REPLICA

Replica's Big Data ABM: A Comprehensive Approach for Transportation Operations and Planning

December 8, 2023

Agenda

- Tools
- Data Sources, Methodology
- Validation, Quality
- Use Cases

OUR MISSION

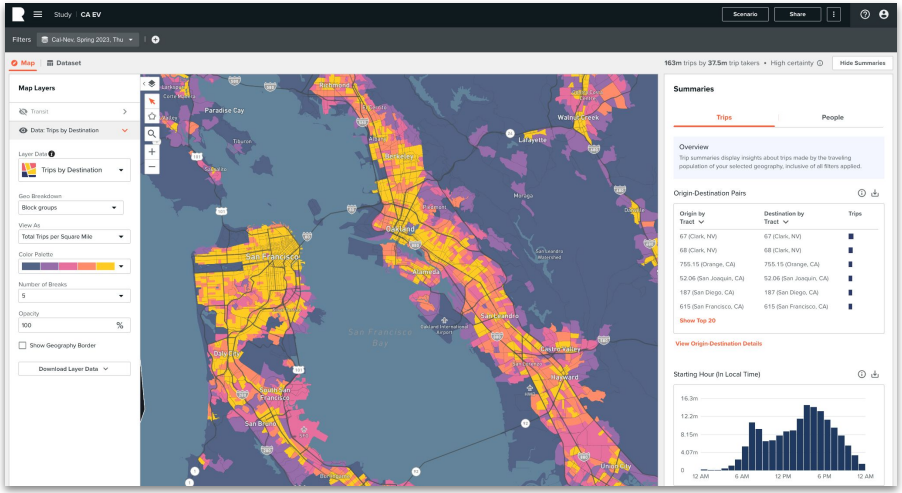
Uncover **data insights** into the **mobility patterns** in your communities, in a way that's **accessible, valuable, and actionable.**

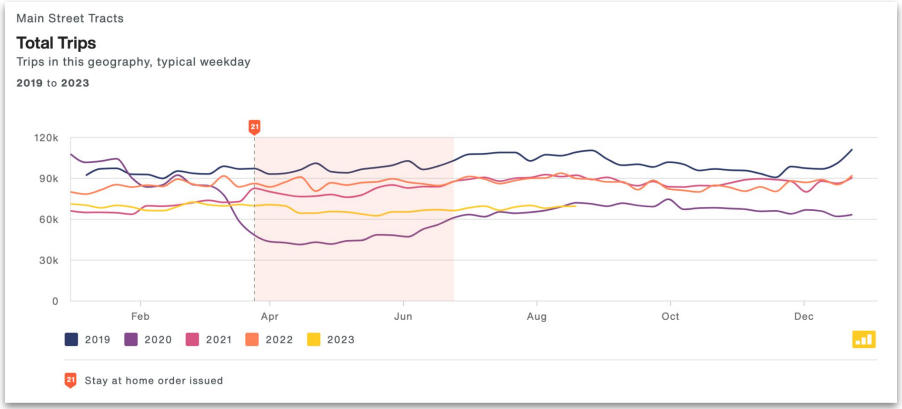
Datasets + Tools

Places
Detailed, disaggregate trip and population data for a particular season (down to block group and network link)

Trends
Near-real time data on mobility and consumer spend (down to Census tract)

Scenario
Builds upon our Places data to forecast future conditions based on potential changes to population, lane use, and transportation infrastructure



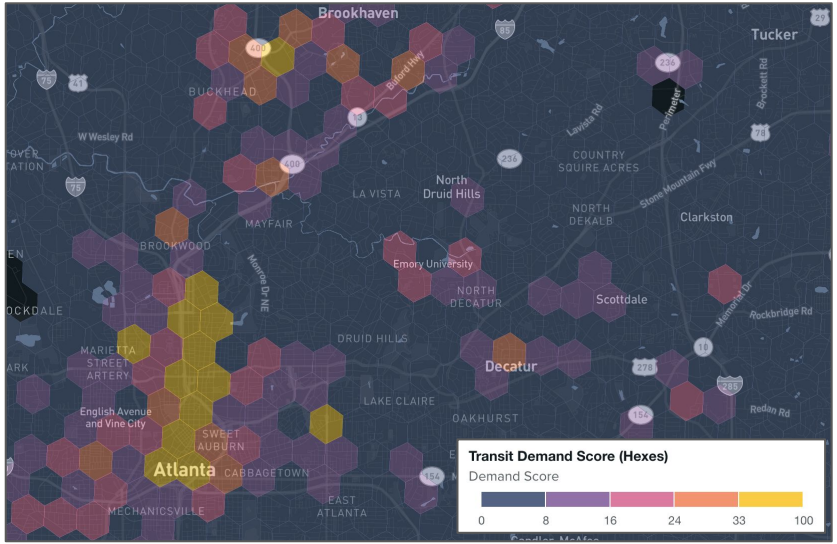


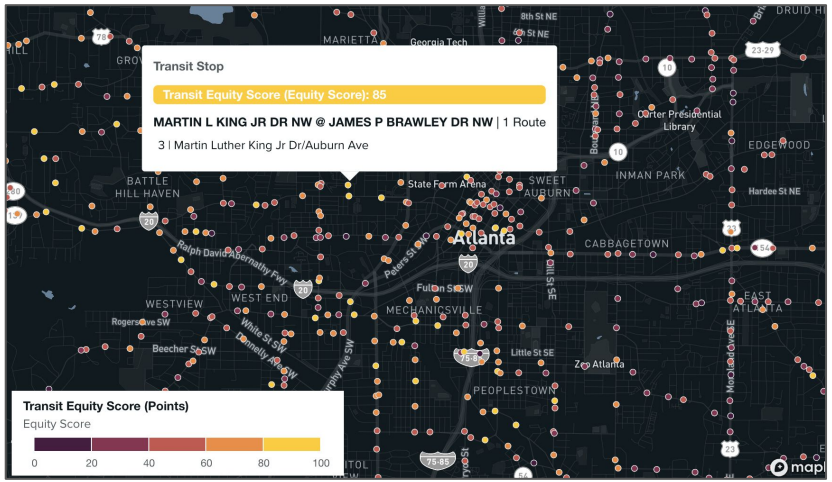
NEW REPLICA TOOL

Transit Demand + Equity

Transit Demand Score: Answers questions about where demand for service is highest and where it would be most utilized if made available.

Transit Equity Score: Answers questions about the existing public transit system and how it serves communities in need.



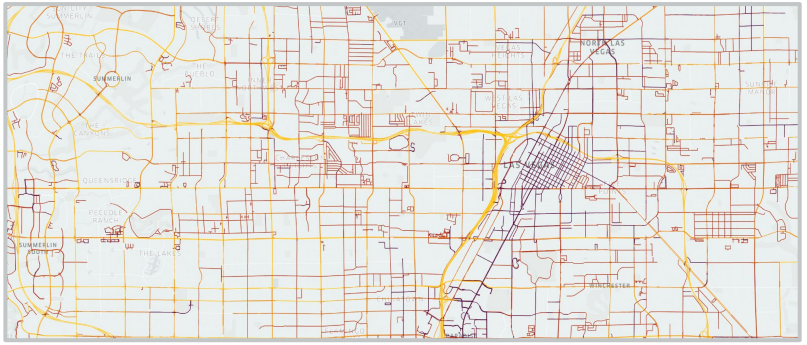


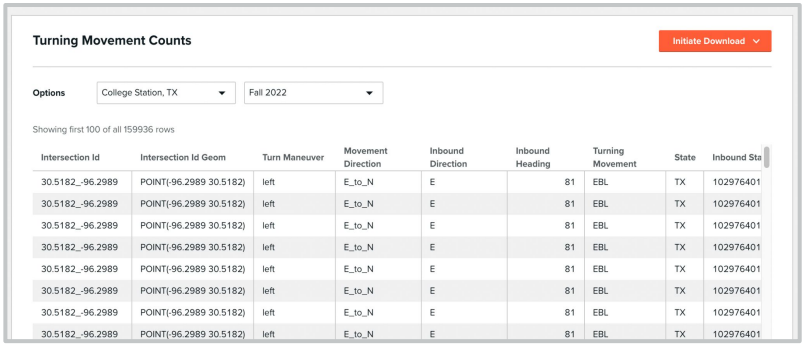
ADDITIONAL DATASETS

Traffic Data

Replica produces a number of additional traffic datasets **at the network link and intersection level**:

- **Annual** free-flow and quarter hourly **speeds**
- **Weekly hourly speeds**
- Vehicular **AADT** and freight AADT on FRC 1+2
- **Turning Movement Counts** at major signalized intersections (controlled for a minimum threshold of observations)





Methodology

Data Inputs

We leverage a diverse set of third-party source data to create our models.

This composite approach is both a risk-mitigation strategy and aligned with our objective to show a **holistic view of the built environment**.

Consumer & Resident Data

Location Data

Built Environment

Economic Activity

Ground Truth Data

HOW IT WORKS

Methodology

Replica generates its data
by running computationally intensive,
large-scale simulations.

These simulations allow us to deliver granular data outputs that match behavior in aggregate, but don't compromise the privacy (or surface the actual movements) of any one individual.

1 Create a **synthetic population** matching the characteristics of a given region

2 Train a number of **behavior models** specific to that region

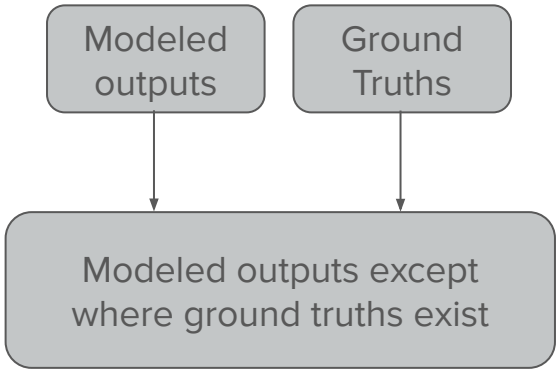
3 Run **simulations** of those models applied to the synthetic population to create a "replica" of transportation and economic patterns

4 **Calibrate the outputs** of the model against observed "ground-truth" to improve quality

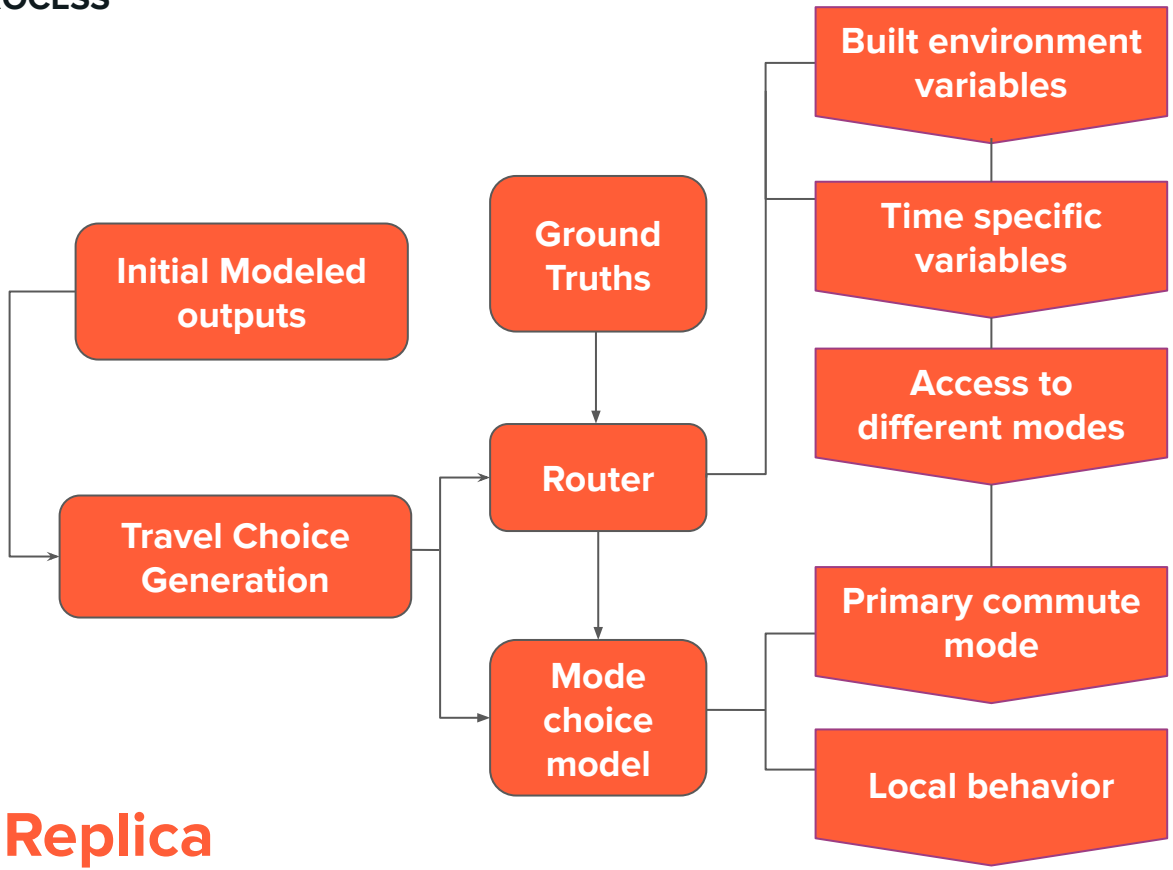
Data Validation

- Ground Truthing
- Quality Reports
- Custom Validations

DATA VALIDATIONS **GROUND TRUTH PROCESS**



Others



Replica

Consistency among agent behaviors and other inputs

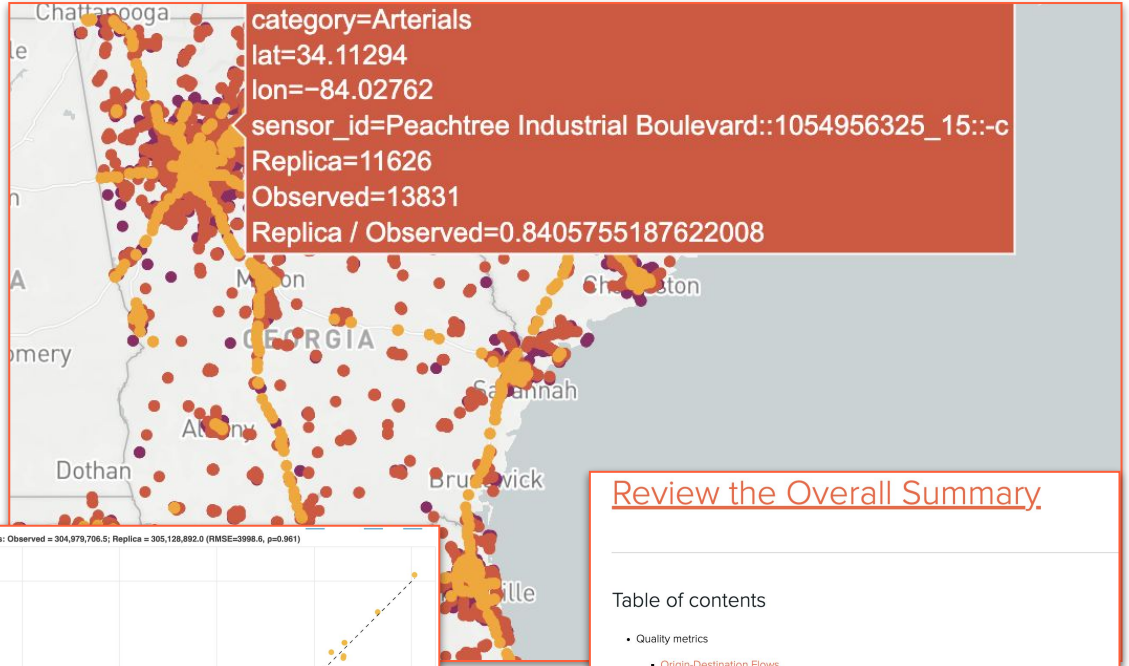
DATA VALIDATION: **QUALITY REPORT**

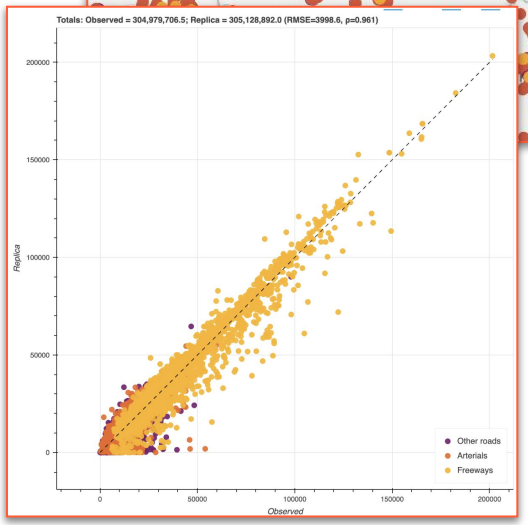
Each release of Replica data comes with a Quality Report for transparent comparison to ground truth and census data.

Sources include auto counts, network volumes, transit ridership, and Uber/Lyft data.

The quality report, and an extensive list of third-party validation reports can be found on our website.

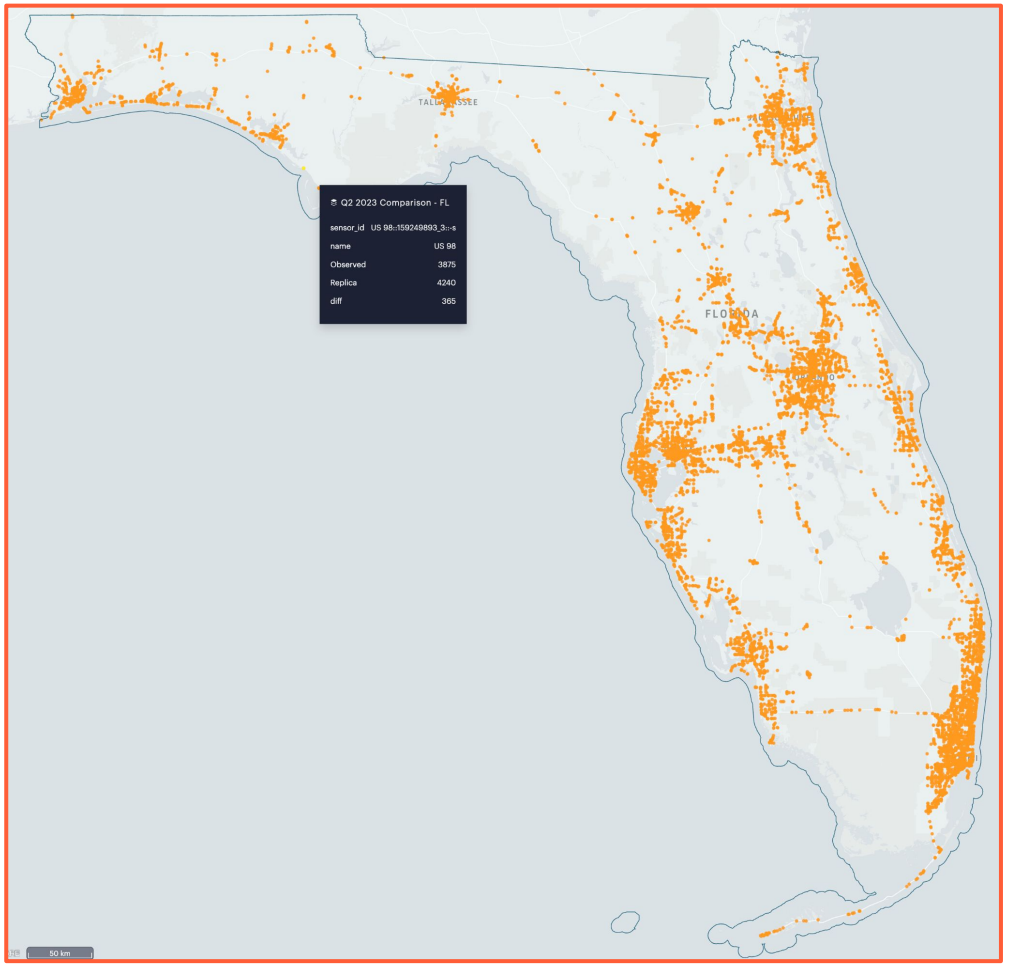
South Atlantic Quality Report





DATA VALIDATION: **FLORIDA**

Daily Volume Aggregate MOE (FL)	
Category	**Error**
1-10K Daily	32%
10-20K Daily	22%
20-30K Daily	15%
30-40K Daily	15%
40-50K Daily	12%
50-60K Daily	12%
60-70K Daily	10%
70-80K Daily	7%
80-90K Daily	9%
90-100K Daily	7%
>100K Daily	6%



Use Cases

Transportation

- Vision Zero, Intersection Safety
- LRTP Plans
- Corridor Studies

Economic Development

- Sales Tax Revenues Forecasting
- Supply Chain Congestion
- Site Selection

Equity & Access

- Access to Transit
- Job Access by Income Level
- Access to Healthcare by Age groups

Disaster Recovery

- Evacuation Route Selection
- EV charging access during evacuation
- Emergency Services Site Selection

Urban Design

- Transit Oriented Development
- Land Use Plan
- Downtown Revitalization Plan

Sustainability

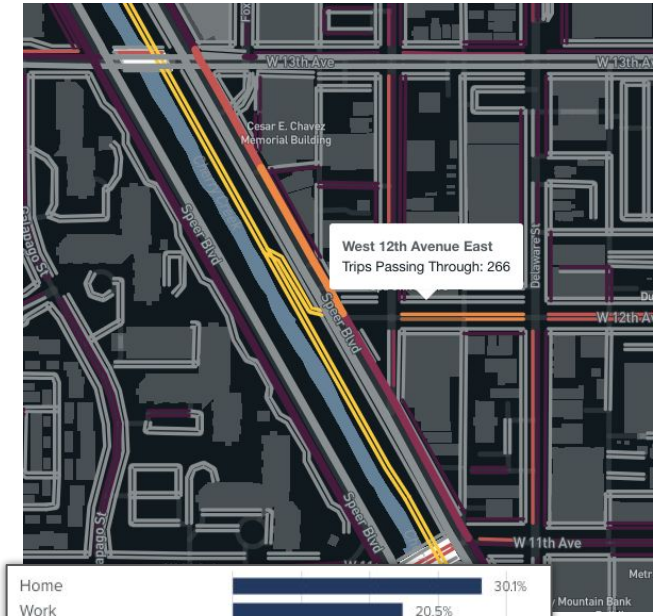
- Environmental Assessment (VMT, etc)
- Congestion Pricing
- EV infrastructure / NEVI

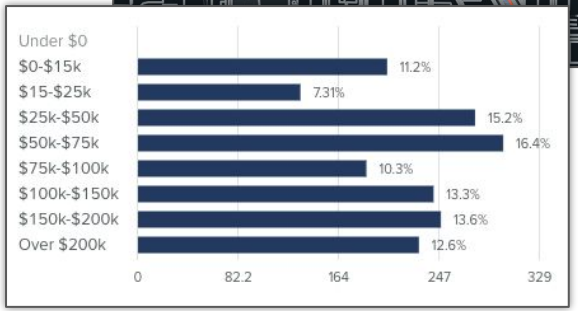
REPLICA

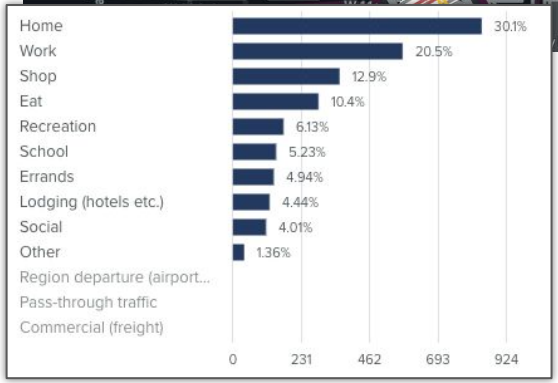
DENVER: **BIKE ROUTES**

Investigate a bicycle facility by identifying:

- Who uses a bike facility
- Most populars connections
- Trip Distance and Length
- Trip Purposes
- Times of Day
- Change over time

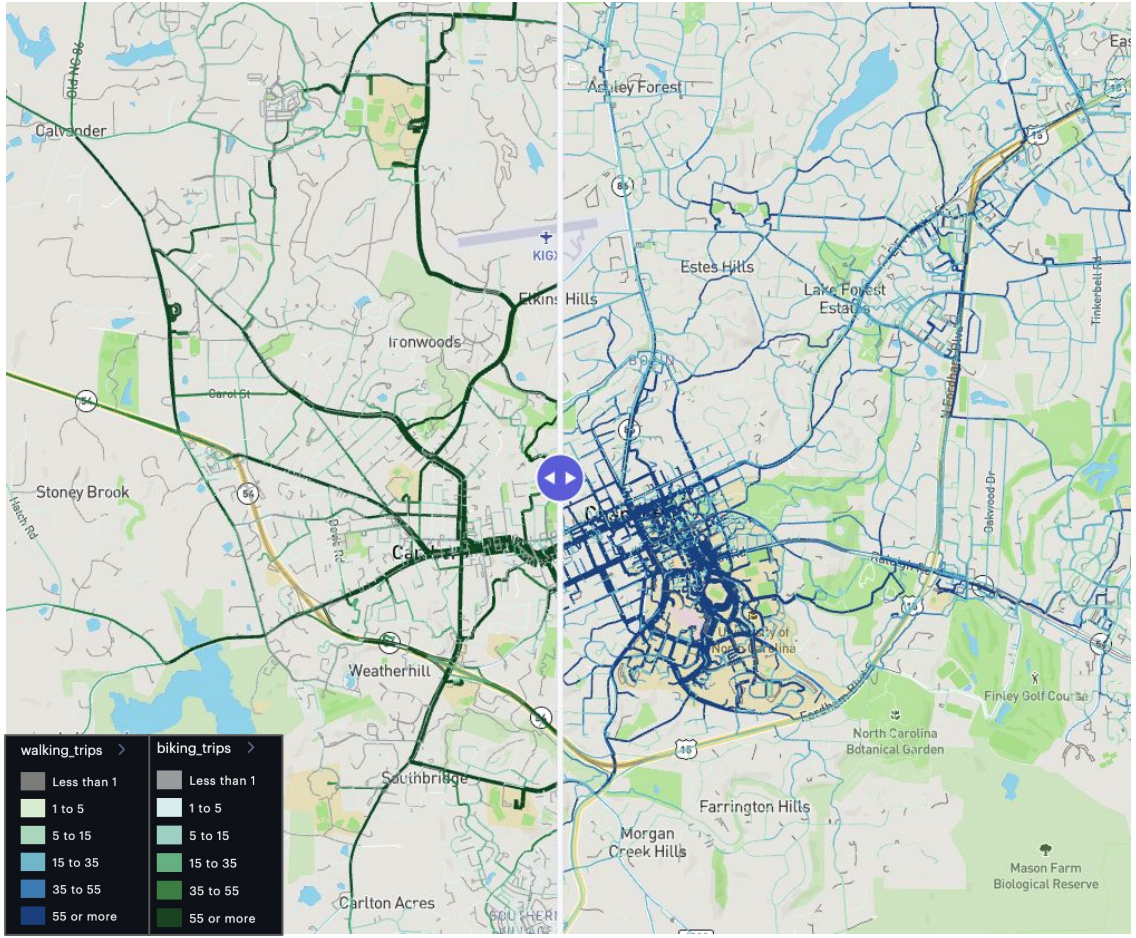






DATA ACCESS

- Visualize active mode trips by network link in app
- Export to csv, shapefile, geoJSON
- Access and query via Google BigQuery in your browser
- Pull and use data in conjunction with your own in Python/R/SQL/others via Jupyter Notebook

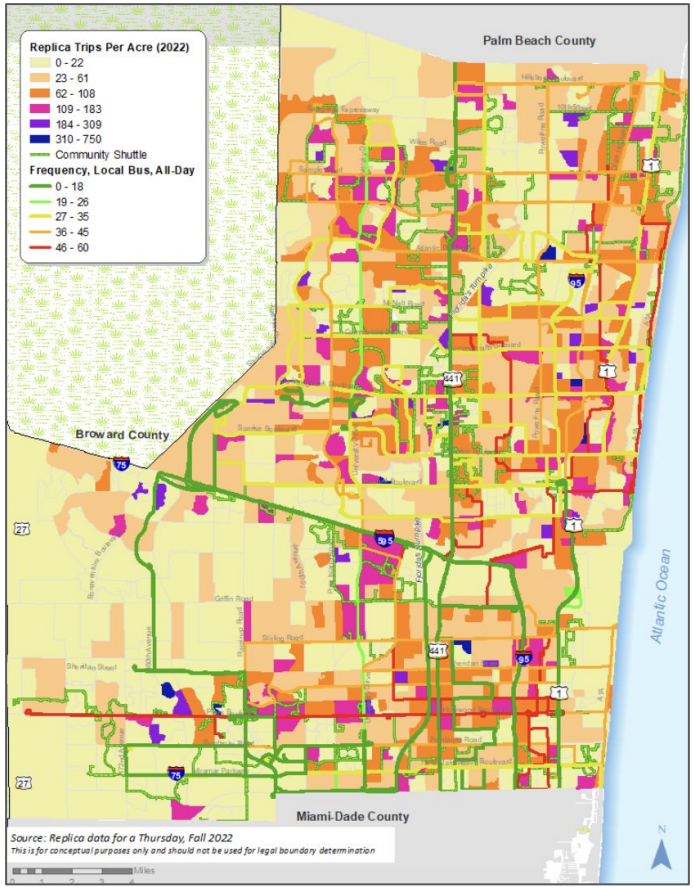


BROWARD COUNTY: **TRANSIT DEVELOPMENT PLAN**

Broward County uses Replica data Origin and Destination flows to study trips between different block groups within Broward County.

In their **2024-33 TDP**, the agency used Replica data for several analyses. The map shown here facilitates transit planning by identifying block groups with a **high and low amounts of travel** so that they can be compared with **transit service offered**.

Broward County also looked at trip changes from 2019 to 2022 to identify how demand is changing in Broward.



Map highlights trips per acre by block group in 2022.

TXDOT: **ORIGIN-DESTINATION ANALYSIS**

Overview

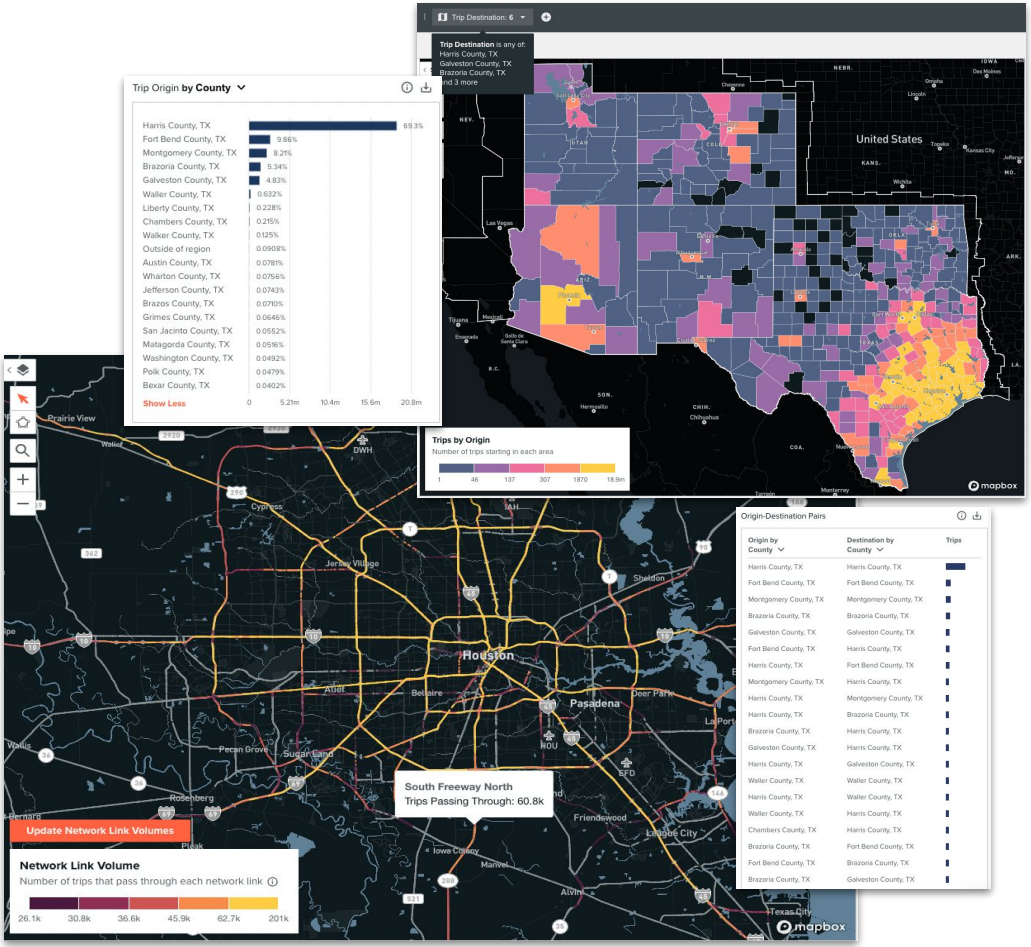
TxDOT Houston District performed an origin-destination analysis using Replica data to better understand travel flows within the 6-county district.

Solution

In Replica, district staff filtered the Replica Places data by trips originating/ending in Brazoria, Fort Bend, Galveston, Harris, Montgomery, or Waller county then visualized the corresponding origins/destinations at the county level.

Further Analysis

Replica's network link volumes map layer was also applied to provide additional insight into which roadways were most commonly used.

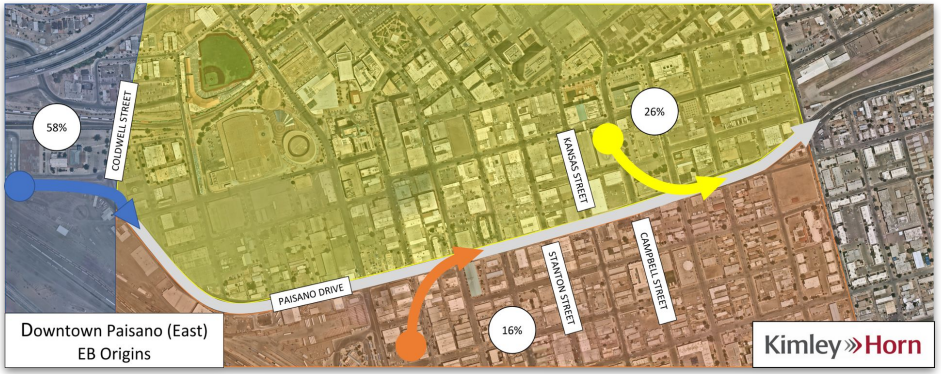


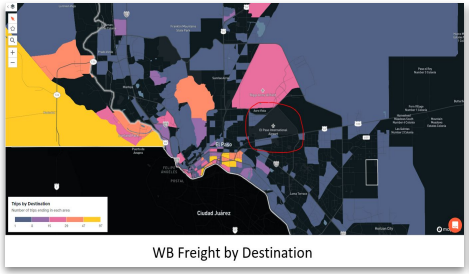
Paisano Dr. Corridor Study

Overview: Corridor planning study in the TxDOT El Paso District to improve multi-modal safety and mobility along Paisano Drive. The 11.5-mile corridor study will produce short-, mid- and long-term improvements for Paisano Drive.

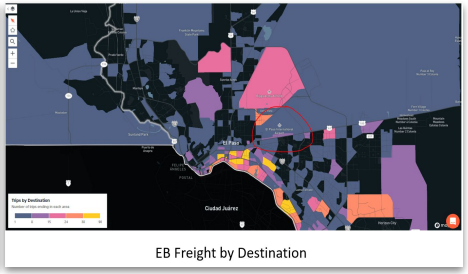
Solution: Kimley-Horn analyzed Replica's origin-destination data to better understand travel patterns along the corridor

- OD flows by mode, specifically private auto, freight, walking, and biking
- Travel time distribution





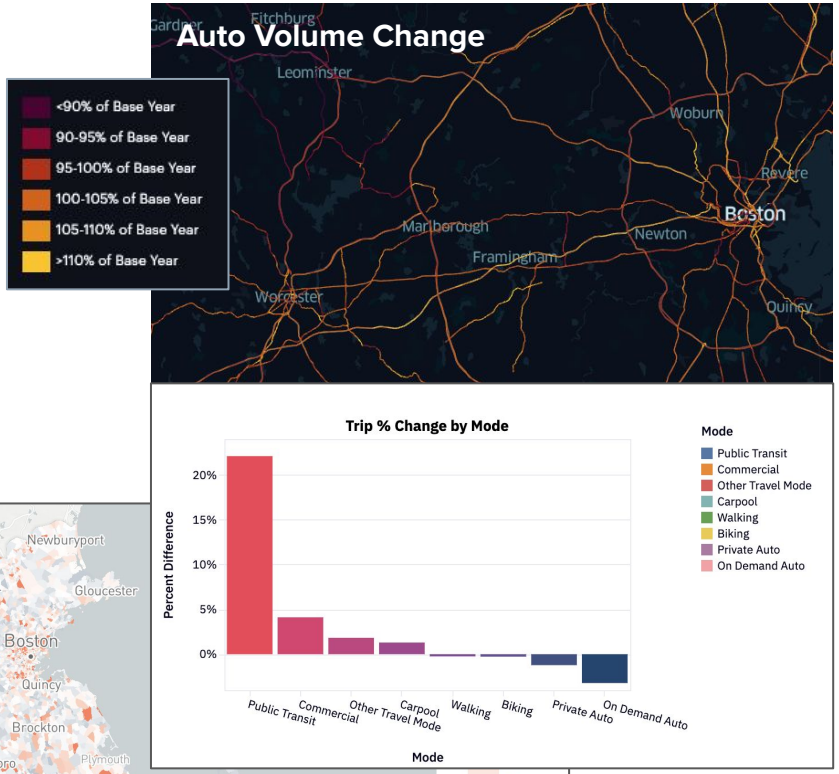
WB Freight by Destination



EB Freight by Destination

CTPS + MASSDOT: **SCENARIO PLANNING**

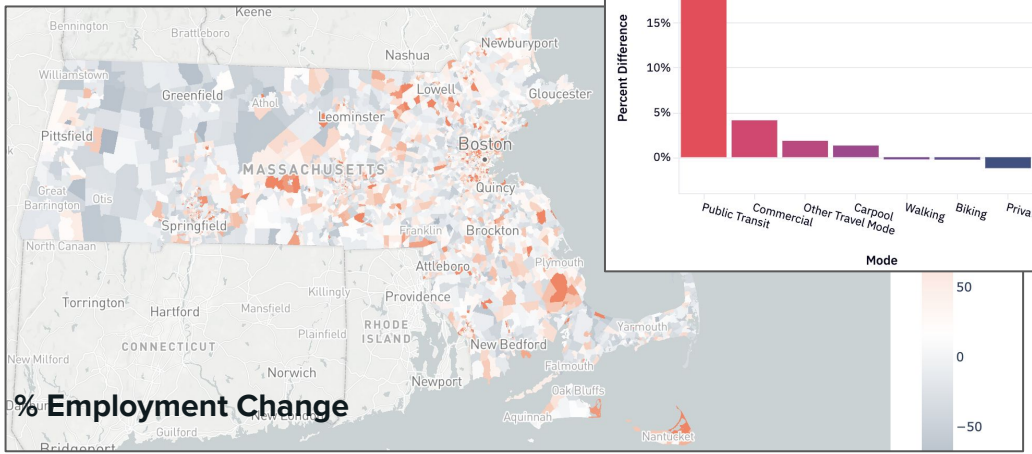
MassDOT and Boston Region MPO (CTPS) used Replica's Scenario to model mobility + employment changes by their proprietary TAZs, to understand the future demand for transit, stressors to road network, and changes to VMT based on their population growth estimates.



VMT by City

City	Base	Build	Diff
Woburn, MA	745.4K	895.3K	149.9K
Methuen Town, MA	1.3M	1.4M	177.2K
Marlborough, MA	930.6K	1.0M	94.5K
Danvers, MA	559.5K	615.0K	55.5K
Gloucester, MA	745.7K	811.2K	65.5K
Pittsfield, MA	731.3K	789.1K	57.7K
Quincy, MA	1.2M	1.3M	91.8K
Norwood, MA	563.1K	602.2K	39.0K
Revere, MA	532.0K	566.3K	34.3K
Framingham, MA	1.4M	1.4M	75.0K
Worcester, MA	3.1M	3.2M	111.8K
Haverhill, MA	1.6M	1.7M	52.8K

1 2 ... 5 59 rows



TRAVEL DEMAND MODELING

Agencies use Replica's data to update their TDM base year data and to validate existing models.

A number of customers use Replica data to augment and inform their travel demand modeling with recent and robust data.

The Boston Region MPO ("CTPS") has validated Replica traffic engineering data such as free-flow speeds data. CTPS is currently building out their new TDM23, in support of a new LRTP using several inputs from Replica.

San Diego Association of Governments (SANDAG) used Replica's network link volumes, speeds, and travel time data in developing an ABM3 for their 2025 Regional Plan.

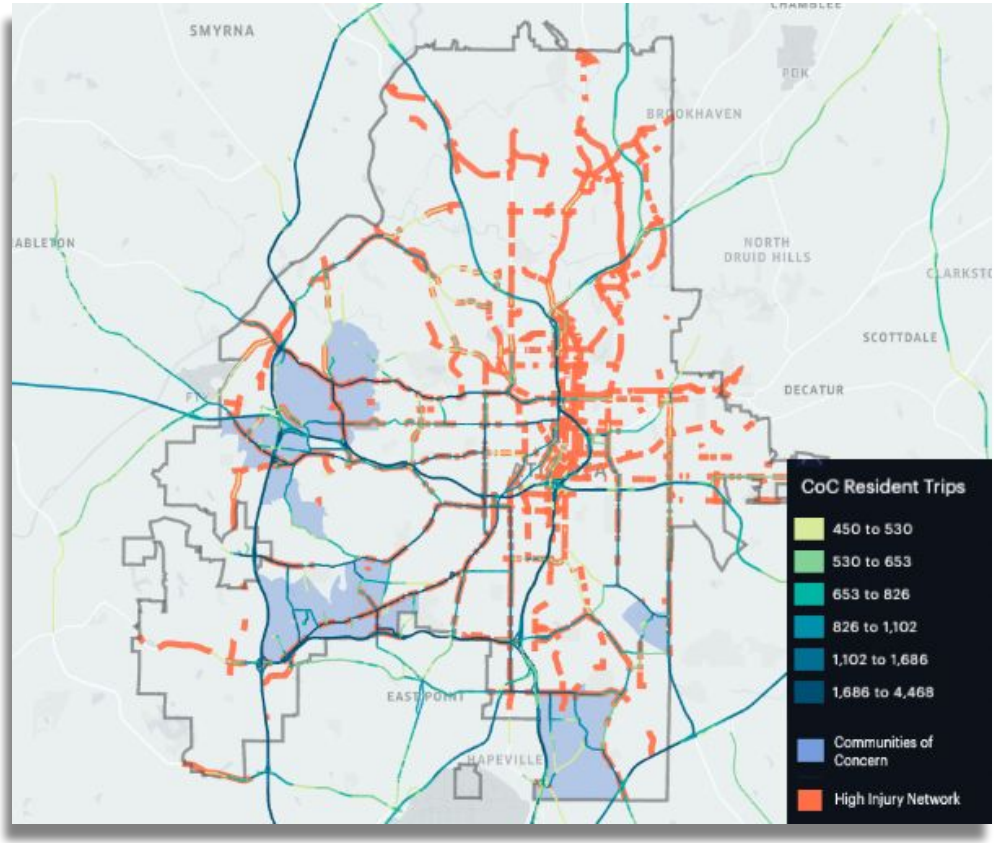
CAMPO used Replica to validate their TDM. They relied on OD flows in the Austin MPO six-county region including sub-areas (~30) and external stations (major roads accessing the region).

ATLANTA: **COC TRIPS ON HIN**

Overlaying the High Injury Network with network link volumes of Residents of Communities of Concern can help create a more holistic approach to Vision Zero.

- CoC resident travel patterns have a clear overlap with HIN streets
- These overlaps extend beyond the borders of CoC neighborhoods
- Isolate resident travel activity

This provide a more holistic, equitable approach to Vision Zero planning.



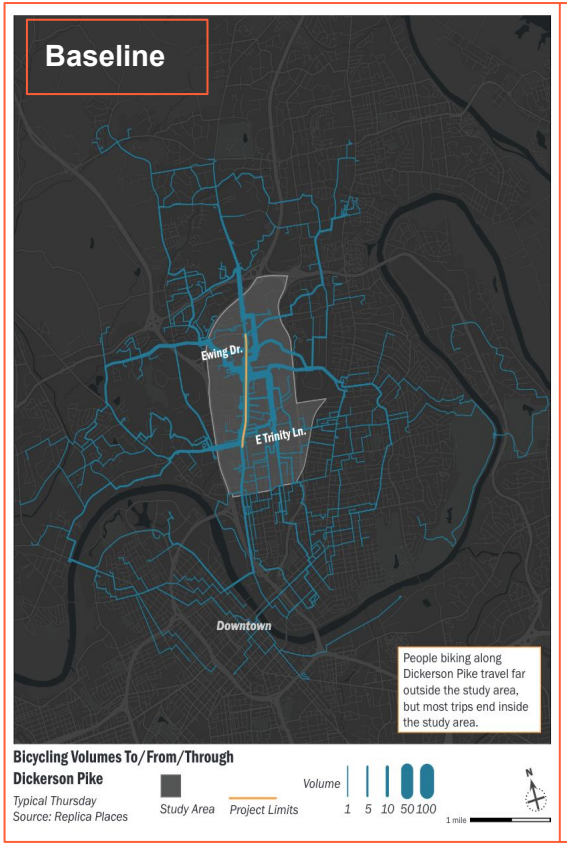
Click here to view web map

TNDOT: **COMPLETE STREETS**

Replica data was used to investigate change in bicycling and pedestrian activity.

Dickerson Pike was shown to have some of the most acute increases in active mode volumes in Nashville and to impact trips far beyond the immediate community.

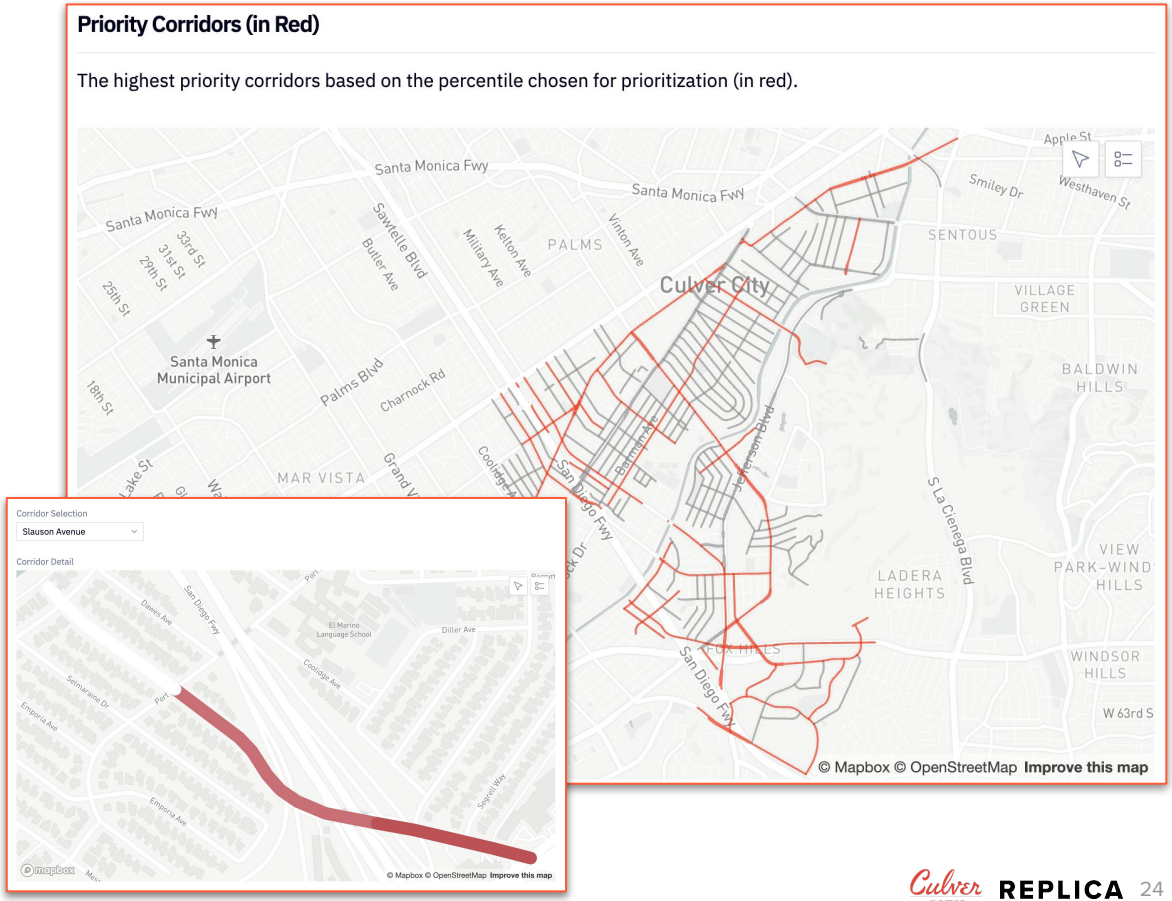
Replica data was used to justify a Complete Street Project and show how it can bolster growing trends, encourage mode shift, and benefit the communities surrounding Dickerson Pike.



CULVER CITY: **IDENTIFYING HIGH CONFLICT CORRIDORS**

Combining Replica data with driver behavior data you can map driver events and active mode trips to **create a corridor prioritization ranking based on highest conflict areas per mile of corridor**.

Culver City now has recent data to support prioritization of active transportation infrastructure and other interventions to **promote safe streets for walking and cycling.**

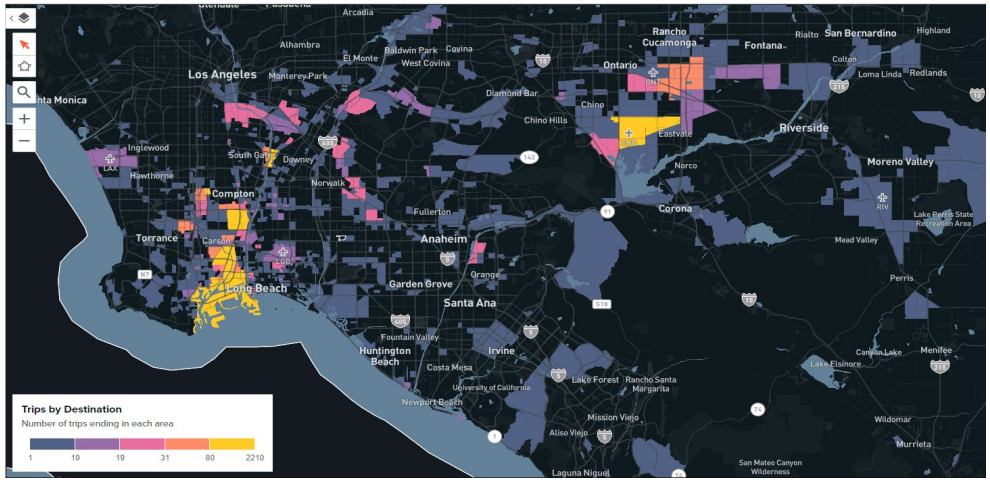


DEWBERRY: **PORT OF LONG BEACH**

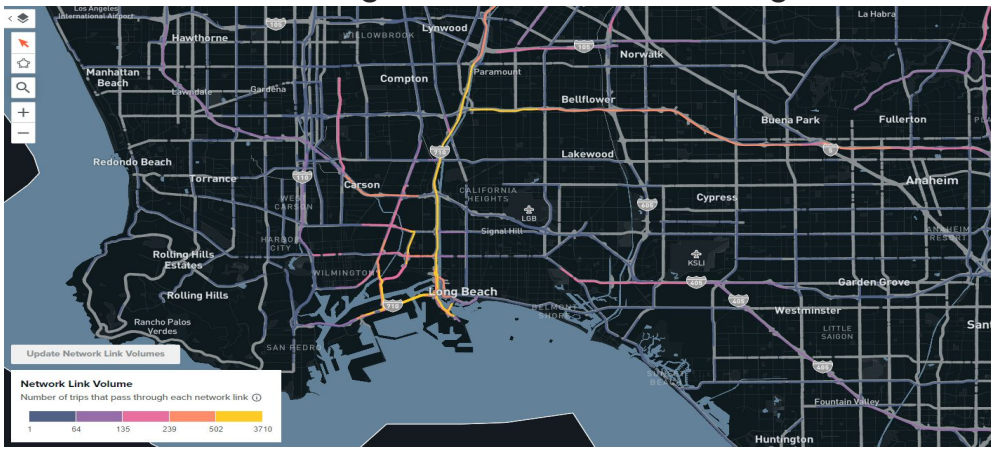
Dewberry consultants used Replica data to analyze freight movements in the Port of Long Beach (POLB) region.

Replica freight data provided insights into the top destinations and the specific corridors used.

Based on the the results of the study POLB received a **$70M Trade Corridor Enhancement Grant** to improve safety and reduce impacts to surrounding communities.



Freight Destinations after leaving POLB

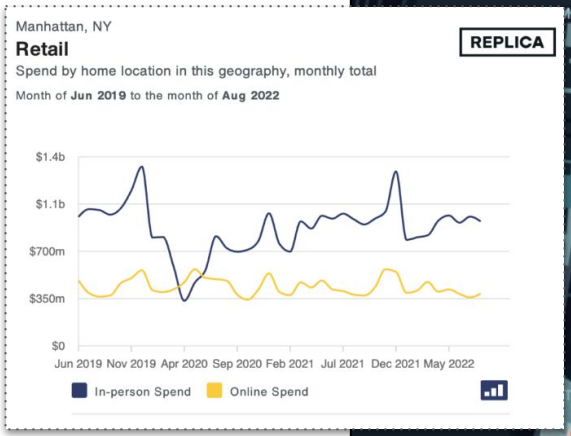


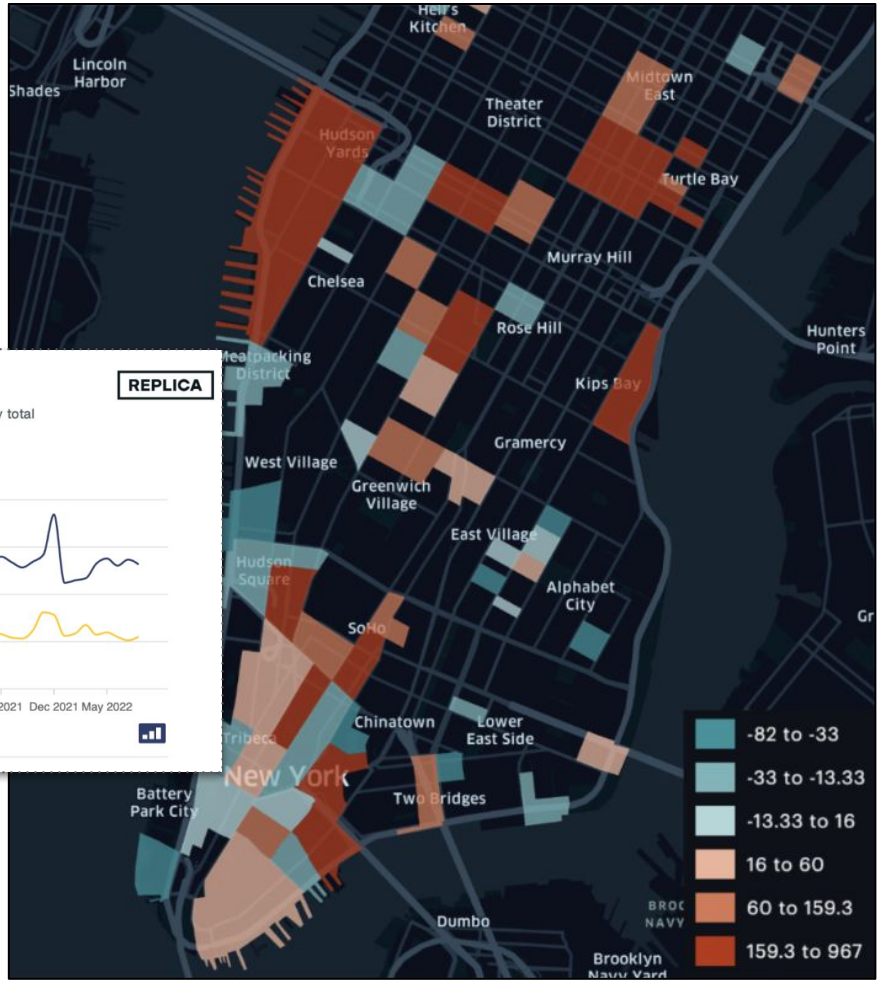
Routes used by Freight after leaving POLB

NEW YORK CITY: **FREIGHT EFFICIENCY**

Replica data is more than a snapshot in time. Our spend data helps quantify another post-pandemic phenomena - decline of efficiency in freight trips.

This chart illustrates that spending is about the same - but truck activity has grown. Less efficient areas require **more freight parking per dollar of retail spending**, potentially impacting safety, emissions, congestion, and quality of life for residents.



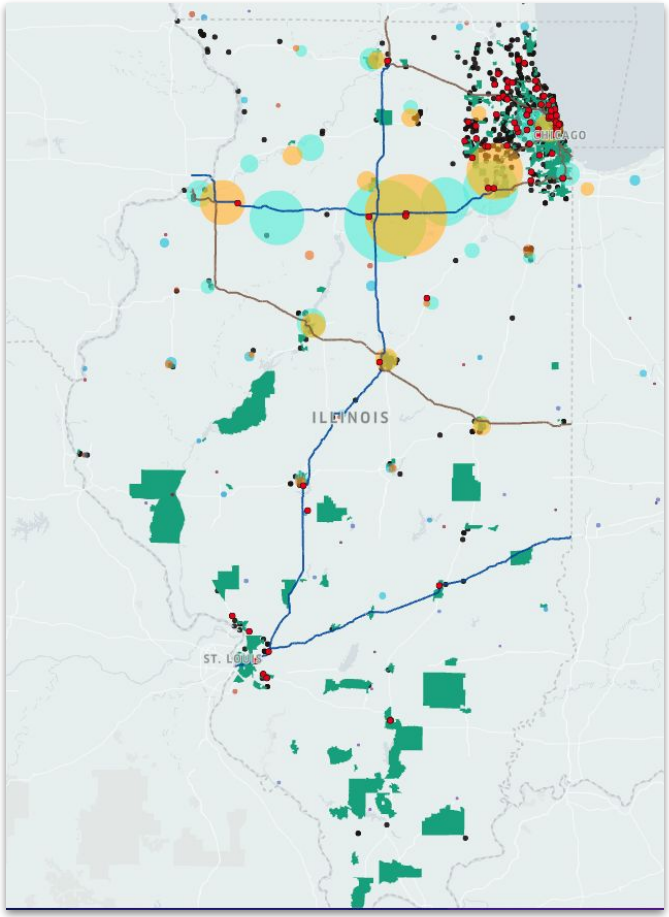


ILLINOIS: EQUITY + **EV CHARGING**

Illinois DOT used Replica to evaluate existing and planned EV charging stations relative to the travel patterns of low-income minority populations across Illinois.

They integrated Replica data with Justice40 DAC GIS shapefiles & U.S. DOE Alternative Fuel datasets

This can inform public policy by leveraging Replica data and public data in a third-party application



Legend

- Existing DC Fast Charging Stations
- All Public/Private Charging Stations
- Justice40 DACs for DOE/DOT
- EV Corridor Ready (sufficient stations exist)
- EV Corridor Pending (insufficient stations exist)
- Work location cluster for daily low-income I-80 travelers
- Home location cluster for daily low-income I-80 travelers

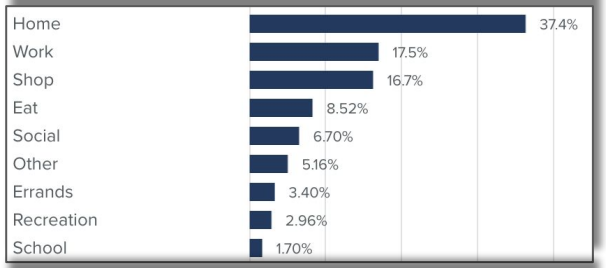
Click here to view the interactive map

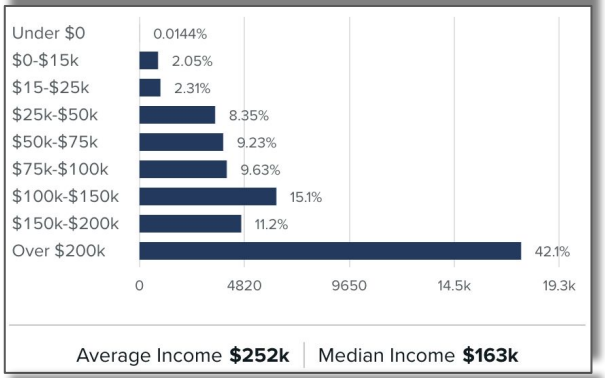
PENNSYLVANIA **EV DATA BEV OWNERSHIP**

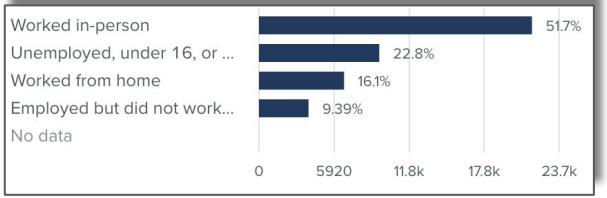
Replica's data allows you to identify concentrations of EV ownership, but the data is also disaggregate, thus enabling analyses like:

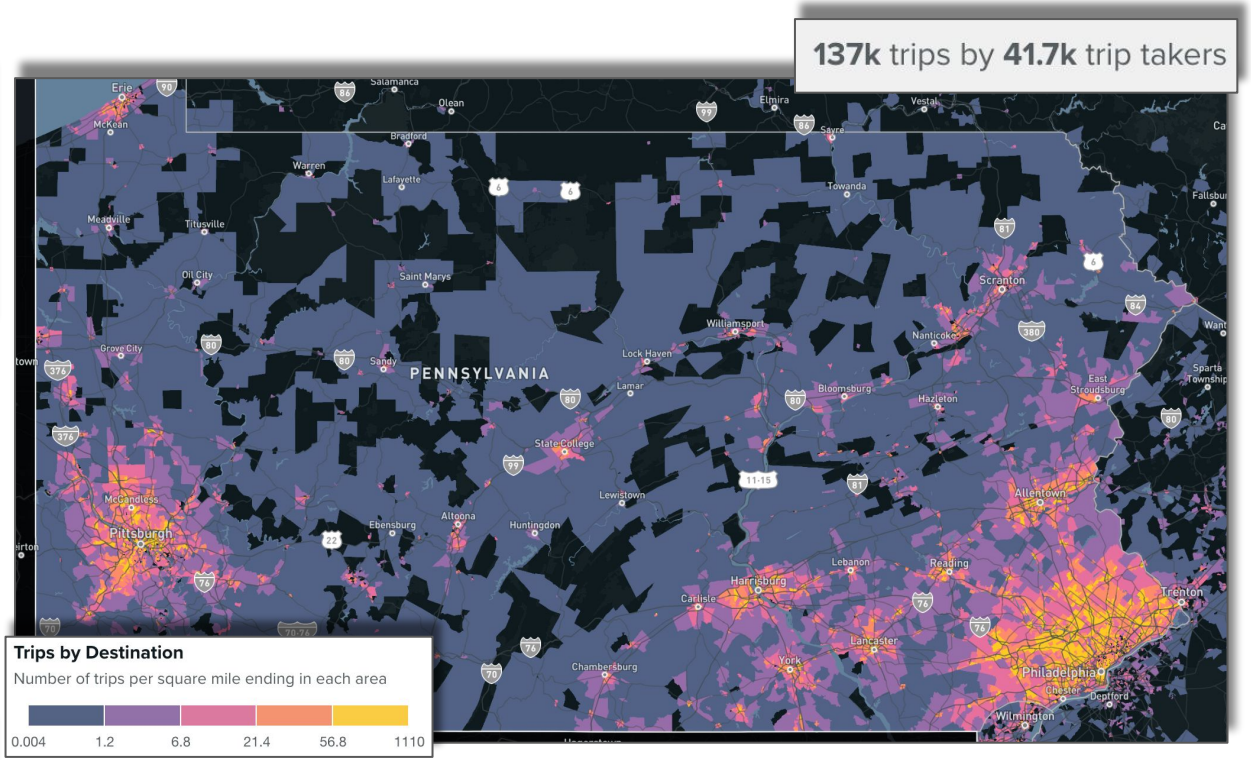
- VMT by fuel type
- Trip O/Ds made by electric vehicles
- Demographic information about EV trip-takers

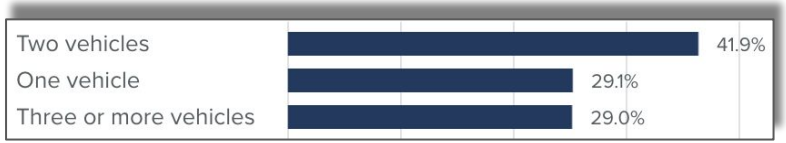
PENNSYLVANIA **BEV OWNERS**









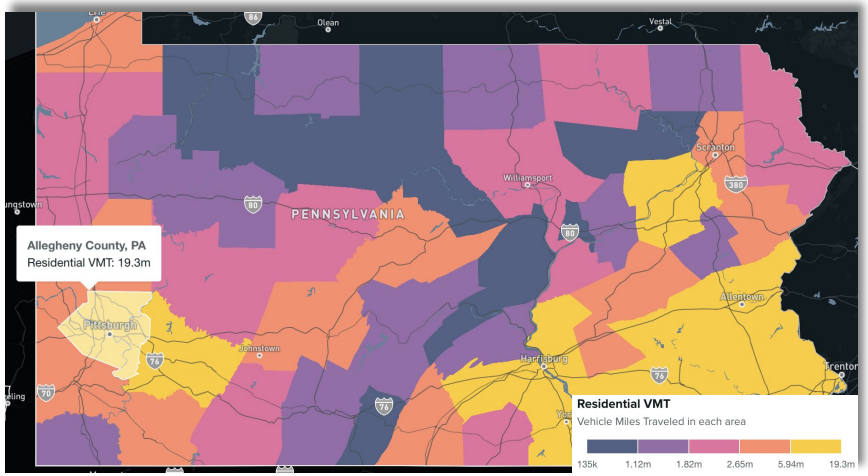


PENNSYLVANIA **VMT PER CAPITA**

Using Replica data, we looked at VMT across the state - **Allegheny County** has the highest residential VMT.

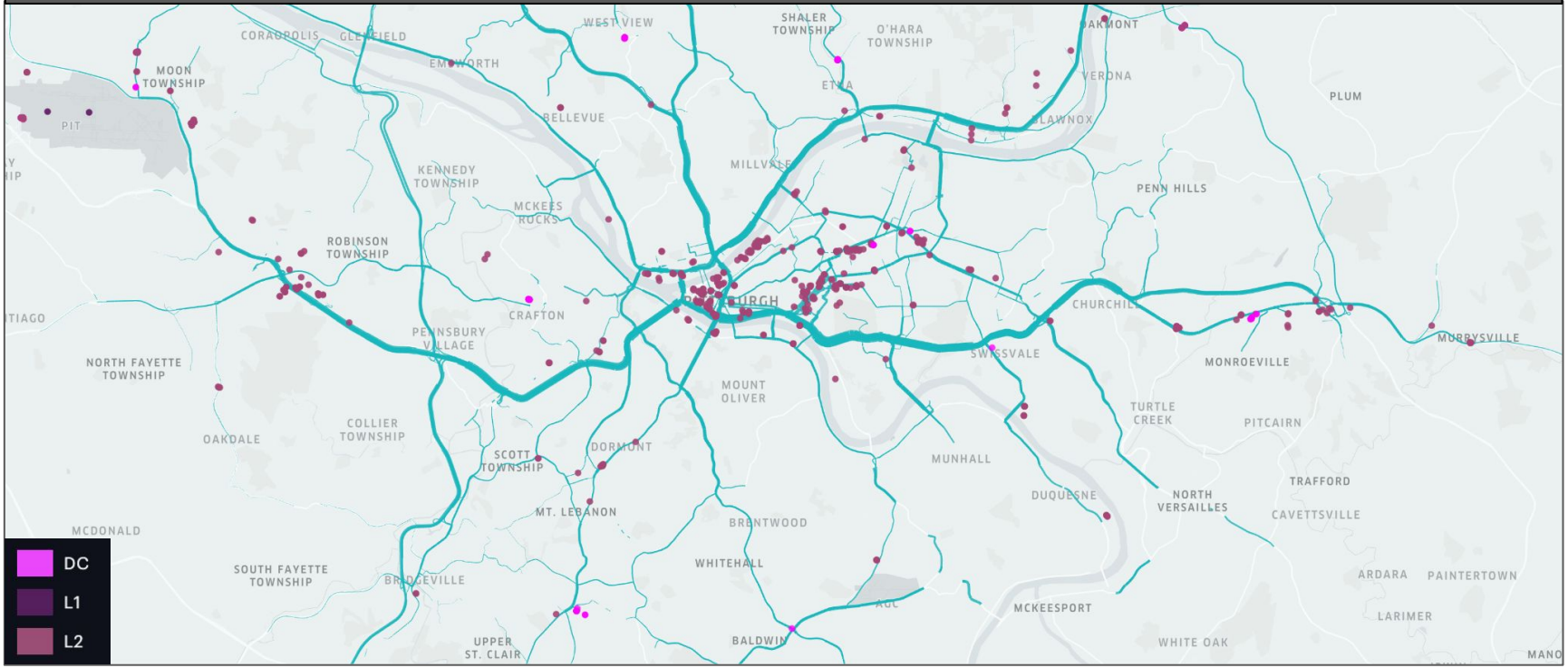
We isolated **network link volumes** to trips with private autos, **by the lowest income residents**, with the highest VMT to identify where EV charging may be most important, for those that may only have access to low capacity EV battery vehicles.

Can continue the analysis by looking at economic impact of top shopping destinations.



ALLEGHENY COUNTY **EV CHARGER SITING**

Top 10 percentile of Lower Income, Multi-Family, and BEV Volumes & Existing EV Chargers



GA MUG: **ATLANTA METRO ACS COMPARISON COMMUTE MODE**

Commute Mode	ACS (5Yr 2021)		Replica (Fall 2021)		Difference	
	Count	Percent Total	Count	Percent Total	Raw	Percent
Not Working	3,077,716	51.2%	3,076,403	51.1%	(1,313)	0.0%
Private Auto	2,385,545	39.7%	2,449,588	40.7%	64,043	2.7%
Worked at Home	401,755	6.7%	389,817	6.5%	(11,938)	-3.0%
Public Transit	68,534	1.1%	70,755	1.2%	2,221	3.2%
Walking	35,661	0.6%	34,937	0.6%	(724)	-2.0%
Bicycle	4,101	0.1%	4,372	0.1%	271	6.6%
Other	34,142	0.6%	-	0.0%	(34,142)	-100.0%
Total	6,007,454	100.0%	6,025,872	100.0%	18,418	0.3%

Compared here are 2021 5-Year ACS outputs to Replica's Synthetic Population for Fall 2021 for residents of **Atlanta-Sandy Springs-Roswell, GA** CBSA. *Replica data augments ACS in the following ways:*

- Synthetic population augmentation from 3rd party data
- More granular geospatial processing
- "Other" category is attributed to observations from other sources

GA MUG: **ATLANTA METRO ACS COMPARISON COMMUTE DURATION**

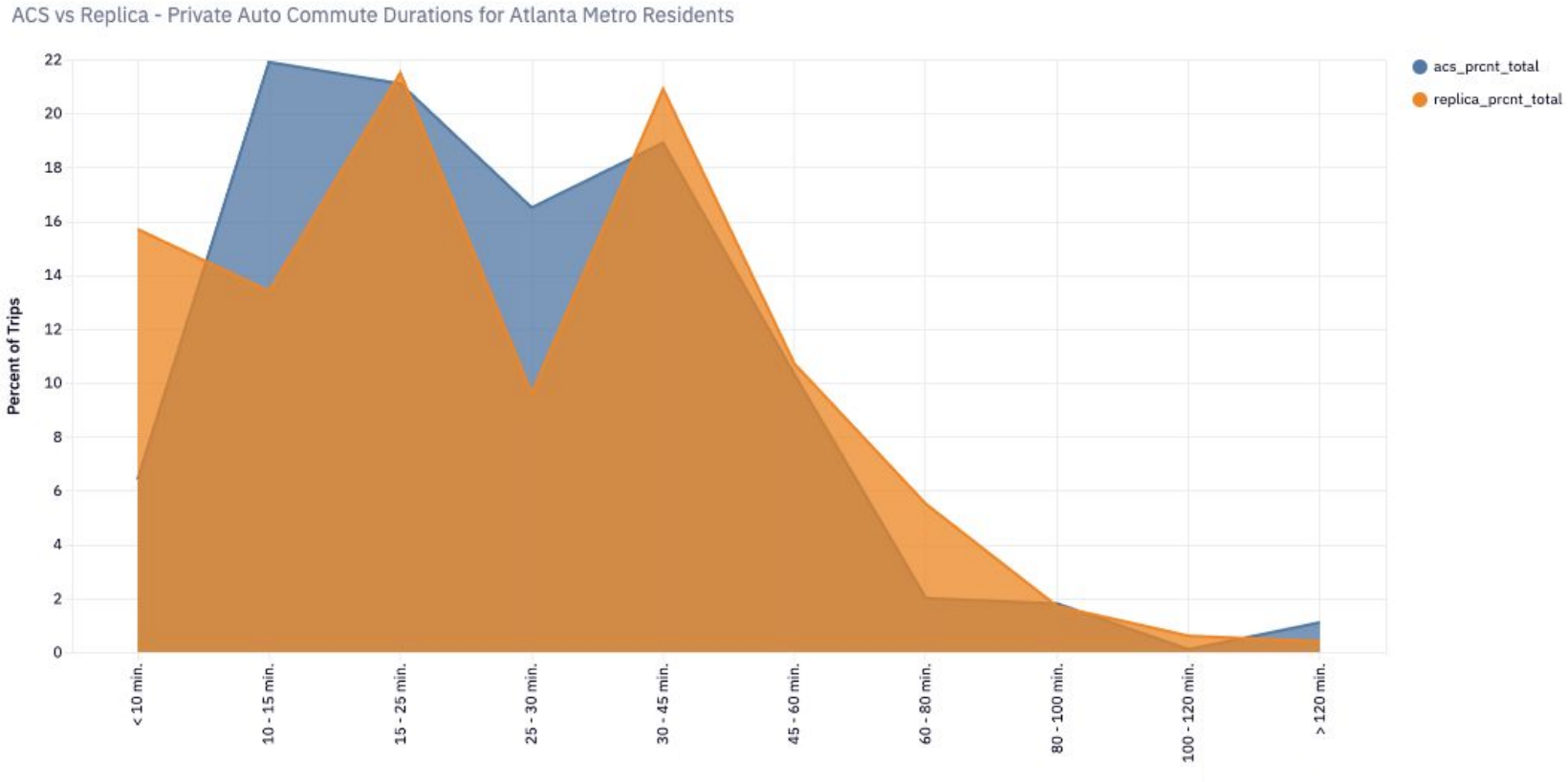
Commute Duration	ACS (5Yr 2021)		Replica (Fall 2021 Weekday)		Difference	
	Count	Percent Total	Count	Percent Total	Raw	Percent
1 - 10 Minutes	390,680	15.5%	304,665	16.3%	(86,015)	-22.0%
11 - 15 Minutes	336,919	13.3%	204,152	10.9%	(132,767)	-39.4%
16 - 25 Minutes	517,791	20.5%	401,492	21.5%	(116,299)	-22.5%
26 - 30 Minutes	409,786	16.2%	184,179	9.9%	(225,607)	-55.1%
31 - 45 Minutes	466,851	18.5%	403,035	21.6%	(63,816)	-13.7%
46 - 60 Minutes	265,376	10.5%	205,538	11.0%	(59,838)	-22.5%
> 60 Minutes	140,580	5.6%	162,243	8.7%	21,663	15.4%
Total	2,527,983	100.0%	1,865,304	100.0%	(662,679)	-26.2%

Compared here are 2021 5-Year ACS outputs to typical weekday for Fall 2021 in Replica data for residents of **Atlanta-Sandy Springs-Roswell, GA**, excluding non-workers and those working from home.

Replica data augments ACS in the following ways:

- WFH modeling specific to time, location, and industry of employment
- Exclusions of shift workers and hybrid workers working from home on the modeled weekday
- Congestion, Routing, and GTFS constraints for specific routes on the modeled weekday

GA MUG: **ATLANTA METRO ACS COMPARISON COMMUTE DURATION**



Q + A

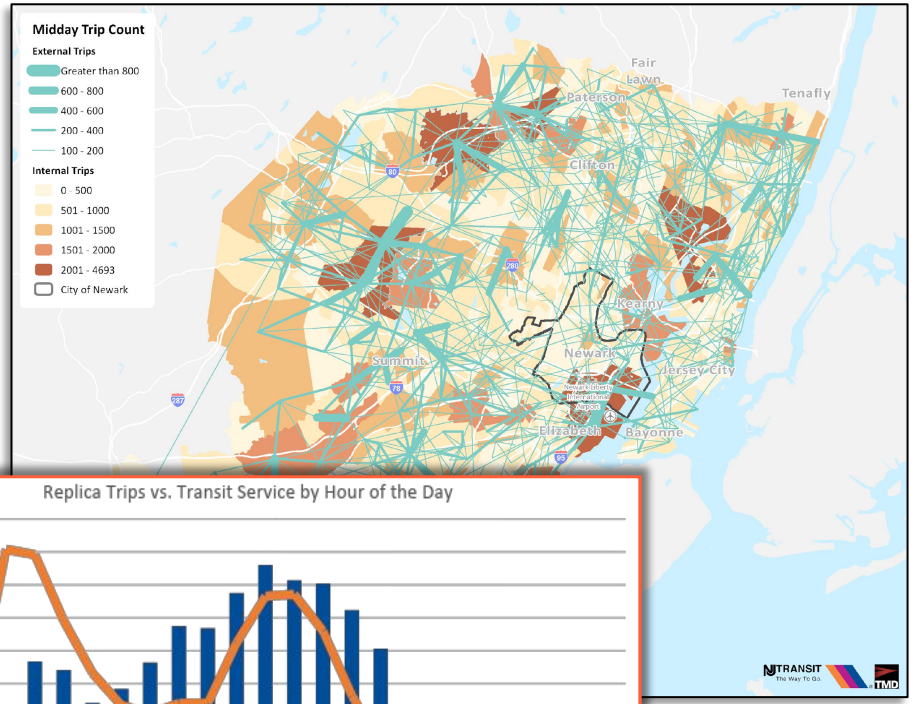
Additional Use Cases

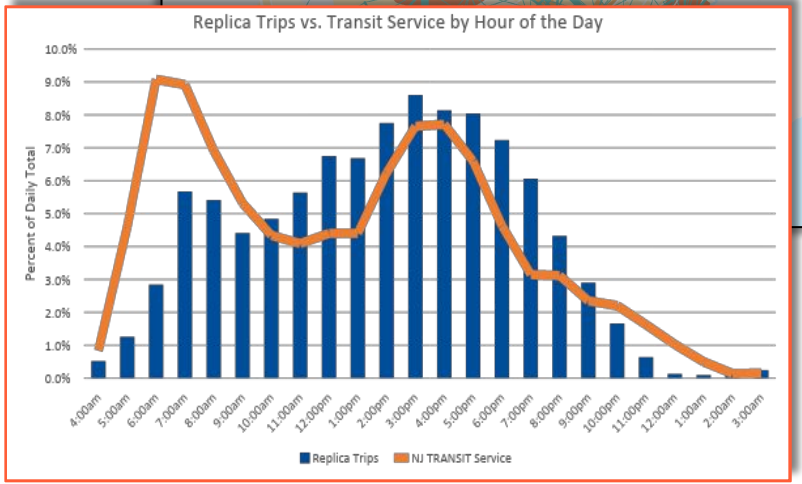
NEW JERSEY TRANSIT: **TRANSIT EQUITY**

Replica data was used for an equity analysis for New Jersey Transit to better align service schedules with demand.

Demand changed significantly after Covid with the shift to WFH. Orange line represents transit service by hour vs. the bar chart is the distribution of trips by hour.

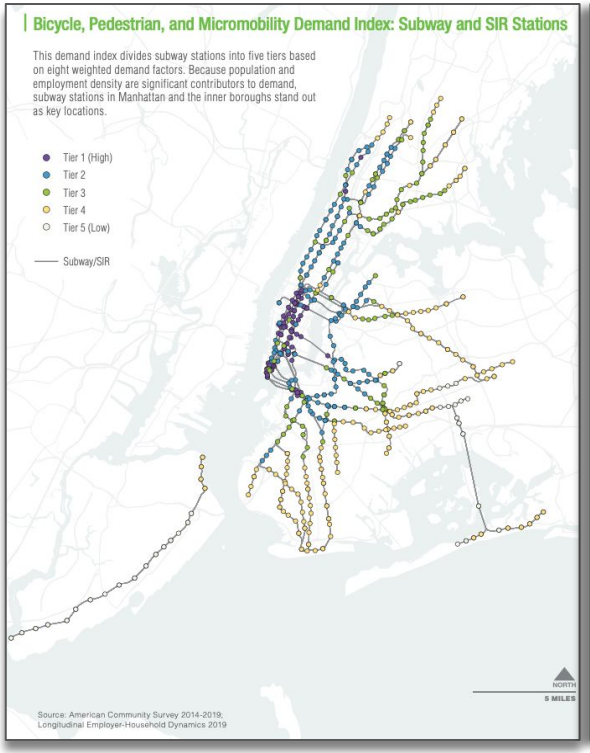
By layering demographic and disaggregate data on how DAC travel, NJT was able to modify service schedules to provide access to a wider rider base.

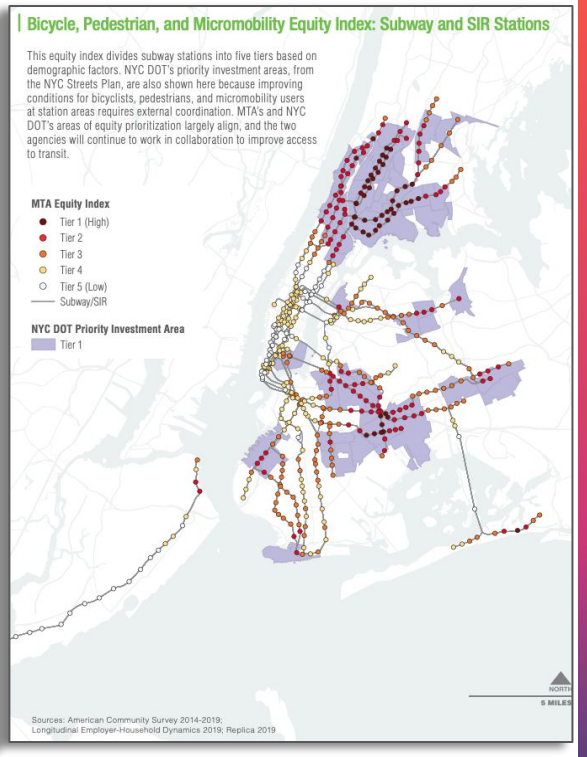




NEW YORK CITY MTA: **TRANSIT CONNECTIONS**

For their recent report "Extending Transit's Reach," the **MTA developed demand and equity indices** that evaluate conditions surrounding subway stations, bus stops, commuter rail stations, and bridge access points. Facilities with **high equity** and **demand** indices are key candidates to be considered for **improved bicycle, pedestrian, and micromobility** access.

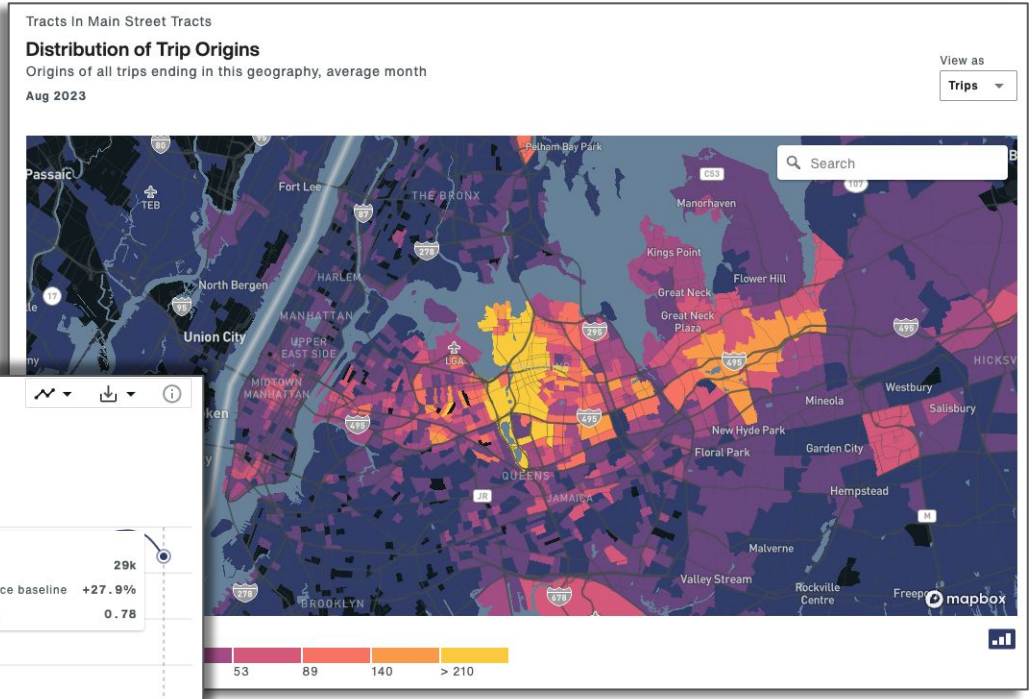


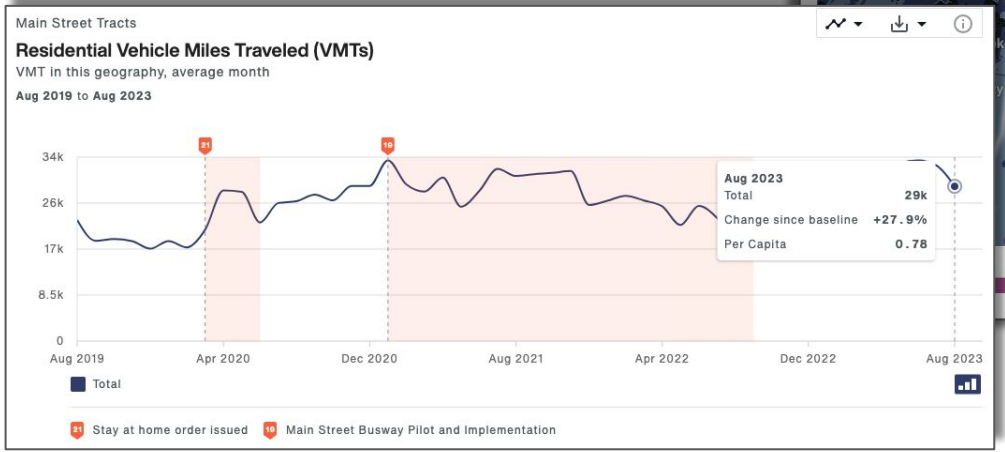


NYC FORDHAM ROAD: **CONSUMER SPENDING**

Eric Adams Promised to Be the Bus Mayor. Riders Are Still Waiting.

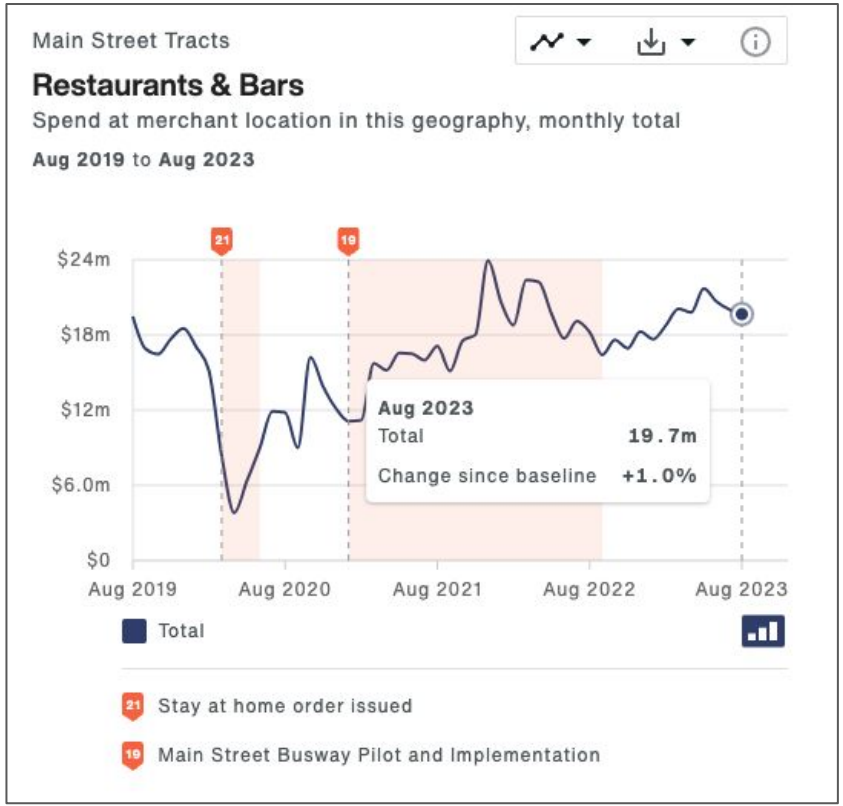
A letter to the mayor from Mr. Feliz and three state lawmakers last month said the new plan would "**negatively impact our thriving economic, social, and health ecosystem**,"

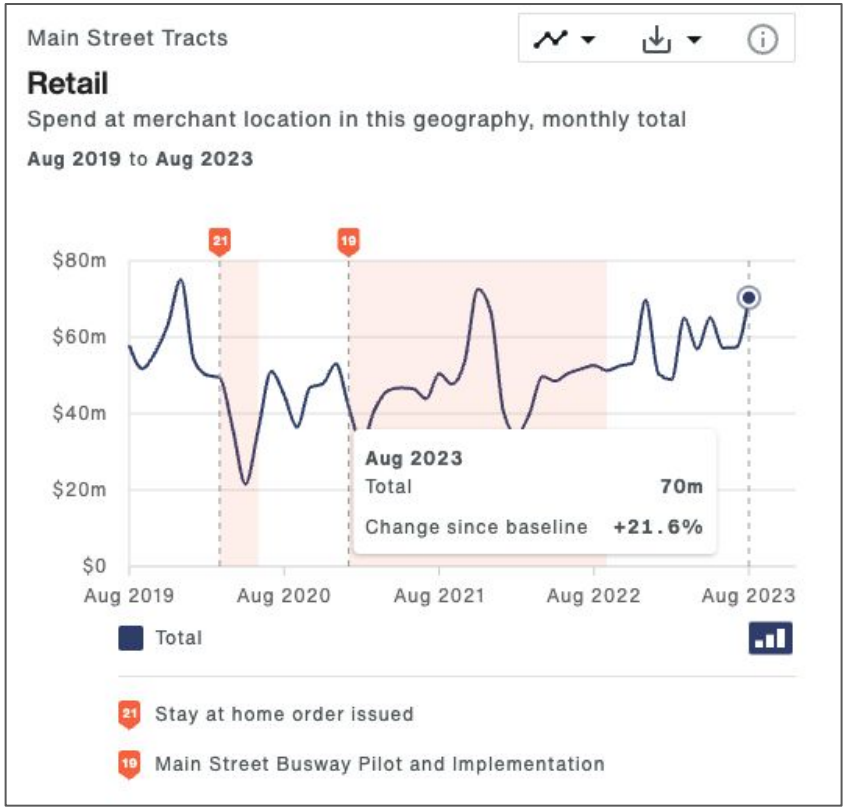




Replica Weekly data and [NY Times Aug, 2023]

NYC FORDHAM ROAD: **CONSUMER SPENDING**





Replica Weekly Trends data

What Makes Us Different?

Comprehensive data sources - uniquely bringing in **active transportation**, taxi/**TNC,** transit, passenger vehicles and freight

A complete picture, including **economic activity data**

Disaggregated data first, aggregated to any level of geography

No PII ingested ever - ensuring privacy and granularity

A platform built for visual storytelling, accessible to a range of technical and non-technical users

Equity-focused insights and metrics

Transparent Methodology

REPLICA

Thank you

Amy Lopez
alopez@replicahq.com

Arthur Getman
arthur@replicahq.com