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Modeling Connected and Automated Vehicles for the Chittenden County Region

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Innovations in Travel Modeling, Atlanta

Team

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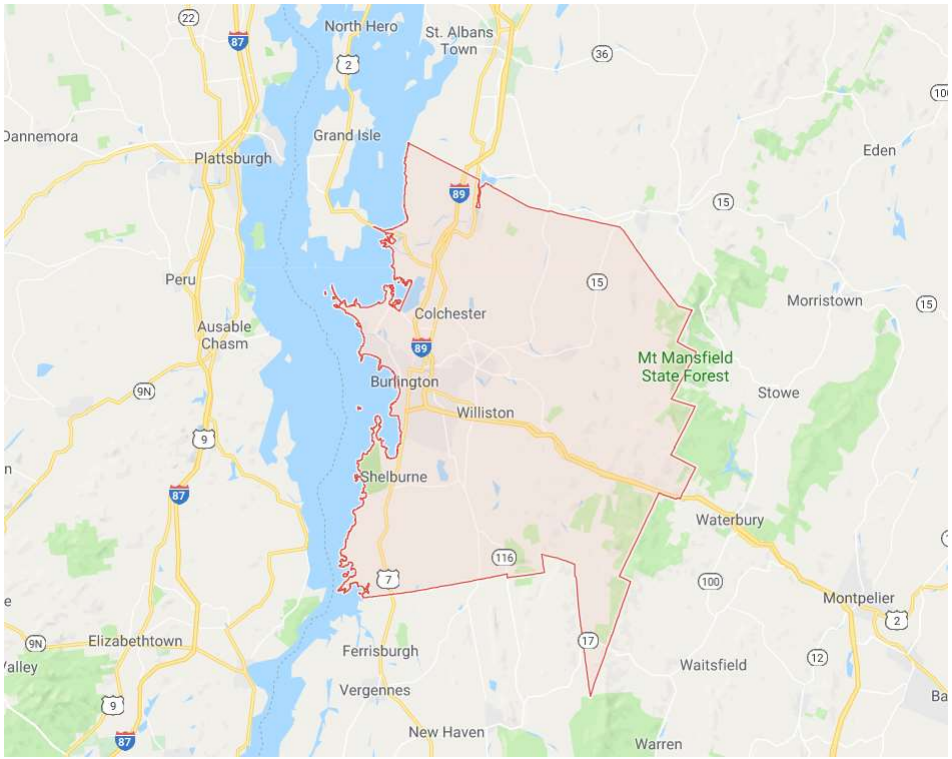
CCRPC – Region Overview

Chittenden County, Vermont

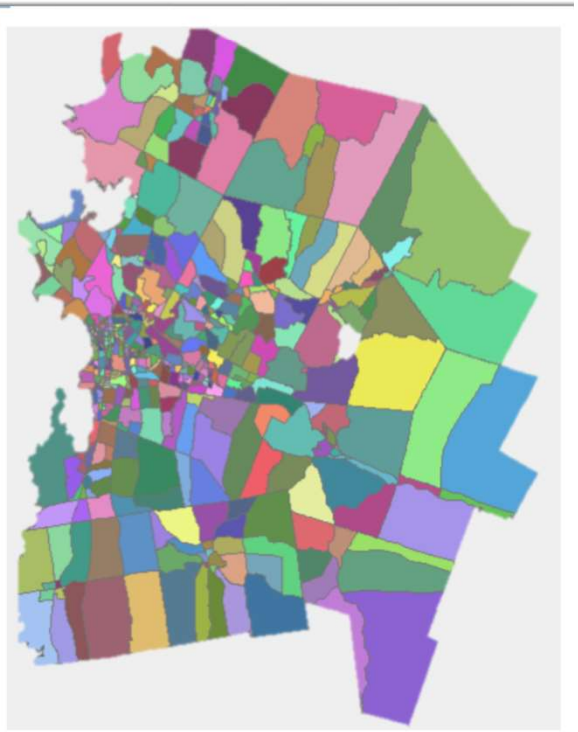


- Population – 161k; Employment – 135k; HH – 64k
- Growth by 2050 – Pop – 14%; Emp – 35%; HH 25%
- Attractions – University of Vermont, Lake Champlain

2018 Chittenden County ECOS Plan

Supplement 5 – Metropolitan Transportation Plan
First Public Hearing Draft 1/5/2018

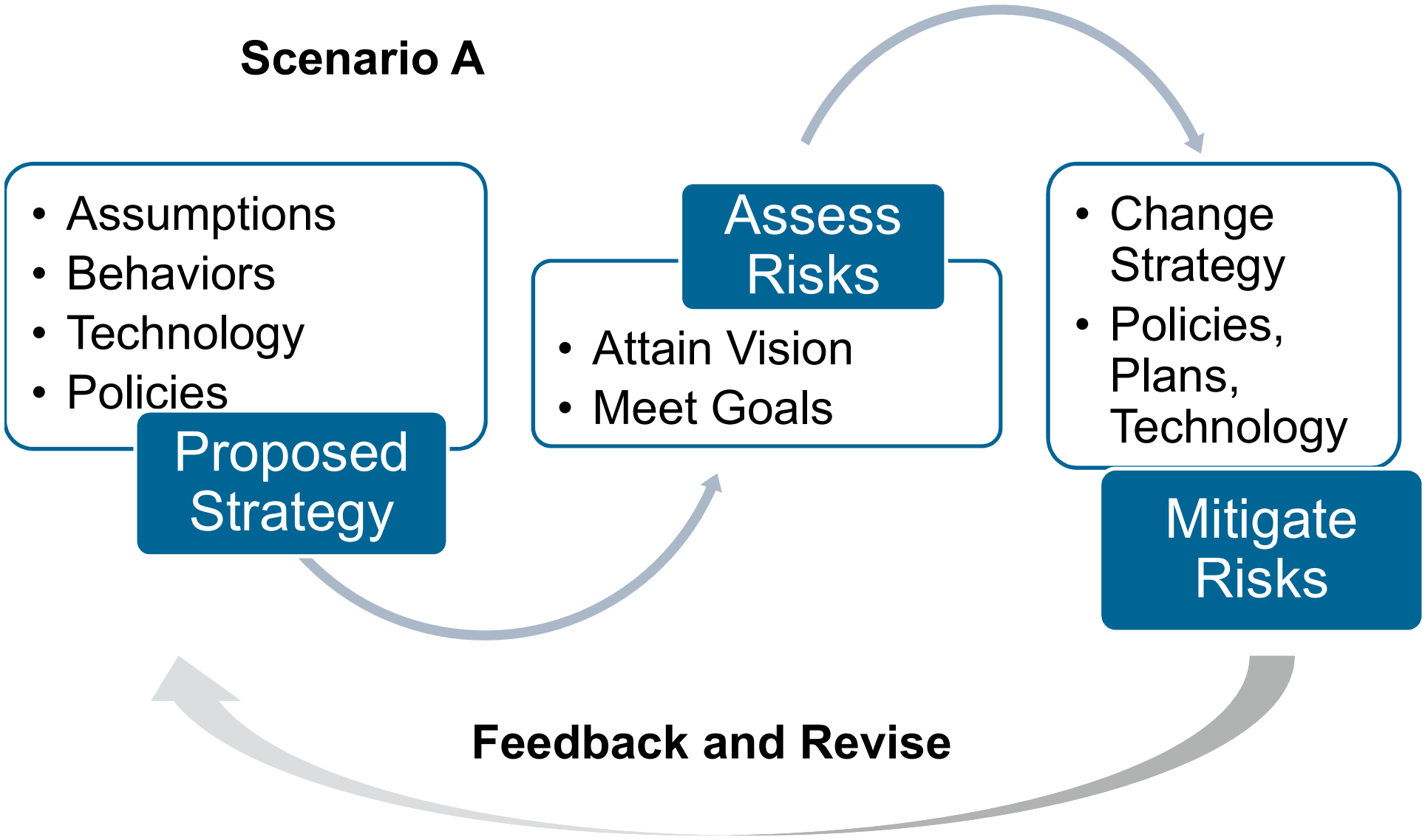
For a healthy, inclusive, and prosperous community



Connected and Automated Vehicles

Source – Lee County MPO

Strategic Process for Uncertainty



Project Goal

- Conducted two CAV scenario tests with the CCRPC Travel Model
  - Intended to start a conversation at the MPO about future transportation and traffic implications of the impending CAV future.
  - Comparison of region-wide MOEs
    - VHT,
    - VMT, and
    - Delay

- Two Scenarios
  - 80% CAV penetration
  - 100% CAV penetration

Methodology

- Baseline 2050 model with default assumptions about the capacity and vehicle fleet composition

- Account for induced demand associated with AVs
  - ZOV trips while “occupants” ran errands
  - ZOV trips returning home from parking
  - MaaS dead-head trips

- Adjust model network to account for increased capacity
  - Reduced headways
  - Reduced lost-time at signals
  - Cooperative merging

Link Capacity Increases

- 80% CAV Scenario
  - X% **increase in freeway capacity**

- 100% CAV Scenario
  - 2X% **increase in freeway capacity**
  - 3X/4% **increase in rural arterial capacity**
  - X/2% **increase in urban arterial capacity**
  - X/2% **increase in major collector capacity**
  - X/2% **increase in ramp capacity**

Intersection Capacity Increases

- 80% CAV Scenario
  - Y/2% **increase in signalized intersection** capacity.
- 100% CAV Scenario
  - 8Y% increase in **signalized intersection capacity**. This assumes elimination of lost time (6 seconds y+ar), 4 phases per cycle, and a 120 second cycle length and a 50% reduction in headways
  - Y% **increase in 1,2,3, way stop intersection capacity** due to less error in judging gaps
  - Y% **increase in on-ramp yield intersection capacity** due to cooperative merging
  - Y% **increase in yield intersection capacity** due to cooperative merging
  - Y% **increase in all-way stop intersection capacity** due to elimination of confusion and hesitation over who has right of way

Factor of Safety

- 80% CAV Scenario
  - Tested with a Passenger Care Equivalent (PCE) factor that added 10% to effective vehicle length in mixed flow.
- 100% CAV Scenario
  - None

CAV Induced Demand

- 80% CAV Scenario
  - 50% of CAV person trips are in CAVs that are privately owned
  - 50% of CAV person trips are in CAVs that are operating with a MaaS shared service
  - No increase in vehicle occupancies assumed

- 100% CAV Scenario
  - 35% of person trips are in privately owned CAVs
  - 65% of person trips are in CAVs operating with a MaaS shared service
  - MaaS CAVs operate with an increased average occupancy of 2.5 people per car

CAV Induced Demand – Increased Mobility

- Children and the Elderly may make more trips with increased mobility options
  - Small % increase in HBO trips

CAV Induced Demand – Circulating Trips

- When running quick errands in areas with constrained parking, the AV car can circle the block without you
  - Applies only to privately-owned CAVs
  - Assumes half of these trips are for a quick enough activity to justify circling the block
  - Assumes only one-tenth of the potential vehicles doing these trips would actually do it due to **progressive tax policy regarding ZOV travel**. (100% CAV Penetration Scenario Only)
  - Applies only to destination zones in core downtown Burlington
- For applicable trips, two additional trips were added to the HBO and NHB person trip tables from each subject zone to and from its nearest neighboring zone, to simulate an empty vehicle completing two laps circling.

CAV Induced Demand – Constrained Parking

- AVs may be sent home to park themselves when vehicle occupants are destined for parking-constrained areas.
  - Applies only to privately-owned CAVs
  - Applies only to HBW trips
  - Applies only to parking constrained zones in core downtown Burlington.

- Where the above criteria are met, one additional trip was added to/from the subject zone in the HBW person trip tables.

CAV Induced Demand – MaaS Dead-Heads

- Reduction in ownership rates but not necessarily VMT.
- New trips between drop-offs and pick-ups.
- A surplus of MaaS vehicles on the network - vehicles return to depot stations.
- A deficit of MaaS vehicles on the network - vehicles dispatched from depot stations.
- New Trips added with short-distance gravity model.

Results

- The 100% CAV scenario tested in this analysis showed an increase in overall VMT and VHT but a reduction in delay due to increased capacity afforded by the full integration of CAVs. Reduction in ownership rates but not necessarily VMT.
- A large benefit of the 100% CAV scenario, in this test, is the assumed increase in MaaS vehicle occupancy to 2.5 people per car. This results in a significant reduction in VMT, as compared with the 80% CAV scenario. However, depending on how such services would be offered, or without appropriate policies in place, such an increase may be difficult to achieve.

Results

	Baseline	CAV (PCE=1) 80% CAV	CAV (PCE=1.08) 80% CAV	CAV (PCE=1) 100% CAV
Total VMT	5,407,153	7,246,070	7,257,230	5,778,606
Total VHT	156,847	225,473	230,545	163,905
VMT/Person	29.5	39.6	39.6	31.5
VHT/Person	0.9	1.2	1.3	0.9
VMT/Person Trip	5.96	6.02	6.02	4.53
VHT/Person Trip	0.24	0.33	0.34	0.3
Total Delay (minutes)	1,686,780	3,056,799	3,338,833	1,441,049
Delay/Person	9.21	16.69	18.23	7.87
Delay/Vehicle Trip	2.53	3.17	3.46	1.79
Average Length of Trip (miles)	8.65	7.50	7.52	7.17
Average Length of Trip (minutes)	16.02	14.01	14.33	12.20
All Vehicle Trips	666,388	965,533	965,533	805,927
ZOV Trips	-	295,009	295,009	269,646
% ZOV	-	31%	31%	33%

Questions?

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