

# Systematic Framework for Sustainable Travel through Smart and Engaged Communities

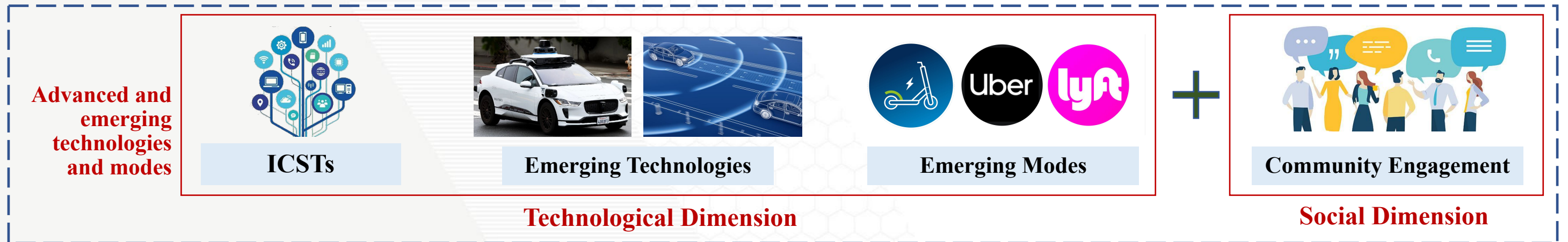
**Srinivas Peeta**

Frederick R. Dickerson Chair and Professor  
Georgia Tech

10th Annual SMART Community Exchange

October 30, 2023

CREATING THE NEXT®



\* ICSTs: Information, communication, and sensor technologies

# Problem Dimensions



## Technological Dimension

Disparate ICSTs and their organic deployment

Prevents decision-makers from using ICSTs in deliberate, holistic manner

Established technologies are not adequately leveraged

Emerging technologies and modes are not systematically explored



## Social Dimension

Sociodemographic heterogeneity

Multiple stakeholder levels

Precludes decision-makers from optimally harnessing technologies for societal benefits

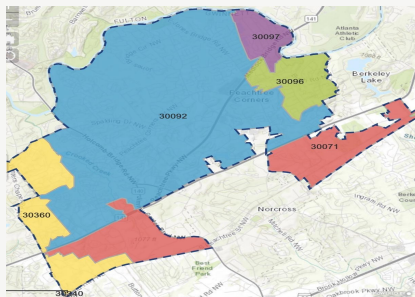
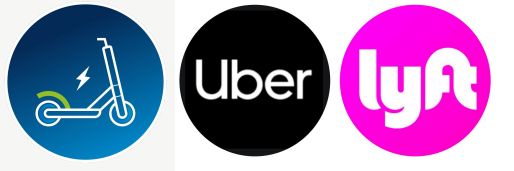
Well-intended solutions may not be equitable (e.g., may exclude disadvantaged groups)

# Issues in Smart and Engaged Communities

## Issues



**Organic emergence of new technologies and modes**



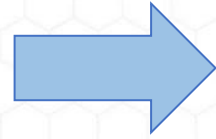
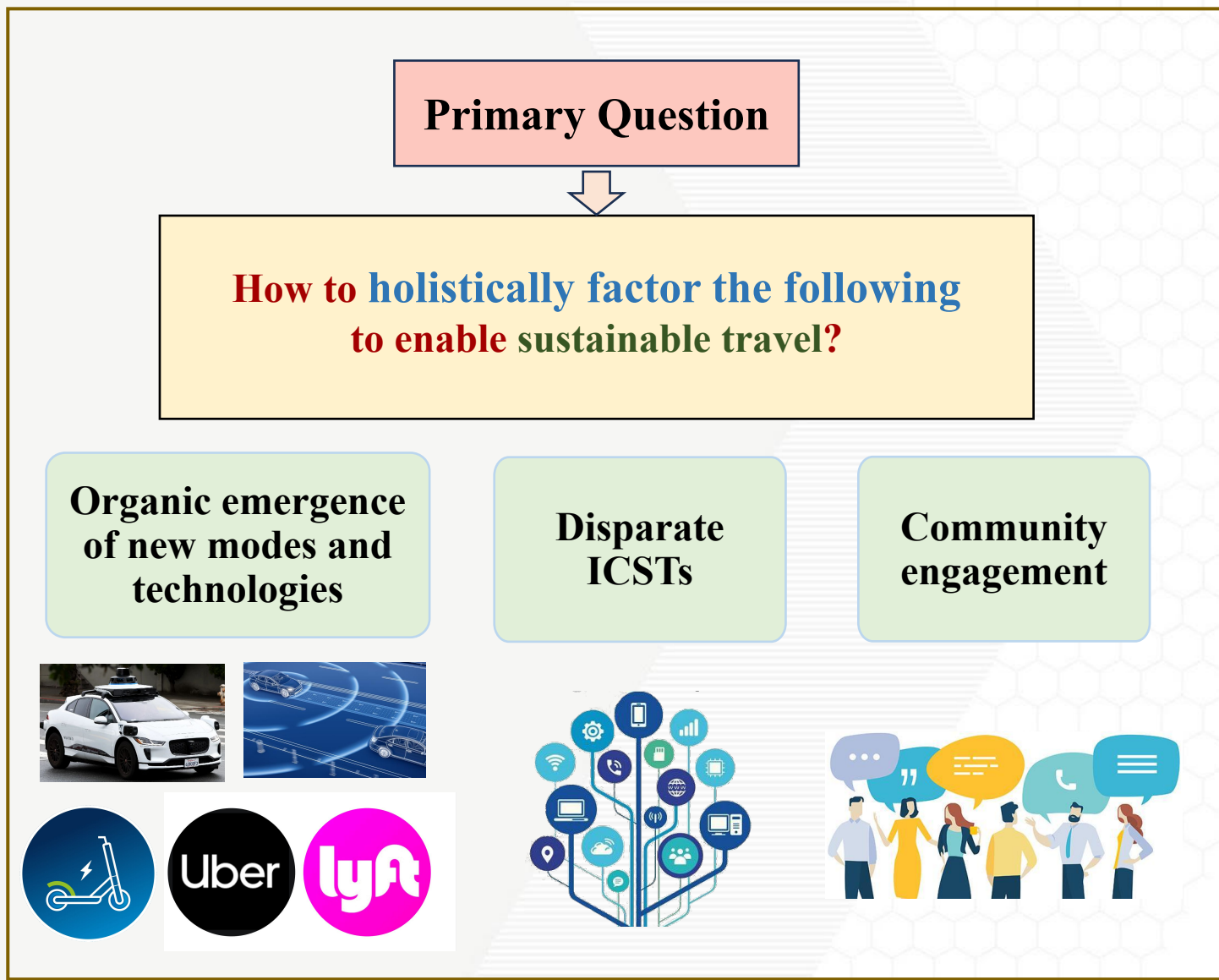
**Lack deliberate, system-level perspectives to generate solutions**



**Lack stakeholder-consistent solutions**



**Optimal societal benefits related to sustainable travel not realized for various stakeholder levels**

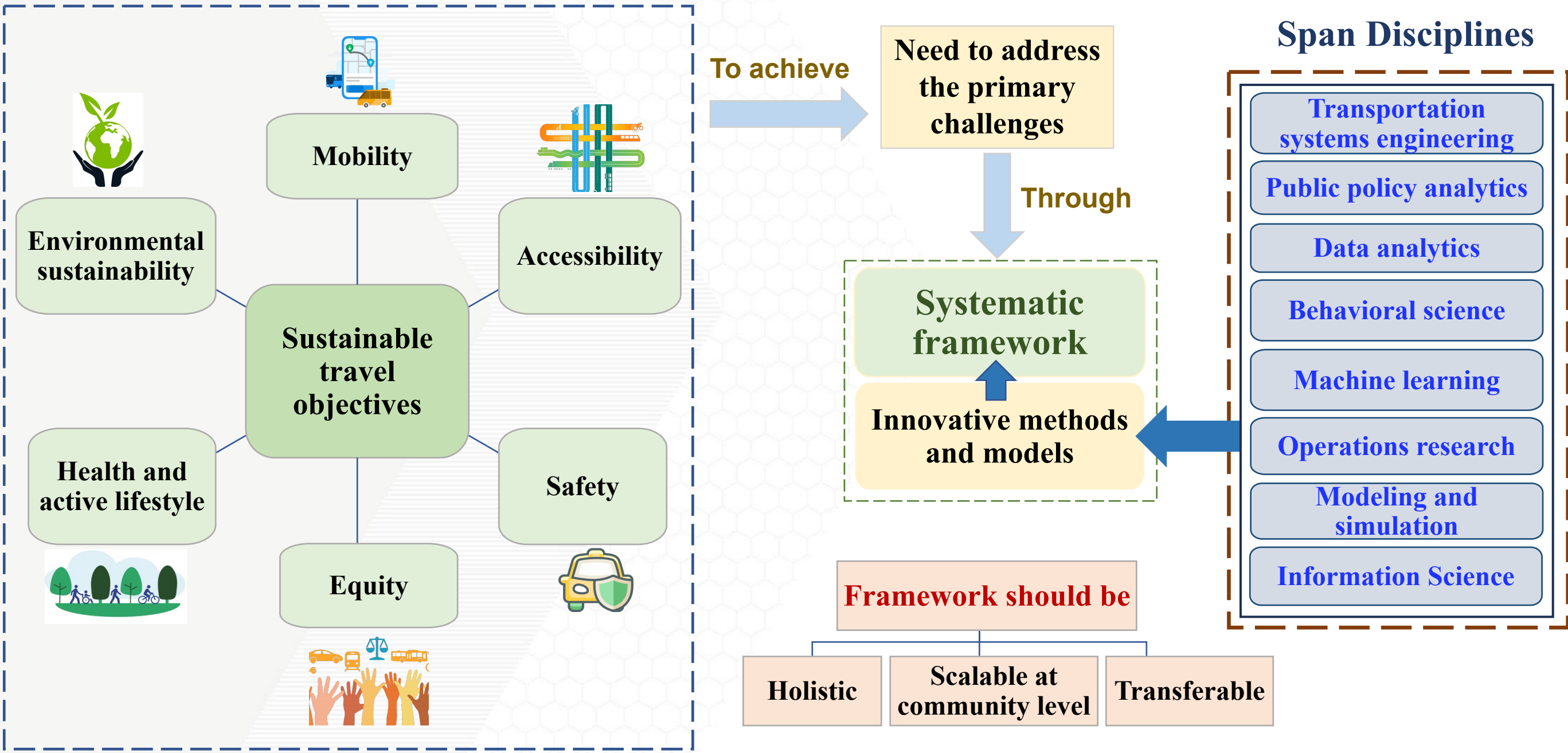


**How to:**

**Four Primary Challenges**

1. Integrate disparate data into actionable intelligence
2. Develop solutions that intelligently target different stakeholder levels
3. Systematically enable the community to progress towards sustainable travel
4. Leverage the organic emergence of new modes with existing modes

# Sustainable Travel



# SCC Project



**Project Title: Fostering Smart and Sustainable Travel through Engaged Communities using Integrated Multidimensional Information-Based Solutions**

**PI: Srinivas Peeta, Ph.D.**  
**Co-PI: Omar Asensio, Ph.D.**

**4-year, \$2.5M project starting October 2021**

## Partners

**Community Partner**

The logo for the City of Peachtree Corners, featuring a stylized white tree on a green and blue background with the text 'CITY OF Peachtree CORNERS' below it.

## Other Partners

The logo for Curiosity Lab at Peachtree Corners, featuring a stylized orange and green circuit-like graphic and the text 'Curiosity Lab at Peachtree Corners'.  
The logo for Gwinnett County Transit, featuring a stylized red and white 'G' and the text 'GWINNETT COUNTY TRANSIT'.  
The logo for Paul Duke STEM High School, featuring a stylized blue and yellow 'P' and the text 'PAUL DUKE STEM HIGH SCHOOL'.  
The logo for PIN Partnership for Inclusive Innovation, featuring the text 'pin partnership for inclusive innovation' in red and black.

## Project aims to

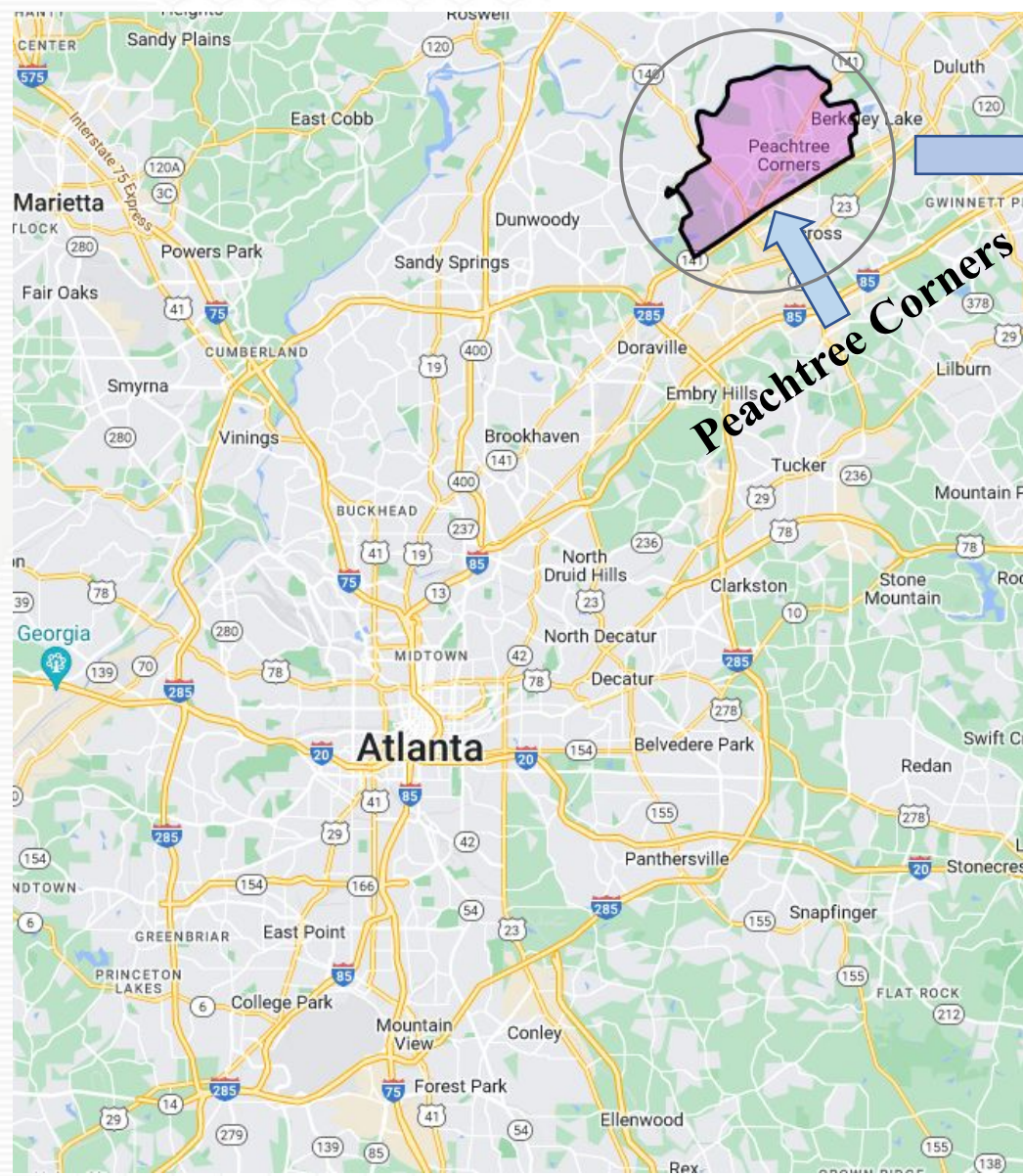
Develop **Multidimensional** solutions to achieve multiple sustainable travel objectives

- At the community level
- Within stakeholder levels
- Across stakeholder levels

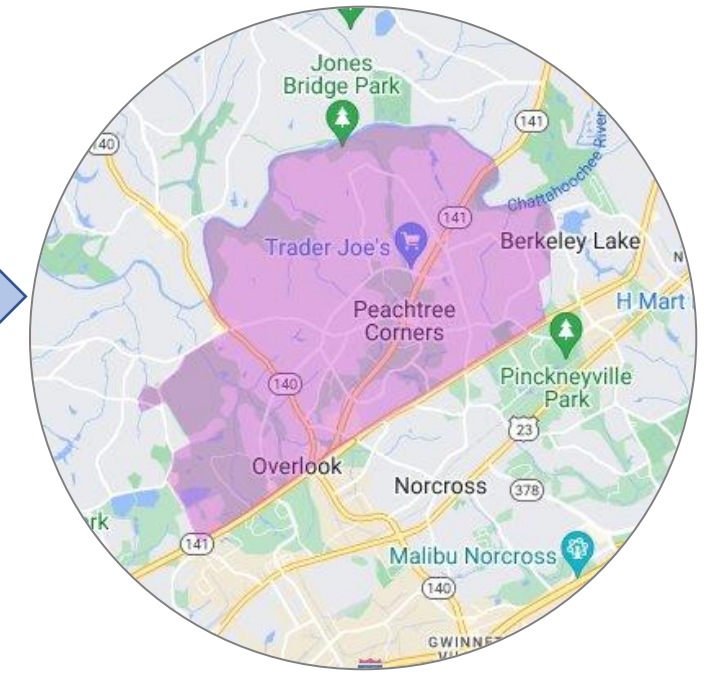
# The Community (PTC)



Immersive living lab for SCC Project

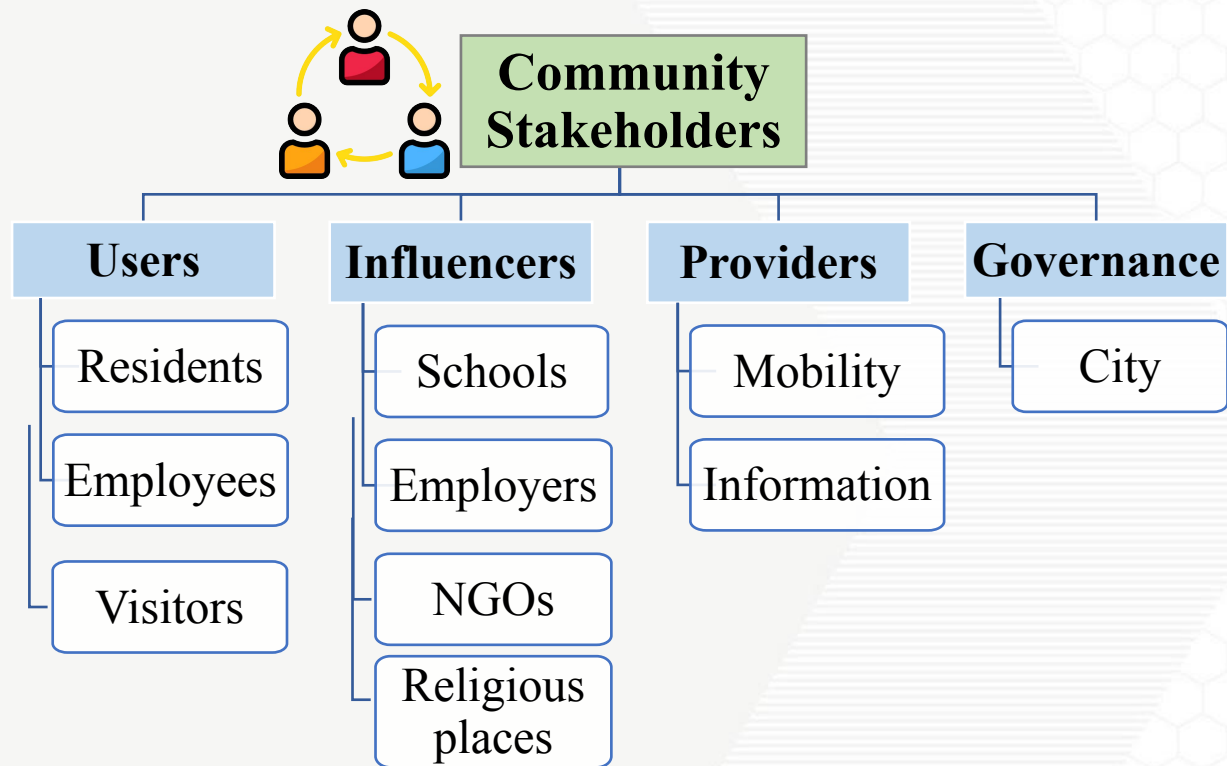


Atlanta (GA) metropolitan area

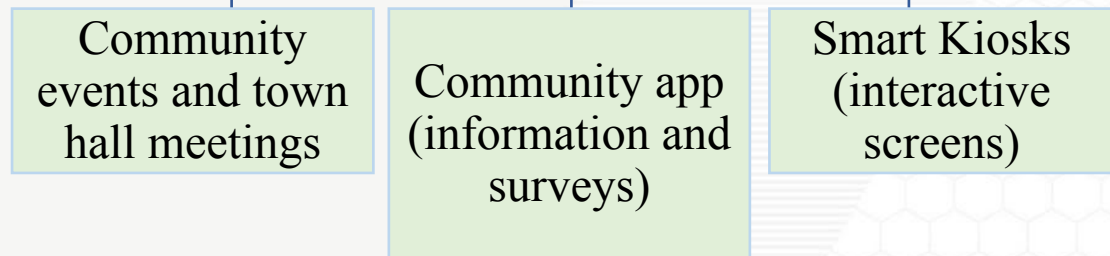


Part of Atlanta metropolitan area	Largest city in Gwinnett County
Population: 42,243 (2020 US Census)	Only northern Atlanta suburb developed as a planned community





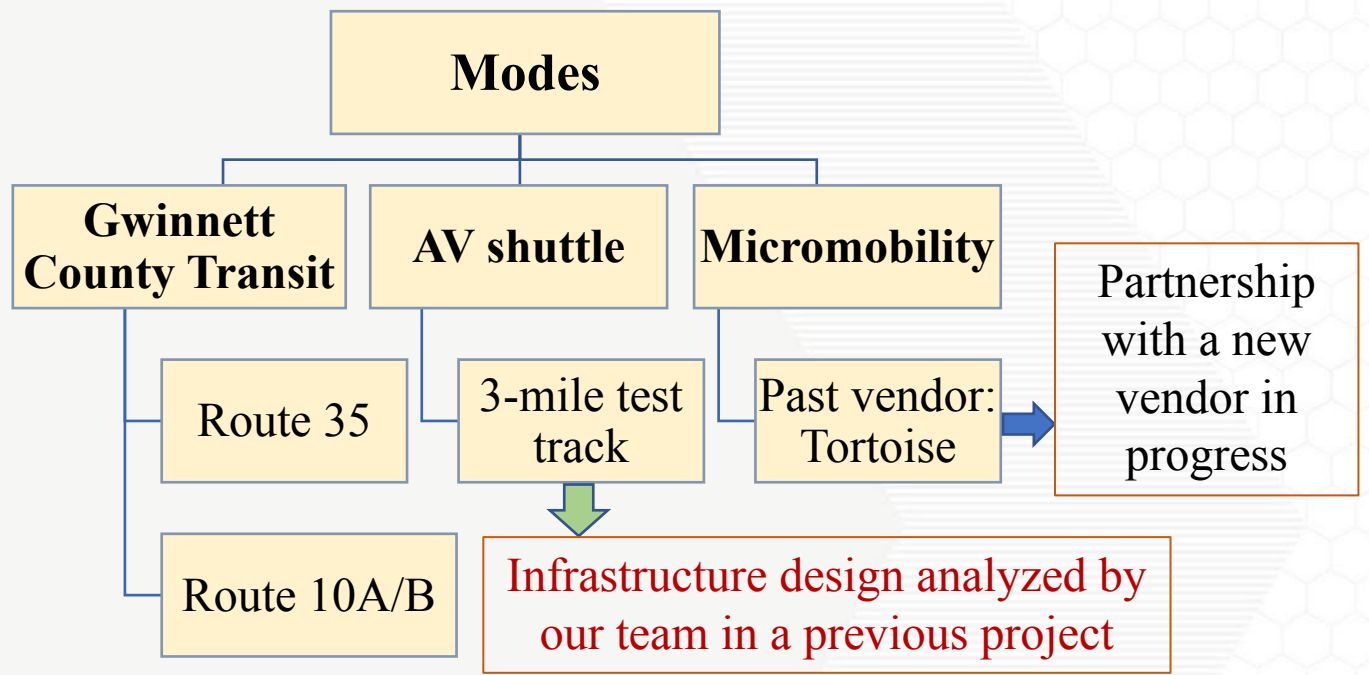
### Community currently engaged through



### Advanced and Emerging Technologies

- Autonomous vehicles (level 3)
- Parking lot APIs
- 5G Wireless environment
- Intelligent traffic cameras and signals
- AV test lane
- Charging station APIs
- DSRC roadside units
- Smart streetlights
- Electric vehicle charging stations
- Interactive displays
- V2X communications
- Smart energy technologies





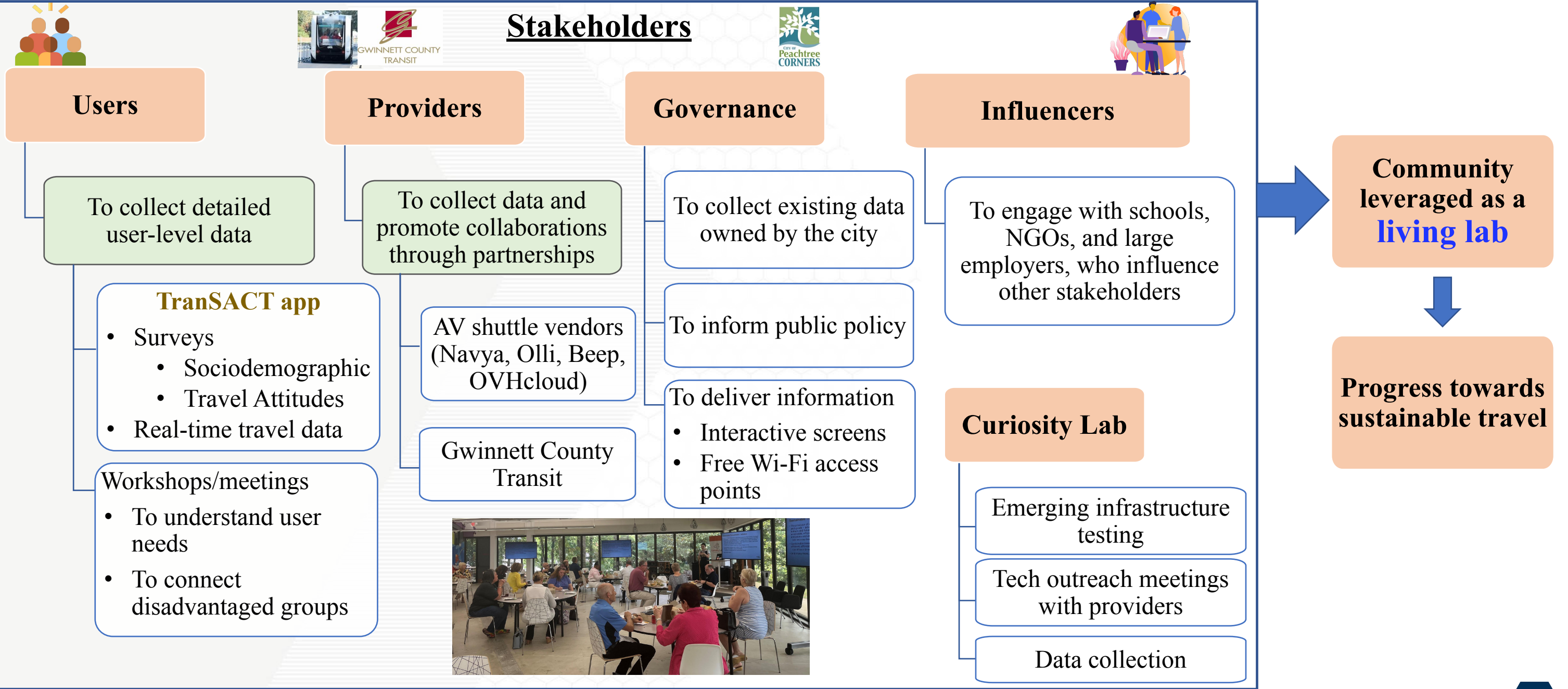
### Mode of Transportation to Work

Car, truck, or van	84.09%
Public transportation	1%
Taxi	1.27%
Bicycle	0.06%
Walk	1.09%
Other modes	0.76%
Worked from home	11.73%

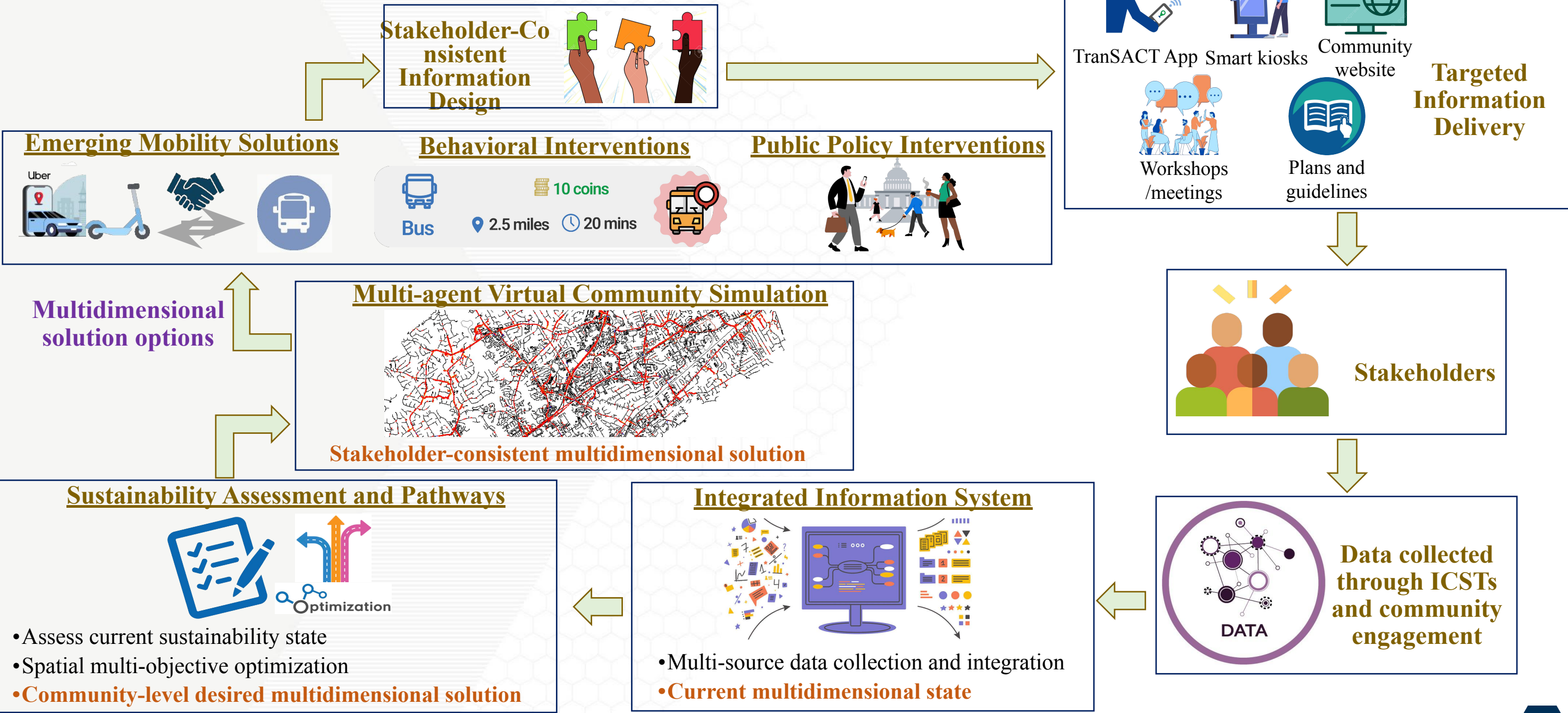
Contributes to congestion

Needs coordination among emerging and public modes to promote sustainable travel modes





# SCC Travel Sustainability Framework



# Integrated Information System

## Integrated Information System

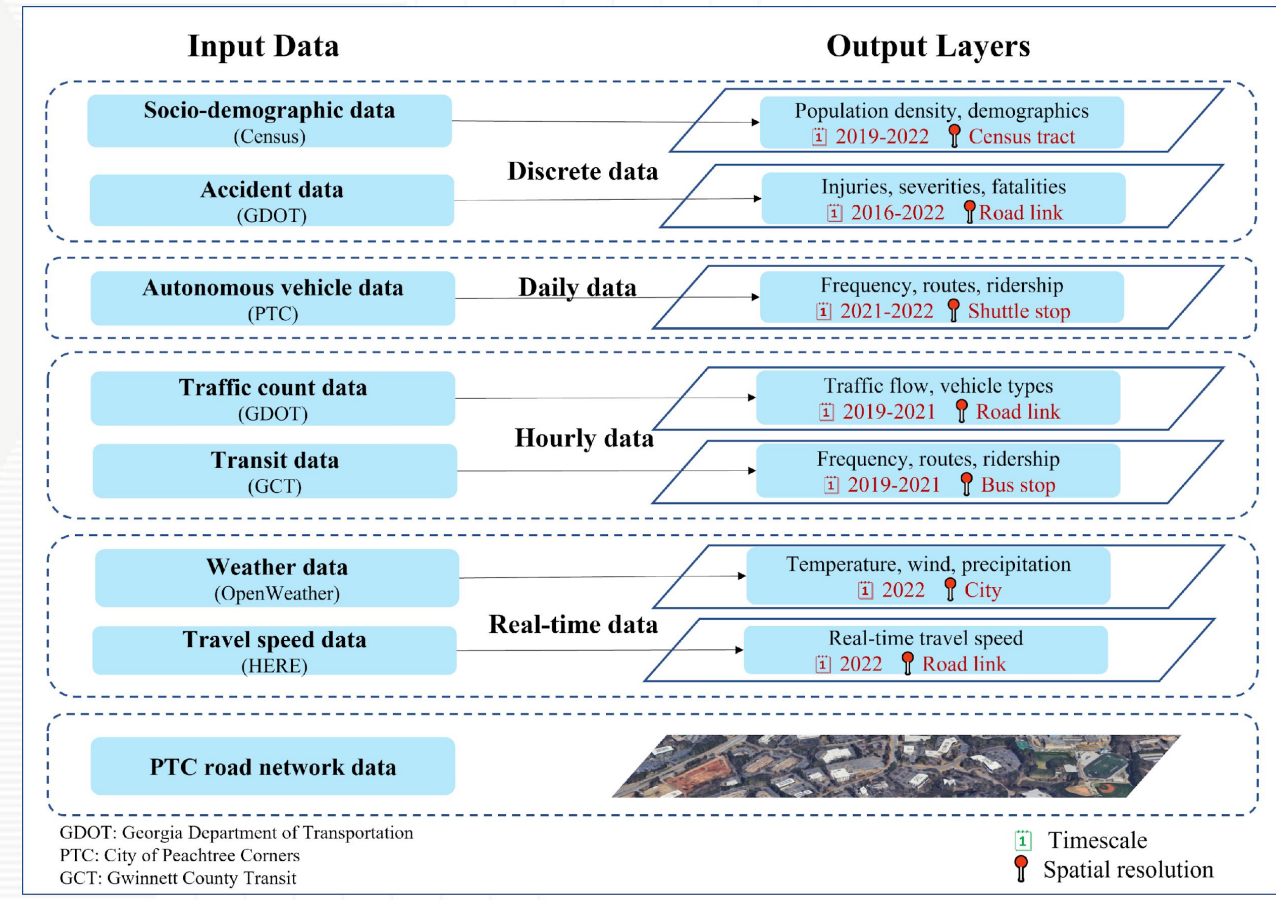
Integrated data are visualized using layers on a **visualization platform**

Translates **multi-timescale and multi-source** data into usable insights

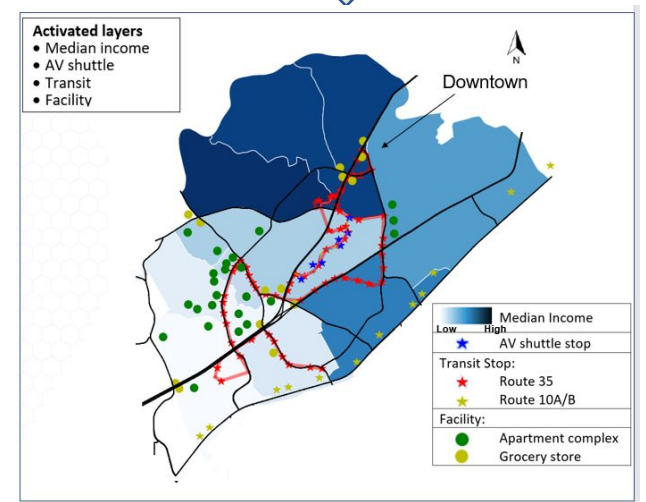
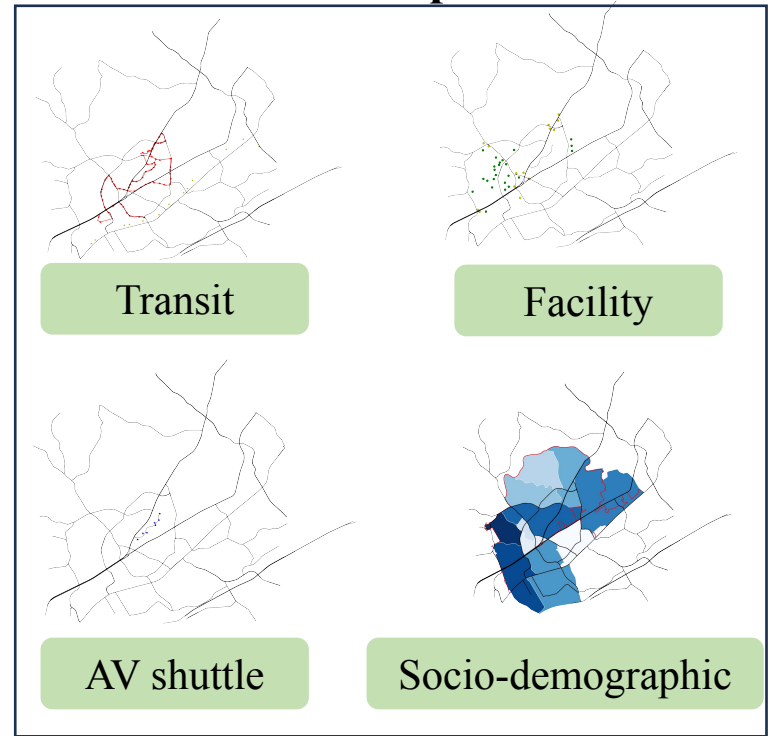
Illustrates community's **current multidimensional state**

Enables decision-makers to **quantifiably measure** progress towards sustainable travel

### Collected and Integrated Data



### Example



# Sustainability Assessment and Pathways

## Sustainability Assessment and Pathways

Assess community's **current sustainability state**

**Quantifiably assess** progress towards community's sustainable travel objectives

Generate **multidimensional pathways** to towards desired objectives

### Metric

#### **S** Mobility

- System time

#### **A** Access

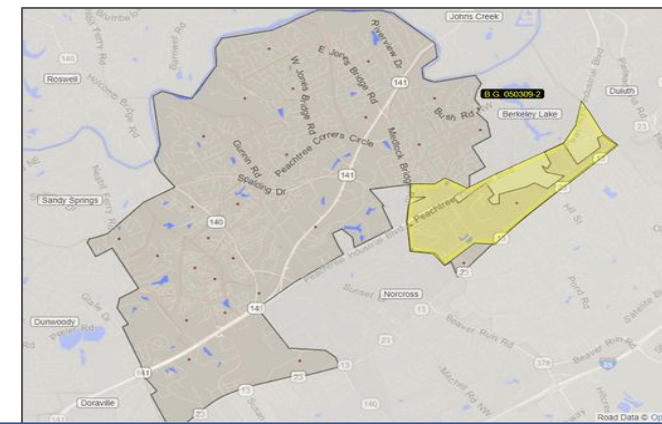
- To societal services/activities (location and utility-based measures)

#### **S** Safety

- Crash count
- Fatality count
- Severity of crashes

#### **E** Equity

- Accessibility equity
- Inclusion equity
- Utility equity



Spatially disaggregated network (done based on **block groups**)

Enables addressing **inequity issues**

**Multi-objective optimization model**

**Community-level desired multidimensional solutions**

# Virtual Community Simulation for Stakeholder Consistency

## Virtual Community Simulation for Stakeholder Consistency

Translates **community-level** solutions **to stakeholder-consistent** solutions

**Scales behavioral interventions** and **emerging mobility solutions**

- ✓ Need **multi-agent** simulation
  - Simulates **complex real-world variables**
    - Characteristics of multiple travel modes
    - Stakeholder behaviors
    - Information delivery and access characteristics
  - Handles **multi-dimensionality**
    - Stakeholder heterogeneity
    - Influencers' impacts
    - Providers' goals and constraints.

### Example of PTC Traffic Simulation

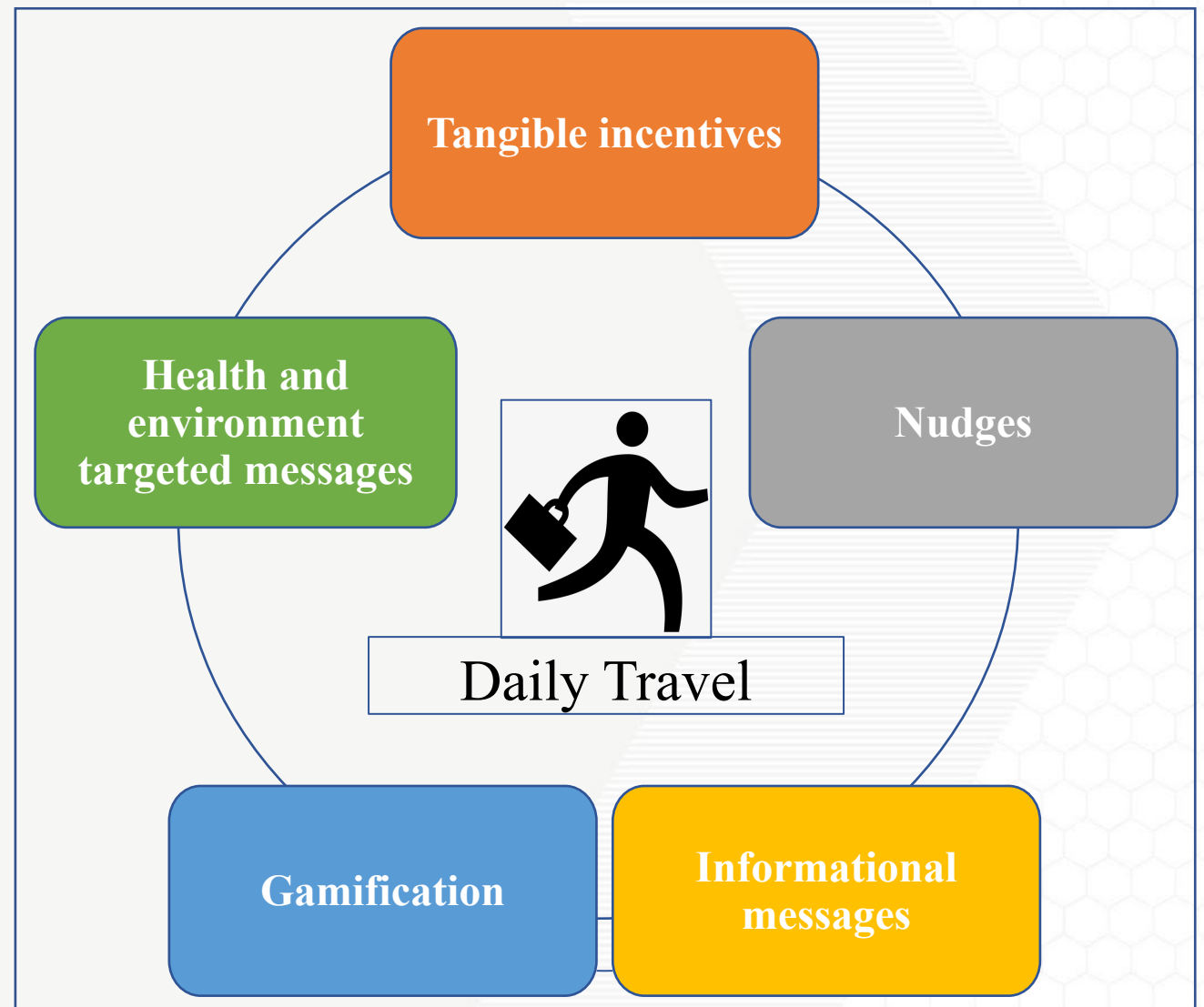


Off-peak period

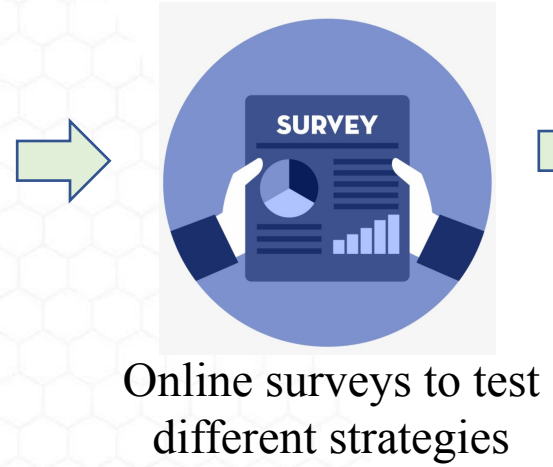


Peak period

# Behavioral Intervention Strategies



Portfolio of behavioral intervention strategies



**Output:** Behavioral intervention strategies with strong potential for inducing sustainable behavior

**Field tests at PTC (through TranSACT app)**

**Outputs**

- ✓ Traveler behavior and attitudes
- ✓ Personalized intervention strategies

**Scaled through multi-agent simulation**



# Emerging Mobility Solutions



Utilize emerging modes to **promote sustainable travel**

Incorporated in:

- Multi-objective model
- Simulation platform
- Behavioral interventions
- Public policy interventions



**Model partnerships** across emerging modes and transit agencies

Emerging modes in private sectors

- TNCs (Uber/Lyft)
- Micromobility (e-scooters)

Public transit agencies



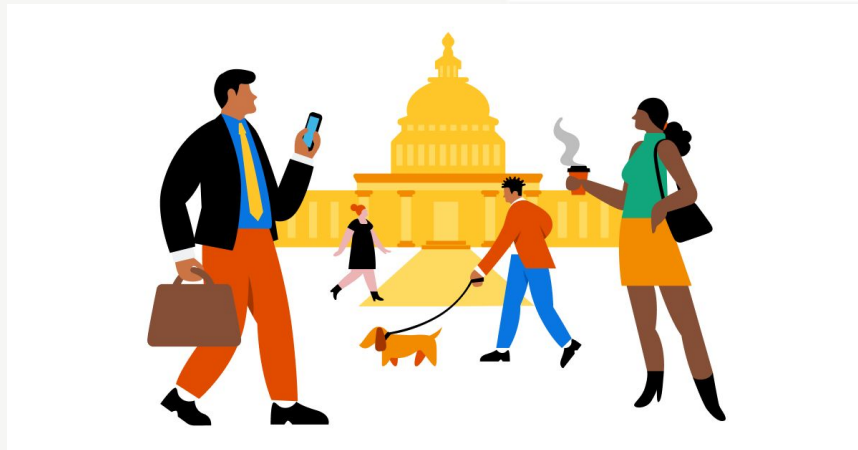
Leverage partnerships to address **first/last mile connectivity** issues

Enhance **accessibility equity**

Enhance **environmental sustainability**



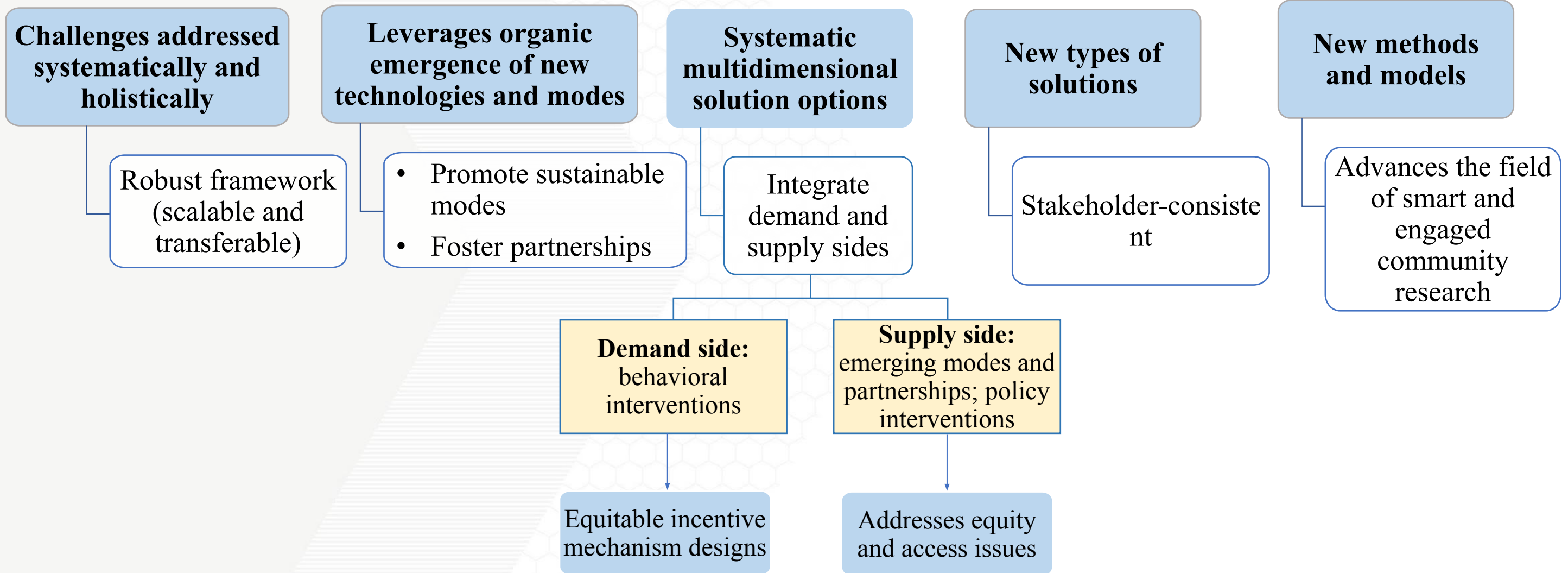
# Public Policy Interventions



Diverse policies targeted at multiple stakeholder levels

- To **enable behavioral interventions**
- To **foster emerging mobility solutions**
- To **enhance travel safety and travel information access**

# Capabilities of SCC Sustainability Framework



# Concluding Remarks

- SCCs have emerging opportunities and challenges
  - ICSTs and other technological advances
  - Emerging mobility modes
  - Disparate data sources
  - Multiple stakeholder levels
- **Question:** How to holistically factor SCC characteristics and emerging opportunities to enable sustainable travel in a community?
- Develop **systematic and holistic framework** to achieve travel-related sustainability objectives
  - Scalable to **community level, transferable, and independently operable** by communities
  - Real world **equity and access issues** are systematically addressed
  - **Leverage** existing and emerging technologies and methods to develop multidimensional solution strategies

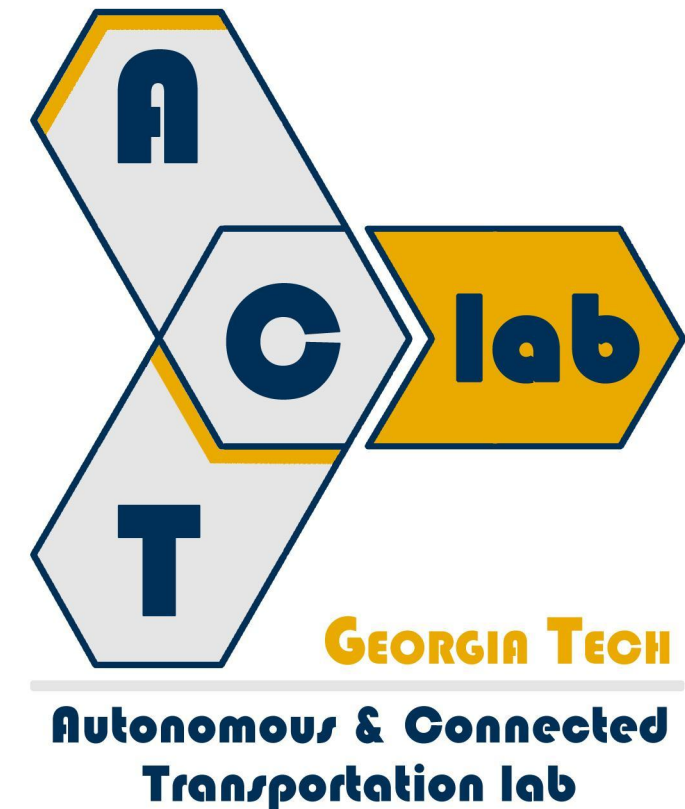
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# Questions and Comments....