Estimating the effects of smart growth strategies on VMT and GHG emissions in Vermont

House Transportation Committee

February 9th, 2023

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Project Objectives

Overarching Hypothesis: Compact, mixed use development patterns intrinsically generate less VMT and GHG emissions per person than more dispersed or rural settlement patterns.

RESEARCH OBJECTIVES:

1. **Demonstrate** the degree to which smart growth strategies, particularly in the Vermont context, can reduce Vehicle Miles Traveled (VMT) to meet transportation related GHG emission reduction targets as promulgated in the Vermont Pathways Analysis Report ("Pathways" report).

2. **Quantify** the co-benefits of smart growth strategies beyond GHG emission reductions. Such benefits include **health** benefits of increased active and multimodal travel, **safety** benefits for reduced VMT, **reduced maintenance** associated with fewer vehicles and possibly fewer lane miles, and **increased economic activity** located in downtowns and community centers.

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Data Sources

Built environment data

The nature of the space (i.e., *smart growth* characteristics)
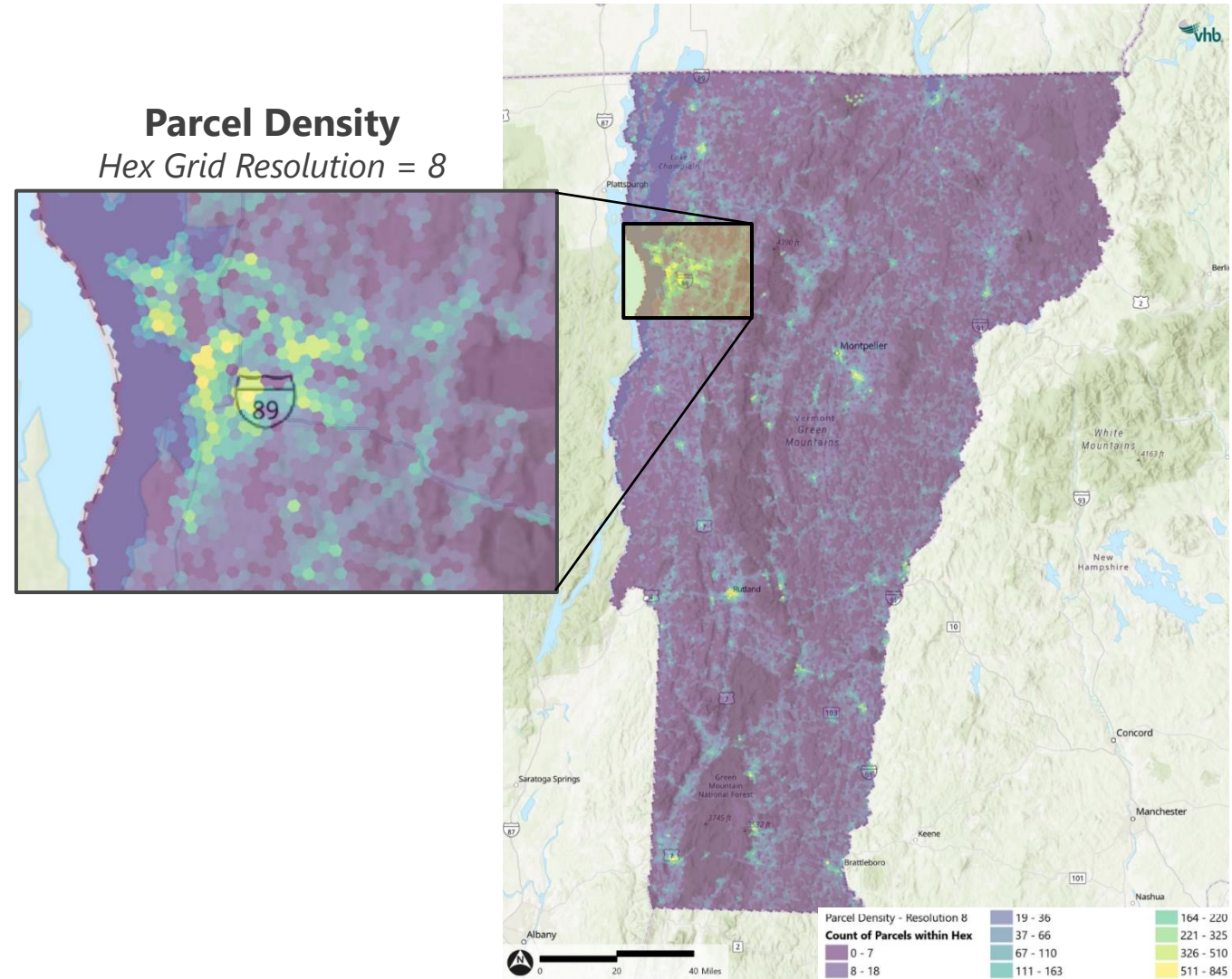- Parcel data, land use, transportation system, census, etc.

Passively collected location data

How do folks move?
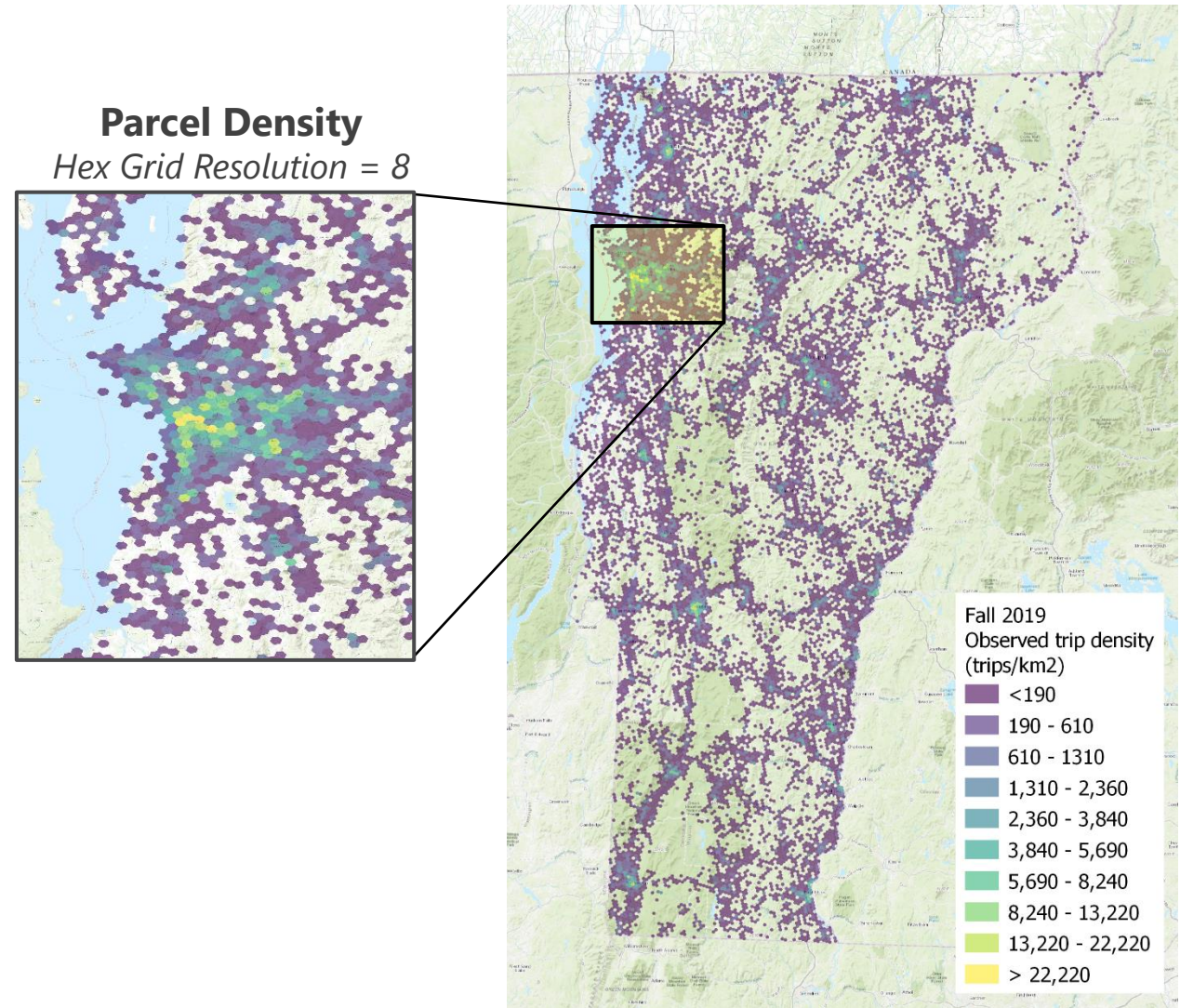- Smartphones + apps reporting user location at regular intervals
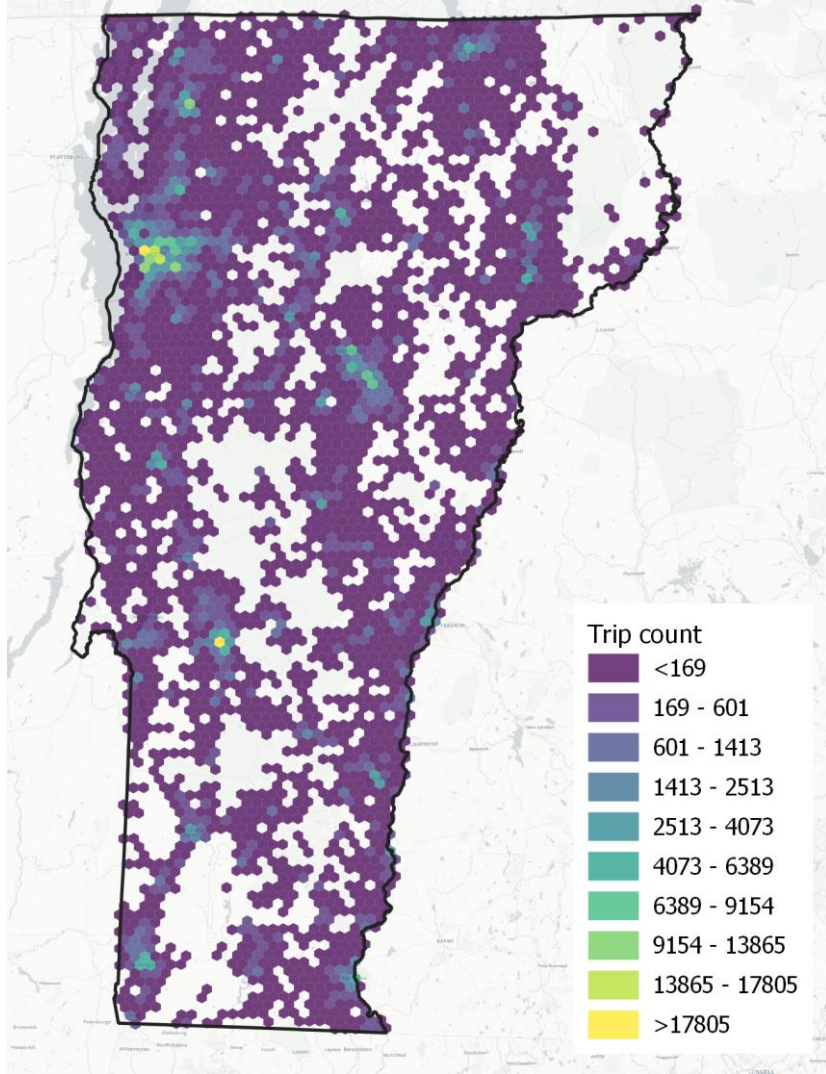
Built Environment Data

- Using **H3** hexagonal grid geospatial indexing system to analyze multiple large datasets
  - Originally developed by Uber to optimize pricing & dispatch
  - Covers geographic space with hexagonal grids
    - Grid resolution adjustable
    - Creates uniform grid to facilitate more efficient analysis
  - Hexagonal grids take on attributes of underlying data (point, polyline, polygon)

Parcel Density
Hex Grid Resolution = 8

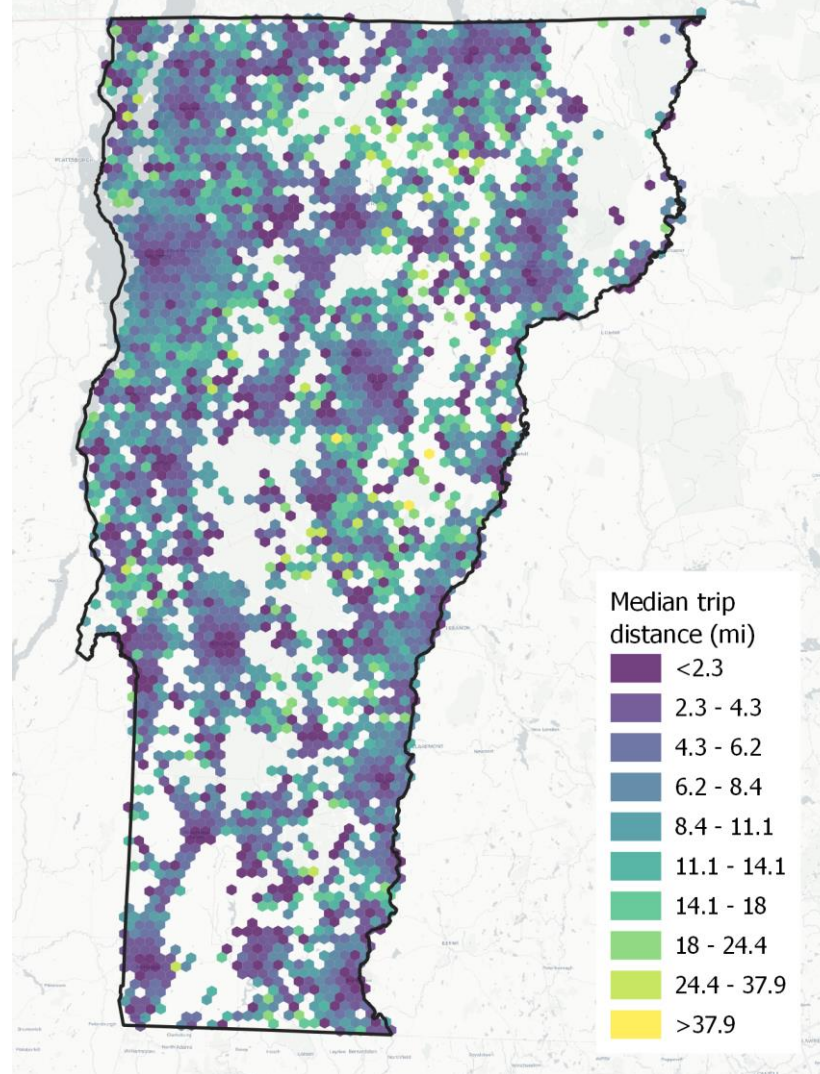| Parcel Density - Resolution 8 | 19 - 36 | 164 - 220 |
Count of Parcels within Hex	37 - 66	221 - 325
0 - 7	67 - 110	326 - 510
8 - 18	111 - 163	511 - 845

Passively Collected Location Data

- Initial rMerge query results for Fall 2019

- Same **H3** hexagonal grid tagged to trips

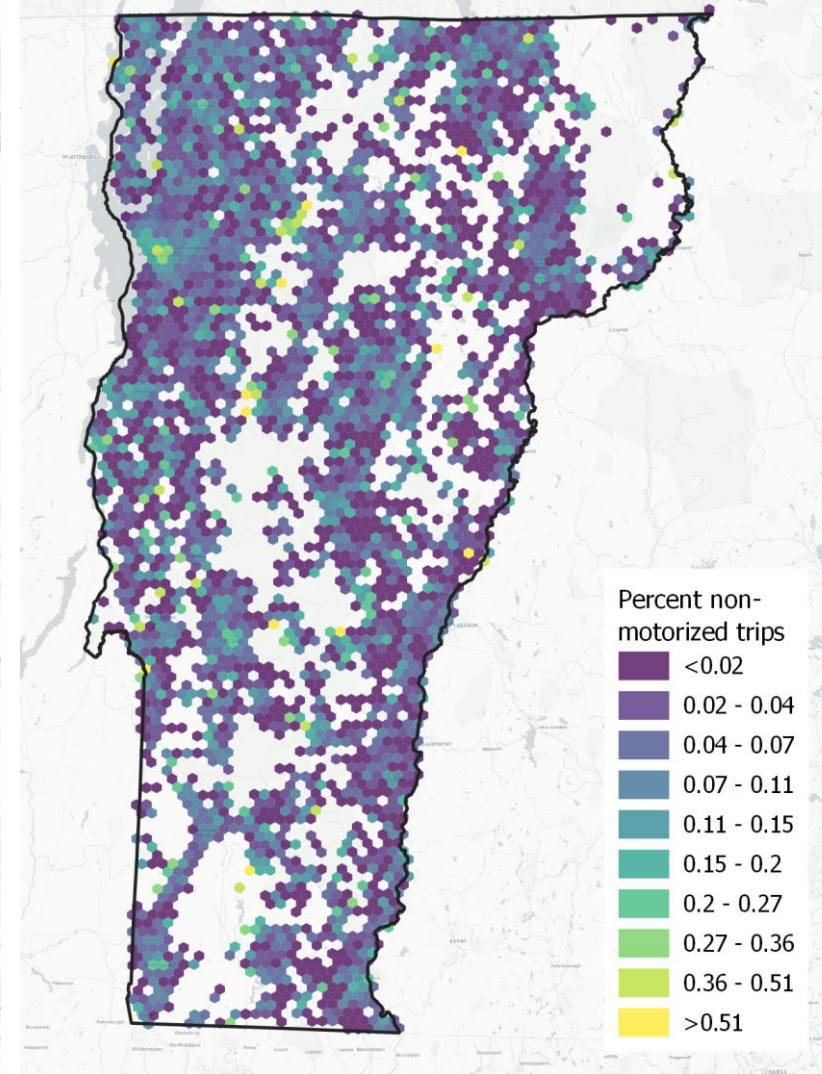- Grid cells will be used to join built environment measures to passive data results

Parcel Density
Hex Grid Resolution = 8

Fall 2019
Observed trip density
(trips/km2)

	<190
	190 - 610
	610 - 1310
	1,310 - 2,360
	2,360 - 3,840
	3,840 - 5,690
	5,690 - 8,240
	8,240 - 13,220
	13,220 - 22,220
	> 22,220

Trip Origins   Trip Distance   Non-Motorized

Applications

Policy

Create strategies for the Vermont context
- Land use, public transit provision
- RPCs + municipalities, public transit – informing future plans

Safety and health

Reduce vehicle usage because proximity, comfort of experience
- GHG emissions, crashes
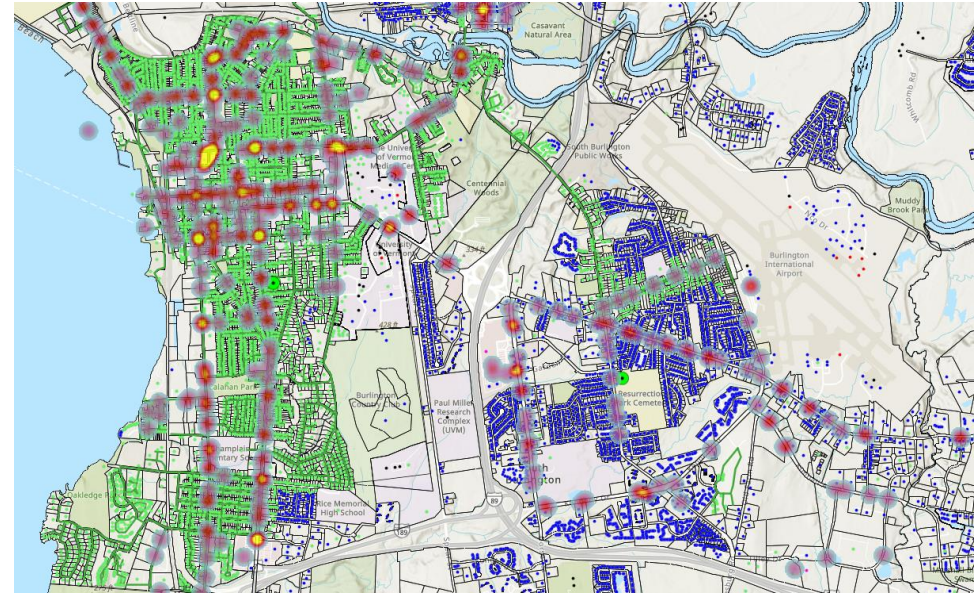- Operations and Safety Bureau – allocating roadway capacity to alternate modes

Maintenance

Reduce operations costs through concentration of assets
- Repaving, snow removal
- Maintenance districts, asset management – less VMT in maintenance, materials costs

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Next Steps

– Develop **VMT-Land Use Model**
  - Estimate GHG emissions
– Quantify **additional co-benefits**
  - Health
  - Safety
  - Reduced maintenance
  - Economic activity
– Prepare **future scenarios**
– Develop **case studies** and final report

5D's of the Built Environment

Density
Diversity
Design
Distance to Transit
Destination Access

Impacts

↑ Transit Trips /Capita

↓ VKT/Capita

R. Cervero & K. Kockelman, **Travel Demand and the 3Ds: Density, Diversity, Design**, *Transportation Research*, 1996.