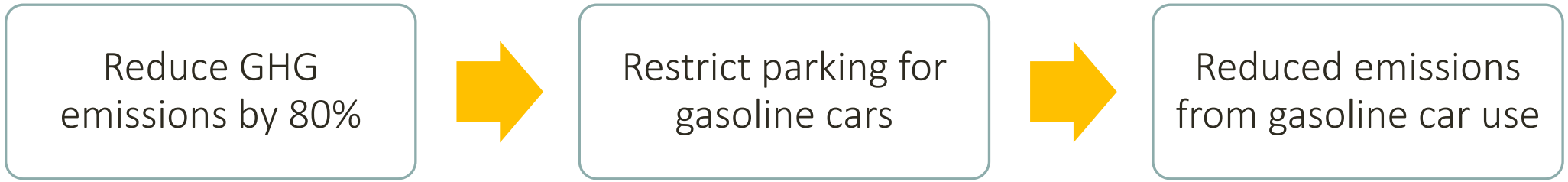
Case study: Vancouver

Conclusions

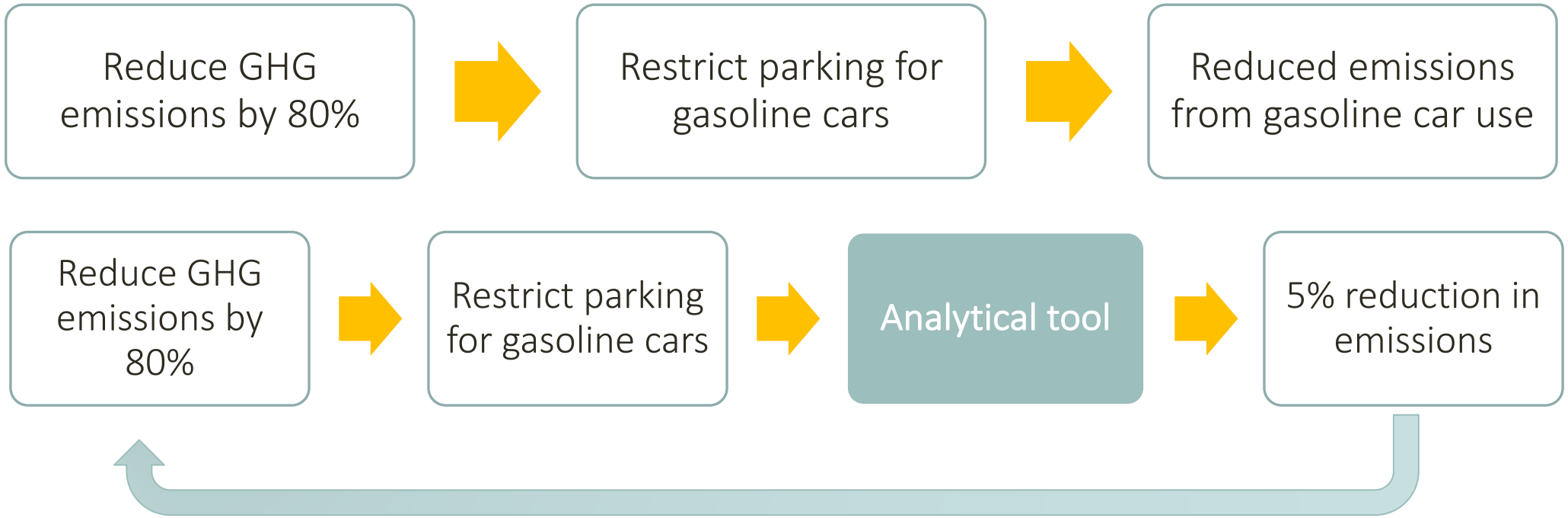
TOOLS IN THE PLANNING PROCESS

TOOLS IN THE PLANNING PROCESS

TOOLS FOR POLICY EVALUATION



TOOLS FOR POLICY EVALUATION



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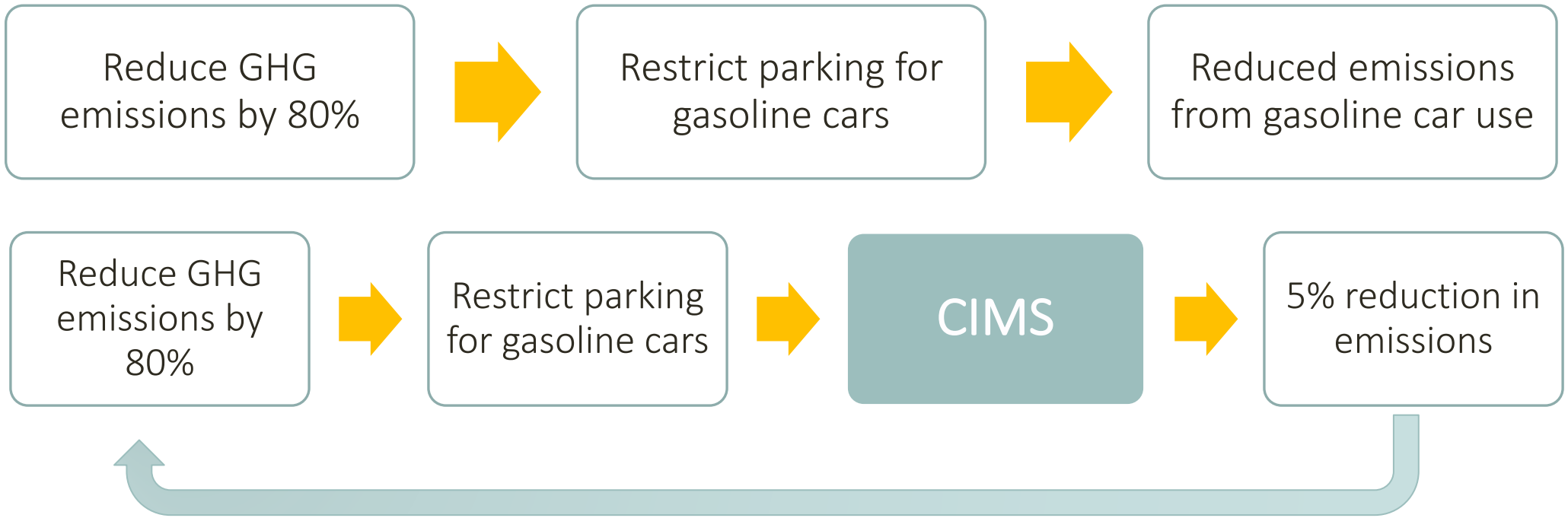

CIMS: AN ENERGY-ECONOMY TOOL

What is the likely effect of a policy/policy package?

… In terms of:

- GHG emissions
- Fuel use
- Market shares of technologies

How does CIMS do this?

Simulates how people make decisions about energy-using technologies

TECHNOLOGIES IN CIMS

What's in the model?

- Lightbulbs
- Refrigerators
- Vehicles
- Furnaces
- Trains
- Air conditioners
- + dozens more

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Market share for electric vehicles

=

INCORPORATING HUMAN BEHAVIOUR

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Why doesn't everyone who drives a 4-door sedan decide to purchase a Honda Civic?

→ Market Heterogeneity

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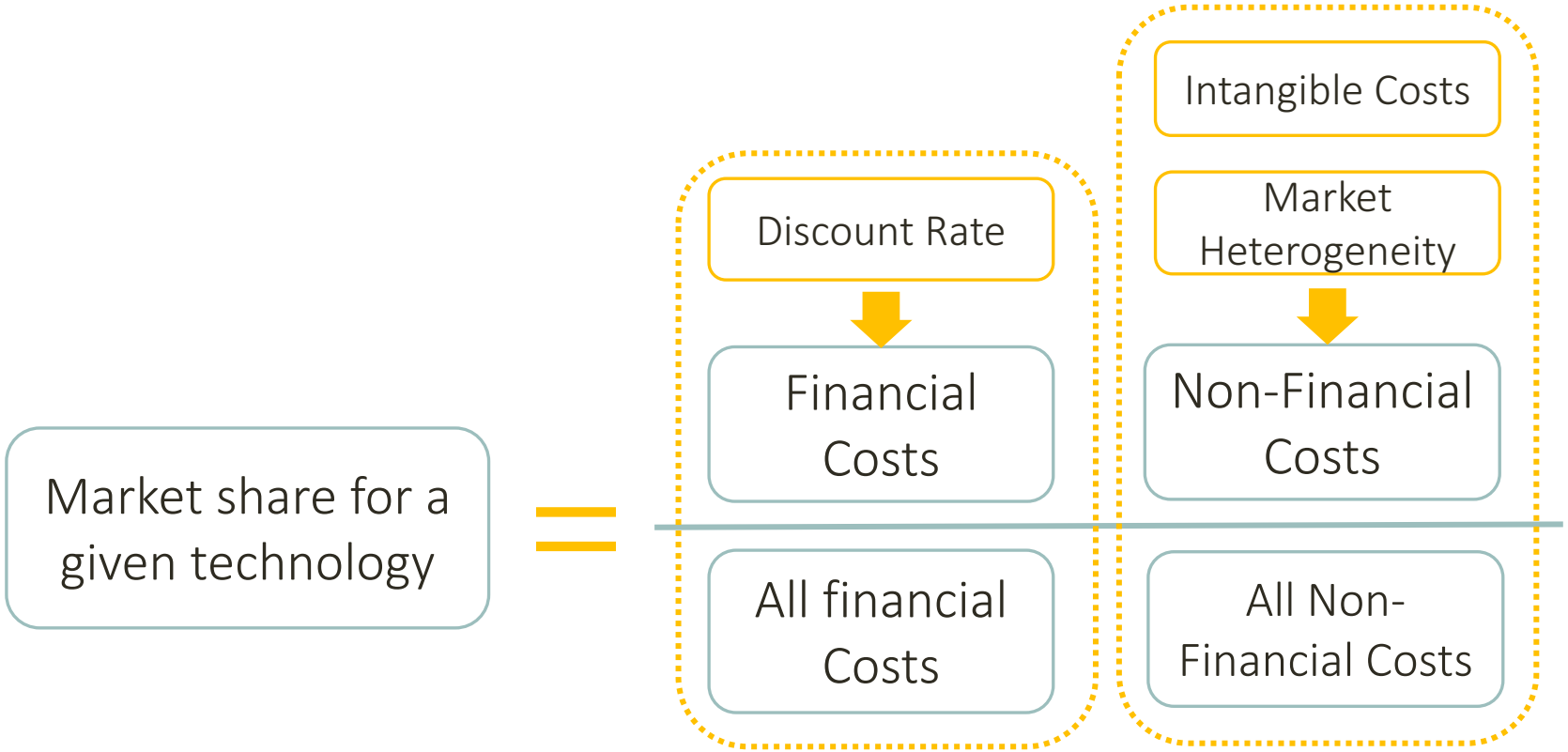
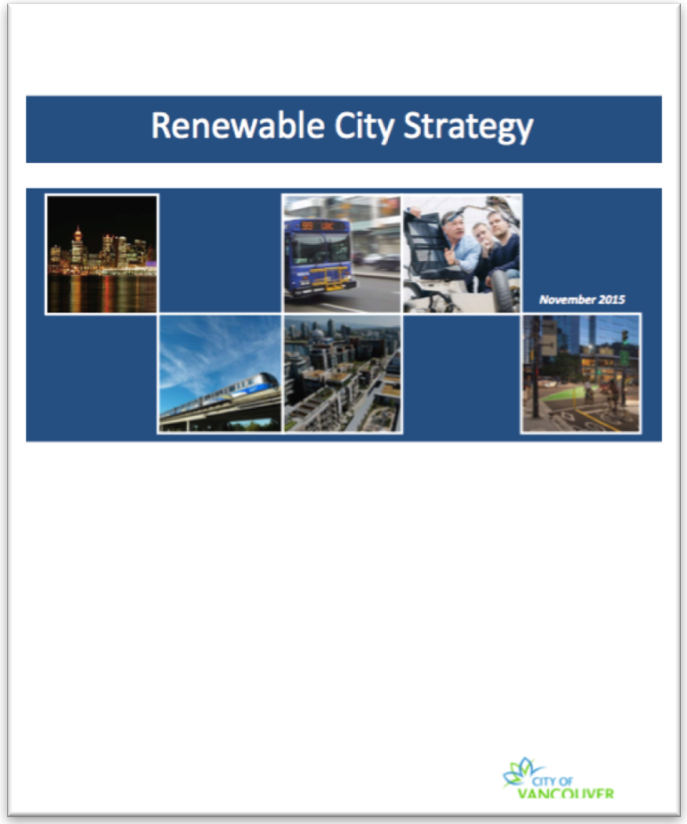


BACKGROUND



2015: Vancouver releases the Renewable City Strategy
→ Goal is to use 100% renewable energy in Vancouver by 2050
+ reduce GHG emissions 80% by 2050

Main sources of emissions:

- Gasoline in cars
- Natural gas in buildings

KEY QUESTIONS

What policies are needed for Vancouver to achieve 100% renewable energy use?

Is the City's current policy pathway sufficient?

How is the City affected by policy made by the provincial/federal governments?

KEY POLICIES

Municipal:

Vancouver's 2040 Transportation plan
Vehicle parking restrictions
Building Code requirements (new / retrofits)

Provincial/Federal:

Carbon tax
Low carbon fuel standard
Fuel emissions requirements

CIMS SPATIAL

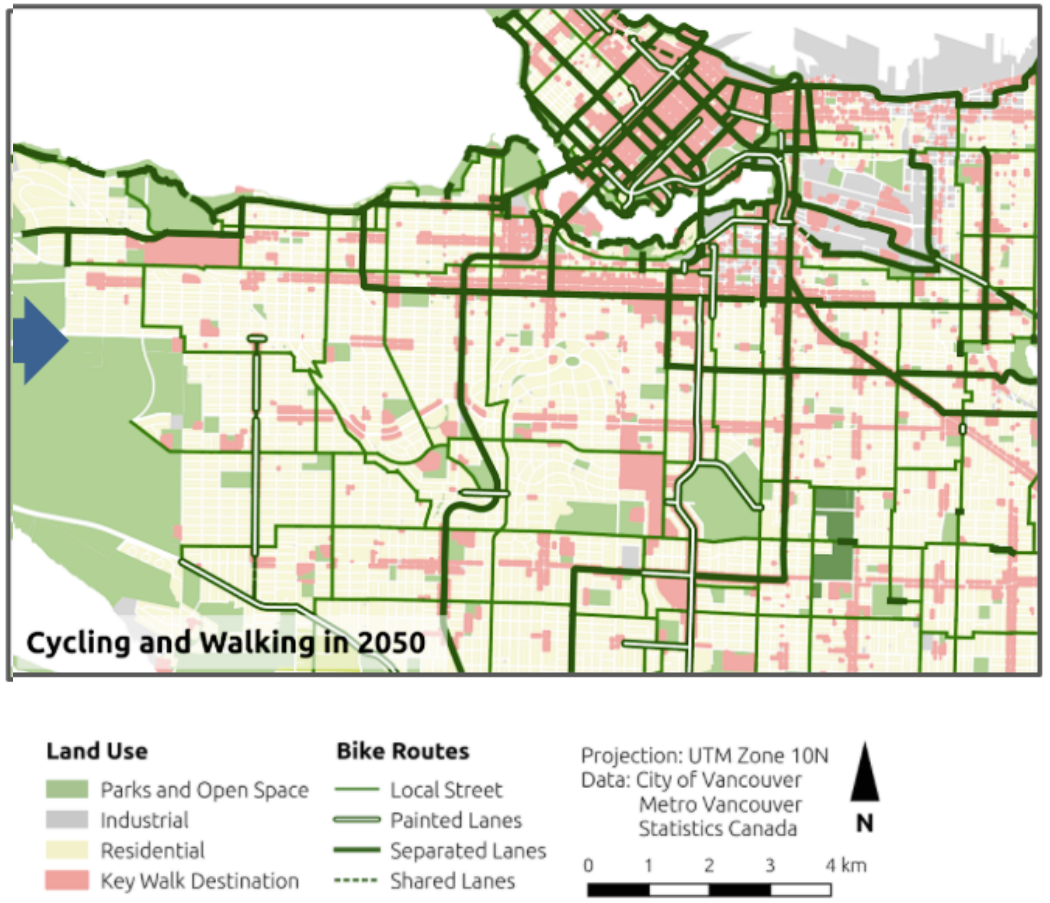
Understand how land use and transportation changes affect intangible costs

Represent planned land use and transportation changes

Model how these changes impact the **intangible costs** of transportation

Use CIMS to evaluate the **impact of changes** on energy use and GHG emissions

CIMS SPATIAL



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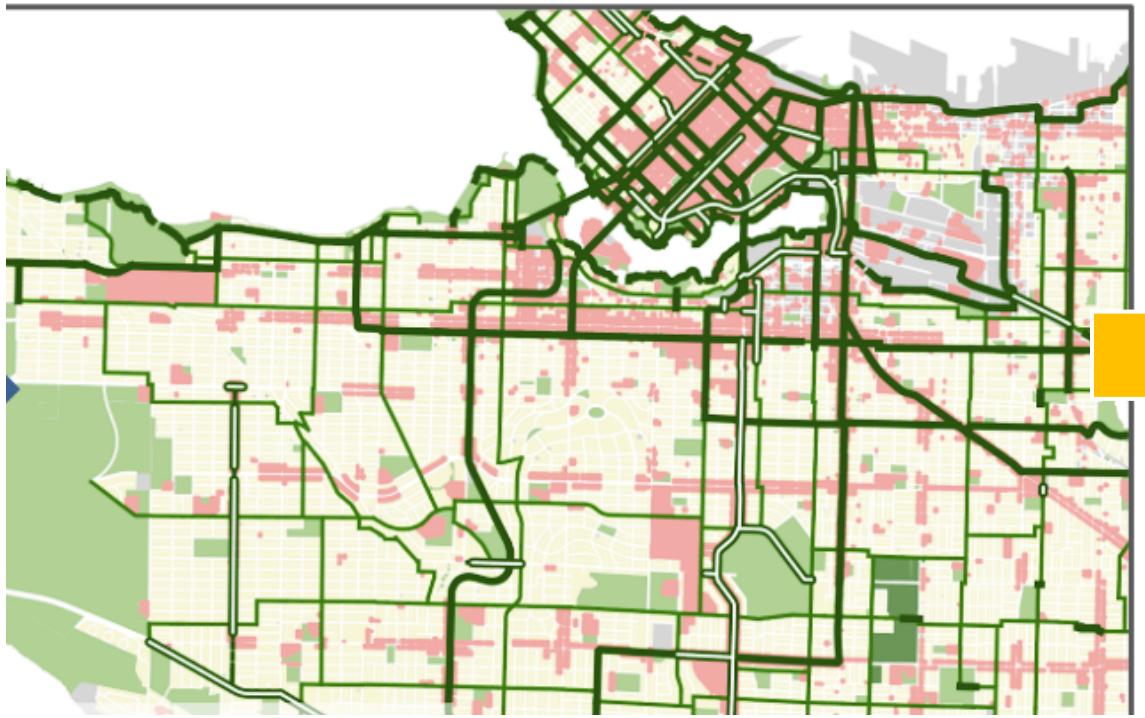

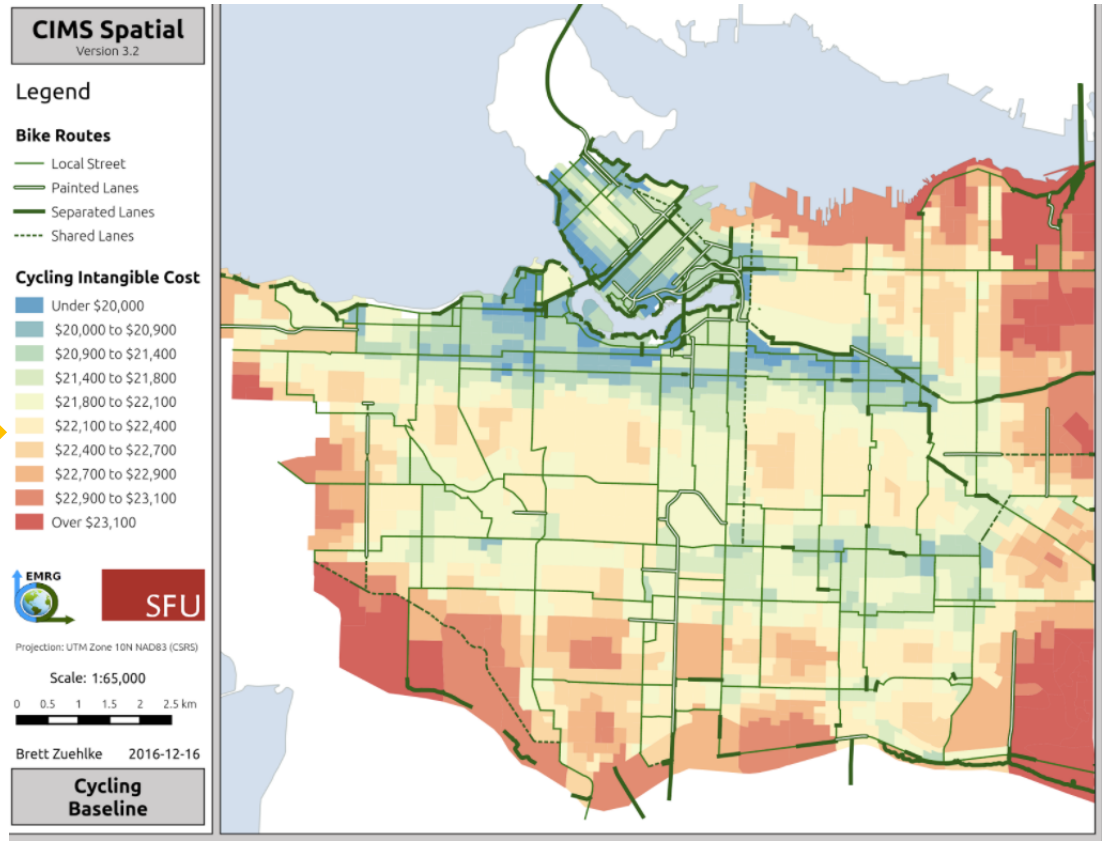

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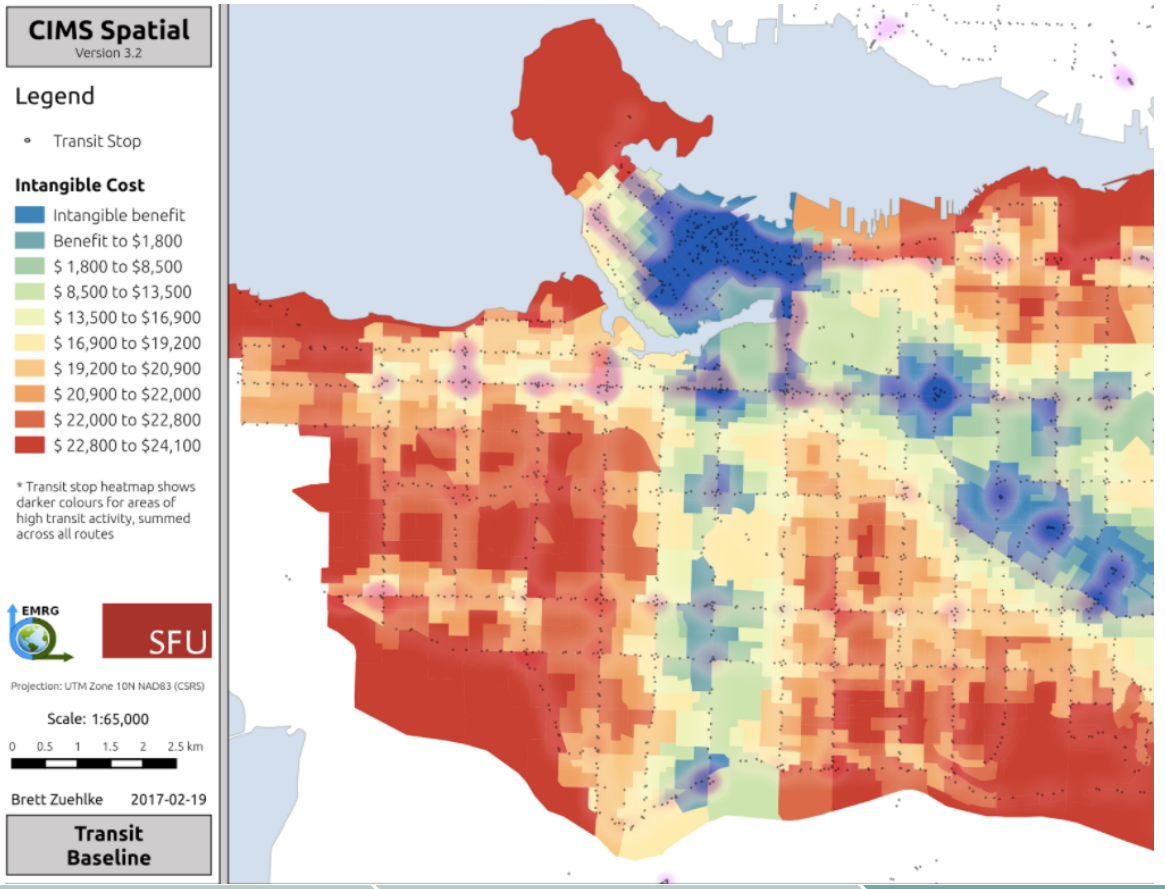

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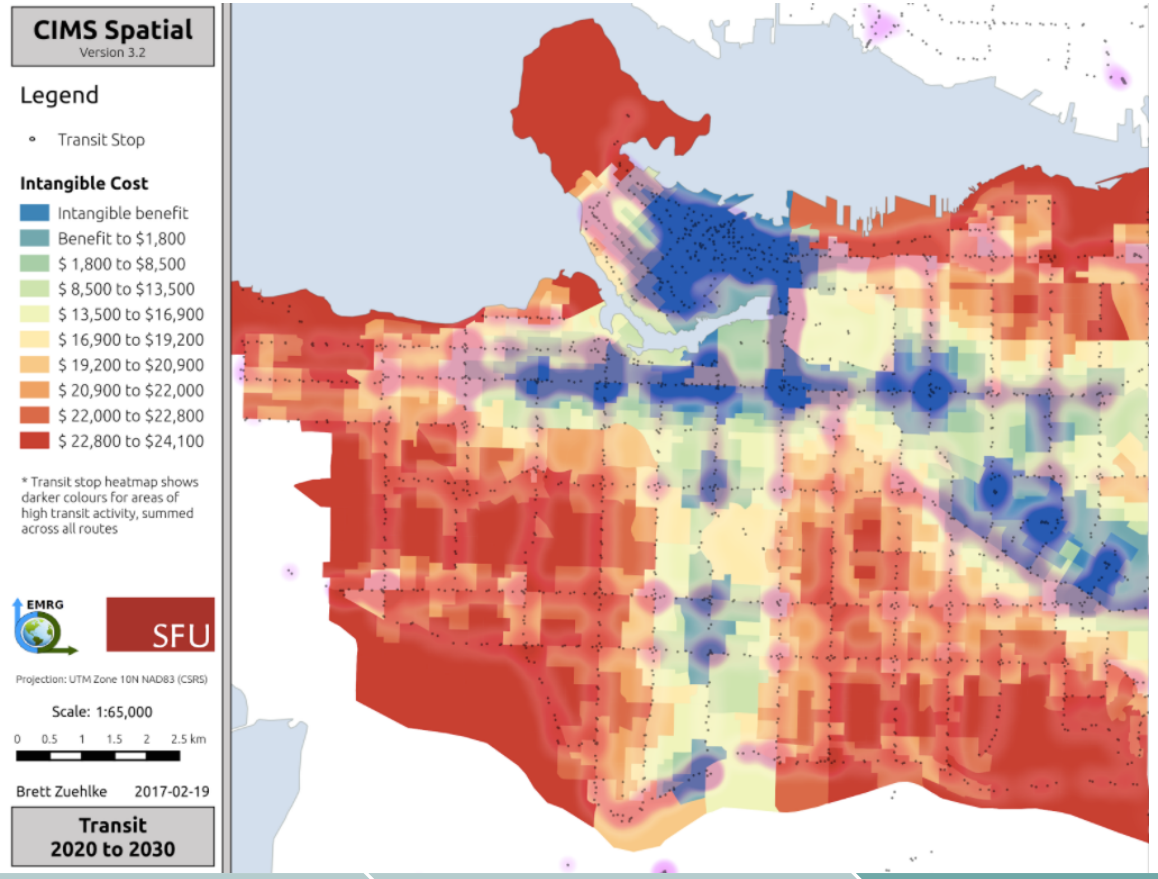

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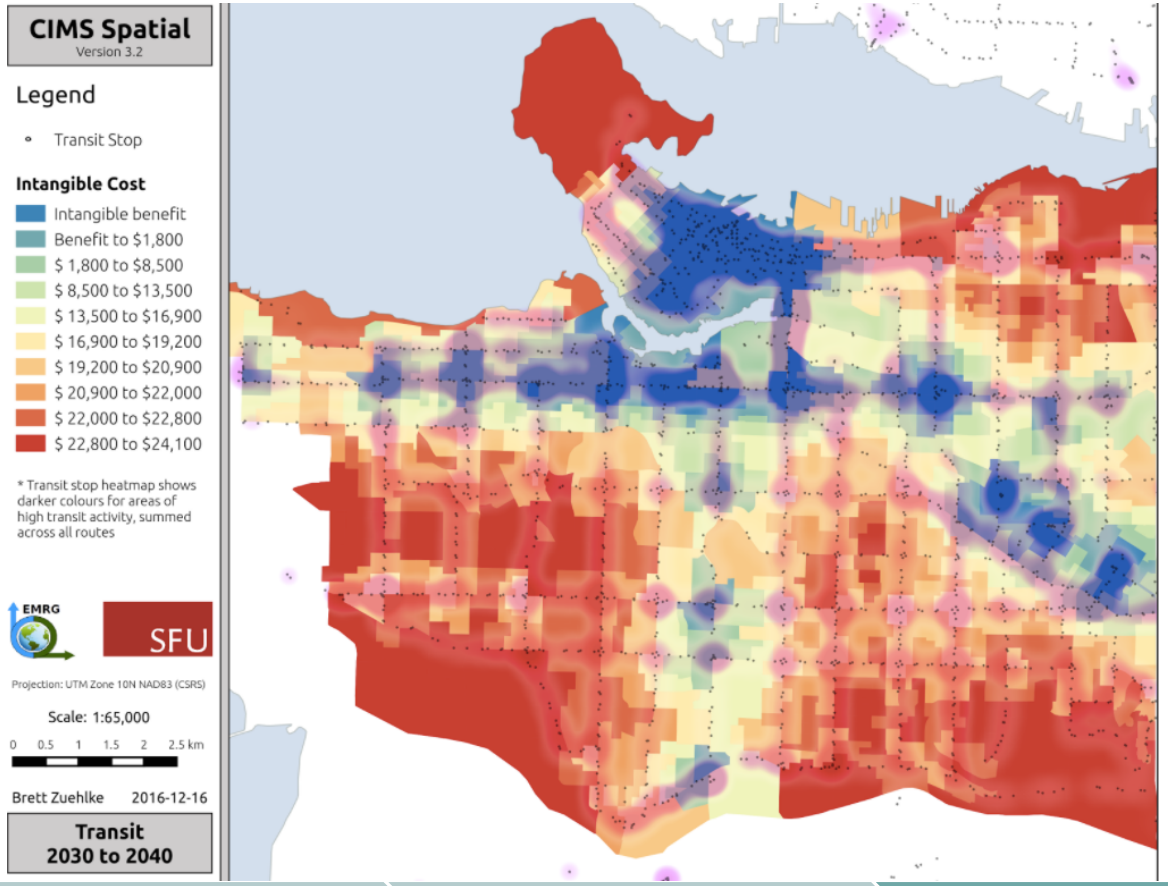

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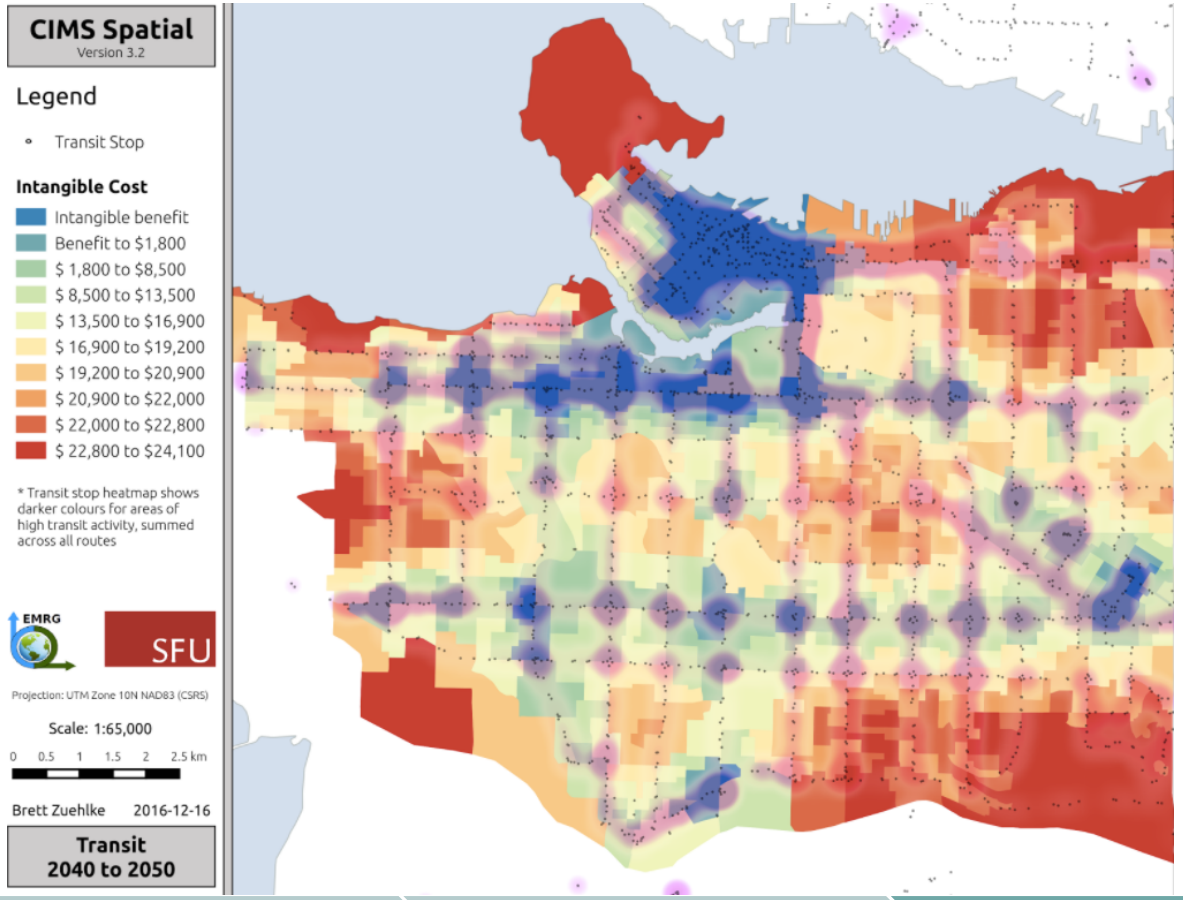
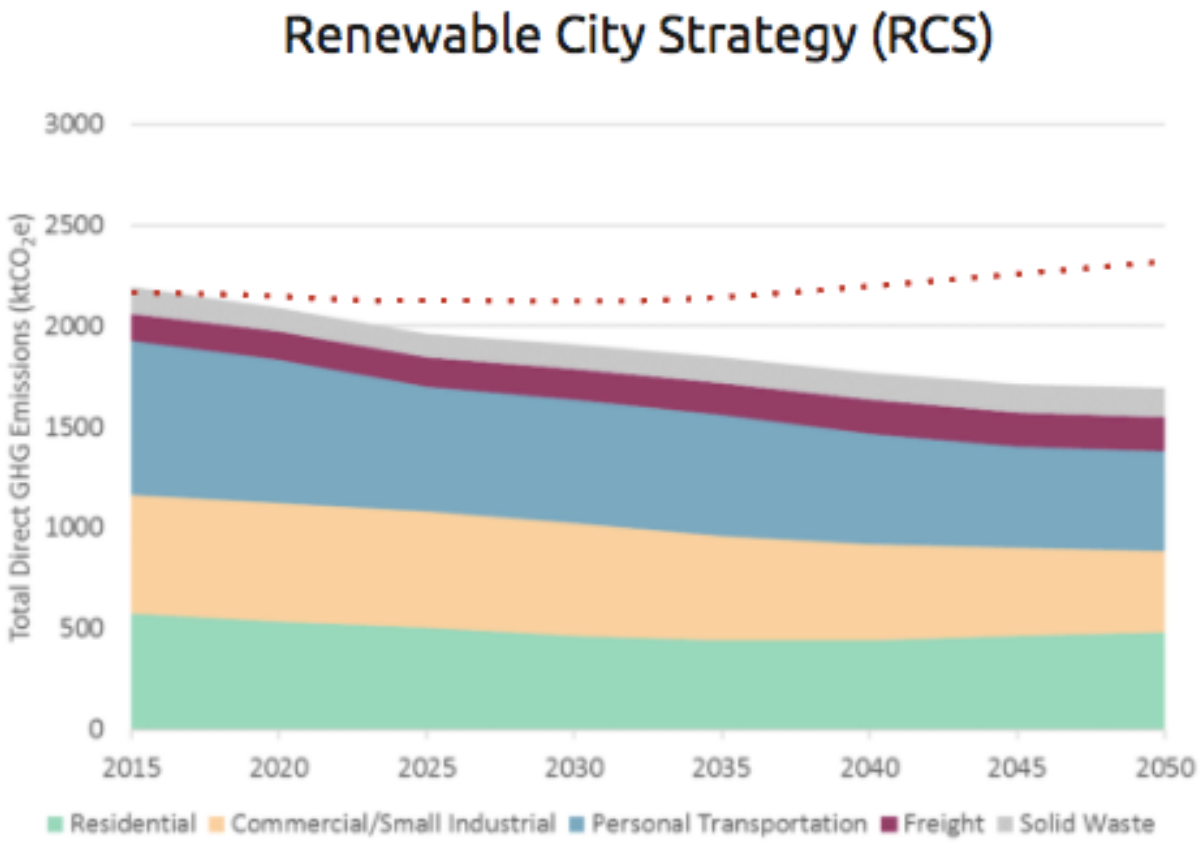
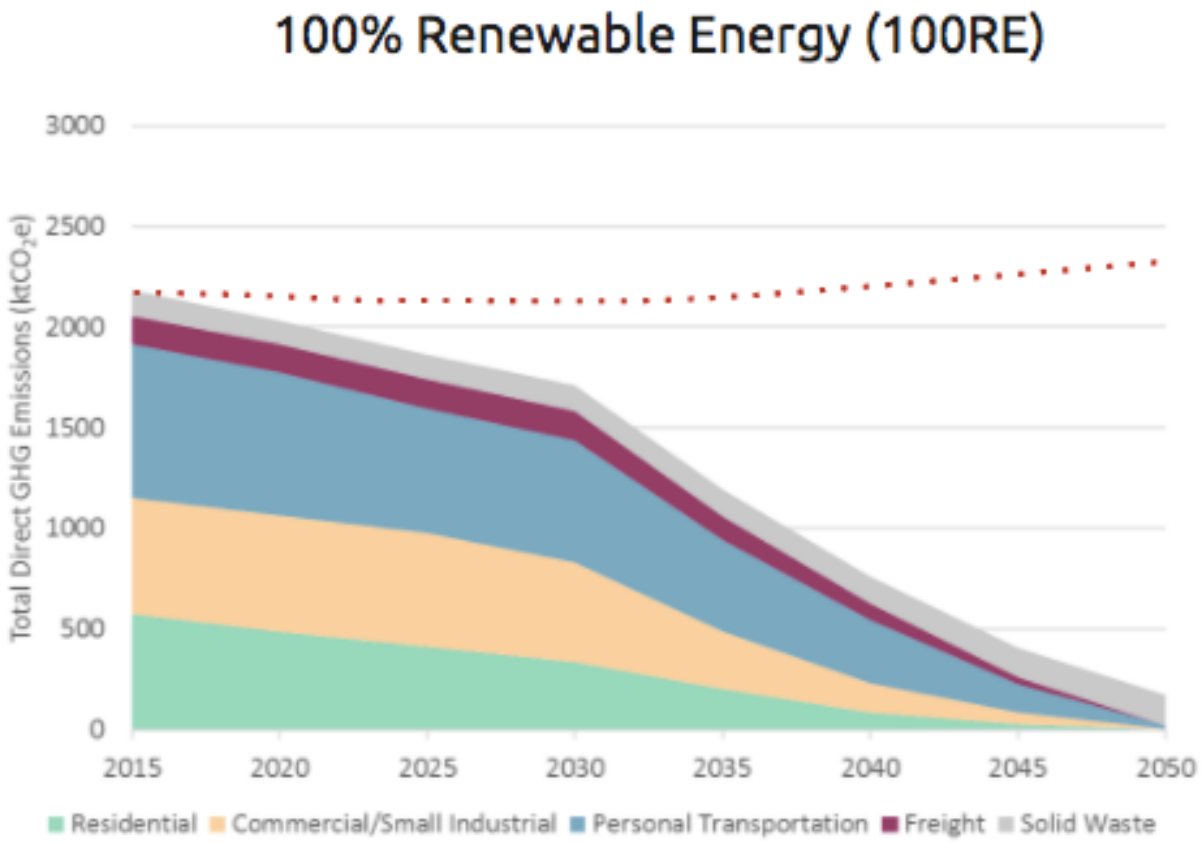
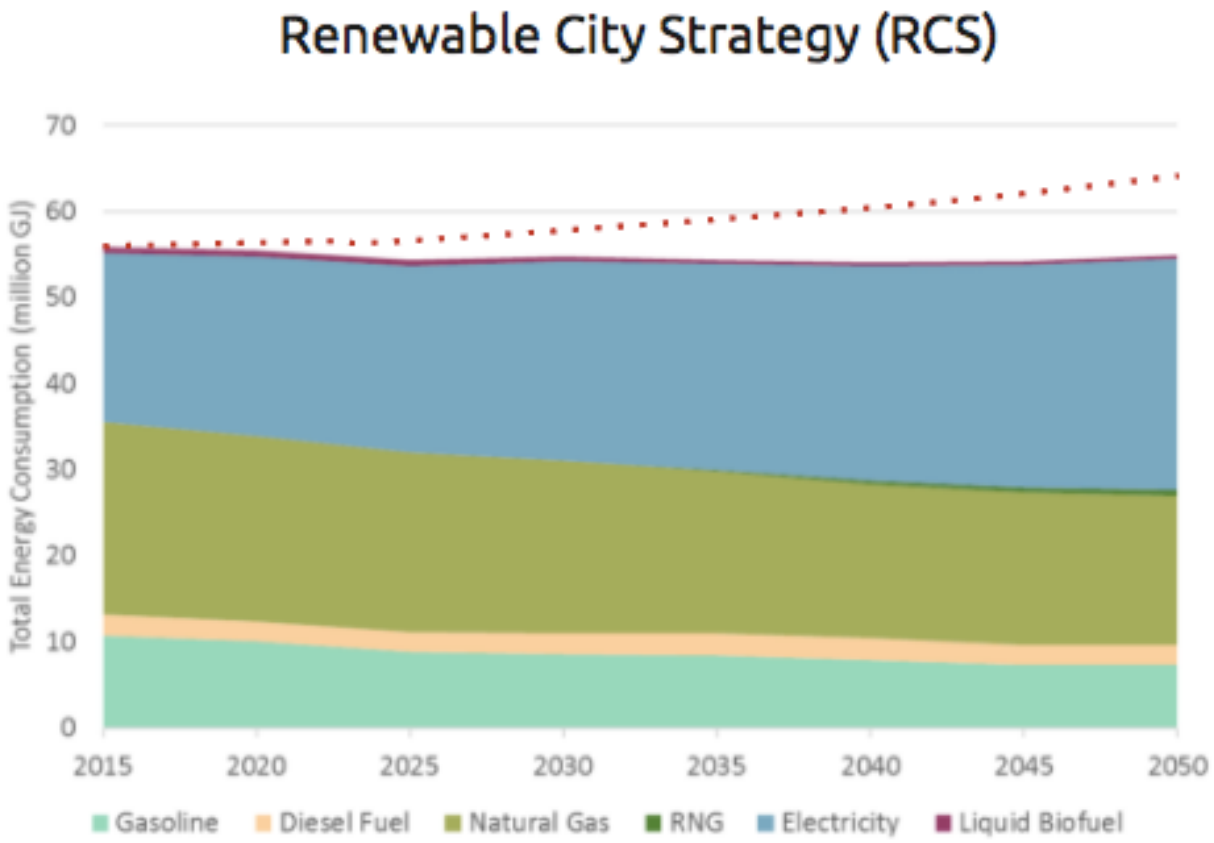


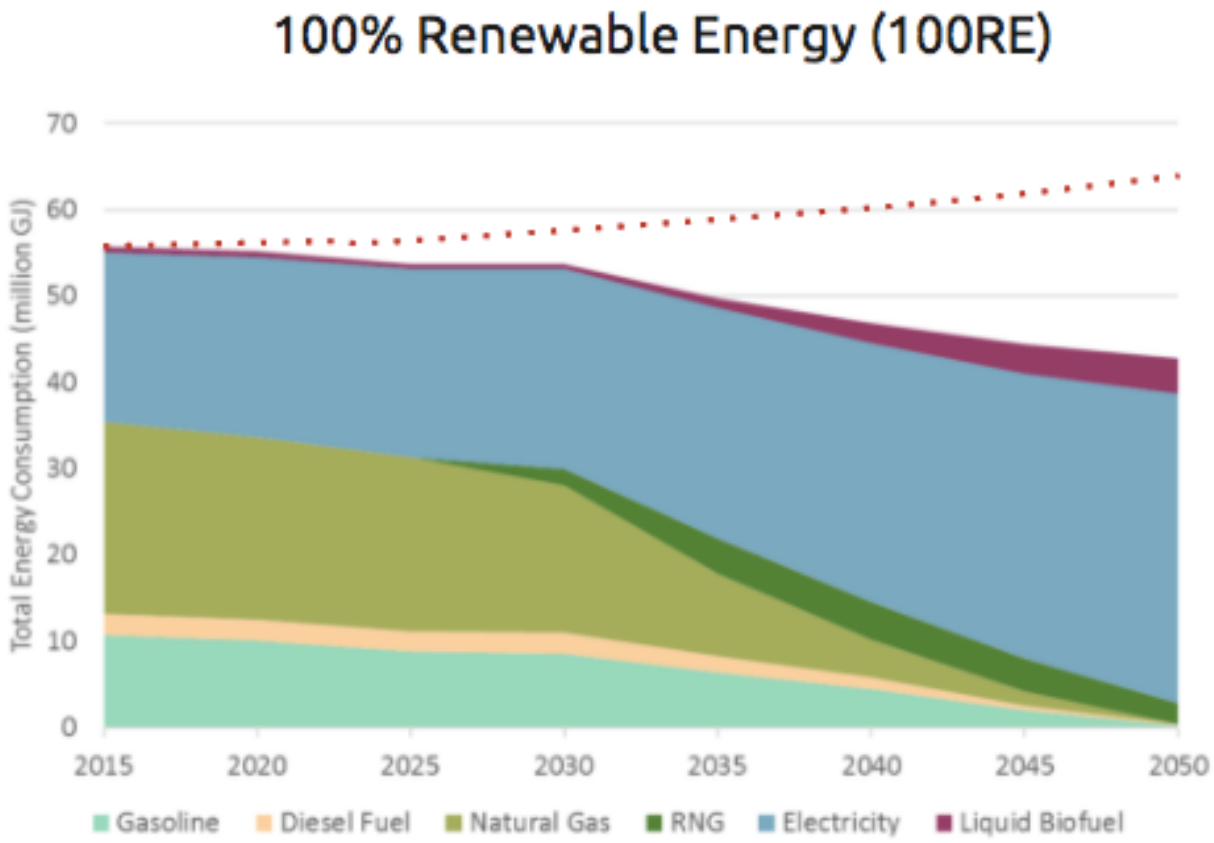
VANCOUVER: EMISSIONS BY SECTOR





VANCOUVER: FUEL USE





ROLE OF ANALYTICAL TOOLS

Use of a tool demonstrated the type of policies that are needed (standards/regulations, government investment)

Use of a tool demonstrated the level of stringency required for these policies to help Vancouver achieve its target

Use a tool demonstrated the outcomes needed (i.e. fuel switching from gasoline and natural gas to electricity and biofuels)

Use of a tool showed that policy intervention at other levels of government may help, but is not required for Vancouver to achieve its goals

APPLYING CIMS TO OTHER COMMUNITIES

Challenges:

- Representing policies for urban form
- Adapting tools for unique local contexts

Opportunities:

- "Truth-testing" for local governments
- Potential to learn from other communities (What works? What doesn't?)
- Giving communities agency to achieve targets in the absence of policy from higher levels of government

Thank you!

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EXTRA SLIDES

ESTIMATING BEHAVIOURAL PARAMETERS

$$MS_j = \frac{\left(CC_j \cdot CRF_j + OC_j + EC_j + i_j\right)^{-v}}{\sum\left(CC_k \cdot CRF_k + OC_k + EC_k + i_k\right)^{-v}} \qquad CRF_j = \frac{r}{1-(1+r)^{-n_j}}$$

Three key behavioural parameters:

- **Discount rate (r) -** time preference as reflected in actual decisions, excluding technology-specific risks
- **Intangible cost (i) –** technology-specific decision factors, especially differences in quality of service and cost risks
- **Market heterogeneity (v) –** reflects the diversity among decision makers in terms of real and perceived costs (logistic curve)

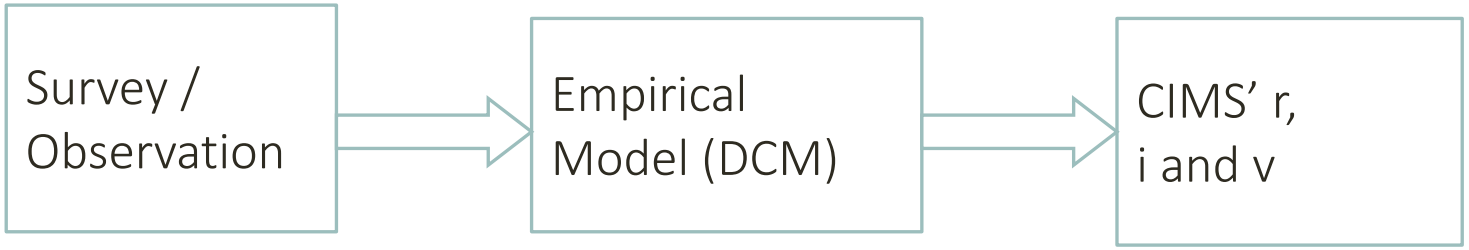
ESTIMATING BEHAVIOURAL PARAMETERS

15 years ago, we began discrete choice surveys to estimate the three behavioral parameters. This included stated and revealed preference studies in:

- transport mode choice (transit, bus, bike, walking, vehicles),
- vehicle choice (efficiency, fuel, motor type)
- industrial boilers and cogeneration,
- commercial and residential building insulation and HVAC.

Increasingly, we focused on cost and non-cost dynamics on technology choices, summarized by “the neighbor effect.”

ESTIMATING BEHAVIOURAL PARAMETERS



Standard discrete choice model for technology choice surveys

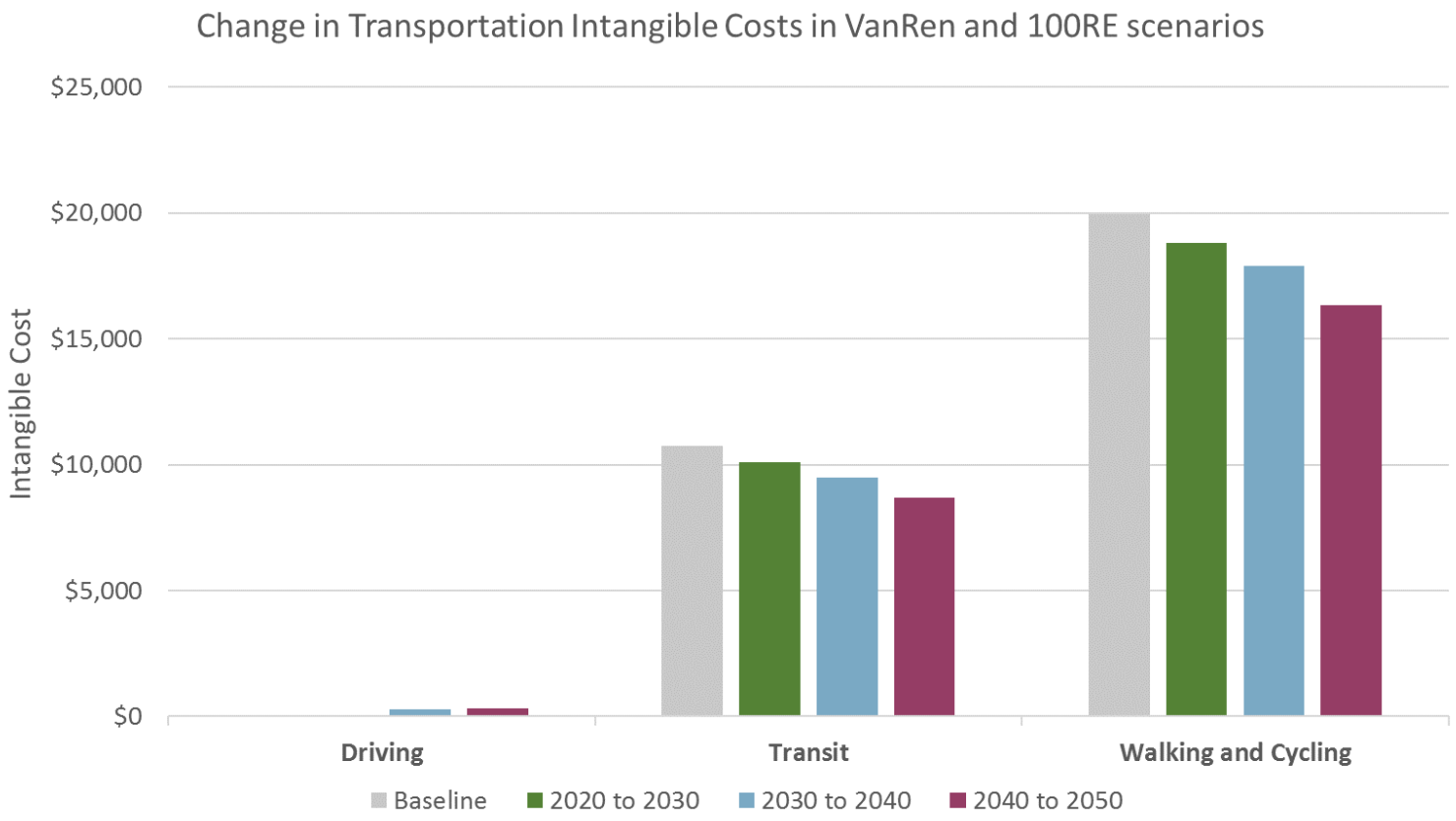
$$U_j = \beta_j + \beta_{CC} CC + \beta_{OC} OC + \beta_{EC} EC + e_j$$

$$\beta_{AC} = \beta_{OC} + \beta_{EC} \qquad r = \frac{\beta_{CC}}{\beta_{AC}} \qquad i_j = \frac{\beta_j}{\beta_{AC}}$$

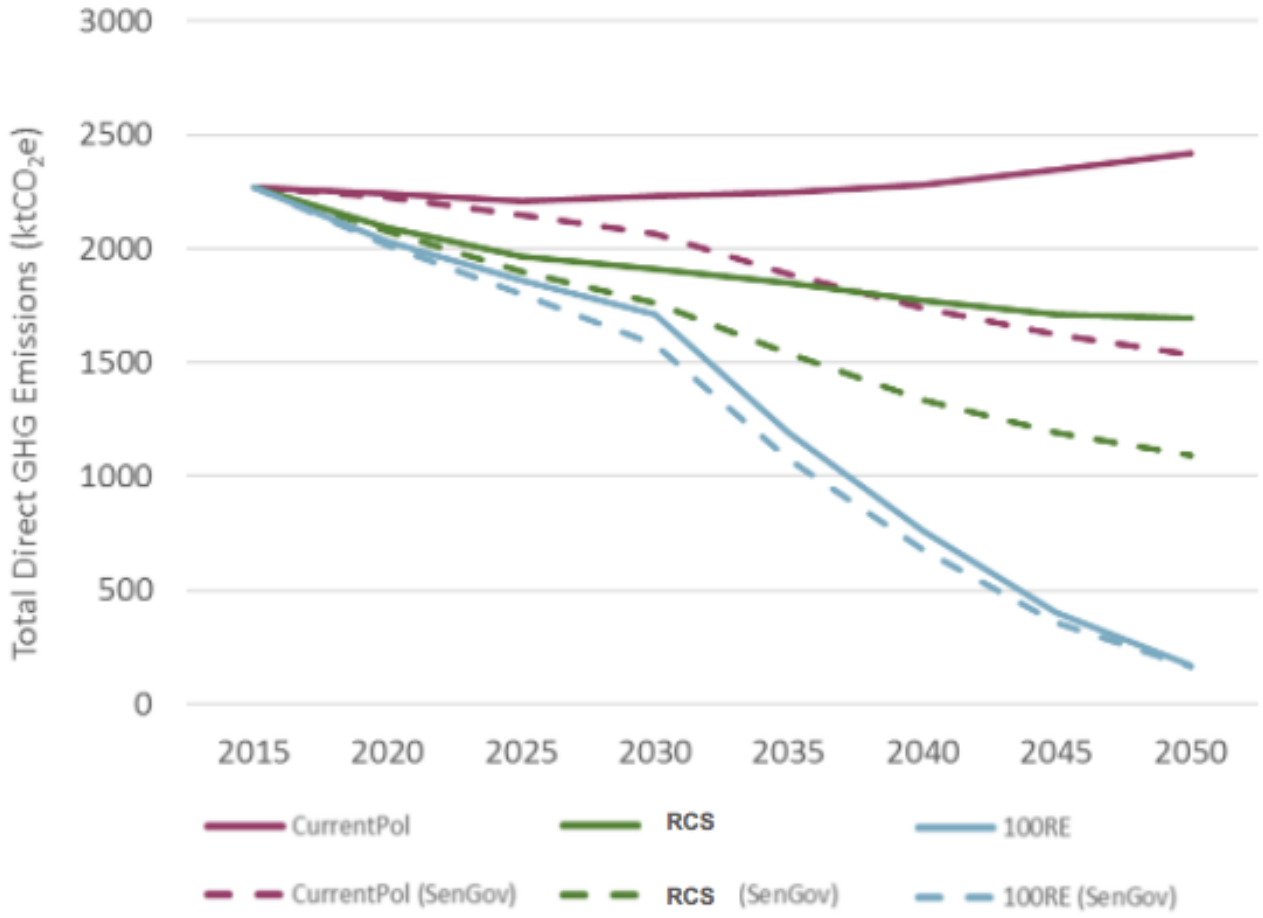
Use OLS to estimate v for which predictions from CIMS are consistent with those from the DCM model (error term size vs betas).

Horne, Jaccard, Tiedemann (2005) "Improving Behavioral Realism in Hybrid Energy-Economy Models Using Discrete Choice Studies of Personal Transportation Decisions," Energy Economics, V27.

SPATIAL MODEL



VANCOUVER: EMISSIONS REDUCTIONS



KEY FINDINGS

More stringent policies than what have been proposed so far are needed to meet the 100% renewables target

Policies must focus on fuel switching in transportation (gasoline) and buildings (natural gas)

Vancouver can come very close to achieving their target without relying on policy intervention from the provincial/federal governments

OVERVIEW: TYPES OF ANALYTICAL AND MODELING TOOLS

Spatial Tools	Analyze spatial characteristics of policies and projects (e.g. land use changes, transportation infrastructure, district energy)	GIS (ArcGIS, QGIS) Plan4DE
Engineering Models	Plan and assess urban developments and related services in terms of economics, logistics, etc.	RETScreen
Financial Tools	Determine costs and benefits of a project/policy to a city	City of London CBA
Simulation Models	Predict the effect of policies on the environment, economy, social indicators, etc.	CIMS CityInSight/GHGProof