Pilot for Equitable Electric Mobility: Smart Charging, Smart Parking, and METRO Pass System

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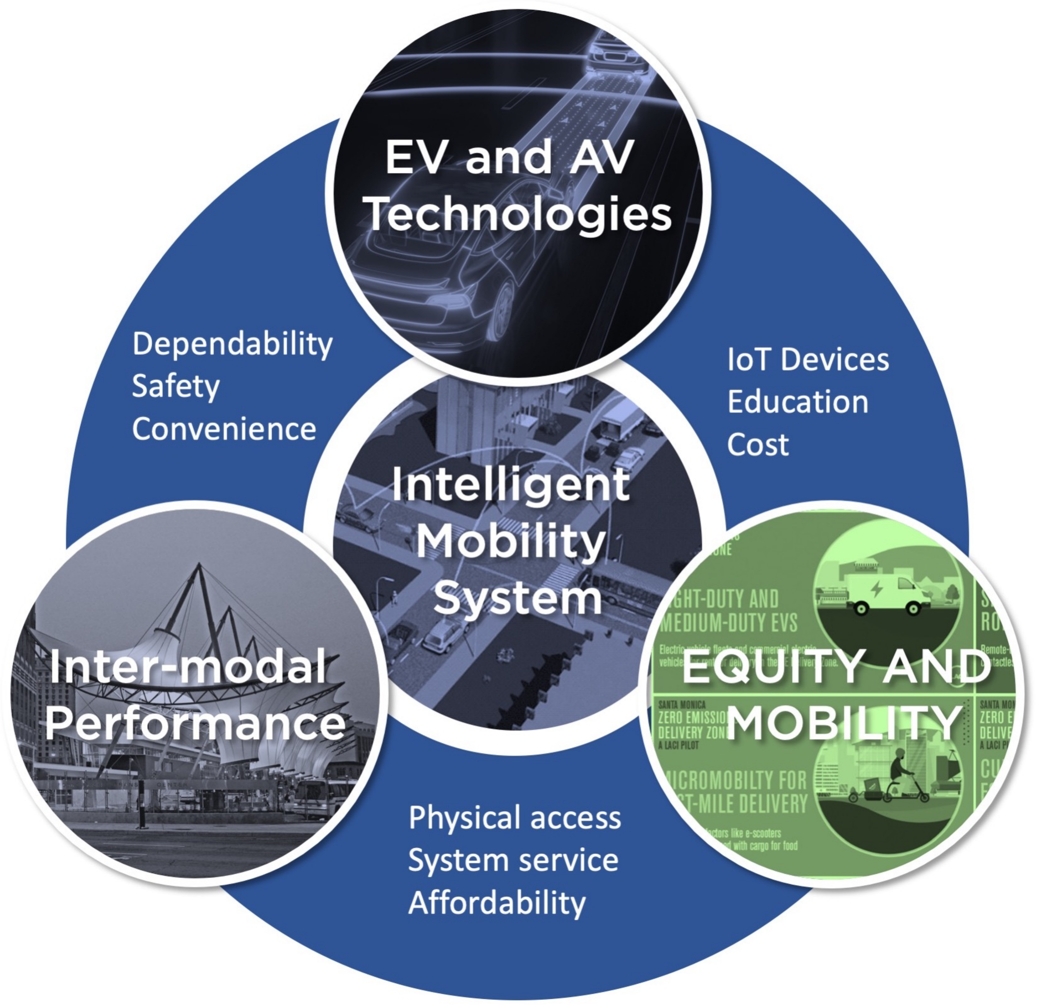
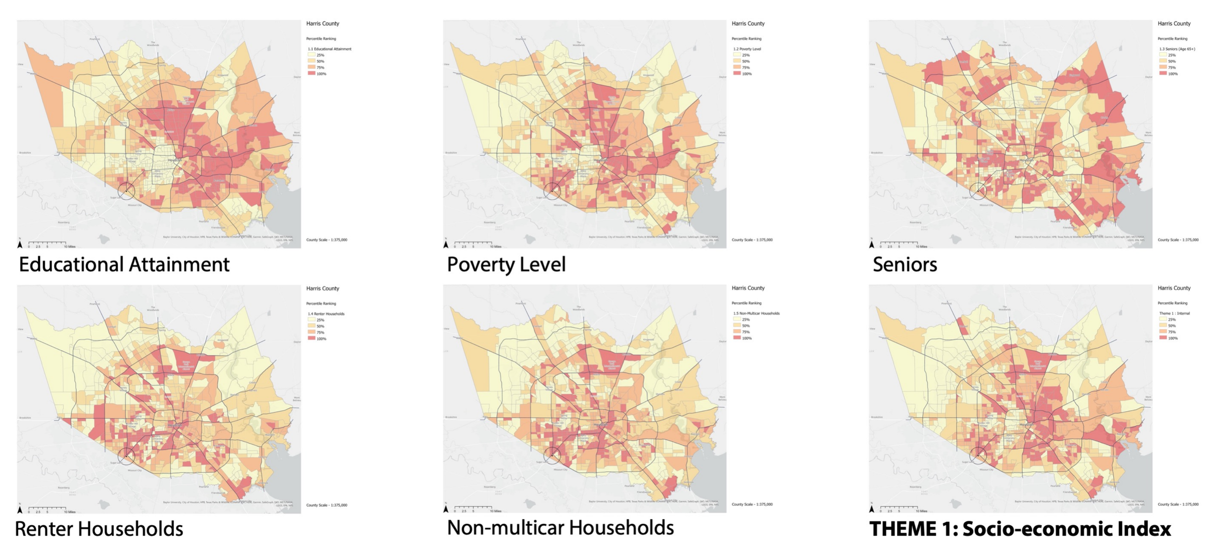


EQUITY OBJECTIVES

- Improved transit service is smarter, more comfortable and safe, and reliable as 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

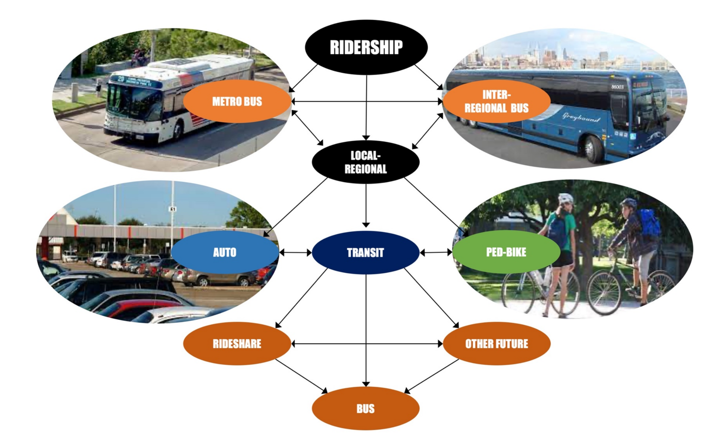
Theme 1: EV SOCIO-ECONOMIC INDICATORS AND INDEX



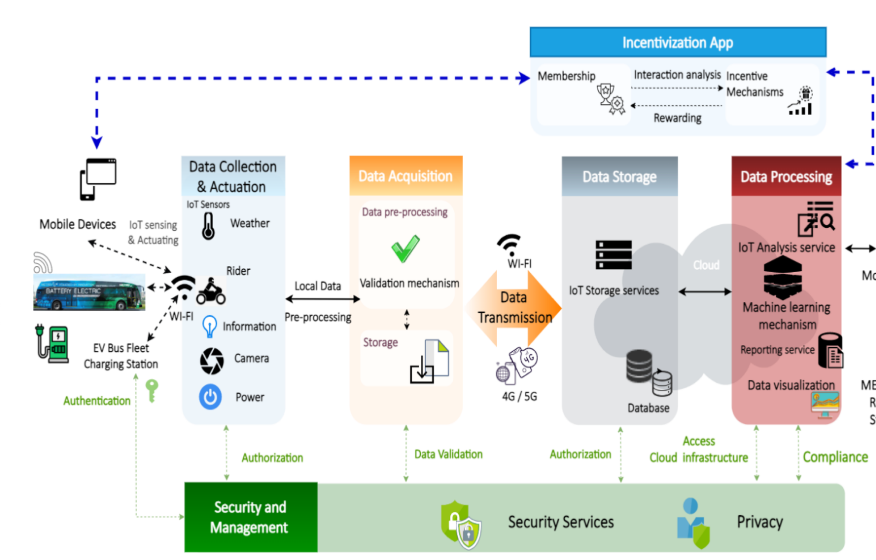
Quartiles Ranked Percentage

SMART TRANSIT HUB OBJECTIVES

- To manage a research planning project that empowers the community to address equitable adoption of EVs as a pilot program with a focus on equitable access to e-mobility.
- To demonstrate how it to provide access to electric vehicles and fast charging within a broader smart parking, charging, and METRO Pass system.
- To engage a community of researchers and community partners to build capacity to deploy data-driven research methodologies using emerging data analytics, smart sensing, and machine learning.



Smart Transit and Parking Architecture



BROADER IMPACTS

This project applies emerging data analytics, smart technologies, and machine learning to tackle a national challenge of equitable access to EV ownership and electric mobility. If this process is not undertaken, the ecosystem supporting improved transit services and equitable electric mobility will be delayed, disproportionately impacting low-income working families with long commutes and high household transportation expenditures. Greater access to new electric mobility technologies requires reduction in economic barriers to EV ownership and transportation services. Communities need to proactively plan for transportation technologies to improve the lives of low-income communities while lowering emissions, increasing transit use, and reducing congestion. Broader impacts include developing a digital ecosystem and incentive programs reflecting the national need to stimulate equitable access to EV ownership; regional policy impact demonstrating collaborative partnerships between cities, EV companies, fast charging developers, and ridesharing services; and research that opens up opportunities to use the data for EV impacts on the energy grid and future smart grid research. This project will identify how the deployment of smart technologies can improve the reliability, comfort, and affordability of transit services.

RESULTS

- **Defined e-mobility/EV adoption equity indicators** and index and mapped Harris County to inform regional fast charging access and incentive programs by the City of Houston and TxDOT regional charging strategies
- **Survey of METRO patrons** at pilot park and ride regarding transit use, demographics and adoption interests in e-mobility and EVs
- **Identified key features in simulation** for ridership demand, fleet and staff deployment, route demand, and EV fleet conversion energy demand and supply for charging strategies
- **Modeled regional commuting scenarios** for energy and emissions for electrification of bus fleet and park and ride commuters (West Bellfort pilot transit routes)
- **Digital architecture** for integrated smart parking, privacy, and incentive/payment systems
- **Interactive process** including weekly METRO staff meetings, Steering Committee, and Technical Advisory Committee
- **Regional and state-wide dissemination** effort of radio shows, webinars, panel presentations, MPO advisory committees, and professional conferences
- **Basis for DoE EV charging equity pilot grant** and follow-up NSF grant

AIM: Deployment of smart technologies that improve the reliability, comfort, and affordability of transit services.

The Data Collection Layer enables the METRO system to collect data from its EV bus fleet and charging station and information about riders to improve their experience. Data will include images, GPS, Weather, etc. This layer involves privacy protection and authentication.

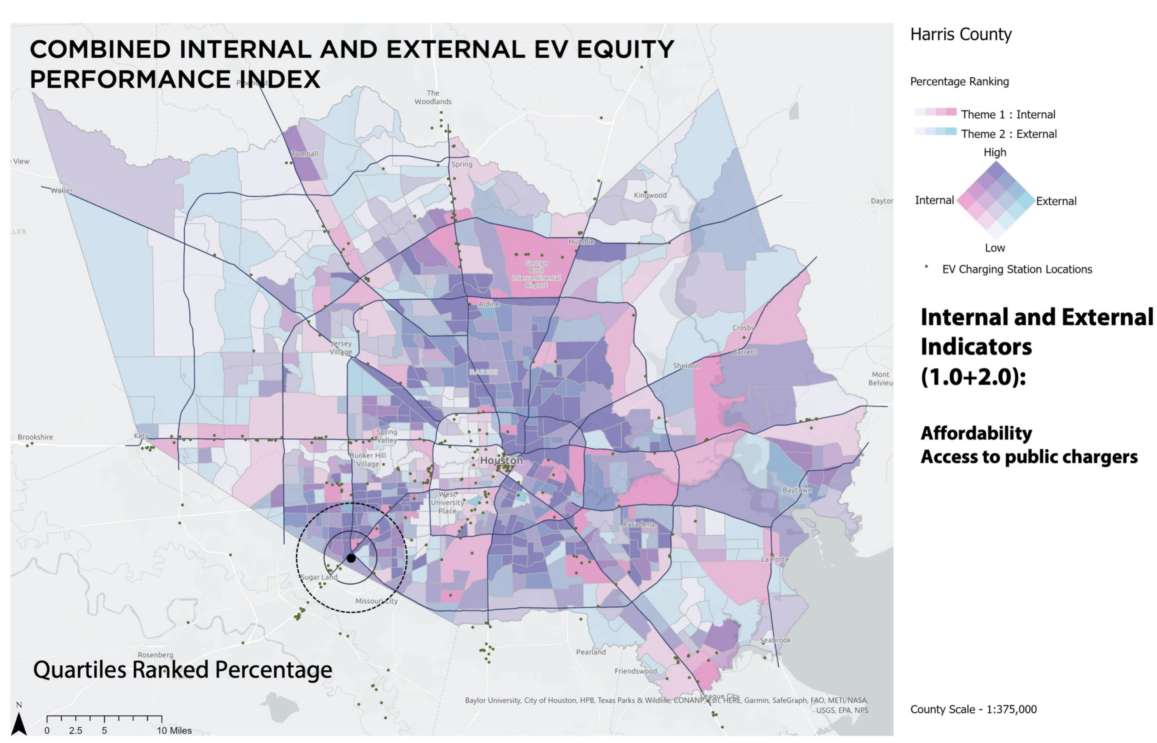
The Data Acquisition Layer receives data from the data collection layer and stores it in the device and buses to apply the data validation mechanism to filter out unqualified data and to hide the private information in the images and videos before submitting it to the cloud. The data will be transmitted to the next layer after it is authorized. If we're using smartphone apps to collect data, users will be able to make decisions about what data is authorized and what modes of transportation is he interested in.

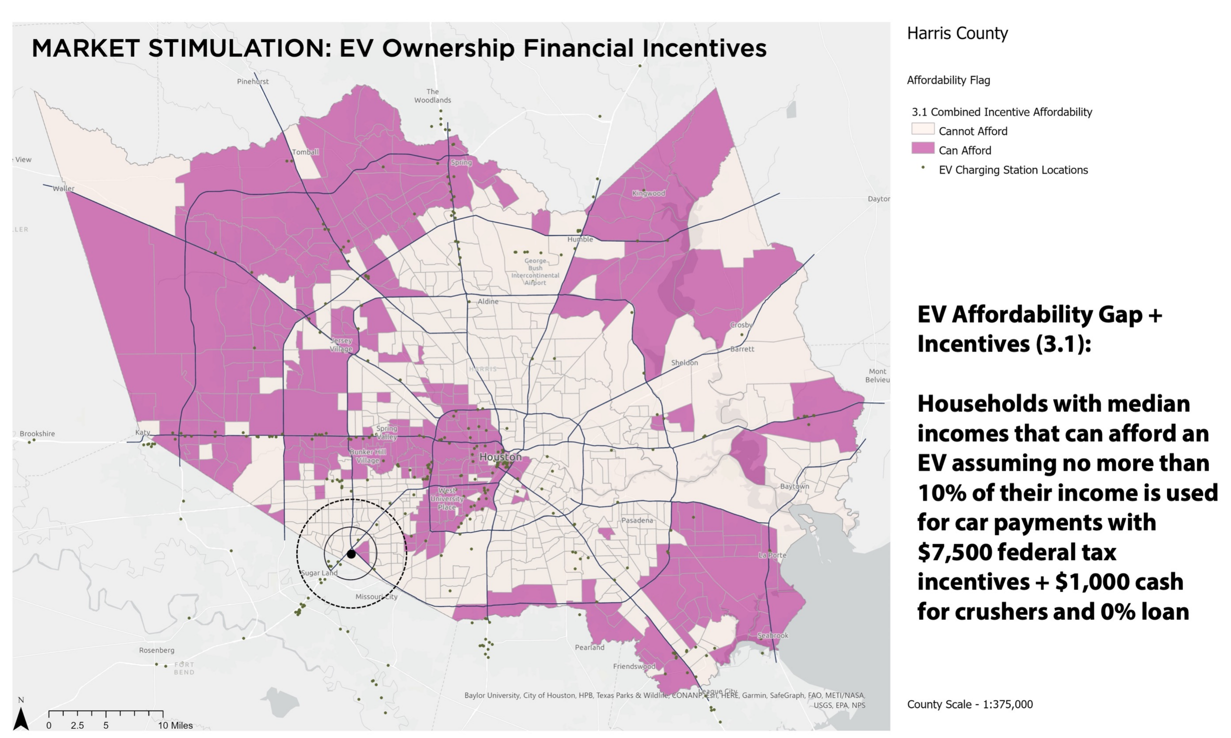
The Data Storage Layer is a cloud server that consists of aggregating data that has been received from the Data Acquisition Layer.

The Data Processing Layer is a cloud computing layer that provides resources to process aggregated data to verify its reliability and eliminate redundant data. This layer also applies data analysis, reporting, and data visualization services to retrieve as much knowledge as possible before providing it to the stakeholder application and designing incentives to engage riders to use public transport integrated with intermodal transport.

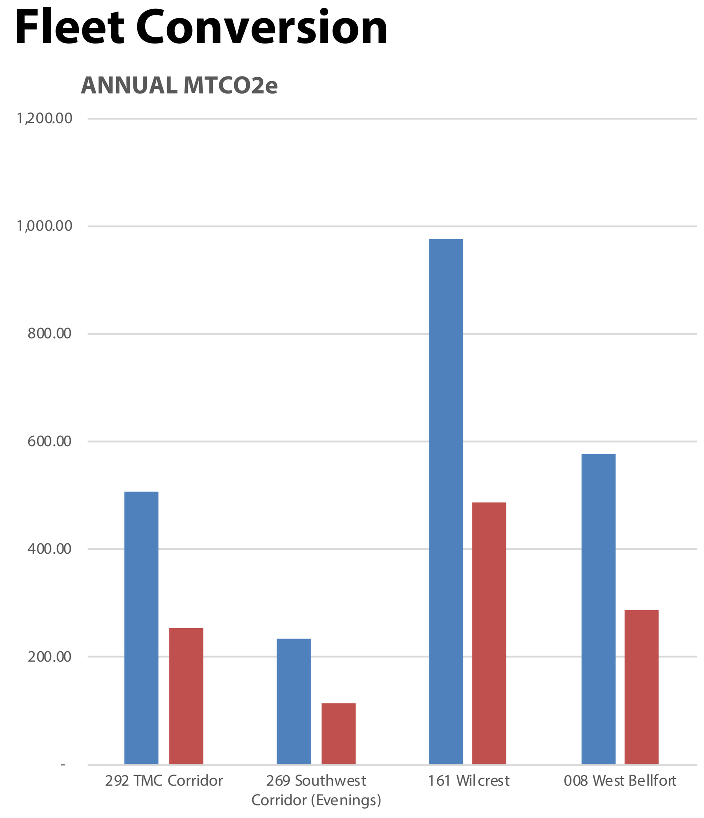
Incentivization App presents the incentive mechanism service. Its main role consists of applying the game design elements we proposed for this architecture, acting as a link between the cloud server which provides incentives to users who favor EV-related services.

Security Management is responsible for providing a secure service that combines varied security aspects such as data security in terms of data integrity, data access, authentication, authorization, and data privacy.





Climate Benefits of METRO Fleet Conversion

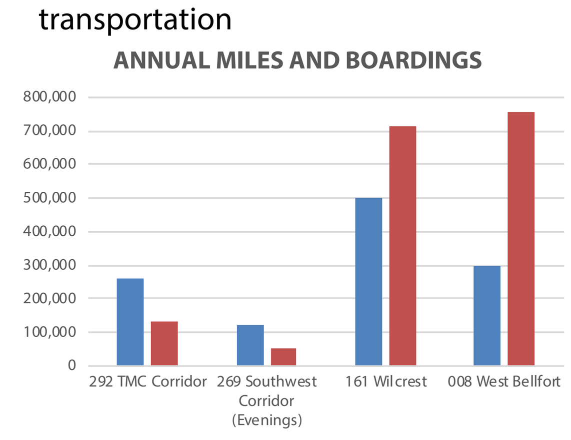


Bus Routes Originating from West Bellfort Park and Ride

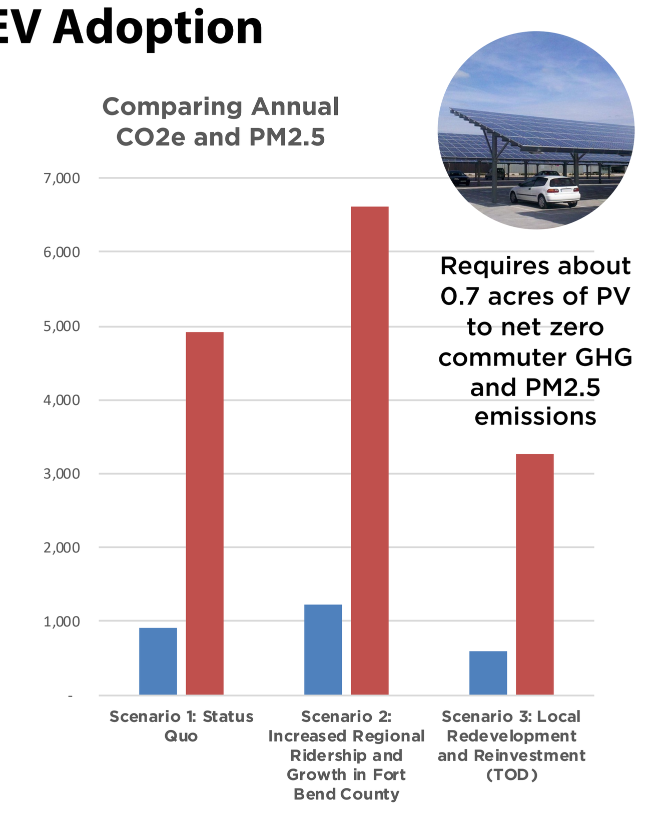
Mapped patterns of METRO patrons and characterized their e-mobility equity context

Demonstrated environmental and economic benefits for EV commuter and transit fleet conversion

Developed regional growth scenarios to contextualize smart transportation



Climate Benefits of Commuter EV Adoption



Commuters using West Bellfort Park and Ride

SCENARIO 1: 2019 Baseline

- 70%-30% regional and local ridership
- 20% reduction in VMT
- 3,000 bus boardings
- 24 MPGe (2014)

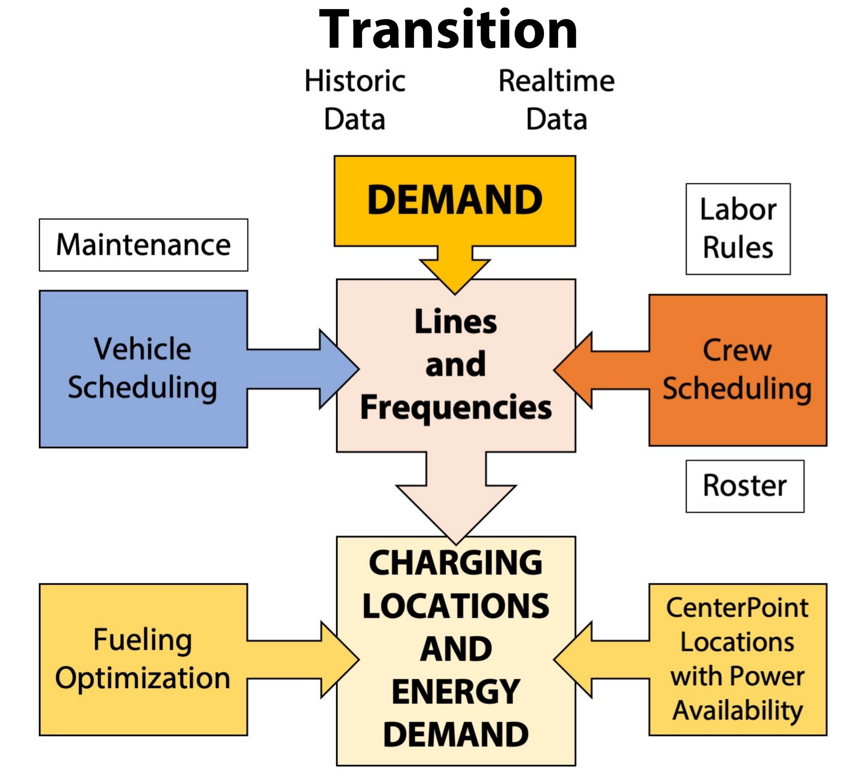
SCENARIO 2: Increased Regional Ridership and Growth in Ft. Bend County (Sprawl Model)

- 90%-10% regional and local ridership
- 30% reduction in VMT
- 5,000 bus boardings
- 54.5 MPGe (Obama era CAFE standards)

SCENARIO 3: Redevelopment of I-69/Loop 8 (TOD Model)

- 60%-40% regional and local ridership
- 40% reduction in VMT
- 7,000 bus boardings
- 112 MPGe EV Fleet

New Normal for Fleet Scheduling and Energy Transition



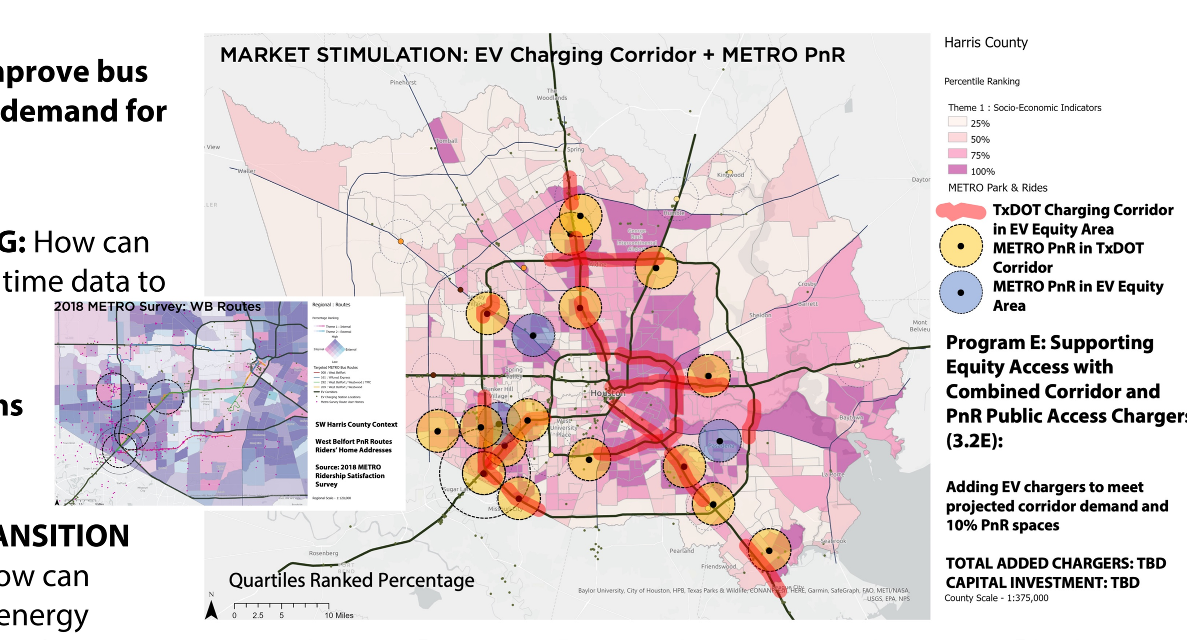
AIM. Use data analytics to improve bus fleet scheduling and energy demand for fleet electrification.

Q1. PREDICTIVE SCHEDULING: How can METRO apply historic and real time data to improve bus scheduling?

Outcomes: Improve on-time performance, fleet operations (optimization/utilization)

Q2. INFORMING ENERGY TRANSITION AND REAL TIME DEMAND: How can predictive scheduling predict energy demand and optimization of EV charging and fleet planning?

Outcomes: Improve energy planning, fleet operations (optimization/utilization)



Regional EV Charging Equity Policies and Strategies

SCC-PG research is the basis for DOE and NSF grant proposals and regional cooperation (MPO, Evolve Houston, METRO, universities)