Equitable Access to E-Mobility

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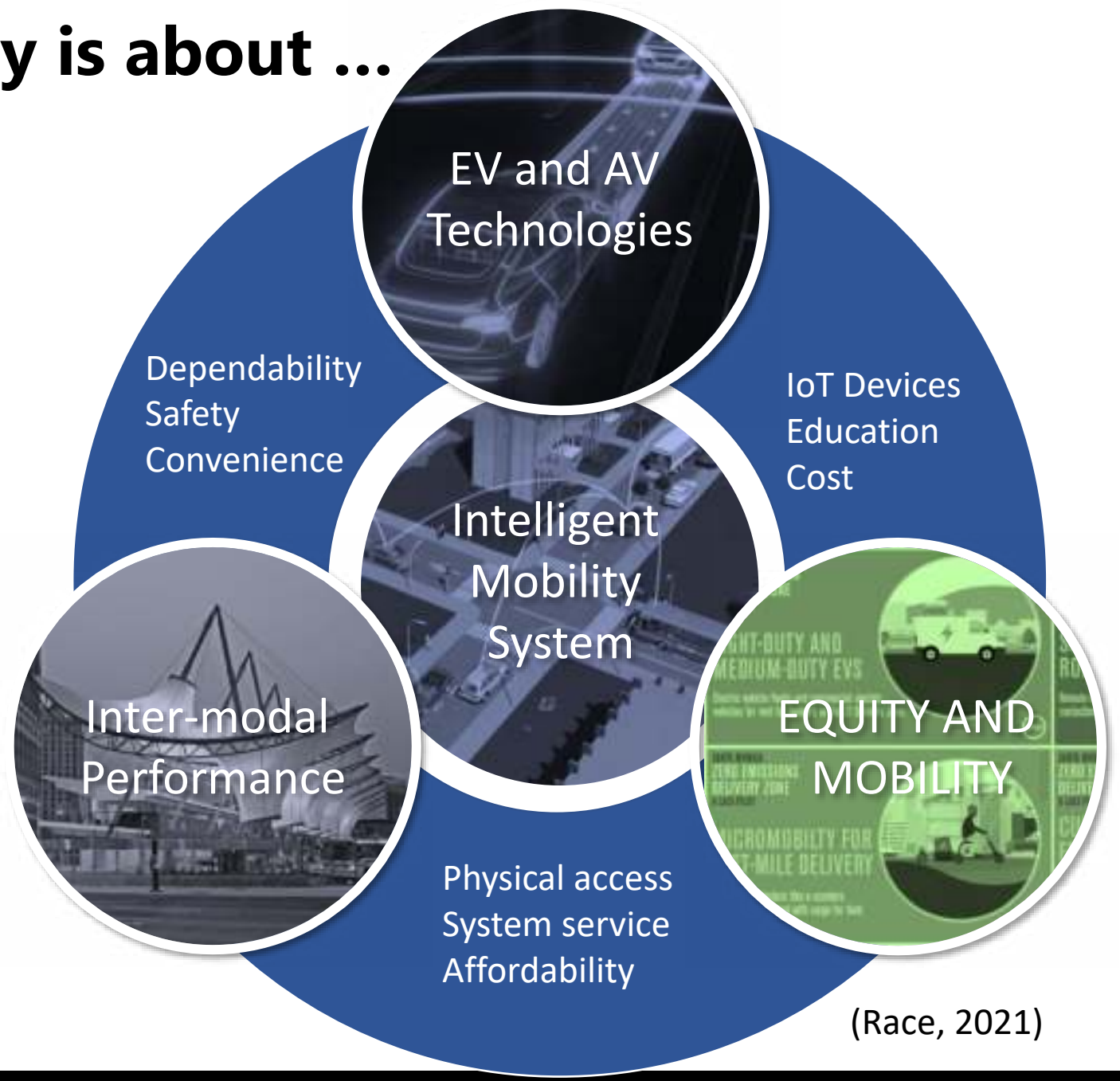
University of Houston

Research Supported by NSF SCC-PG: Pilot for Equitable Electric Mobility: Smart Charging, Smart Parking, and METRO Pass System

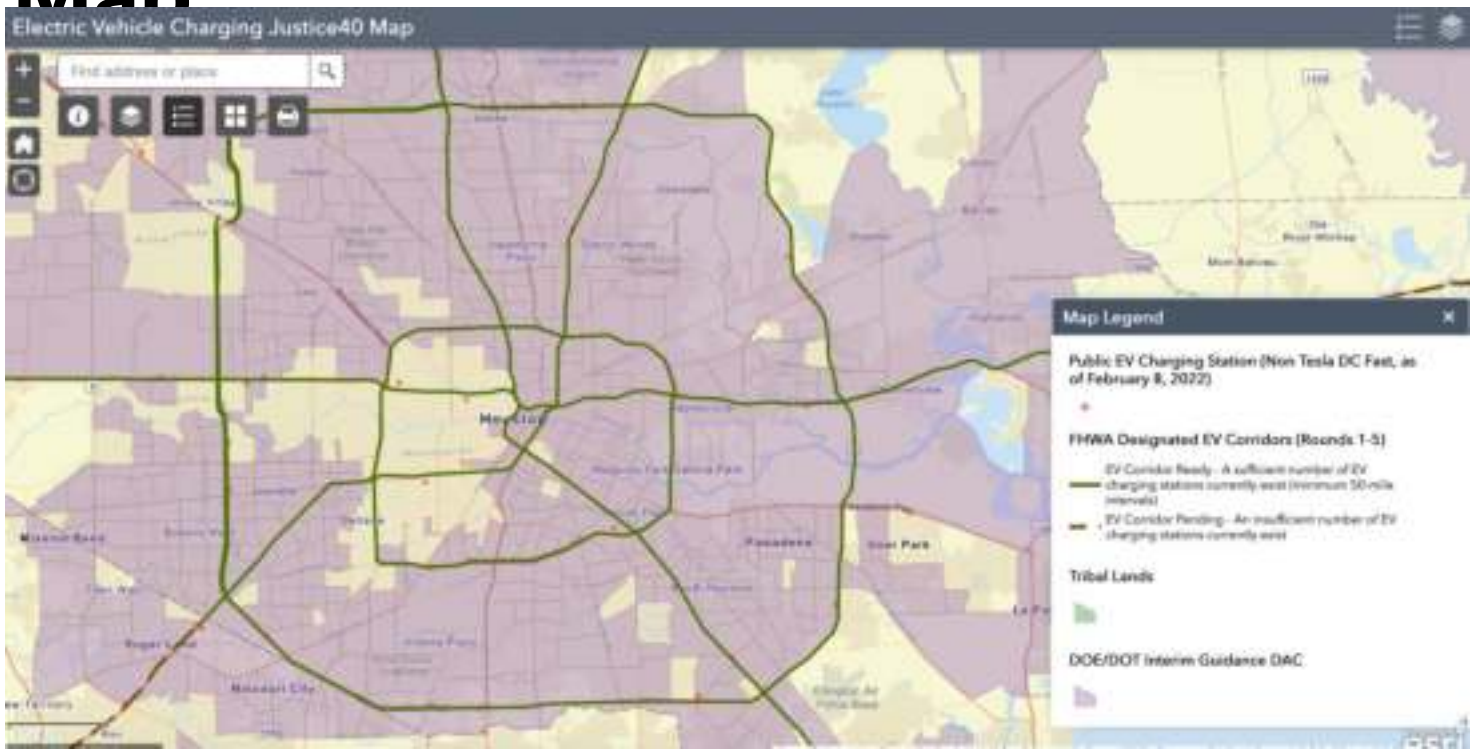
Smart Equitable E-Mobility is about …

- **Improved transit** service
  - Smarter, more comfortable, and safe, and reliable
  - Is an end-to-end experience
- **Inclusive** where the benefits of innovation are a shared experience
- **Breaking barriers** to EV ownership and sharing
- Recognizing **early adopters** can underwrite **EV infrastructure**
- **There are co-benefits** - - cleaner air, reduced climate impact, and a healthier
- AND - - new green energy, tech, and sales **jobs**



(Race, 2021)

TxDOT Electric Vehicle Charging Corridors onJustice40 Map



https://anl.maps.arcgis.com/apps/webappviewer/index.html?id=33f3e1fc30bf476099923224a1c1b3ee

+ Comprehensive

+ Federal agency metrics used for EV locations to guide 40% investment into disadvantaged communities

- Too general to inform specific EV adoption and access strategies

- Too general to inform or estimate the impacts of programmatic approaches to EV charging and access

- Argonne National Lab DAC Map blends DOE and DOT indicators
- DOE 36 indicators at a census tract level:
  - Fossil Dependence (2)
  - Energy Burden (5)
  - Environmental and Climate Hazards (10)
  - Vulnerability (socioeconomic, housing burden, transportation burdens, etc.) (19)
- DOT 22 indicators by census tract level:
  - Transportation access disadvantaged (4)
  - Health disadvantaged (3)
  - Environmental disadvantage (6)
  - Economic disadvantage (7)
  - Resilience disadvantage (1)
  - Social disadvantage (1)

Evolve Houston

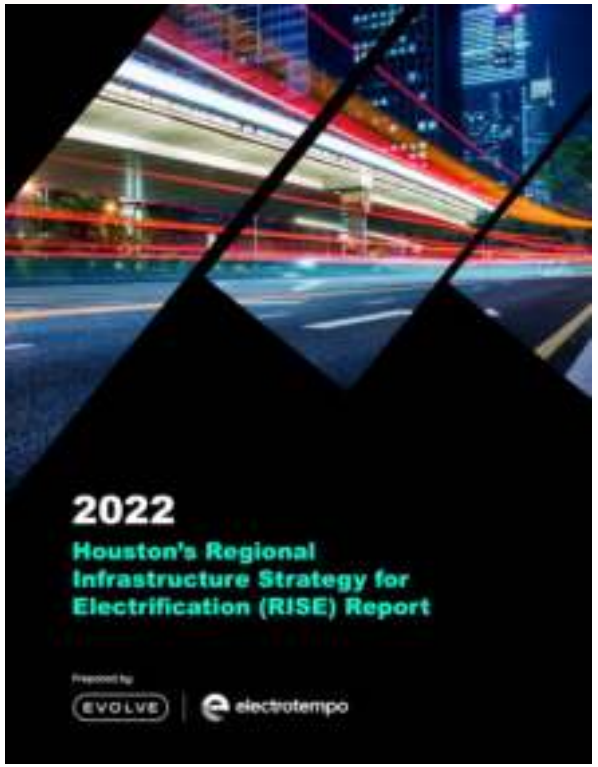
Clean and electric transportation is here and Evolve's primary mission is to guide Houston through this electric revolution. Evolve is a nonprofit organization working to accelerate EV adoption within the Greater Houston area by bringing together public and private organizations, residents, and government. Let's achieve zero emissions y'all.

ADVANCE EQUITABLE EMOBILITY

EMOBILITY MICROGRANT APPLICATION OPEN NOW

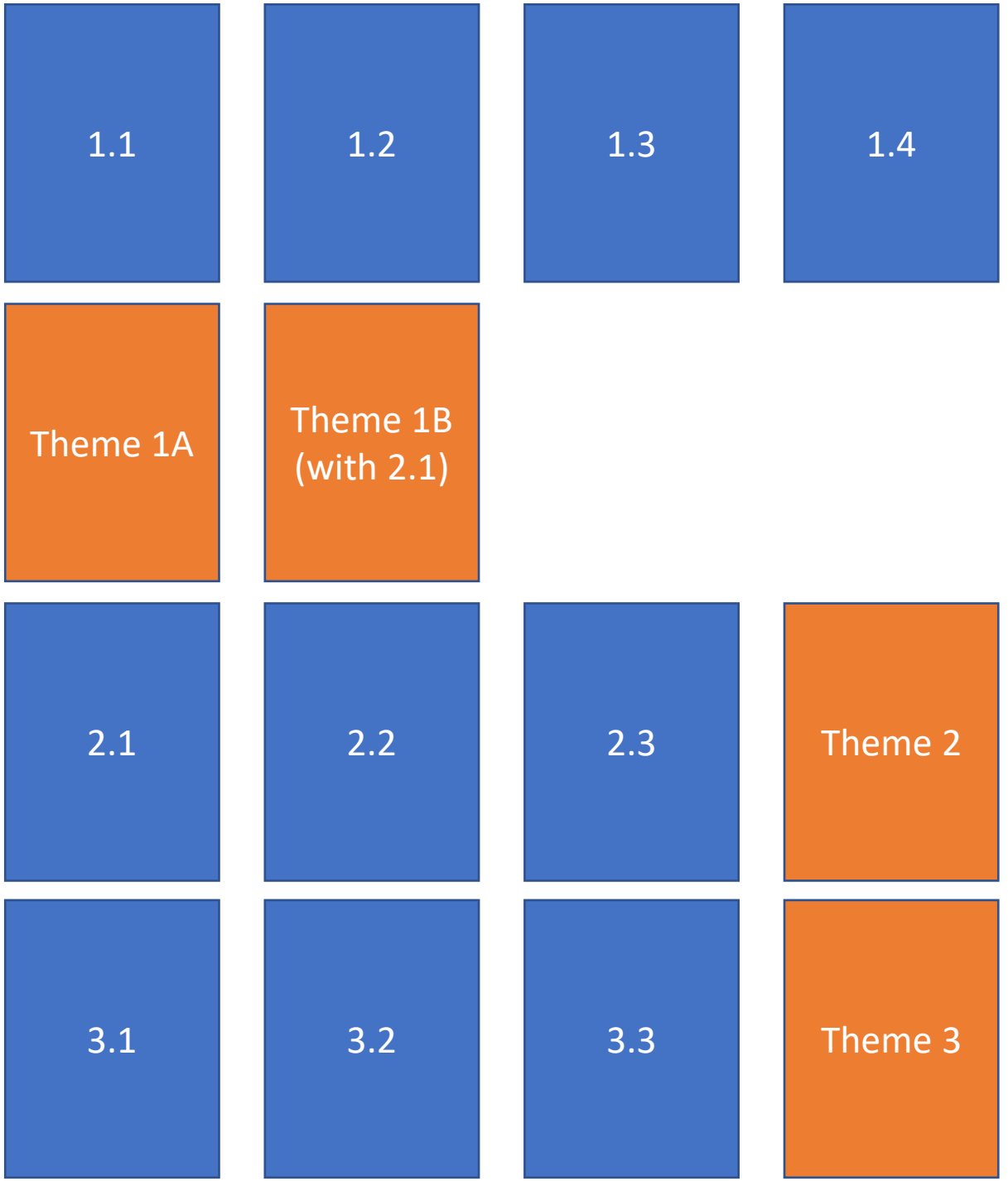
Evolve is partnering with local nonprofits, Community Champions, and Corporate Catalysts to award funding to grassroots eMobility projects that address community mobility needs in Houston's historically underserved neighborhoods.

Grant applications are now available online at apply.evolvehouston.org.



EV Equity Mapping

EV Adoption Indicators		
EQUITY		
Theme 1: Internal Soci-Economic Index		
Indicators	**Indicator Maps**	**Index Maps**
1.1 Educational Attainment	1.1 Map indicator individually	**Theme 1**
1.2 Poverty Level Households	1.2 Map indicator individually	**Theme 1**
1.3 Seniors (+65)	1.3 Map indicator individually	**Theme 1**
1.4 Renter Households	1.4 Map indicator individually	**Theme 1**
1.5 Non Multi-car Households (less than 2 cars)	1.5 Map indicator individually	**Theme 1**
PERFORMANCE		
Theme 2: External Index		
2.1 Public Charger Access	2.1 Map indicator individually	**Theme 1 Theme 2**
2.2 Cost of EV Purchase	2.2 Map indicator individually	**Theme 2**
2.3 Tax Incentives	2.3 Map indicator individually	**Theme 2**
MARKET STIMULATION		
Theme 3: Interventions Index		
3.1 Affordability Gap	3.1 Map indicator individually	**Theme 3**
3.2 Access to Charging	3.2 Map indicator individually	**Theme 3**
3.3 Alternative EV Access	3.3 Map indicator individually	**Theme 3**



Theme 1: EV EQUITY SOCIO-ECONOMIC INDICATORS AND INDEX

- Purpose: To map the locations where communities have **socio-economic barriers** to EV adoption in **Harris County's 785 census tracts**

- BASED ON LITERATURE REVIEW
  - Key indicators for EV adoption
  - **Educational attainment**
  - **Income**
  - **Age**
  - **Two or more cars**
  - **AND - - access to charging**

- Mapped two ways - - CDC SVI 90th percentile method (used by the CDC for the SVI mapping) and percentage quartiles

Theme 1: EV SOCIO-ECONOMIC INDICATORS AND INDEX

Educational Attainment

Poverty Level

Seniors

Renter Households

Non-multicar Households

THEME 1: Socio-economic Index

(Race, 2022)

Theme 1: EV SOCIO-ECONOMIC INDICATORS AND INDEX

Educational Attainment

Poverty Level

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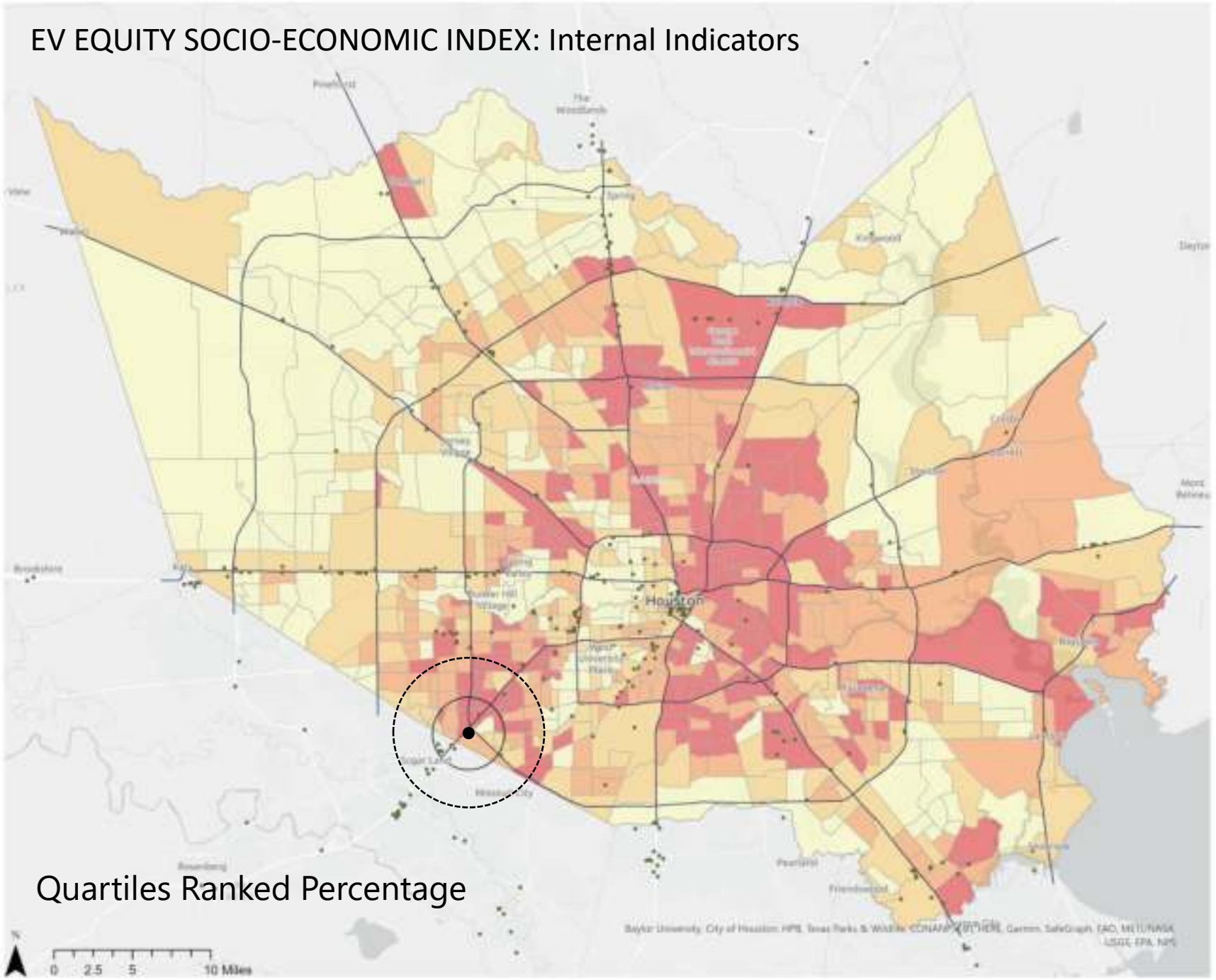
THEME 1: Socio-economic Index

(Race, 2022)



Indicators 1.1-1.5 and 2.1 (US Census, 2018)

1.1 Bachelor and Graduate Degrees
1.2 Households Living in Poverty
1.3 Seniors (+65)
1.4 Apartments
1.5 Less than 2 Cars per Household

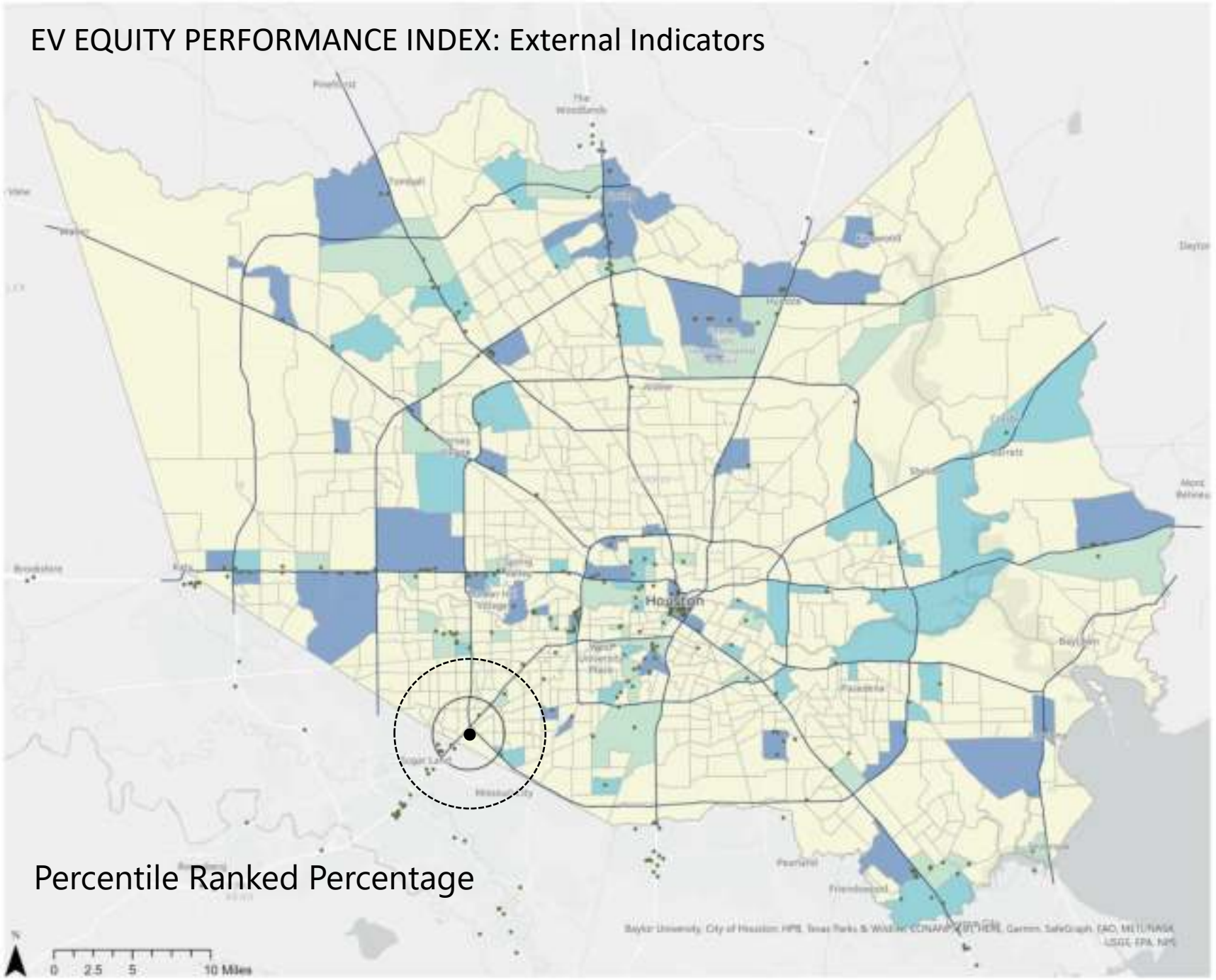
2.1 EV accessibility

(Race, 2022)

Theme 2: EXTERNAL EV EQUITY PERFORMANCE INDICATORS AND INDEX

- Purpose: To map the locations where communities have **cost barriers to EV** adoption/ownership

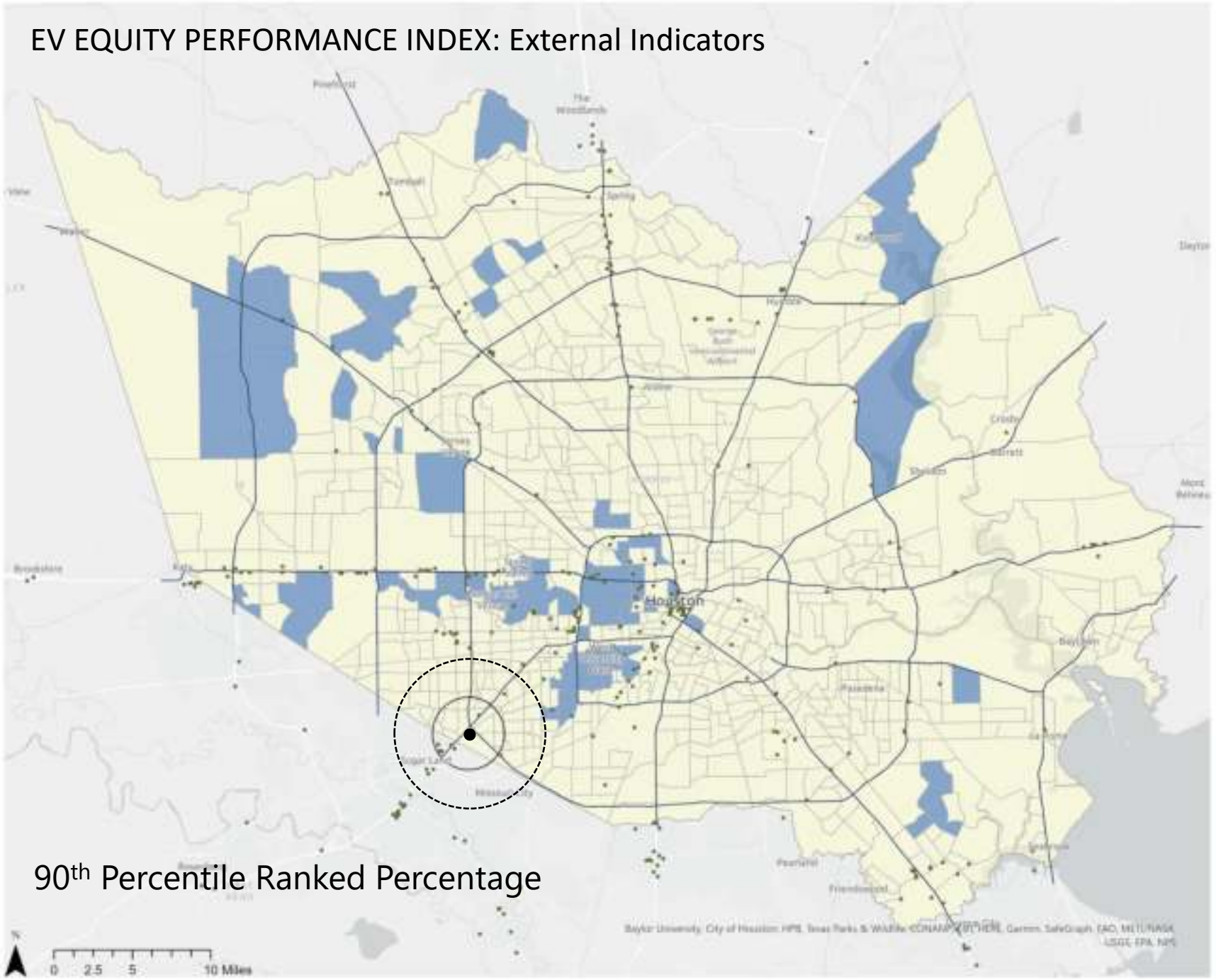
- ASSUMPTIONS:
  - **10 % of median HH income** in census tracts dedicated to auto payments
  - Average new car payments in Texas
  - Percent **premium for EV payments (32%)** (153 census tracts, 19%, can afford a new EV)
  - Existing tax incentives (incentives of $7,500 per vehicle increases affordability to 226 census tracts - - 73 more tracts, increased to 28%)
  - Low number of public charger locations (252)
- **New Federal Tax Incentives**
  - 28% census tracts can afford a new EV with $7,500 incentive
  - 44% census tracts can afford a used EV with $4,000 incentive
- Mapped two ways - - CDC SVI 90th percentile method and percentage quartiles



EV Charger Access for Renters (2.1B):

Areas where renters have EV chargers in their Census Tract

(Race, 2022)

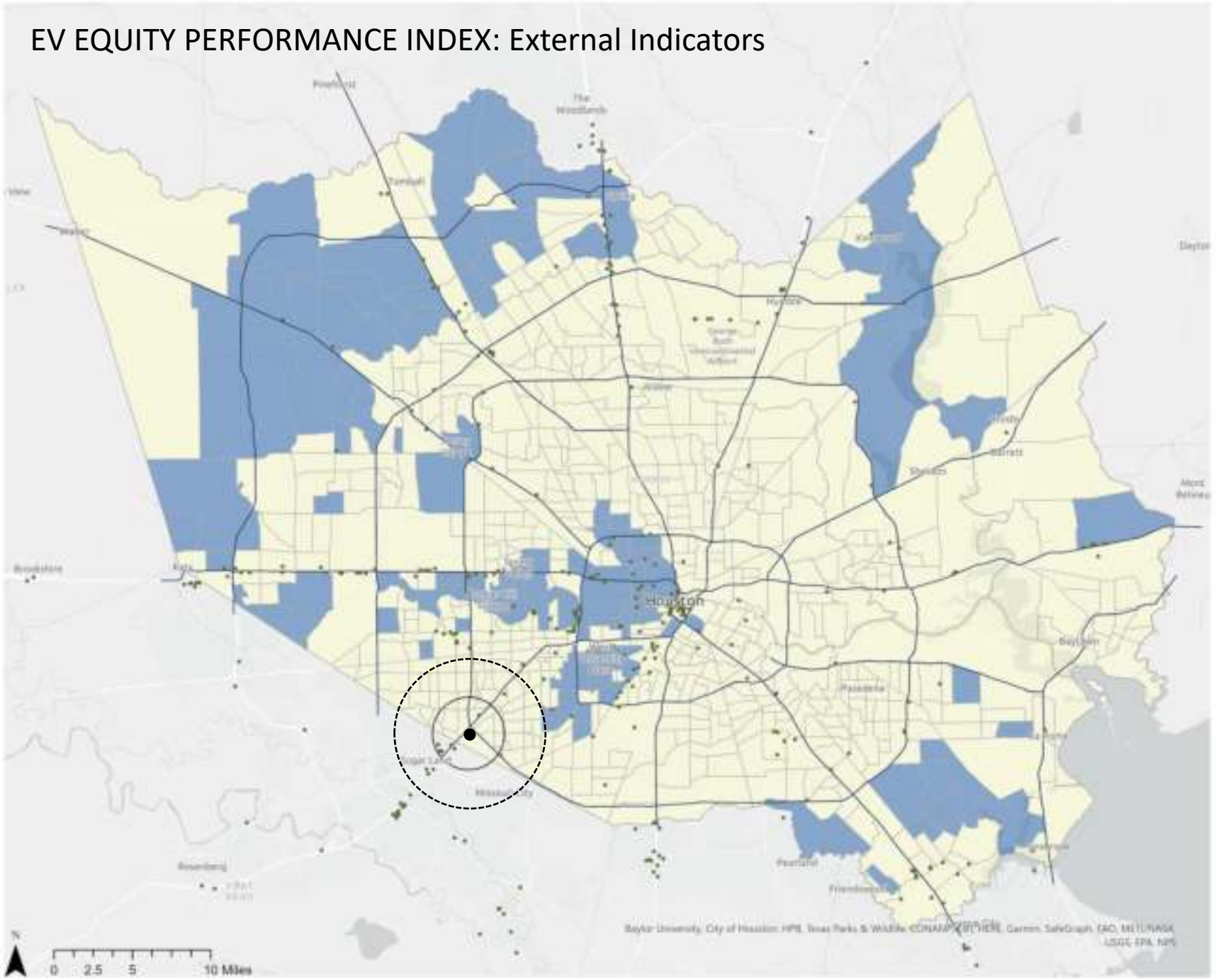


EV Affordability Gap (2.2A):

Households with median incomes that can most afford an EV assuming no more than 10% of their income is used for car payments

(Race, 2022)

EV EQUITY PERFORMANCE INDEX: External Indicators



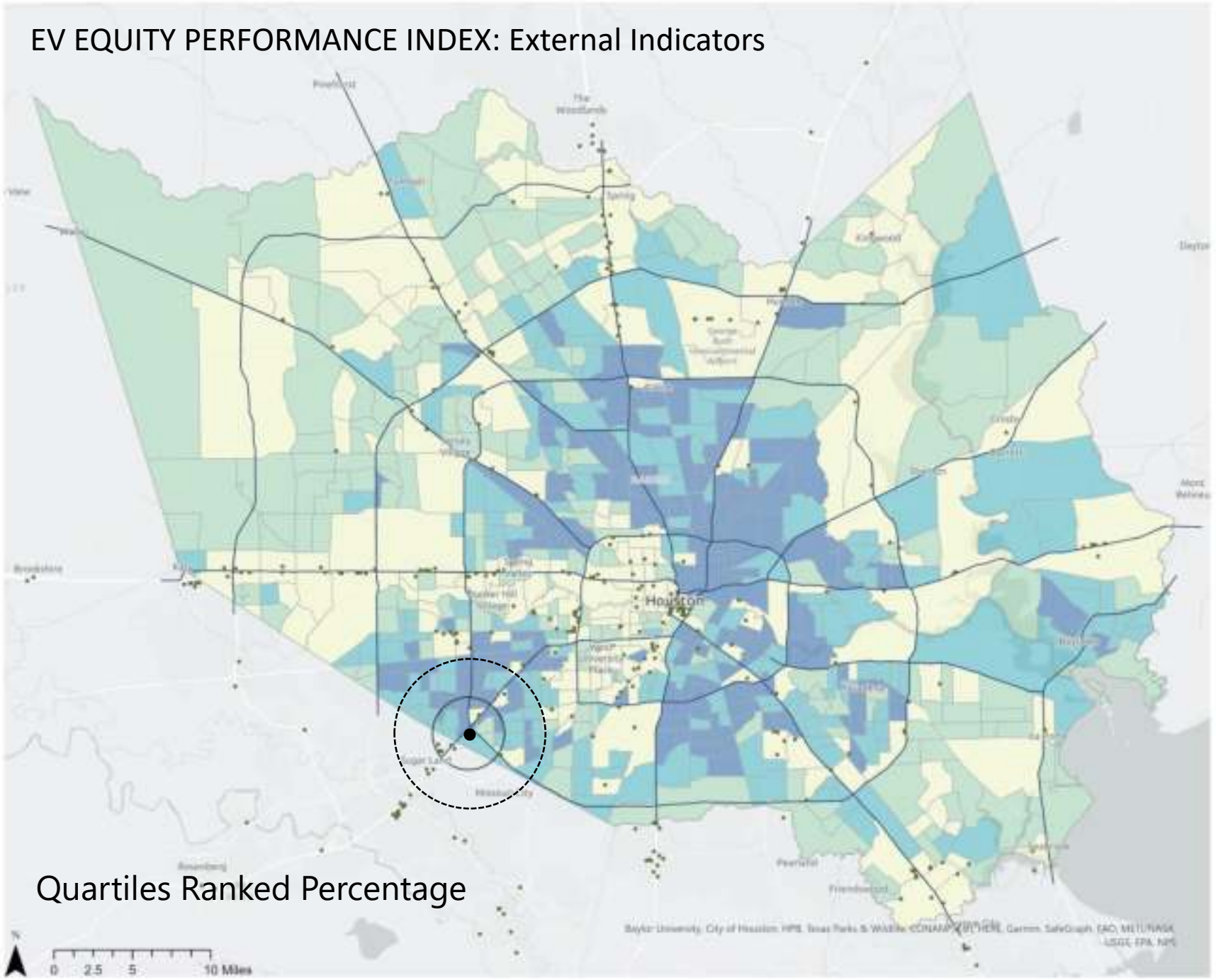
EV Affordability Gap (2.2B):

Households with median incomes that can afford an EV assuming no more than 10% of their income is used for car payments

19% of Census Tracts Median HH Income can Afford a New EV

(Race, 2022)

EV EQUITY PERFORMANCE INDEX: External Indicators

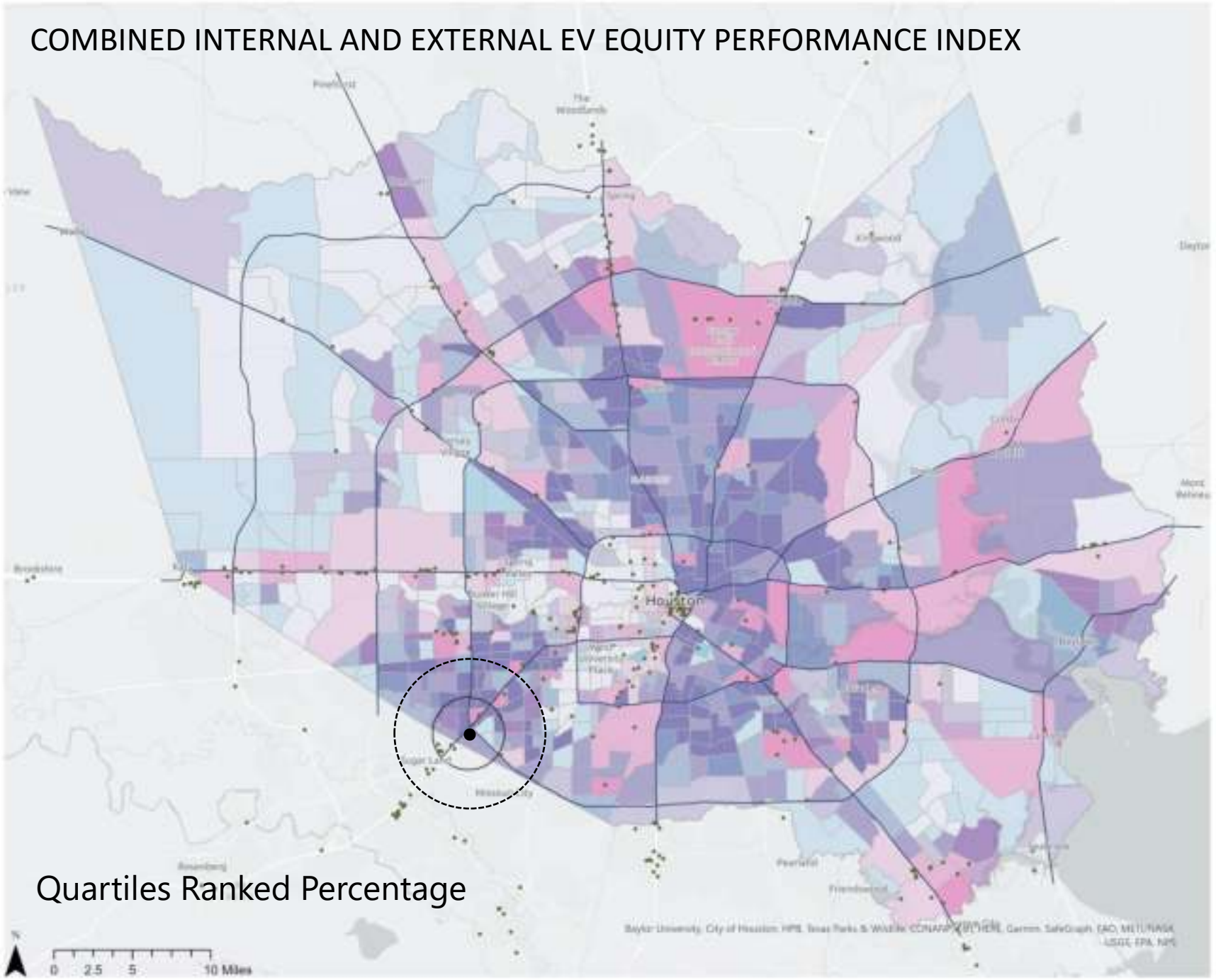


External Indicators (2.0):

Affordability
Access to public chargers

County Scale - 1:375,000

(Race, 2022)



Internal and External Indicators (1.0+2.0):

Affordability
Access to public chargers

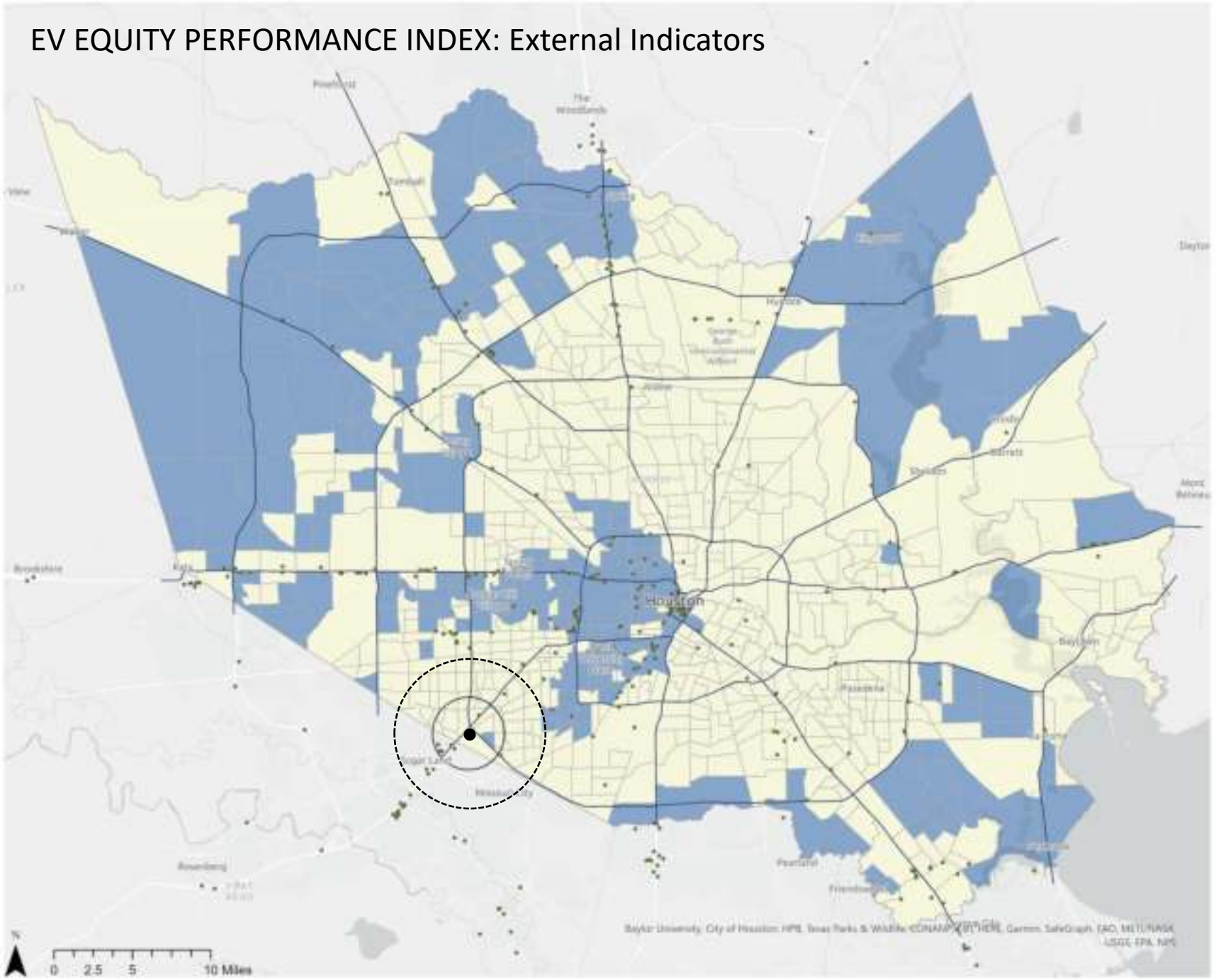
(Race, 2022)

Theme 3: MARKET STIMULATION FOR IMPROVED EV EQUITY INDICATORS AND INDEX

- Purpose: To map the locations **where incentives can have an impact** on community EV adoption/ownership

- ASSUMPTIONS:
  - Affordability gap: adding incentives to $7,500 Federal Tax Incentives increases census tract affordability by 150 (increases EV affordability from 19% to 38% of census tracts)
    - 0% loan program
    - $1,000 cash for crushers program
  - Access to charging - - four strategies
    - **Public Charger Program A: Public Facilities** (assume average number of chargers per HH for tracts with >1 Theme 1 indicators) - - 272 new chargers locations assuming one per location
    - **Public Charger Program B: Apartment Sites** (assume average number of chargers per HH for 90th percentile tracts) - - 2,691 new charger locations
    - **Public Charger Program C: METRO Park and Rides** (10% of parking with EV charging distributed by HH) - - 3,375 new chargers
    - **Public Charger Program D: TxDOT Charging Corridors Program** (assume per capita charger access to 500,000 new chargers in Biden plan) - - 6,952 new chargers
    - **Layered access strategy** - - charging corridors and PnRs combined to meet needs in census tracts with poor socio-economic, affordability gaps, and access to public charging
  - **Alternative EV access**
    - EV car sharing program
    - Qualified second hand car program

EV EQUITY PERFORMANCE INDEX: External Indicators



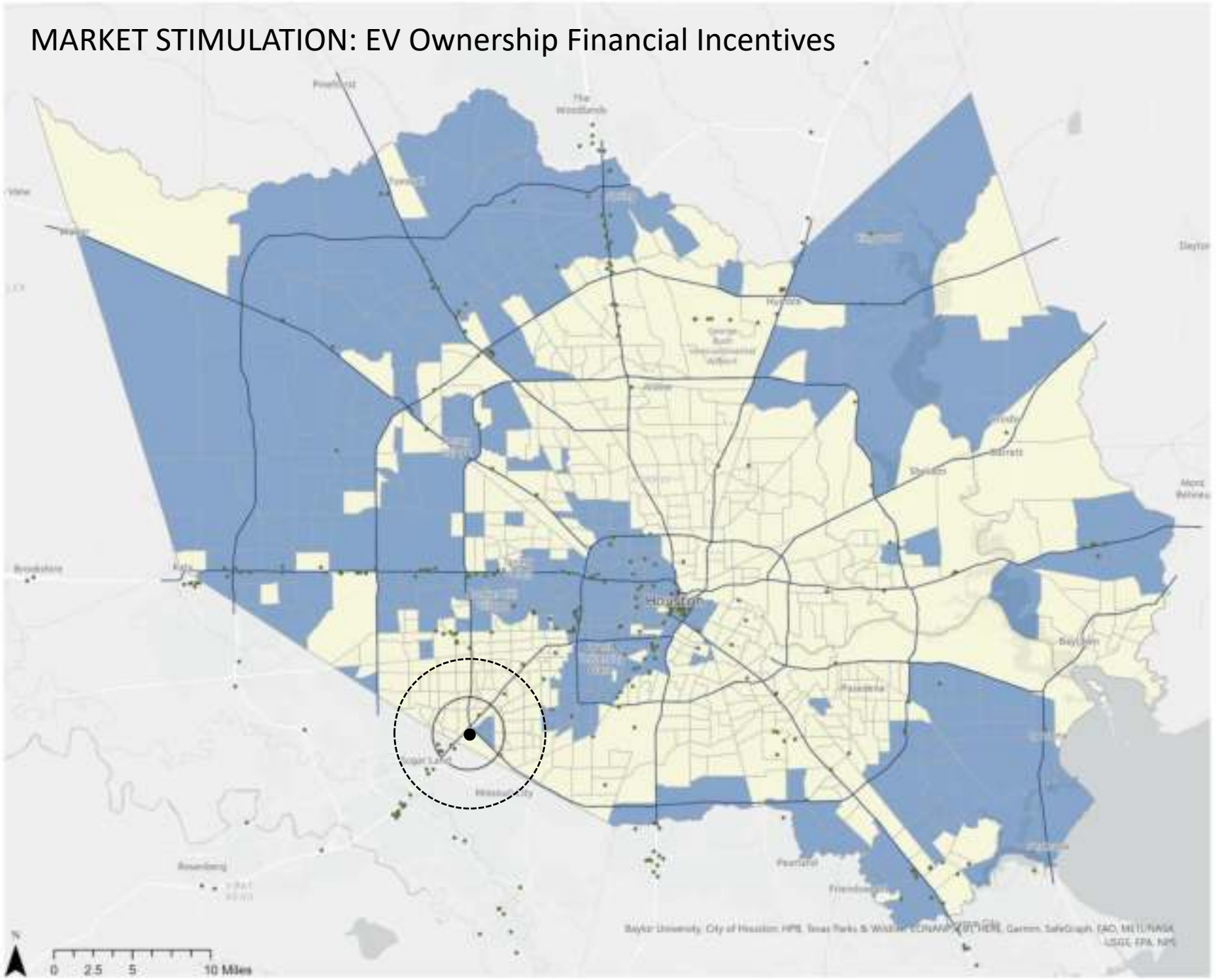
EV Affordability Gap (2.3):

Households with median incomes that can afford an EV assuming no more than 10% of their income is used for car payments with $7,500 federal tax incentives

28% of Census Tracts Median HH Income can Afford a New EV

(Race, 2022)

MARKET STIMULATION: EV Ownership Financial Incentives



EV Affordability Gap + Incentives (3.1):

Households with median incomes that can afford an EV assuming no more than 10% of their income is used for car payments with $7,500 federal tax incentives + $1,000 cash for crushers and 0% loan

39% of Census Tracts Median HH Income can Afford a New EV

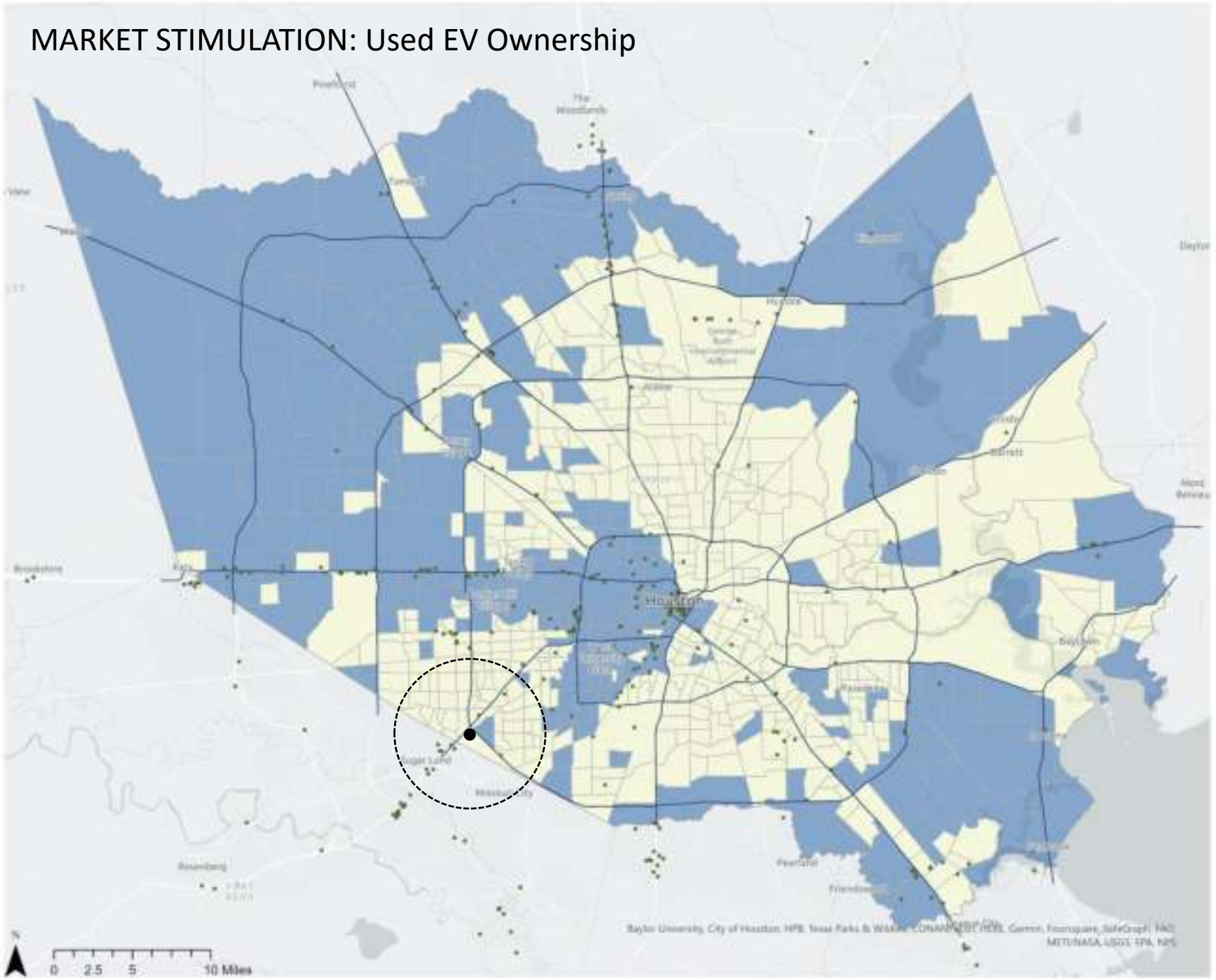
(Race, 2022)

2022 Inflation Reduction Act (IRA)

Tax credits for drivers who buy electric cars

- The bill includes a credit to help consumers purchase an electric vehicle — but it has some major caveats.
- Any individual who makes less than $150,000 — or $300,000 for married couples — can take advantage of a **$7,500 credit to buy a new EV or up to $4,000 for a used version.**
- But the bill specifies that the EV batteries must be sourced in certain amounts from North America and the United States' trading partners.
- These requirements are being phased in over time.

MARKET STIMULATION: Used EV Ownership



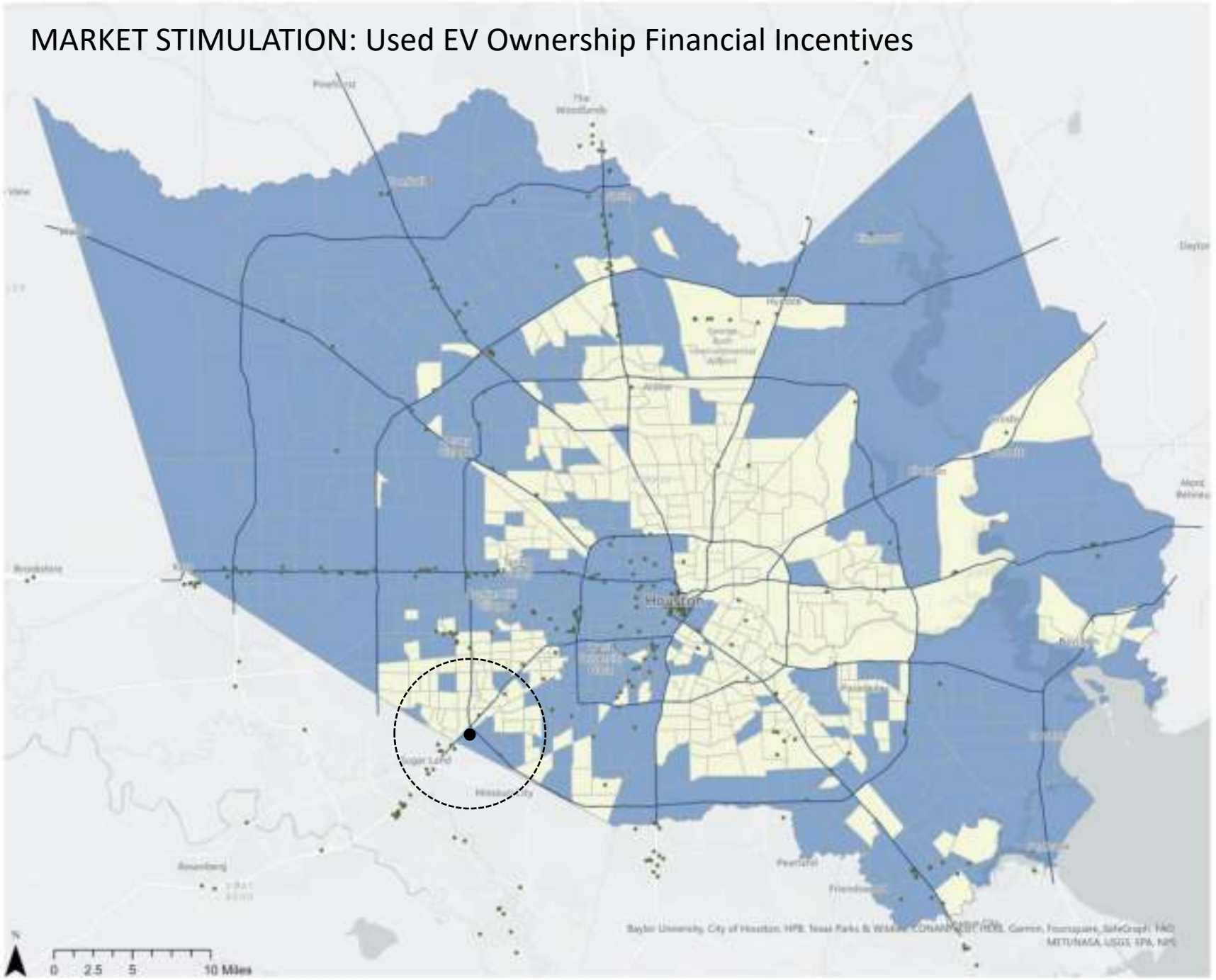
EV Affordability Gap + Incentives (3.1A):

Households with median incomes that can afford a used EV assuming no more than 10% of their income is used for car payments

30% of Census Tracts Median HH Income can Afford a New EV

(Race, 2022)

MARKET STIMULATION: Used EV Ownership Financial Incentives



EV Affordability Gap + Incentives (3.1A):

Households with median incomes that can afford an EV assuming no more than 10% of their income is used for car payments with $4,000 federal tax incentives

44% of Census Tracts Median HH Income can Afford a New EV

(Race, 2022)

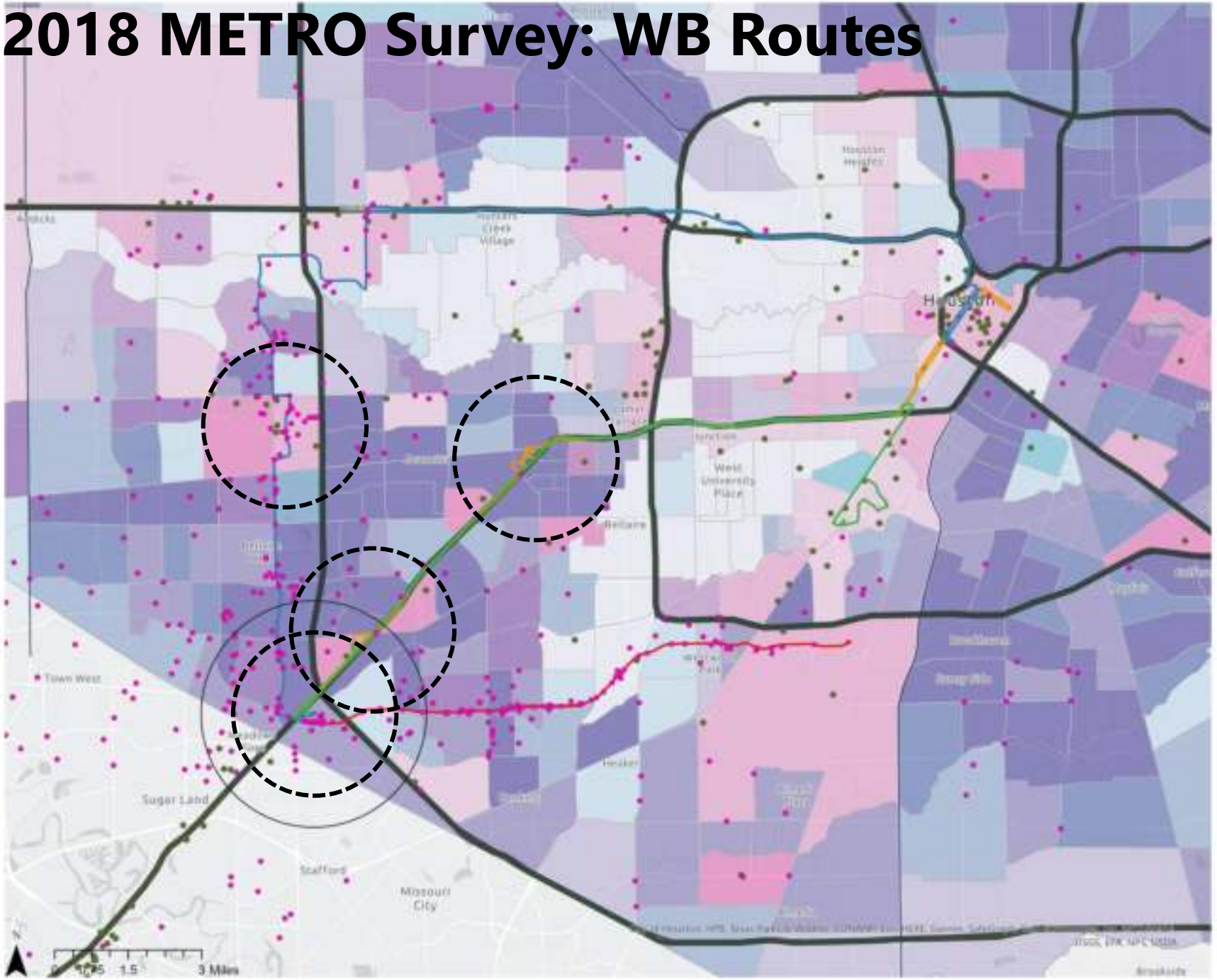
FILLING IN THE GAPS: Other Potential Incentive Programs

https://www.adhaiwell.com/Creative-Bus-Shelter-Interactive-Bus-Shelter-in-Paris-id3405275.html

https://www.denvergov.org/Government/COVID-19-Information/Public-Health-Orders-Response/News-Updates/2021/Electric-Car-Share

- Car sharing
  - Commercial programs - - https://carshare.org/
  - Denver partners with careshare ($300,000 CaresAct grant) to provide EV access to underserved neighborhoods
- Qualified secondhand EV car programs
  - Used EV rebate program - - LA Water and Power $1,500 rebate for qualified residential customers (https://afdc.energy.gov/laws/12312)
  - Connecticut income-qualified residents who purchase or lease EVs - - up to $3,000
- Uber/Lyft EV Fleet Incentives
  - 40% of drivers in EVs by 2030
- Integrated Intermodal First and Last Mile EV

2018 METRO Survey: WB Routes



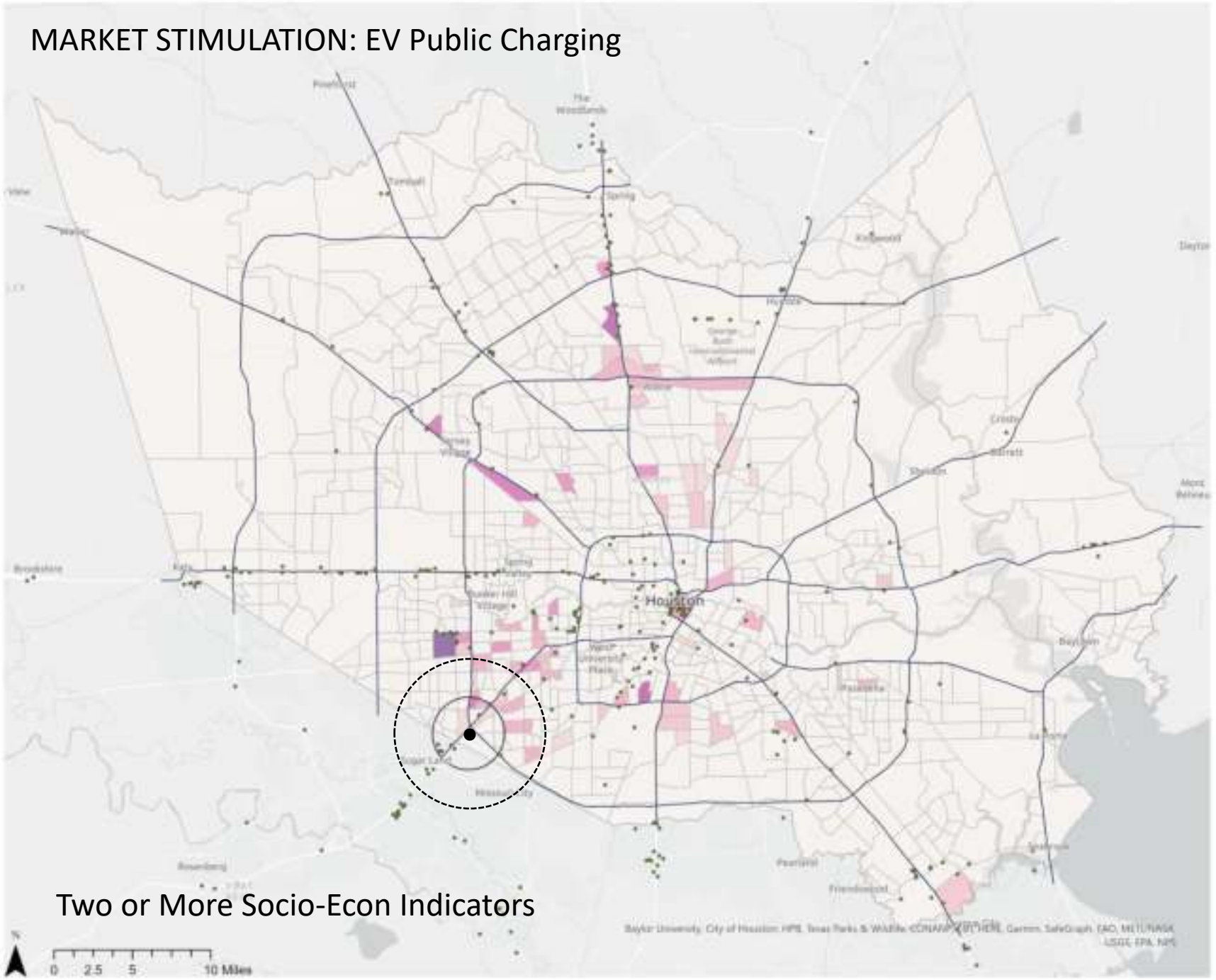
SW Harris County Context

West Belfort PnR Routes Riders' Home Addresses

Source: 2018 METRO Ridership Satisfaction Survey

(Race, 2022)

MARKET STIMULATION: EV Public Charging



Program A: Added Chargers at Public Facilities (3.2A):

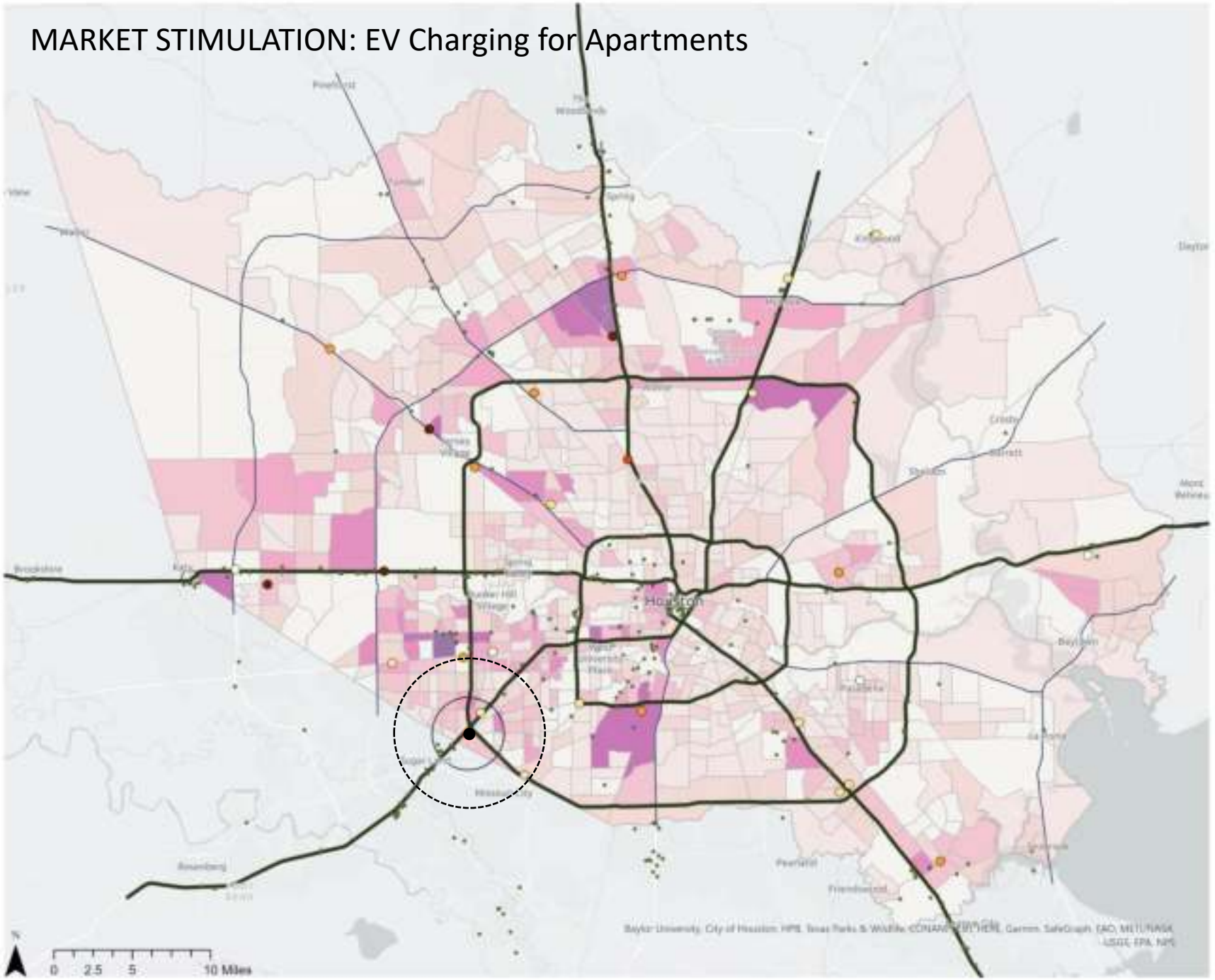
Adding EVC charging at public facilities - - assumes average number of chargers per HH for tracts with >1 Theme 1 indicators

TOTAL ADDED CHARGER LOCATIONS: 272

CAPITAL INVESTMENT: $2M @ $7,300 per L2 charger

(Race, 2022)

MARKET STIMULATION: EV Charging for Apartments



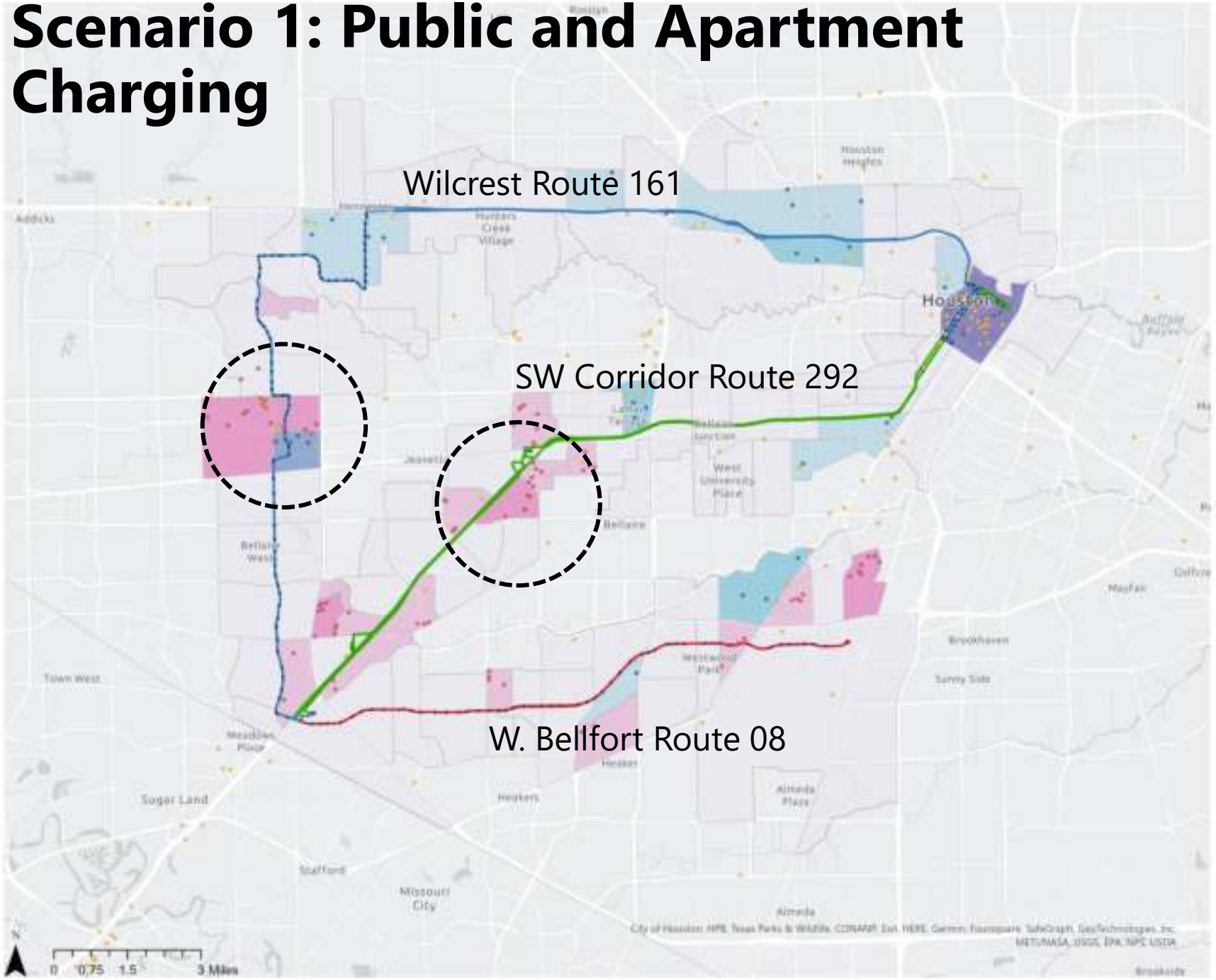
Program B: Added Chargers at Apartment Sites (3.2B):

Adding EV chargers at apartment sites - - assumes average number of chargers per HH for 90th percentile census tracts

TOTAL ADDED CHARGERS: 2,691
CAPITAL INVESTMENT:
$19.6M @ $7,300 per L2 charger

(Race, 2022)

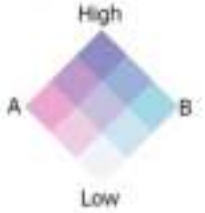
Scenario 1: Public and Apartment Charging



Regional : Routes

Scenario 1 : Baseline

- 008 : West Bellfort
- 161 : Wilcrest Express
- 269 : West Bellfort / Westwood
- EV Charging Station Locations
- Program A Sites
- Program B Sites
- A : Public Facilities
- B : Apartment Sites



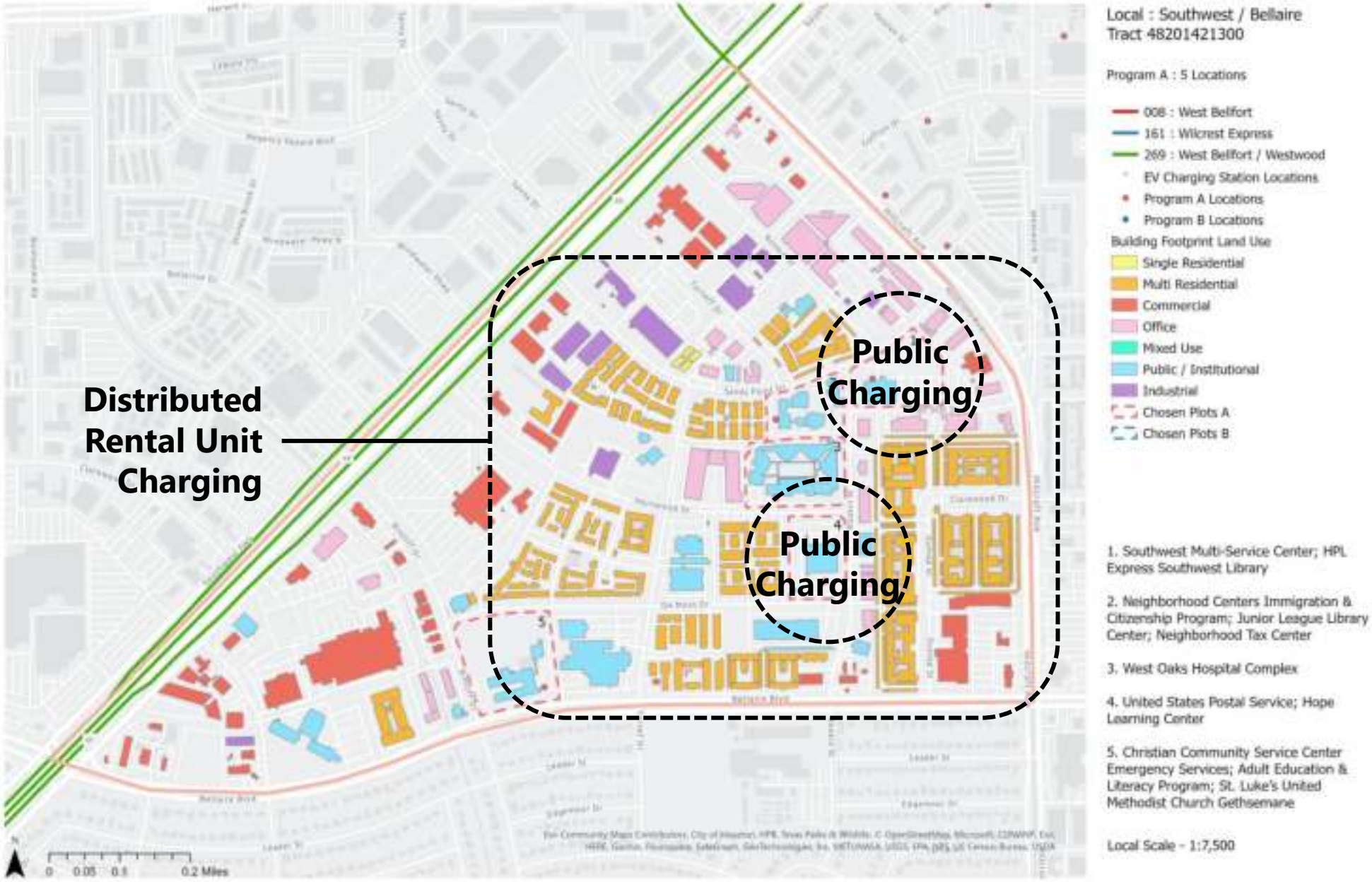
HC per capita charging through incentives and local programs for underserved communities

Program A: Charging at Public Facilities

Program B: Charging at Selected Apartments

(Race, 2022)

Program A+B: RT 292



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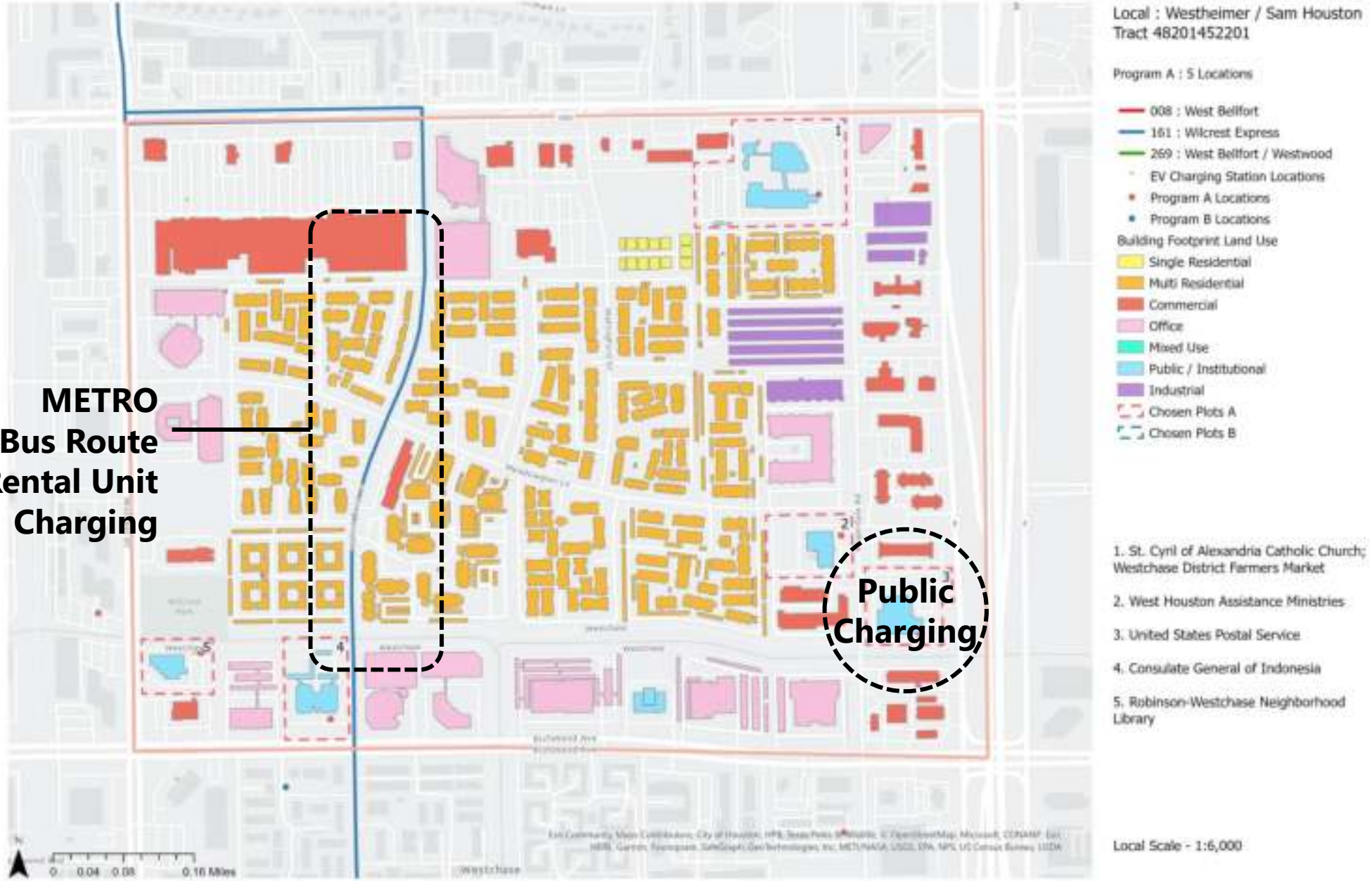
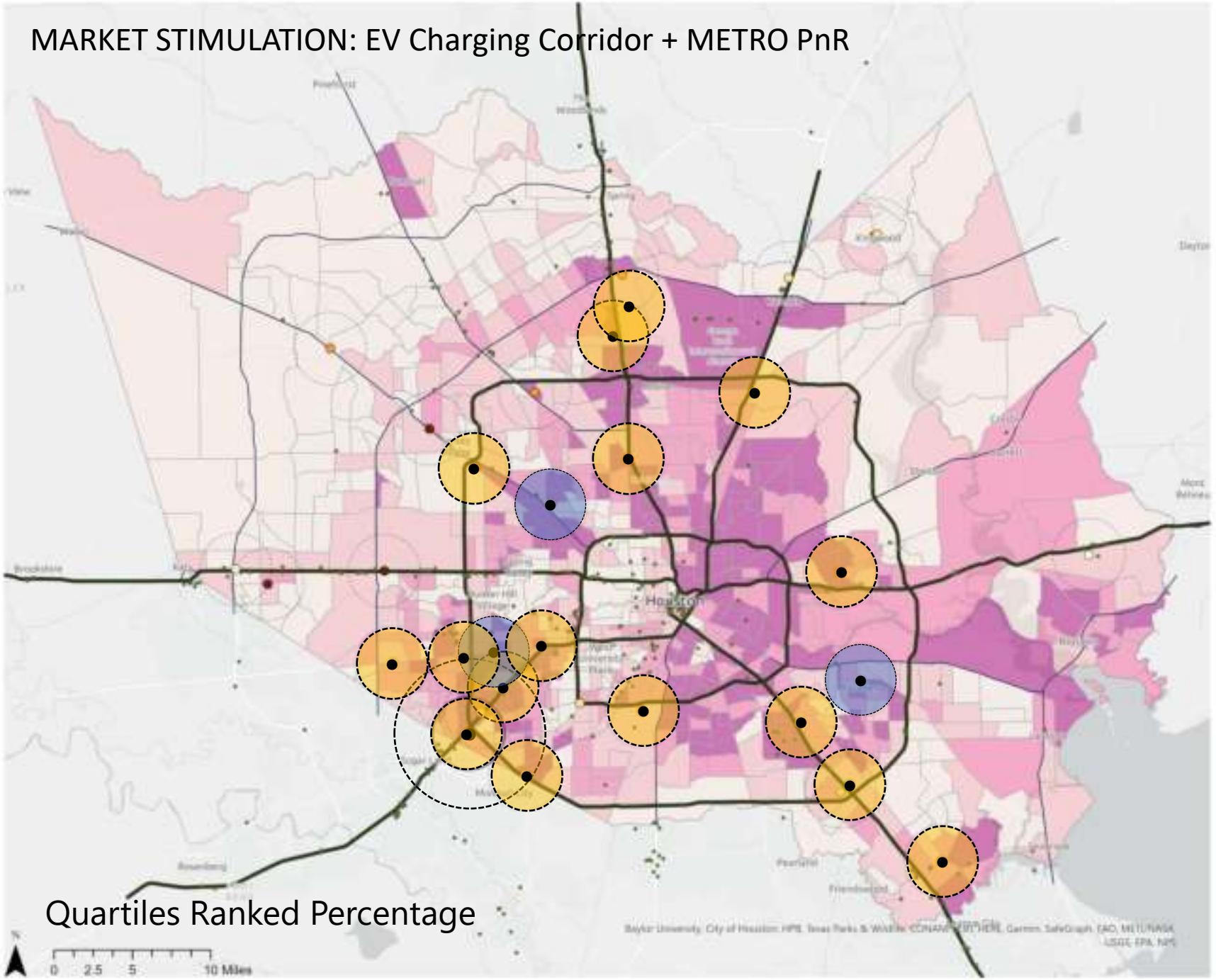
Program A+B: RT 161



(Race, 2022)

MARKET STIMULATION: EV Charging Corridor + METRO PnR



METRO PnR in TxDOT Corridor

METRO PnR in EV Equity Area

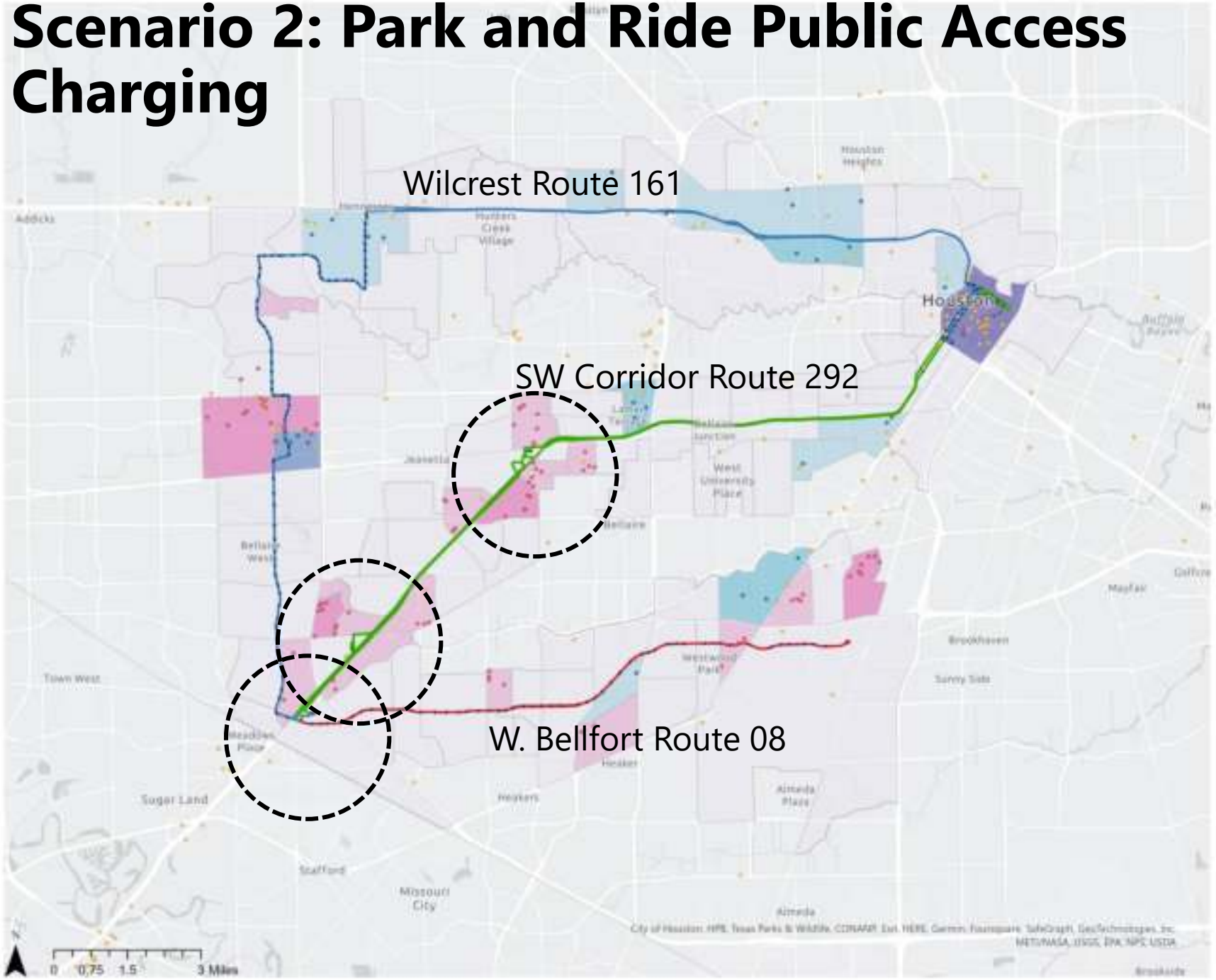
Program C: Supporting Equity Access with Combined Corridor and PnR Public Access Chargers (3.2E):

Adding EV chargers to meet projected corridor demand and 10% PnR spaces

TOTAL ADDED CHARGERS: TBD
CAPITAL INVESTMENT: TBD

(Race, 2022)

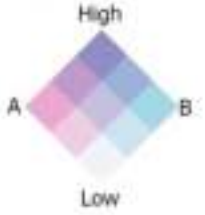
Scenario 2: Park and Ride Public Access Charging



Regional : Routes

Scenario 1 : Baseline

- 008 : West Bellfort
- 161 : Wilcrest Express
- 269 : West Bellfort / Westwood
- EV Charging Station Locations
- Program A Sites
- Program B Sites
- A : Public Facilities
- B : Apartment Sites



HC per capita charging through incentives and local programs for underserved communities

Program C: Charging at Park and Ride locations

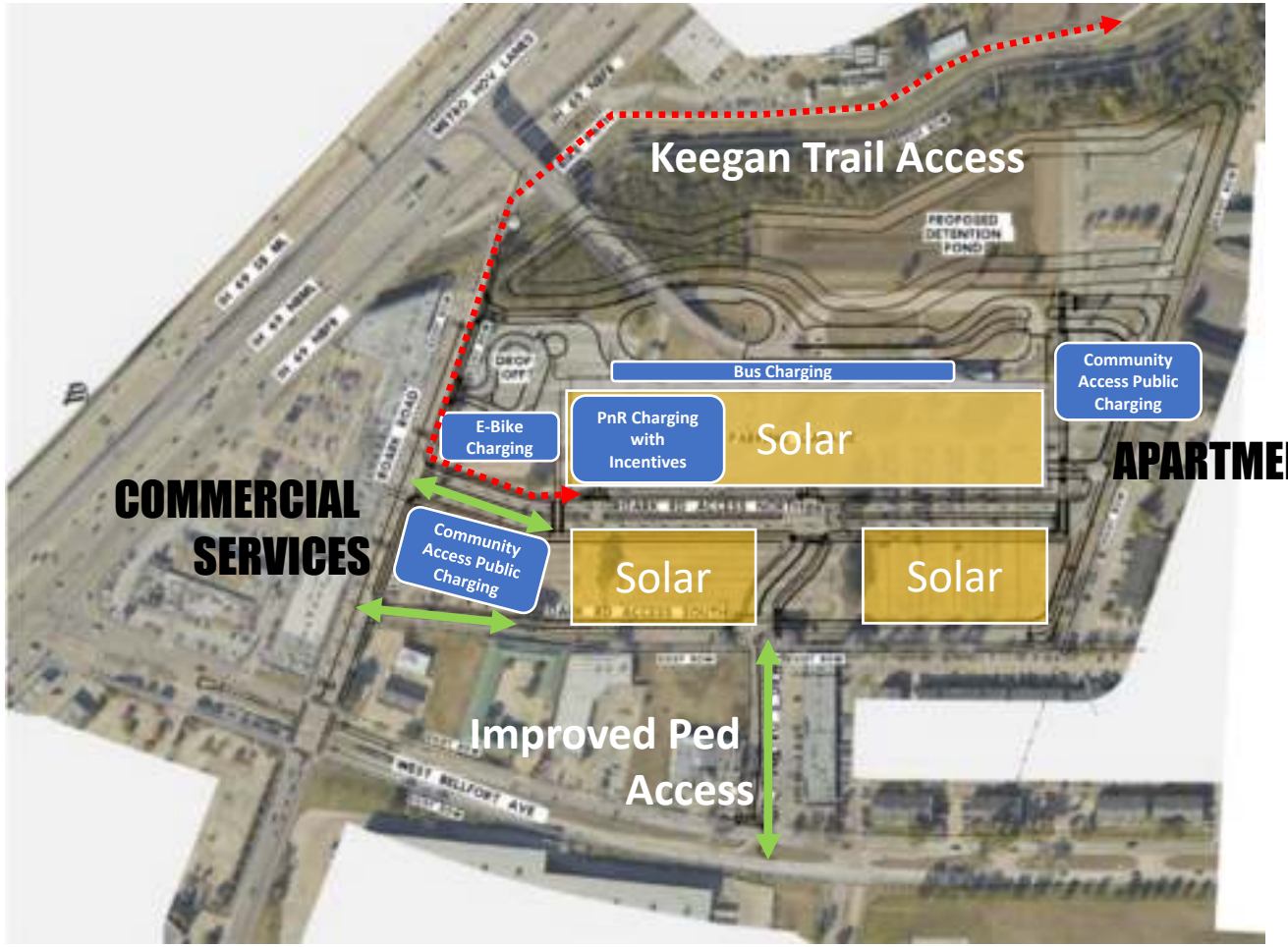
Regional Scale - 1:120,000

(Race, 2022)

Program C: PnR Public Charging

PnR Public Chargers

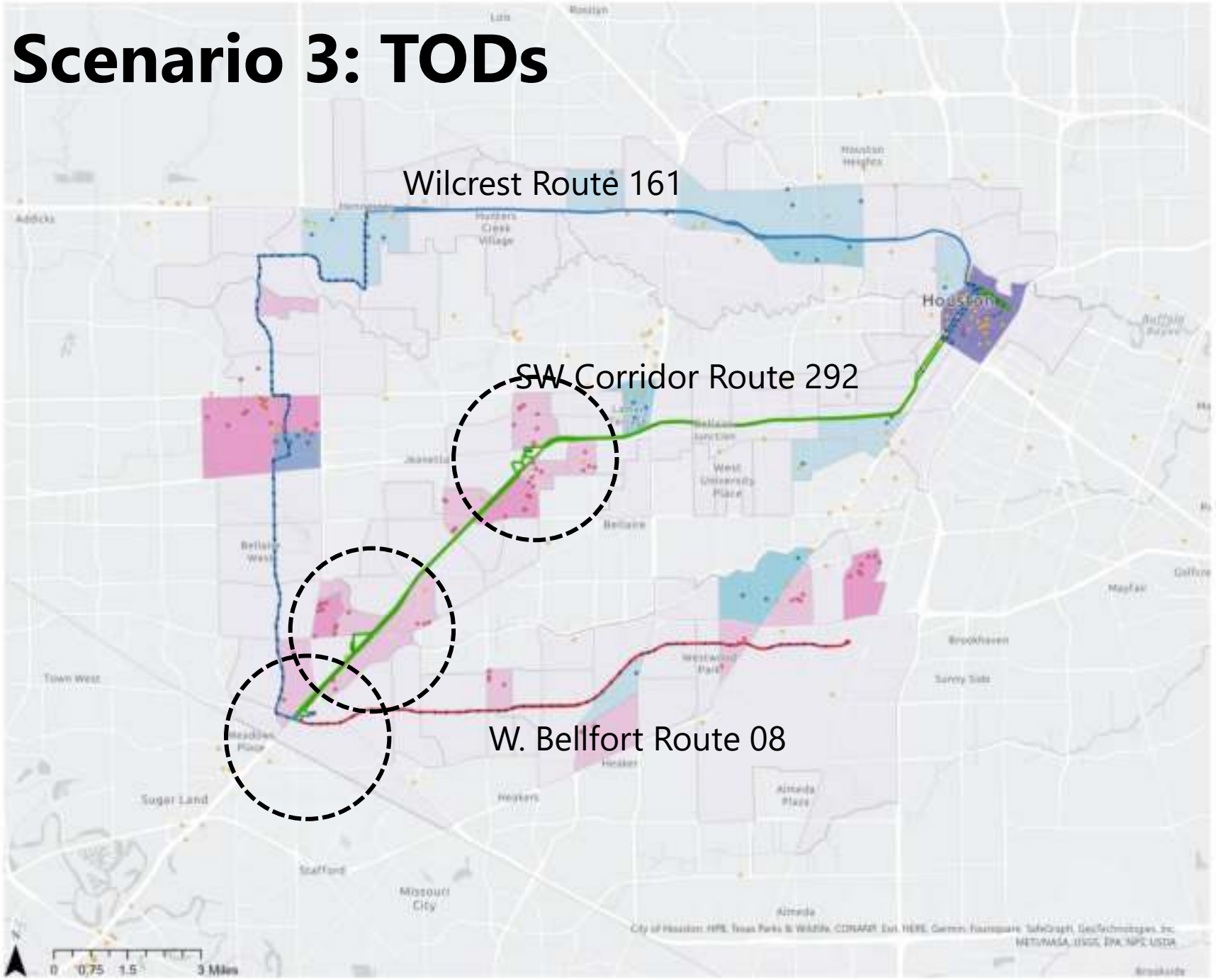
- Central to communities
- Land use context
- Public auto access
- Visibility/wayfinding
- Security



Site Access and Renewable Energy Considerations

(Race, 2022)

Scenario 3: TODs



Regional : Routes

Scenario 1 : Baseline

- 008 : West Bellfort
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- EV Charging Station Locations
- Program A Sites
- Program B Sites
- A : Public Facilities
- B : Apartment Sites

High

A B

Low

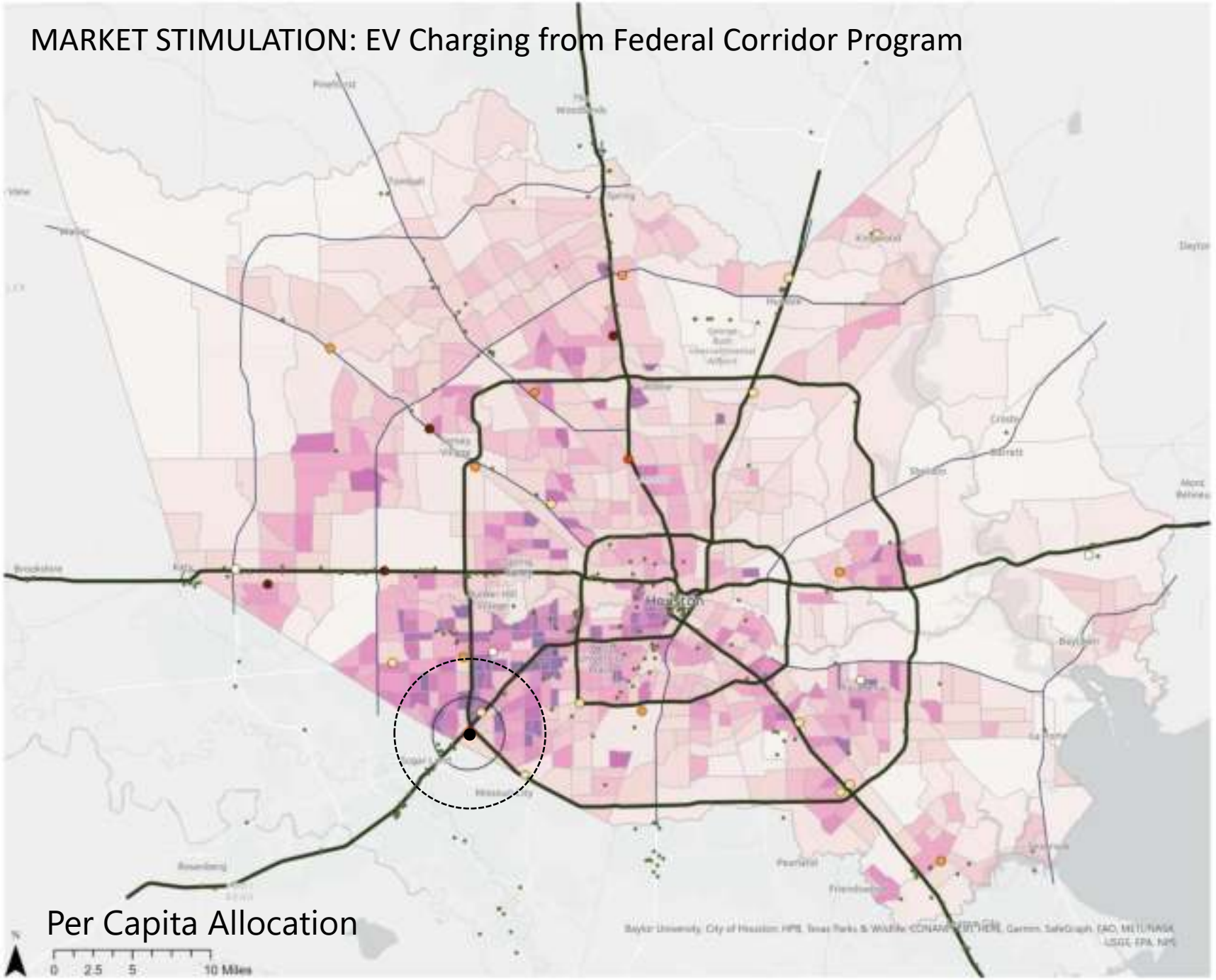
HC per capita charging through incentives and local programs for underserved communities

Program C/D: Park and Ride and TxDOT Corridor Charging

Regional Scale - 1:120,000

(Race, 2022)

MARKET STIMULATION: EV Charging from Federal Corridor Program



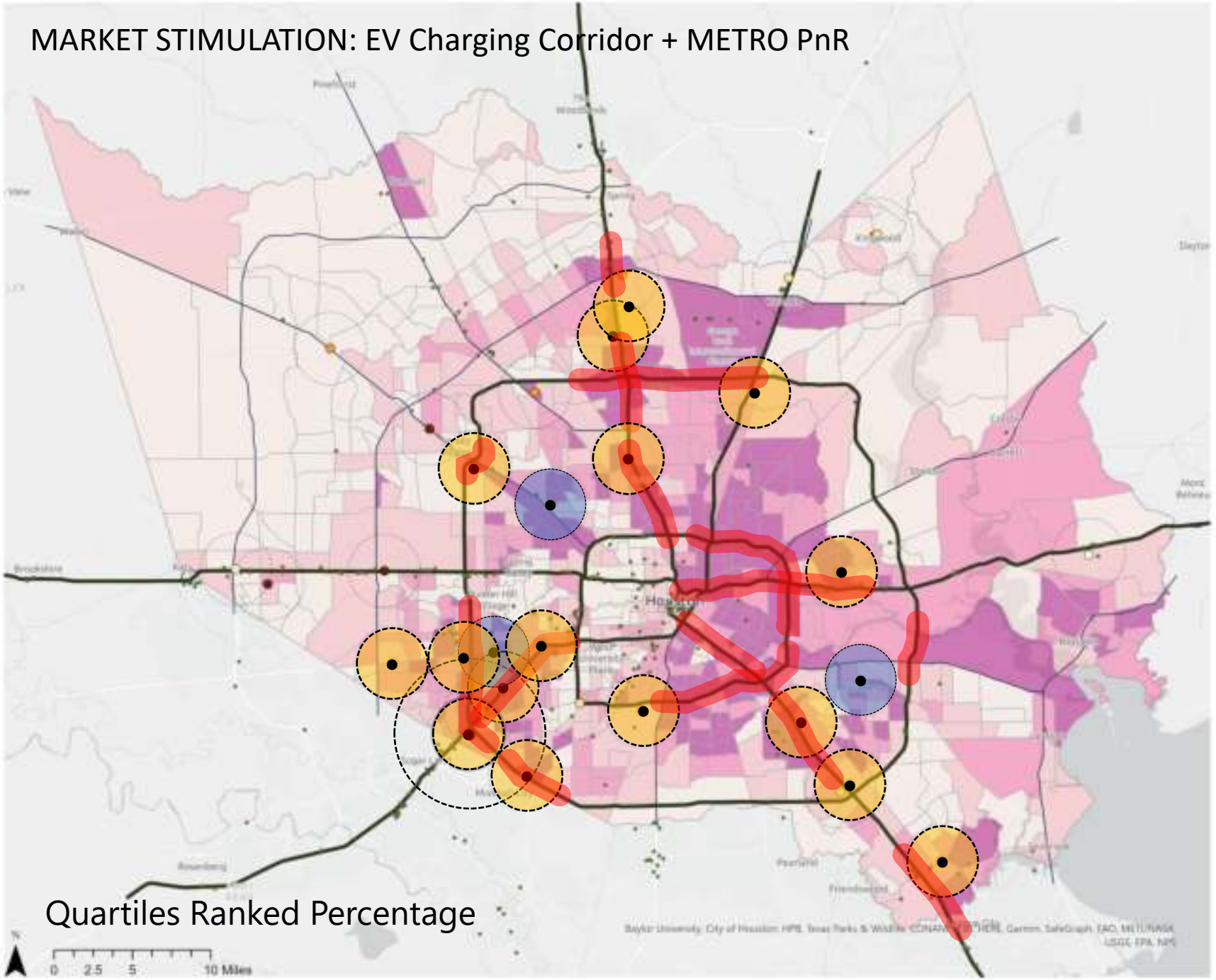
Program D: Adding Chargers Reflecting National Per Capita of 500,000 Chargers (3.2D):

Adding EV chargers at per capita level - - assume per capita charger investment for each tract

TOTAL ADDED CHARGERS: 6,952
CAPITAL INVESTMENT:
$51M @ $7,300 per L2 charger

(Race, 2022)

MARKET STIMULATION: EV Charging Corridor + METRO PnR



TxDOT Charging Corridor in EV Equity Area

METRO PnR in TxDOT Corridor

METRO PnR in EV Equity Area

Program ABCD Stacked: Supporting Equity Access with Combined Corridor and PnR Public Access Chargers (3.2E):

Adding EV chargers to meet projected corridor demand and 10% PnR spaces

TOTAL ADDED CHARGERS: TBD
CAPITAL INVESTMENT: TBD

(Race, 2022)

Author: Dr. Bruce Race, Center for Sustainability and Resilience, University of Houston