

The Electric Commute: Envisioning 100% Electrified Mobility in New York City

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Robert Mieth



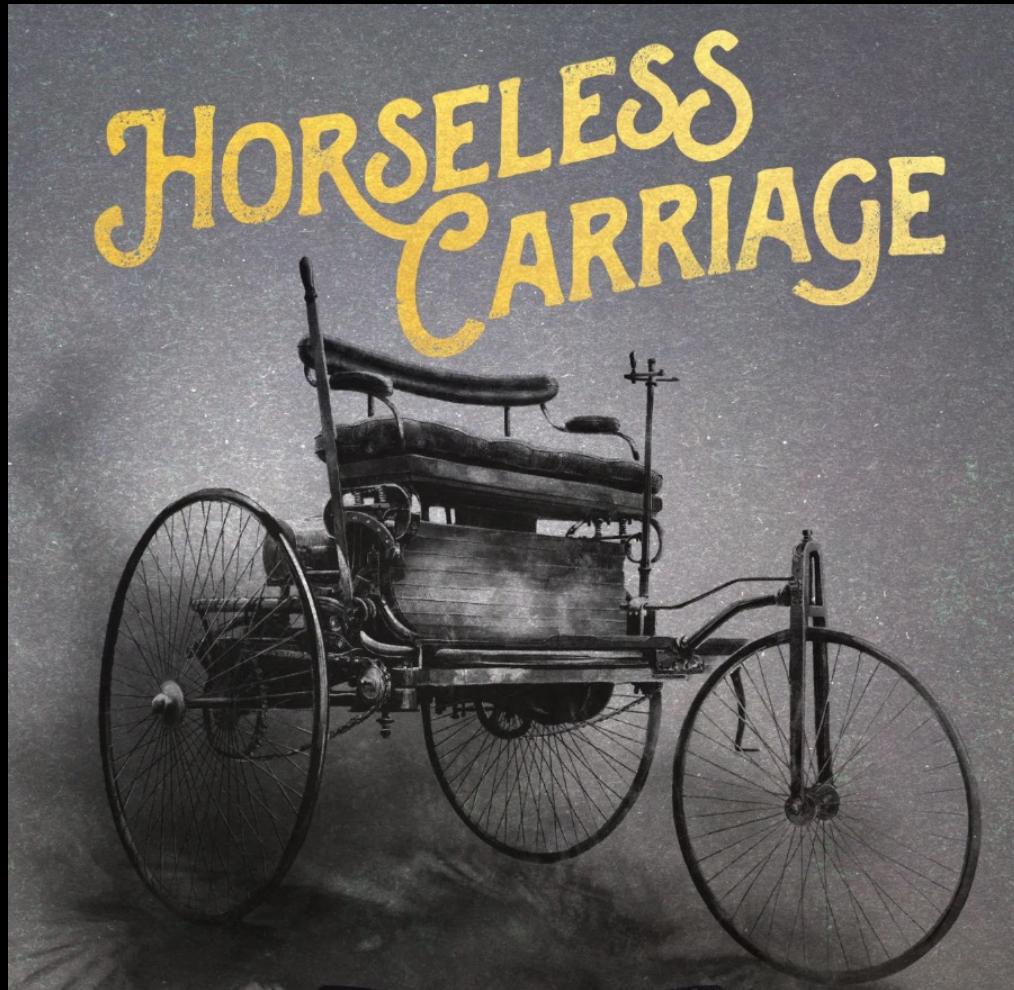
#nycSOdata

#NYC #OpenData

#opendataweek

Technological Advancement
+

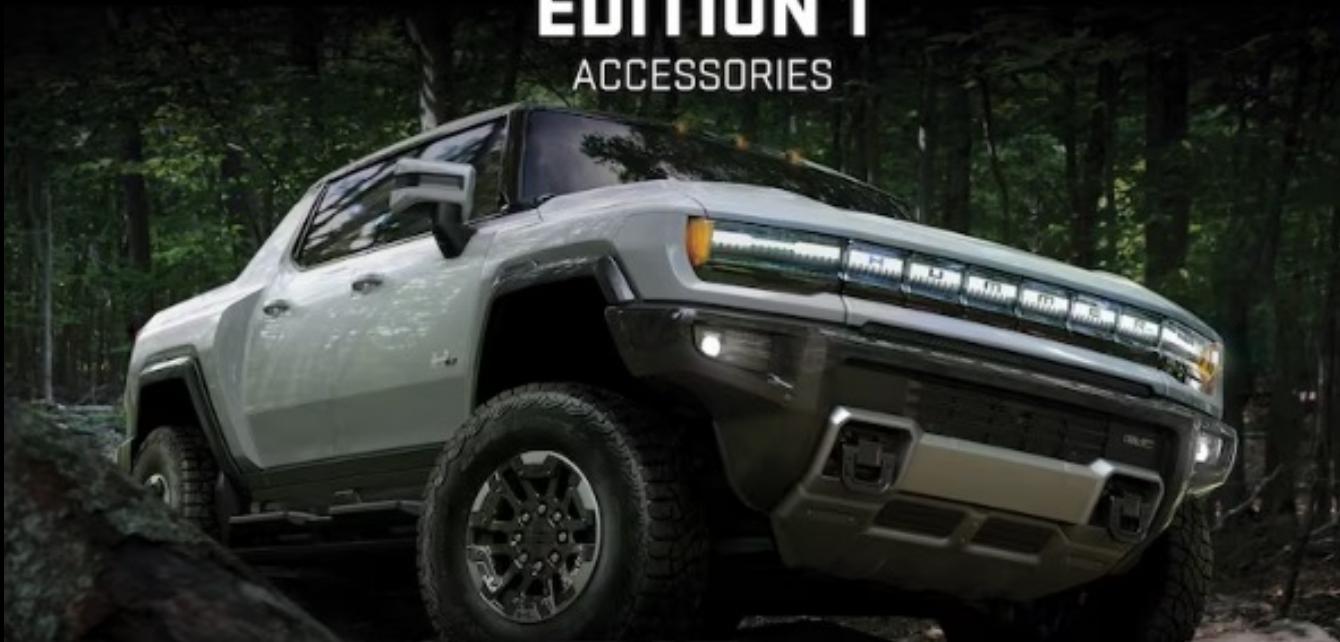
Traditional Vision



Technological Advancement
+

Traditional Vision

**GMC HUMMER EV PICKUP
EDITION 1**
ACCESSORIES

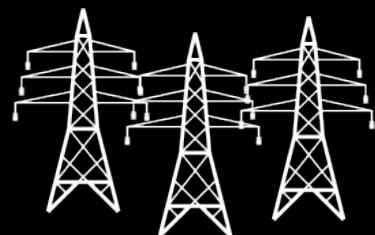




- 1) What if tomorrow all cars commuting in and out of NYC were electric? How much electricity demand?



- 2) What alternatives do commuters have to electrify their commute and how does this impact demand?



- 3) How does the resulting demand compare to power system capability?

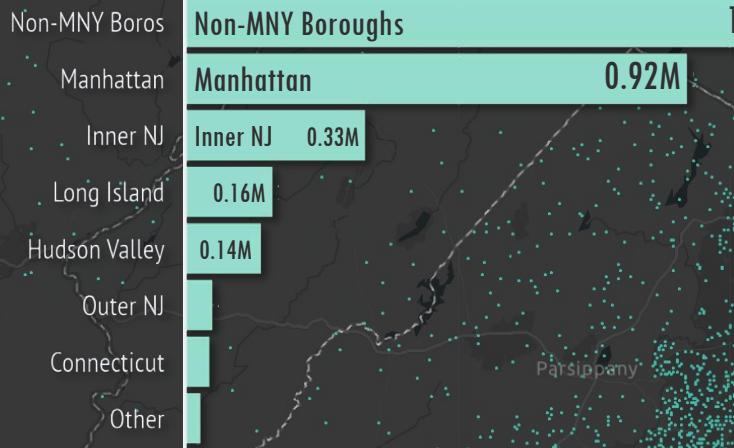
- 1) Overview and data
- 2) Commuter model
- 3) Electricity demand model
- 4) Case study and scenarios

**Center for Urban
Science + Progress**



~3M Manhattan Commuters' Place of Residence

Total Number of Manhattan Commuters by Subregion of Residence

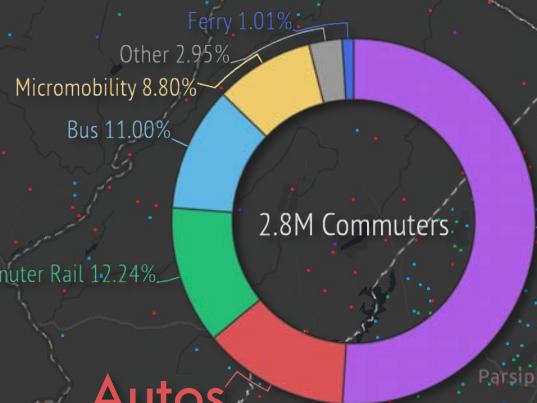


1 Dot = 50

Data Source: ACS via IPUMS USA, 2019

How Do They Commute?

The Proportion of Manhattan Commuters' Modes to Work



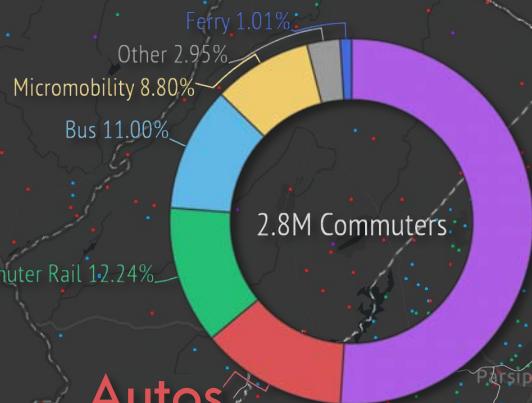
Autos
13.0%
365K Commuters

1 Dot = 50

Data Source: ACS via IPUMS USA, 2019

How Will They Commute?

The Proportion of Manhattan Commuters' Modes to Work



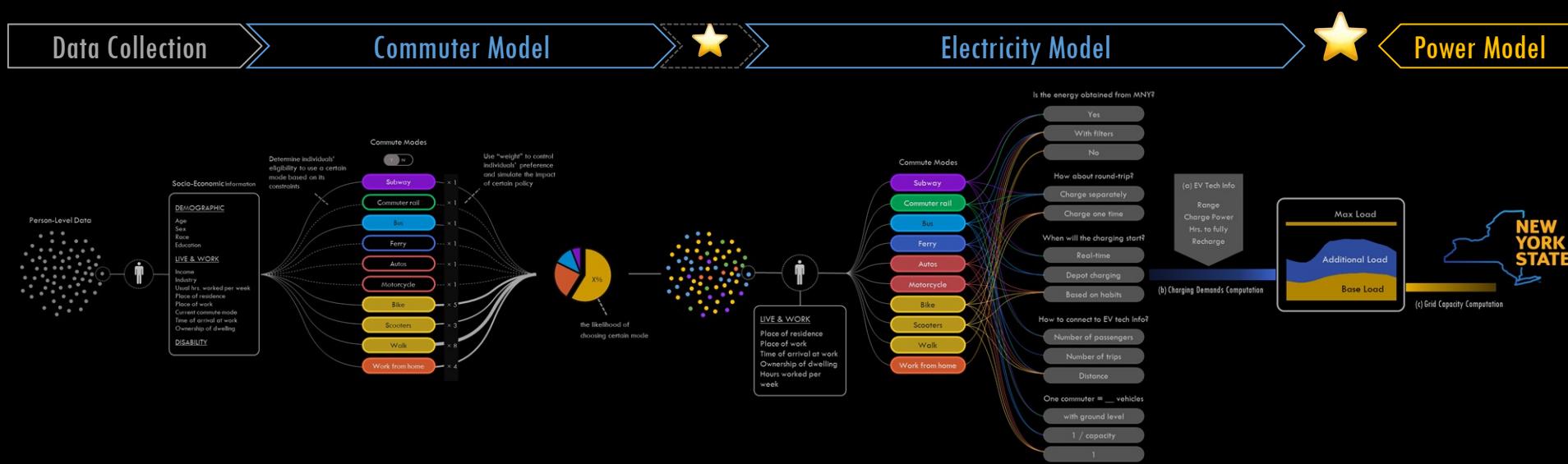
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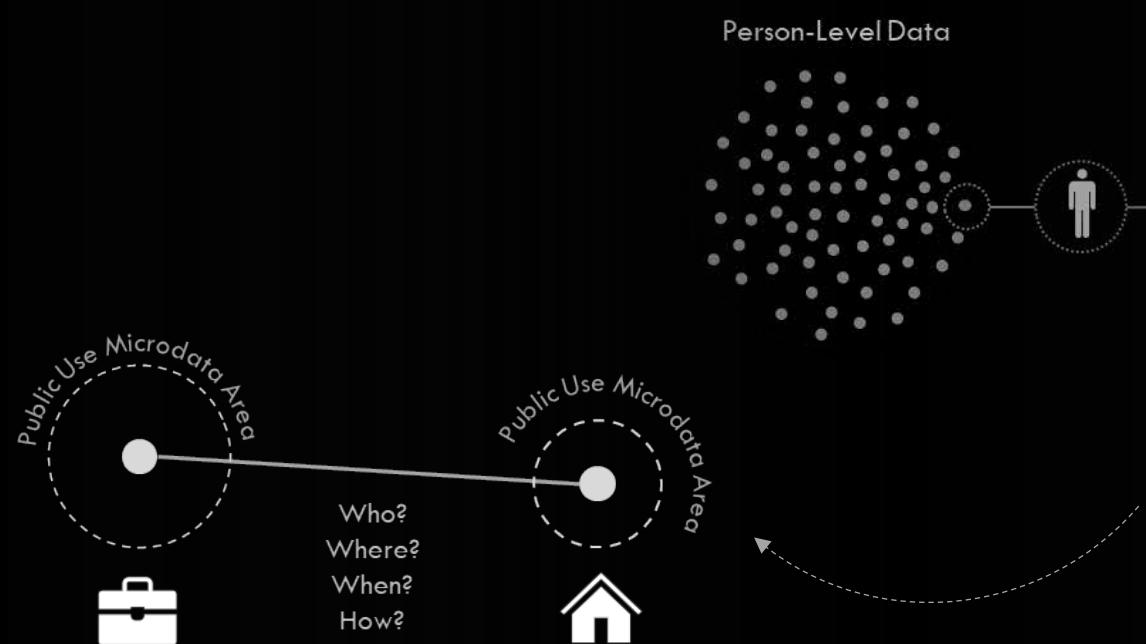
Data Source: ACS via IPUMS USA, 2019

Modeling 100% Electrified Transportation

Person-Level
Commuter Traffic → Electricity Demand



Data Source: ACS



Socio-Economic Information

DEMOGRAPHIC

Age
Sex
Race
Education

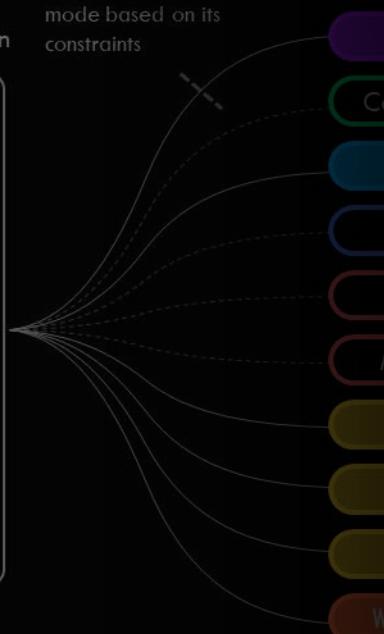
LIVE & WORK

Income
Industry
Usual hrs. worked per week
Place of residence
Place of work
Current commute mode
Time of arrival at work
Ownership of dwelling

DISABILITY

Determine individuals' *eligibility* to use a mode based on its constraints

Cor



Socio-Economic Information

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DISABILITY

Determine individuals' **eligibility** to use a mode based on its constraints

Commute Modes



Subway

× 2

Commuter rail

× 2

Bus

× 2

Ferry

× 2

Autos

× 1

Motorcycle

× 1

Bike

× 5

Scooters

× 3

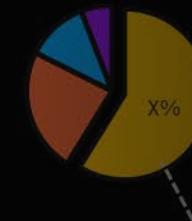
Walk

× 8

Work from home

× 4

Use "**weight**" to control individuals' preference and simulate the impact of certain policy



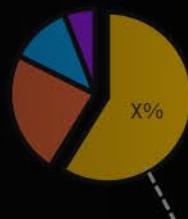
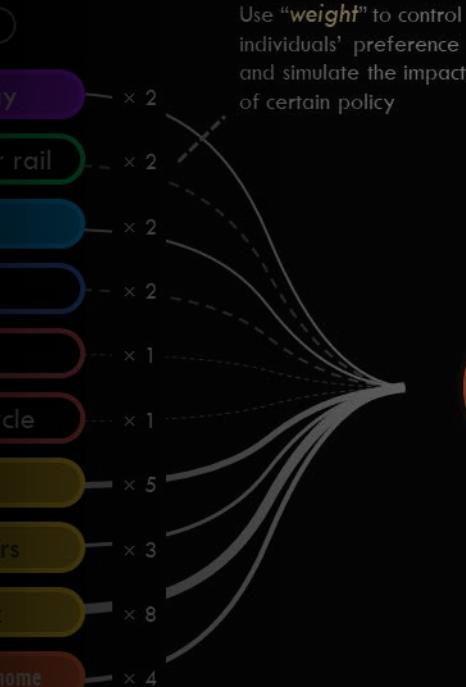
the likelihood of choosing certain mode

Weight Assignment Model

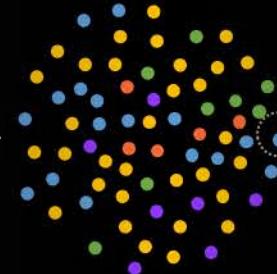
Commuting Scenario

Person-Level Commute Data

Modes



the likelihood of
choosing certain mode

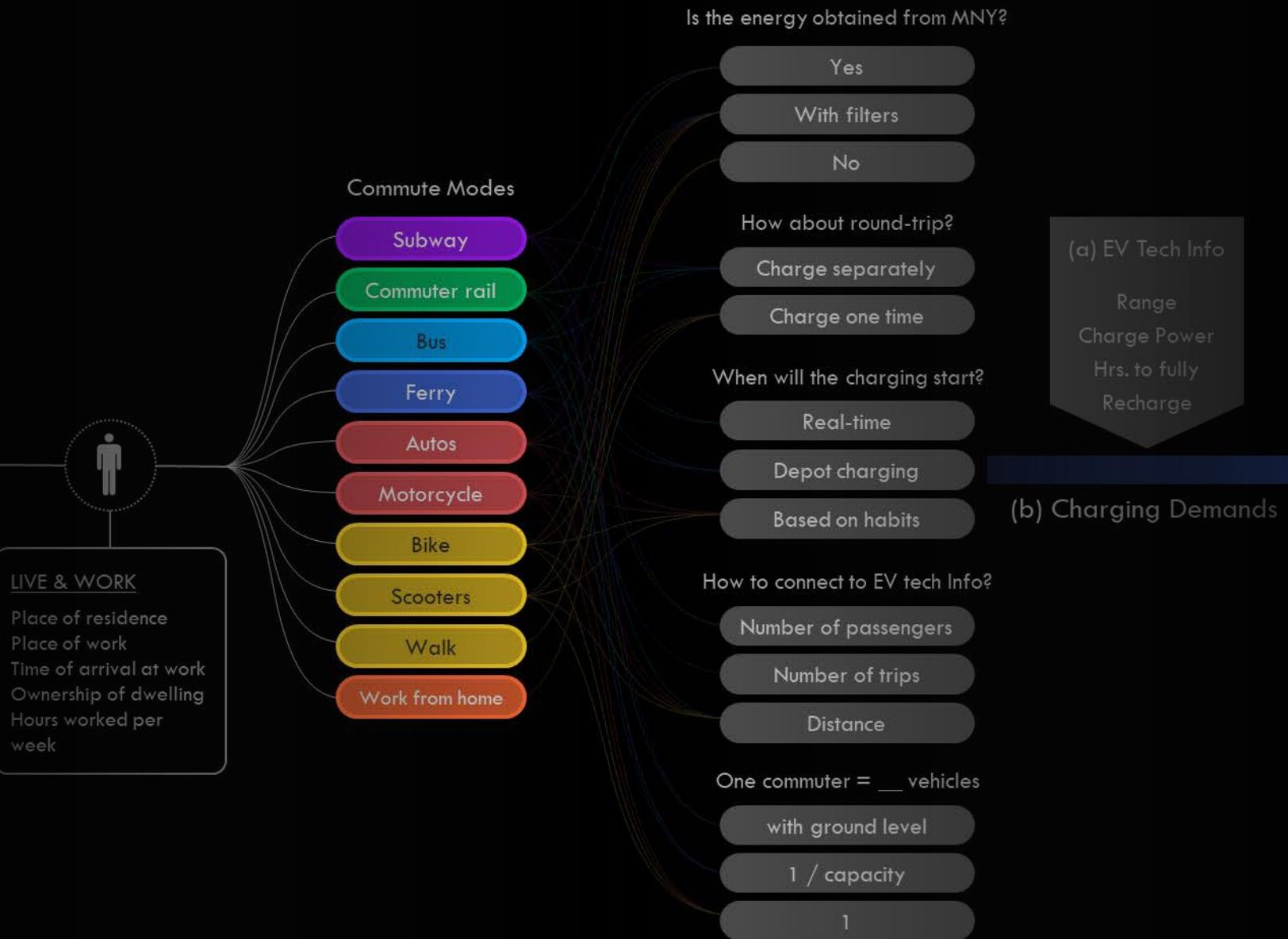


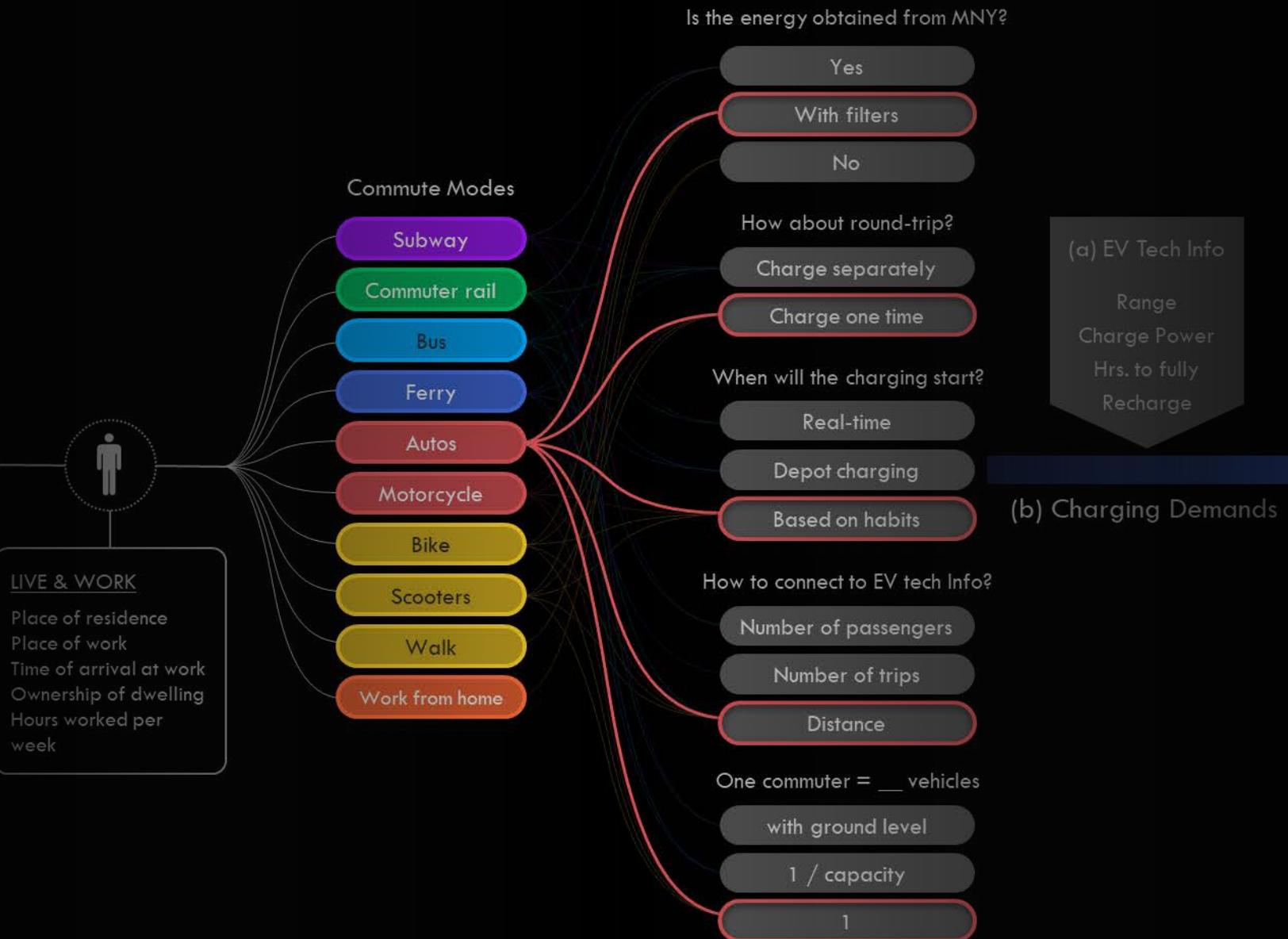
LIVE & WORK
Place of residence
Place of work
Time of arrival at work
Ownership of dwelling
Hours worked per week

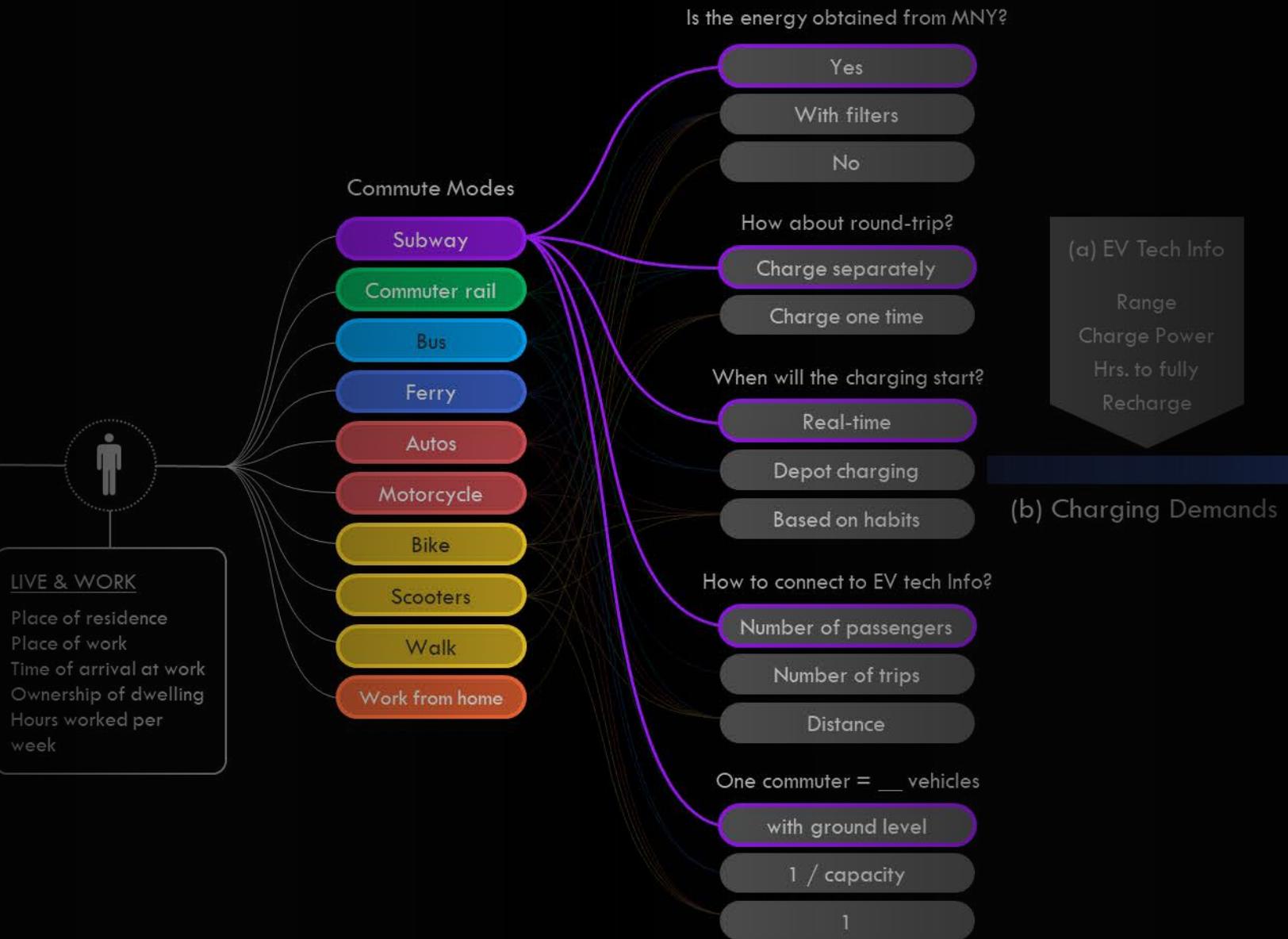
Commute Modes

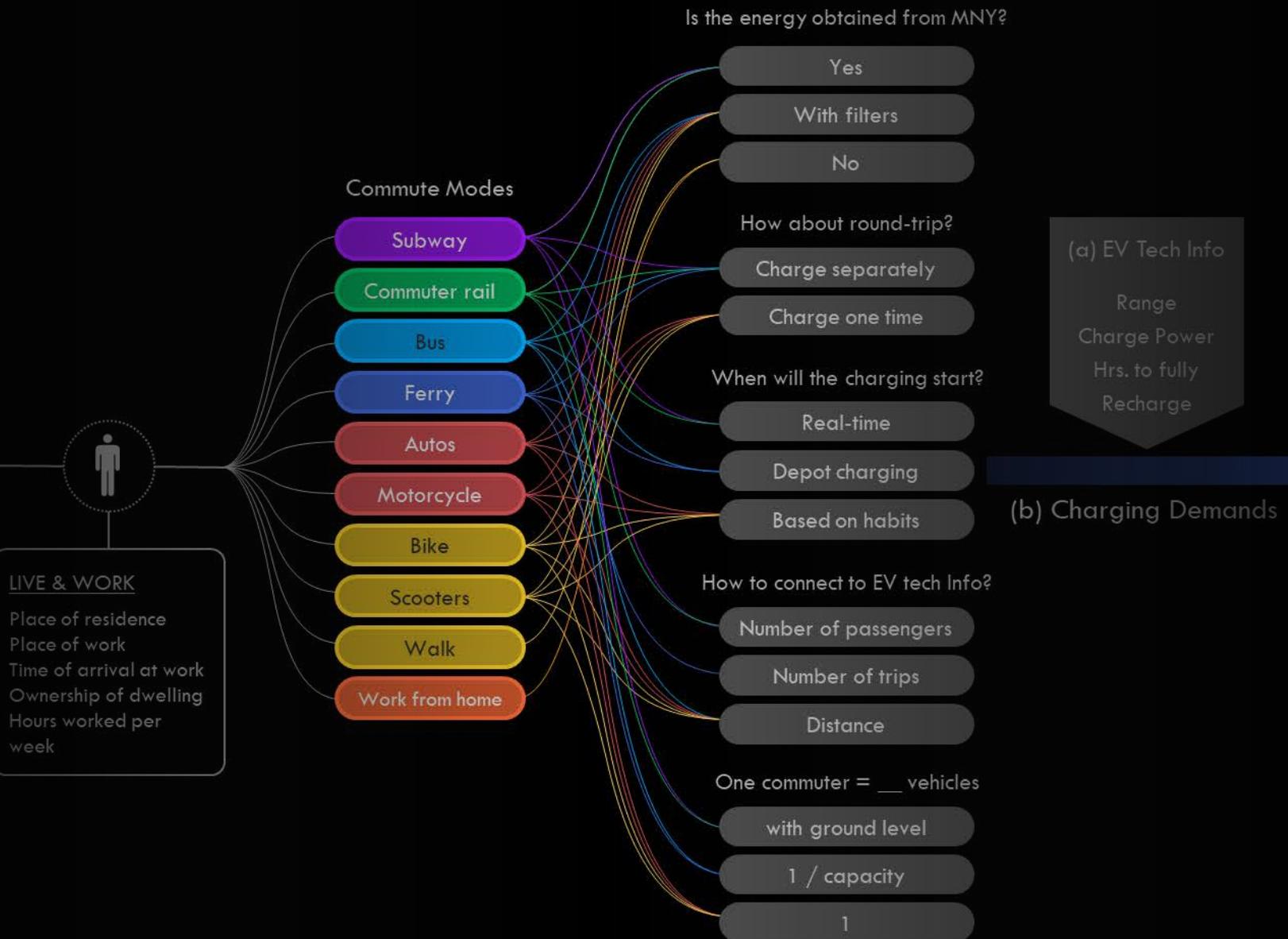


Ch









ing Mechanism by Mode

Electricity Demand

NYISO Power System

the energy obtained from MNY?

Yes

With filters

No

How about round-trip?

Charge separately

Charge one time

When will the charging start?

Real-time

Depot charging

Based on habits

(a) EV Tech Info

Range
Charge Power
Hrs. to fully
Recharge

(b) Charging Demands

Max Load

Additional Load

Base Load

**NEW
YORK
STATE**

(c) Grid Capacity

How to connect to EV tech Info?

Number of passengers

Number of trips

Distance

One commuter = __ vehicles

with ground level

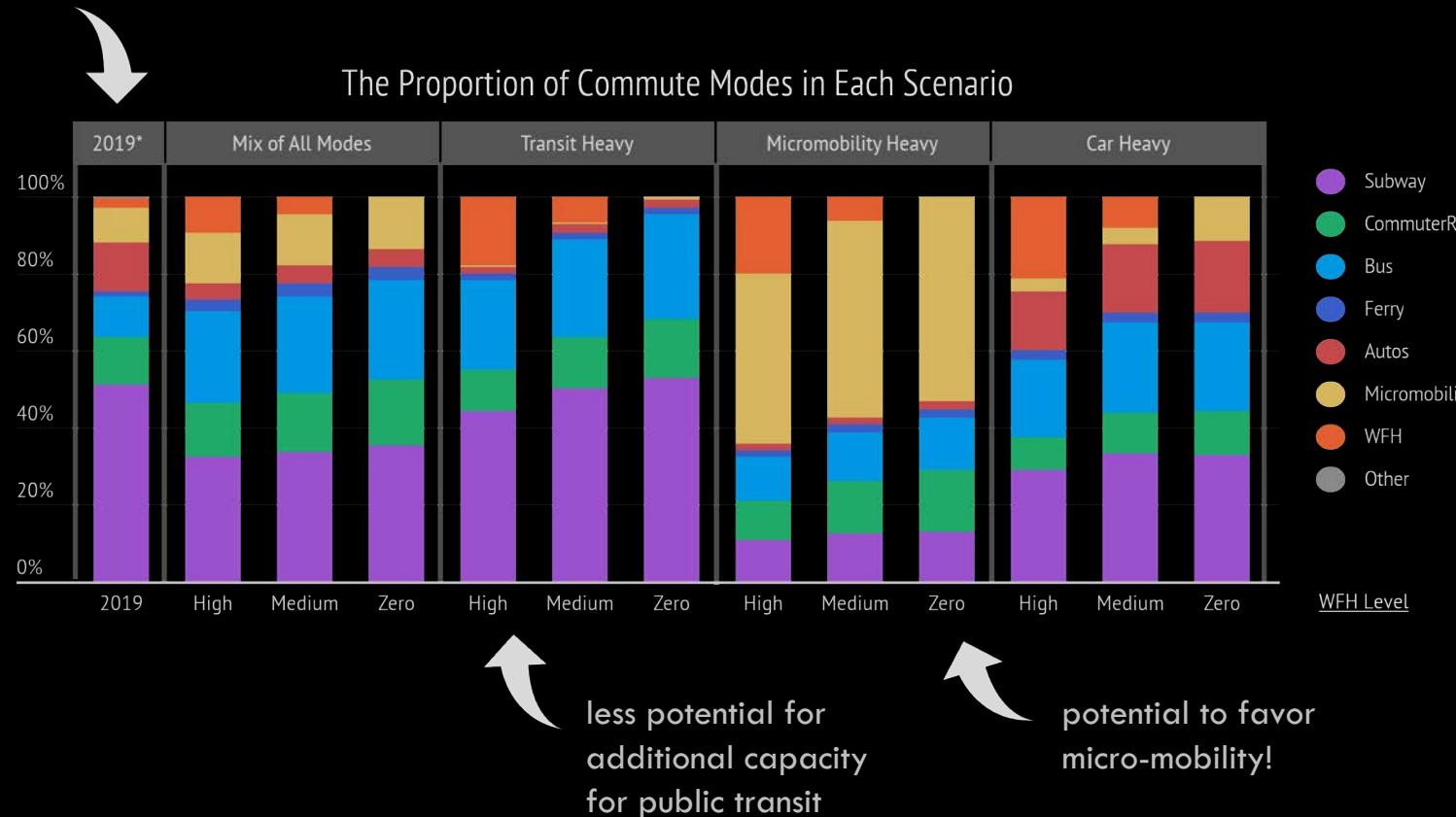
1 / capacity

1

Preset Scenarios

Mode Pattern (4 categories) × Work-from-home (3 levels)

2019 baseline



Electricity Demand



Demo

<https://tecnyc.herokuapp.com/>



The screenshot shows the TEC-NYC Dashboard application running in a web browser. The interface is divided into several sections:

- Left Panel:** NYU logo and title "The Electric Commute". Sub-sections include "Envisioning 100% Electrified Mobility in New York City", "Load Profile" (with options for season and wind level), "Commuting Scenario" (with options for transit pattern and work-from-home level), and a "Switch Scenarios" button.
- Main Map Area:** A map of Manhattan showing the "Manhattan Workers' Place of Residence & Power System". It displays travel modes (Walk, Scooter, Bicycle, Ferry, WFH, Autos, Bus, Motorcycle, Taxicab, CommuterRail, Subway, Other) as colored dots. A legend on the left identifies these modes. A callout button "Place of Residence Map" is located below the map.
- Top Right Summary:** Framework and About sections. Key figures: 51746 MWh Total Energy, 7243 MWh Total Trans. Energy, 766 MW Peak Trans. Load.
- Energy Profile Section:** A graph showing Power (MW) over time for different commuting scenarios (Earliest, Latest, Random, Manhattan*, Restraint*). A blue button labeled "Energy Profile" is centered below the graph.
- Bottom Right Summary:** Travel Mode Share (a donut chart showing mode distribution by subregion) and Mode Choices by Subregion (a stacked bar chart showing mode choices for Manhattan, Non-MNY Boros, NJ, LI, Hud, CT, and Other).
- Bottom Buttons:** "Commute Profile" button with a car icon.

Some Insights

<https://tecnyc.herokuapp.com/>



The Electric Commute x TEC-NYC Dashboard + Incognito

NYU

The Electric Commute

Envisioning 100% Electrified Mobility in New York City

Select any of the load profiles and preset scenarios of home-work commuting activities in Manhattan.

Load Profile

1. Select Season
 Summer Winter
2. Select Wind Level
 Low High
3. With offshore wind projects

Commuting Scenario

1. Select Transit Pattern
 Mode Choices in 2019 Mix Modes Heavy Transit Heavy Micro-mobility Heavy Car Usage
2. Select Work-from-home Level
 High WFH Mid WFH No WFH

2019 Baseline Scenario

Main **Detail** **Framework** **About**

Manhattan Workers' Place of Residence & Power System

Travel_Mode: Walk, Bicycle, Ferry, WFH, Autos, Bus, CommuterRail, Subway, Other

Commuting (radio button selected) Power System (radio button)

53264 MWh Total Energy **8760 MWh** Total Trans. Energy **1096 MW** Peak Trans. Load

Energy Profile of Manhattan's Home-Work Commuting Activities

Start time for EV charge: Random, Earliest, Latest

Power (MW) vs Time (Hours)

The need for infrastructure investments

The usefulness of flexible charging policies

Travel Mode Share

~2.7M Workers

Subway, Bus, Car, Micro, Walk, WFH, Autos, Ferry, Other

Mode Choices by Subregion

Manhattan, Non-MNY Boros, NJ, LI, Hud, CT, Other

Subway, Autos, Bus, Walk, WFH, Ferry, Other

Some Insights

<https://tecnyc.herokuapp.com/>



The Electric Commute x TEC-NYC Dashboard + tecnyc.herokuapp.com Incognito

NYU

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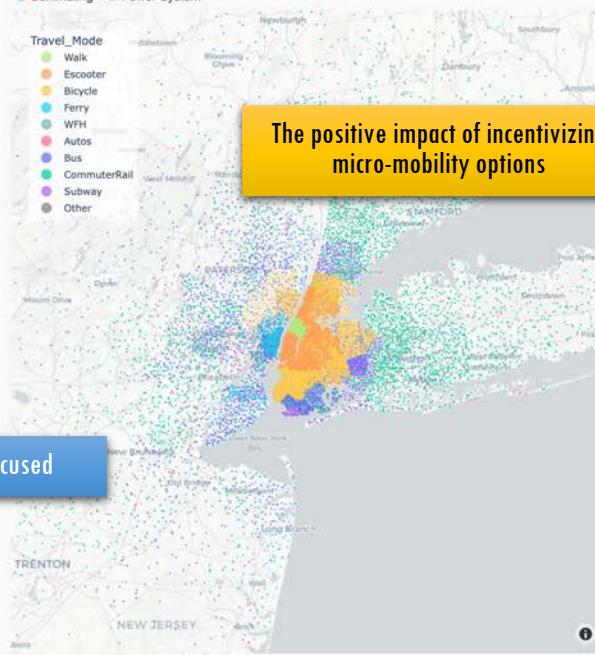
Micro-mobility Focused

Main

Manhattan Workers' Place of Residence & Power System

Travel_Mode: Walk, Escoter, Bicycle, Ferry, WFH, Autos, Bus, CommuterRail, Subway, Other

Commuting (radio button selected) Power System (radio button)



Detail

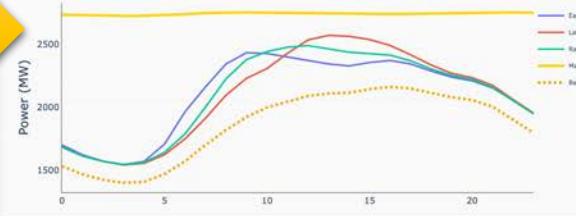
50473 MWh Total Energy

5969 MWh Total Trans. Energy

524 MW Peak Trans. Load

Energy Profile of Manhattan's Home-Work Commuting Activities

Start time for EV charge: Random, Earliest, Latest



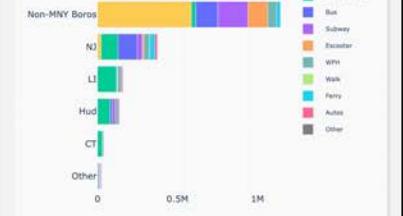
Framework

Travel Mode Share



~2.7M Workers

Mode Choices by Subregion



Bicycle, CommuterRail, Bus, Subway, Escoter, Walk, Ferry, Autos, Other

About

Create a custom scenario?

<https://github.com/BNewborn/mobility-electrification>



This project has the following workflow.

An example of running the entire models can be found [here](#).

Part 1: Commuter Model

We model the individual mode choices and the resulting aggregate commute scenarios as depicted in Fig. 1. The model is composed of four parts: (a) commute data collection, (b) eligibility model, (c) weight assignment model, and (d) scenario creation.

You can run the code of `commuter_model.py` [here](#).

The details and sources for the Eligibility Model can be found [here](#).

The WFH conditional probabilities can be found [here](#).

Part 2: Energy Model

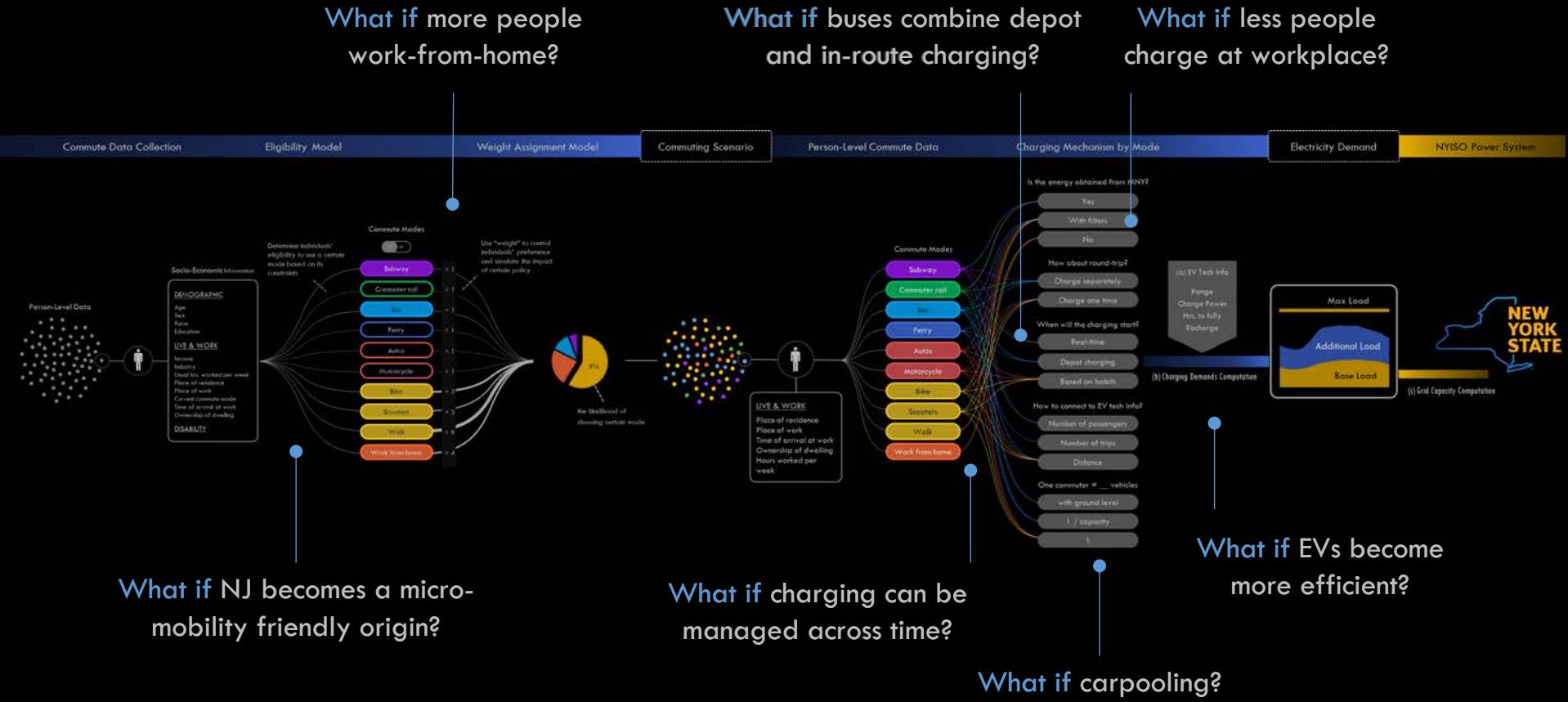
Any commuting scenario will result in its own unique energy requirements given mode choices and travel distances. We propose a framework for comparing the electricity demand identified in the commuter model with the current state of the New York Independent System Operator (NYISO) power system as illustrated in Fig. 2. The Energy Model has three parts: (a) EV technical information collection, (b) charging demand computation, and (c) grid capacity computation.

https://github.com/BNewborn/mobility-electrification/blob/main/05_Compiler_Electric_Pipeline/Make_Objects_For_Dashboarding_Scenarios_V3.ipynb

Sample codes

```
In [35]:  
## Transit Heavy ## ***** df ***** df ***** df *****  
## commuter_model_nowfh_transit.ipums_df['FLAG_AUTO'] = commuter_model_nowfh_transit.auto_flag_binary(  
    max_age=78  
    ,min_income = 5  
    ,min_income = 32626  
    ,male_pct = 15  
    ,female_pct = 15  
    ,age_dist = None  
)  
  
## E-Scooter  
commuter_model_nowfh_transit.ipums_df['FLAG_ESCOOTER'] = commuter_model_nowfh_transit.escooter_flag_binary(  
    max_age=0  
    ,max_distance=4  
    ,escooter_friendly_origins=commuter_model_nowfh_transit.bike_friendly_origins  
    ,male_pct=10  
    ,female_pct=10  
)  
  
## Walking  
commuter_model_nowfh_transit.ipums_df['FLAG_WALK'] = commuter_model_nowfh_transit.walking_flag_binary(  
    max_age=100  
    ,max_distance=2  
    ,male_pct=100  
    ,female_pct=100  
)  
  
## E-Bike  
commuter_model_nowfh_transit.ipums_df['FLAG_EBIKE'] = commuter_model_nowfh_transit.ebike_flag_binary(  
    max_age=10  
    ,max_distance = 35  
    ,male_pct = 50  
    ,female_pct = 40  
    ,age_dist = None  
    ,bike_friendly_origins=commuter_model_nowfh_transit.bike_friendly_origins  
)  
  
## Motorcycle  
commuter_model_nowfh_transit.ipums_df['FLAG_MOTORCYCLE'] = commuter_model_nowfh_transit.motorcycle_flag_binary(  
    max_age=35  
    ,max_distance = 100  
    ,min_income = 50000  
    ,male_pct = 5  
    ,female_pct = 1  
    ,age_dist = None  
)  
  
#### Taxi cab  
commuter_model_nowfh_transit.ipums_df['FLAG_TAXICAB'] = commuter_model_nowfh_transit.taxicab_flag_binary(  
    max_age=35  
    ,min_income = 15  
    ,male_pct = 5  
    ,female_pct = 2  
    ,age_dist = None  
)
```

What if? Quantitative Decision Support



An exemplary "What if ..." story



CUSP The Electric Commute

<https://arcg.is/WrvSf>

Transport Future is Electric

"Heartbeat" of NYC

Understanding NYC Commute

Electrifying NYC Commute

Delivering the Power

What if?

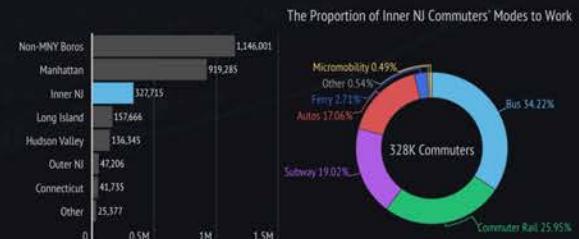
Dive Deeper

Background

Inner NJ
0.33M in-commuters

In-commuters from New Jersey

Inner NJ in-commuters represent the largest share of New York non-resident workforce in Manhattan. They largely rely on the mass transit system and private cars to commute to work.



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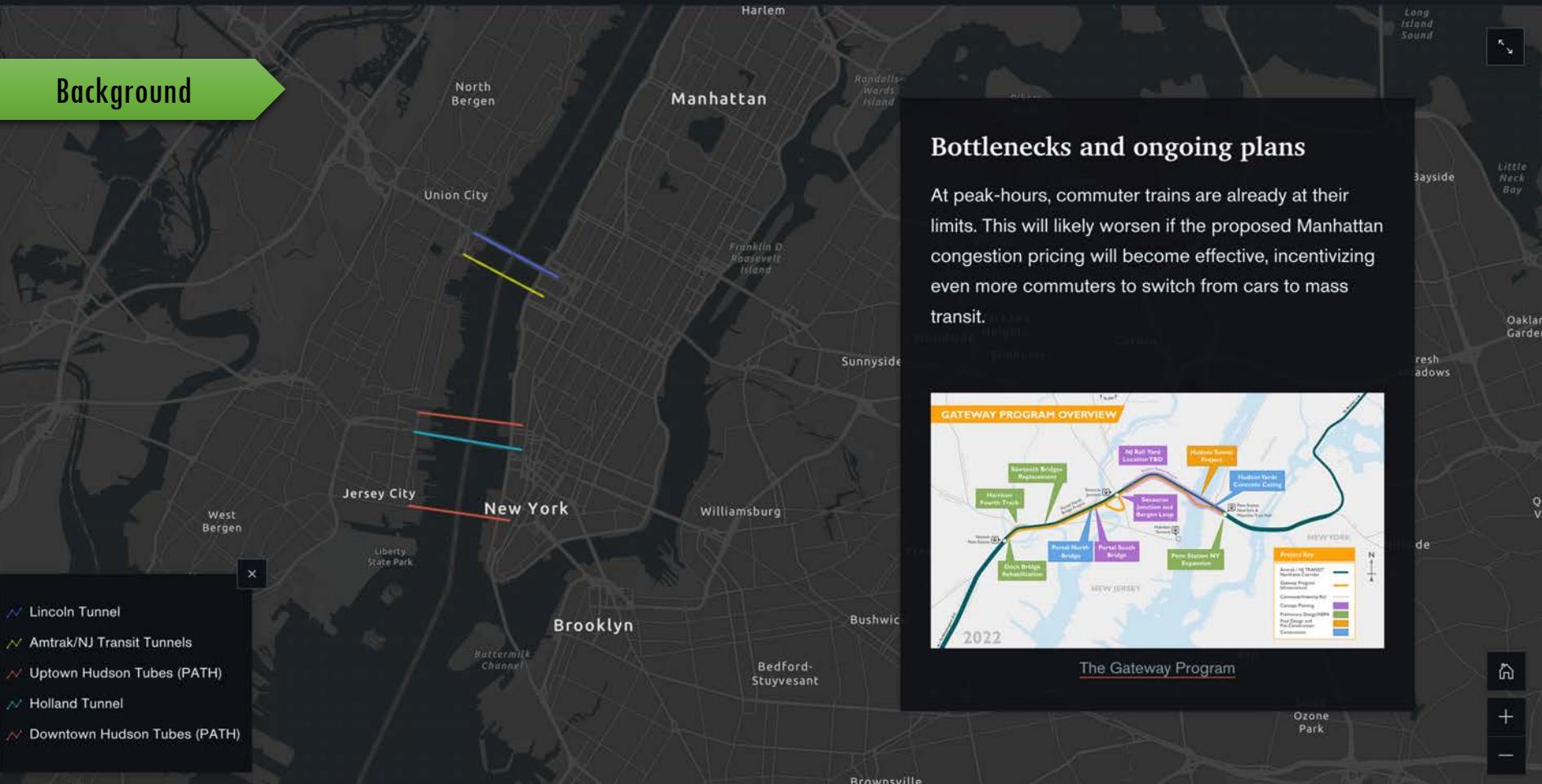
Electrifying NYC Commute

Delivering the Power

What if?

Dive Deeper

Background



An exemplary "What if ..." story



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What if?

Dive Deeper

Background

A map of New York City and surrounding areas, focusing on the George Washington Bridge route. The map shows the bridge crossing the Hudson River from Jersey City to Manhattan. A blue line indicates the route, which is approximately 35 km long and takes about 2 hours by bike. The map also shows the locations of various neighborhoods in Jersey City, New York City (Manhattan, Brooklyn), and New Jersey (Hackensack, Teaneck, Fort Lee). A green arrow points from the text 'Background' towards the map.

George Washington Bridge

~35 km, 2 hour

Hudson River

Parkside

How about micro-mobility between Jersey City and Manhattan?

NYC has many bike lanes, but the George Washington Bridge is Manhattan's only West Side river crossing built with bicyclists and pedestrians in mind. And carrying bikes on the ferry costs extra. As a result, many Jersey residents are obstructed from using micro-mobility such as electric bikes.

NYC Ferry welcomes all NYC bikers!

The right side of the slide features a photograph of a person loading a bicycle onto a NYC Ferry. The ferry is docked at a terminal, and the person is using a bike rack to secure the bicycle. The background shows the interior of the ferry and the water beyond.

An exemplary "What if ..." story



CUSP The Electric Commute

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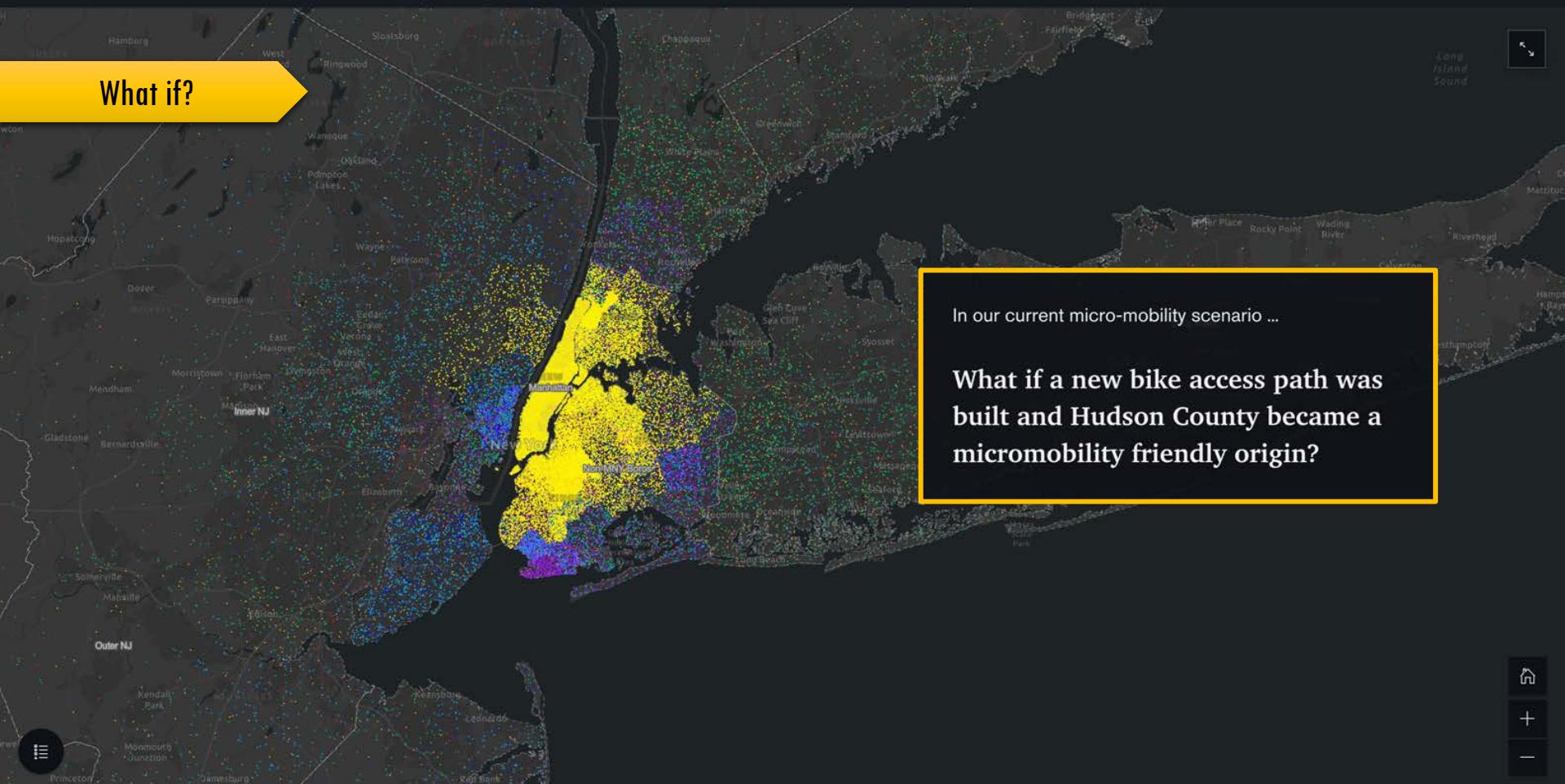
Electrifying NYC Commute

Delivering the Power

What if?

Dive Deeper

What if?



An exemplary "What if ..." story



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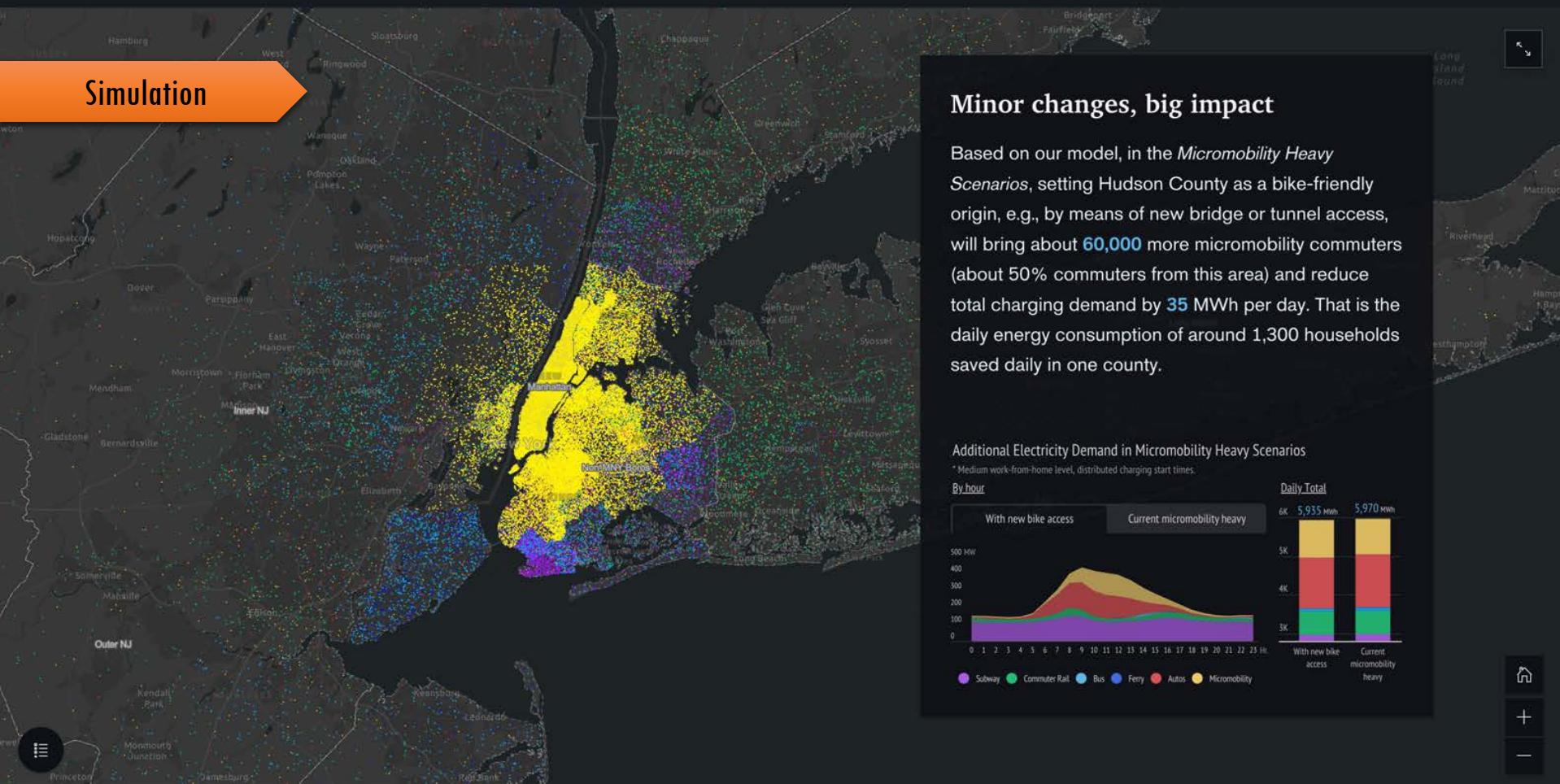
Understanding NYC Commute

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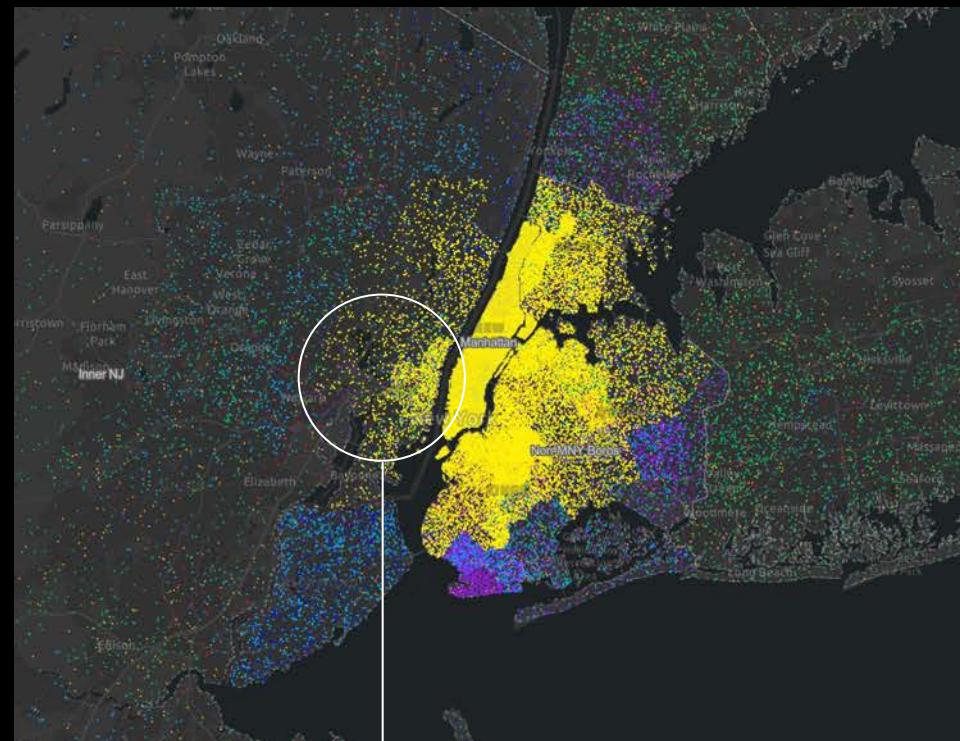
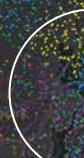
Dive Deeper



An exemplary "What if ..." story

What if a new bike access path was built and Hudson County became a micro-mobility friendly origin?

Summary



Hudson County, 105k commuters



70k+ micro-mobility, 35MWh– charging demand





The Electric Commute

StoryMaps

Code

Dashboard

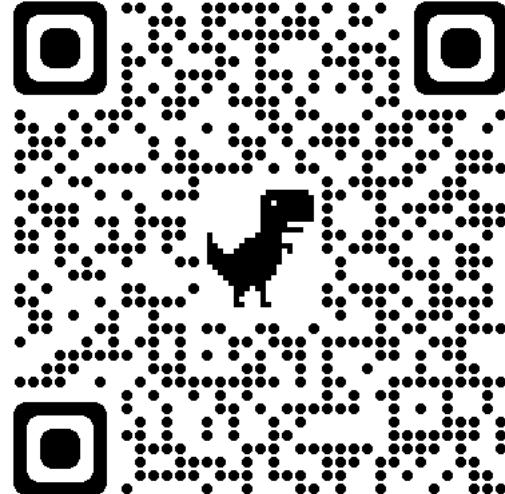
Publication

Open Data · Open Source · Open Science



All here! 🚻

<https://arcg.is/WrvSf>



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jingrong.zhang@nyu.edu

Thank you!

Stay in touch
at beta.nyc/links

NYC
SCHOOL
OF DATA
2023

BetaNYC

#nycSOdata

#NYC

#OpenData

#OpenDataWeek