Applying EERPAT for GHG Analysis in Massachusetts

presented to

Northern Transportation and Air Quality Summit

presented by

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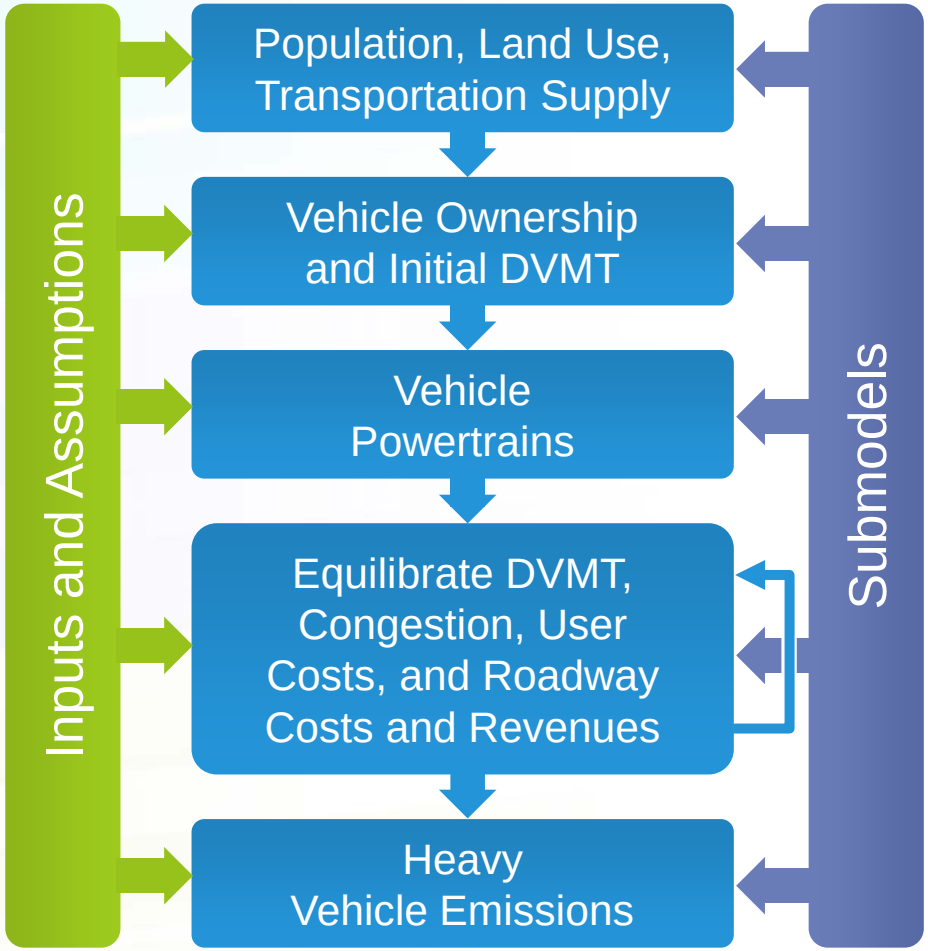
Think Forward

Project Overview

- Project funded by grant from FHWA
- Objective – Apply EERPAT to test transportation GHG reduction strategies
- Focus on strategies that MassDOT and other state and local agencies can implement
- Team
  - MassDOT (Client)
  - Cambridge Systematics, Inc.
  - Oregon Systems Analytics (Brian Gregor)

Overview of EERPAT

- National version of GreenSTEP, developed in Oregon
- Model Structure – a system of disaggregate household-level models that better accounts for interactions between policies



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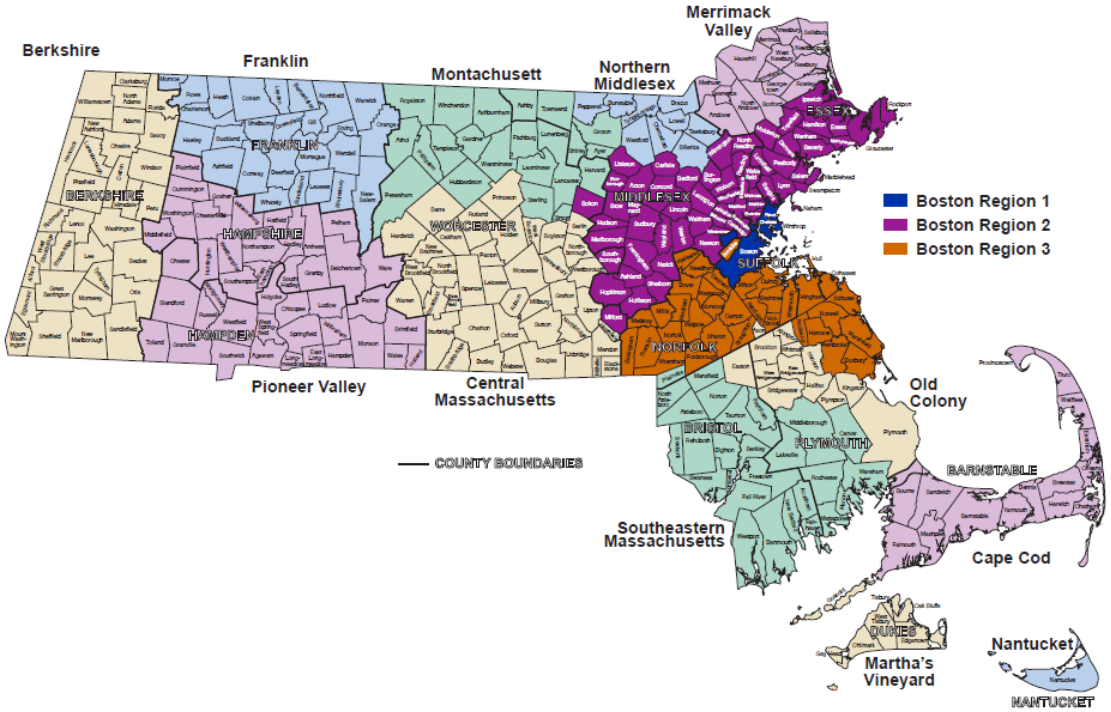
Geographic Application

- Regional level – corresponding to MPOs/RPAs



Metropolitan Planning Regions

Berkshire County Regional Planning Commission
Boston Region Metropolitan Area Planning Council
Cape Cod Commission
Central Massachusetts Regional Planning Commission
Franklin Regional Council of Governments
Montachusett Regional Planning Commission
Martha's Vineyard Commission
Merrimac Valley Planning Commission
Northern Middlesex Council of Governments
Nantucket Planning and Economic Development Commission
Old Colony Planning Council
Pioneer Valley Planning Commission
Southeastern Regional Planning and Economic Development District

** Three municipalities in the Boston Region MPO are also affiliated with Old Colony Planning Council: Duxbury, Pembroke, and Stoughton*

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Scope of Analysis

- Highway vehicles + urban rail
  - Passenger cars + light trucks (household travel)
  - Light commercial vehicles
  - Heavy trucks
  - Transit buses
  - MBTA light/heavy rail
- Direct transportation emissions only, consistent with state inventory
  - Biodiesel included but not ethanol or electricity *(per client direction)*

Base Model Data Requirements, Including…

- Arterial and freeway lane-miles
- VMT – percentage trucks, percentage on freeway and arterial, percentage HH versus commercial service (light-duty vehicle)
- Transit VRM per capita
- Population/households – forecasts; by age cohort and income category; percent metro, town, rural
- Urban land area, rural density
- Vehicle age distributions
- …. All of the above for each geographic unit (county or MPO)

Calibration

Calibration Factors	Data Source
Household Income	Bureau of Economic Analysis
Vehicle Ownership	Mass RMV
VMT	MassDOT
Fuel Consumption	Highway Statistics Motor Fuel Sales
Transit VRM & Fuel	National Transit Database

Scenario B
Baseline

- "Current policies" 2015 estimate and 2020-2050 forecast
  - Inputs developed in 1- or 5-year increments
  - Outputs for 2020, 2030, 2040, 2050
- Includes
  - Federal light-duty (through MY2025) and heavy-duty (through MY2018) GHG/efficiency standards + RFS2
  - California 10% ZEV rule
  - Actions in regional transportation plans and TIPs/CIPs
    - Bicycle facilities/complete streets
    - Transit investment and clean vehicles
    - ITS and TDM

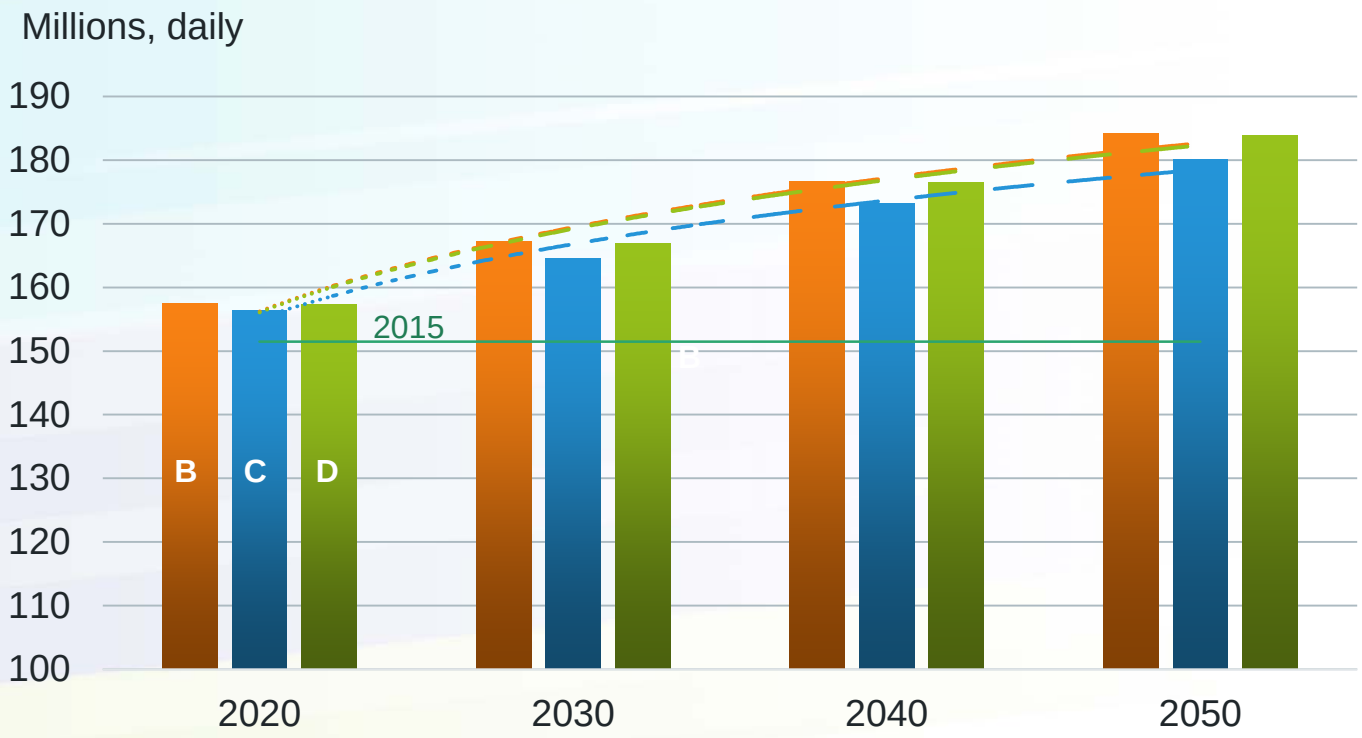
Scenario C
Additional MassDOT Policies

Policy	Scenario B, Current Plans and Policies	Scenario C, Additional Policies
Transit Investment/ Service	Zero per-capita growth (trend)	~1% simple annual increase in per-capita VRM
Clean Buses	Current Federal standards	All hybrid buses purchased statewide in 2017; electric bus purchasing phased in 2021-29
Bicycle Infrastructure	Estimated increase based on 5-year/20-year state and regional plans	Additional investment ($ and facility-miles) to triple bike mode share from current levels by 2030
Travel Demand Management	Current MassRides/Mass Commute participation	Additional funding to reach employers with >100 employees, increasing workforce reached from 25% to 37%
Intelligent Transportation Systems	Funded expansion consistent with ITS strategic plan	Expansion of incident management to all eastern Mass. highway segments; deployment of adaptive signal coordination on 500 more State signals by 2030

Scenario D
Other State and Local Policies

Policy	Scenario B, Current Plans and Policies	Scenario D, Other State and Local Policies
Land Use/Smart Growth	Current MPO forecasts	At least 80% of new households locate in mixed-use areas in 2020 to 2030; 90% in 2030+
Electric Vehicles	California 10% ZEV rule through 2025, flatline thereafter	$25 million in additional annual State subsidies to increase sales through 2030
Mileage-Based Fee	None	VMT fee of 0.6 c/mi
Congestion Pricing	None	Severely congested: $0.25/mi; Extremely congested: $0.50/mi Existing tolled Boston MPO highways/all Boston MPO limited-access highways
Clean Fuels Standard	EPA Renewable Fuel Standard-2	10% carbon intensity reduction versus gas/diesel by 2030

Scenario Results
Vehicle-Miles of Travel



C versus B	-0.6%	-1.7%	-2.0%	-2.6%
D versus B	-0.2%	-0..5%	-0.3%	-0.3%

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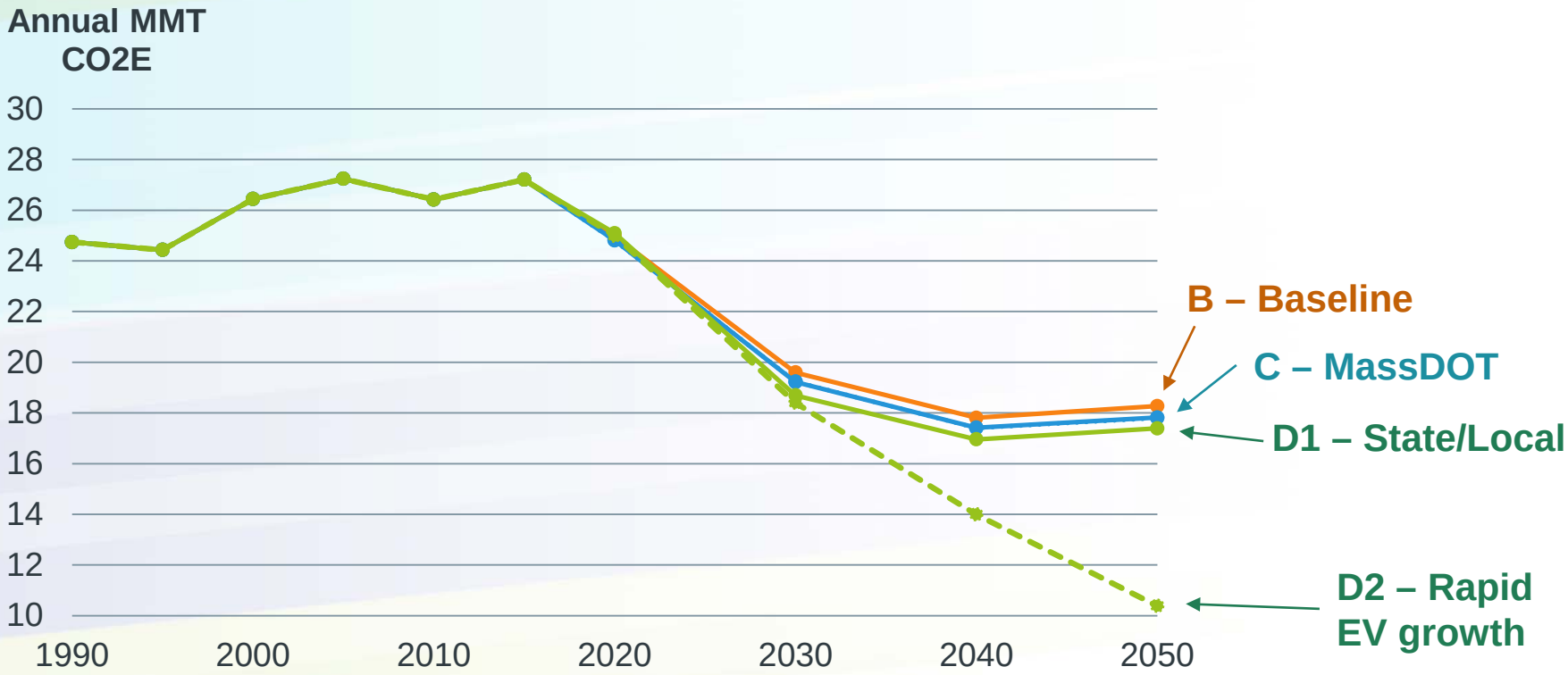
Scenario Results

Historical + Forecast On-Road Emissions



Δ, mmt per year (%)				
C versus B	**-0.1** (-0.6%)	**-0.4** (-1.9%)	**-0.4** (-2.3%)	**-0.5** (-2.5%)
D1 versus B	**+0.1** (+0.3%)	**-0.9** (-4.5%)	**-0.8** (-4.8%)	**-0.9** (-4.9%)

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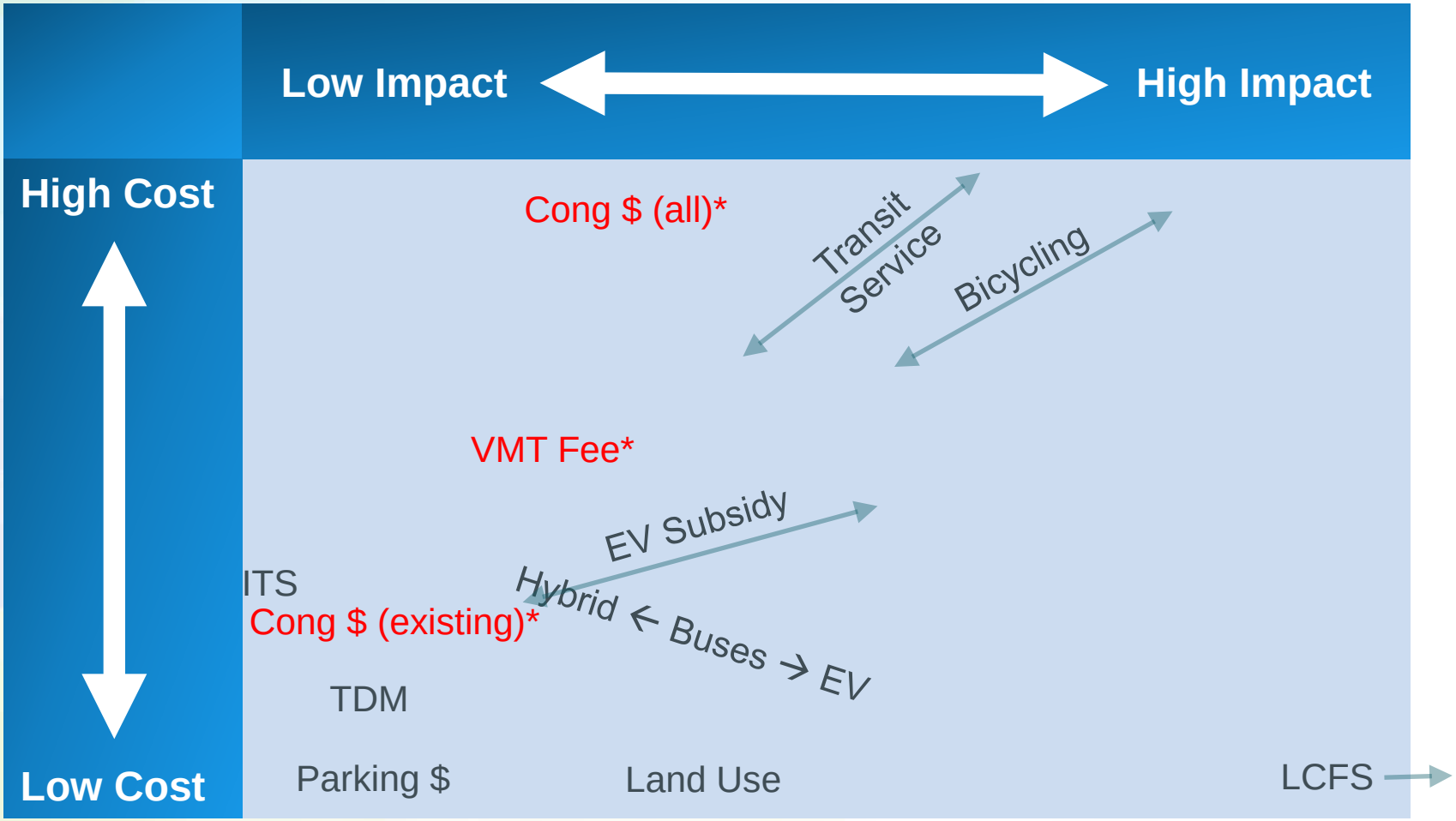
GHG Reductions and Estimated Costs MassDOT Policies

Policy	Change in 2030 GHG Emissions, Metric Tons	Percentage of On-road Emissions	Approximate Cost, $million/ year	Order-of-Magnitude Annual Cost per Ton
Transit Investment/ Service	-73,000	-0.37%	127	$1,700
Clean Buses – Hybrid	-25,000	-0.13%	23	$920
Clean Buses – Hybrid & Electric	-98,000	-0.50%	7	$71
Bicycle Infrastructure	-180,000	-0.91%	91	$510
Travel Demand Management	-20,000	-0.10%	6	$300
Intelligent Transportation Systems	+3,000	+0.01%	20	NA

GHG Reductions and Estimated Costs Other State & Local Policies

Policy	Change in 2030 GHG Emissions, Metric Tons	Percentage of On-road Emissions	Approximate Cost, $million/ year	Order-of-Magnitude Annual Cost per Ton
Land Use/Smart Growth	-53,000	-0.27%	<1	$19
Electric Vehicles	-68,000	-0.34%	25	$370
Mileage-Based Fee	-34,000	-0.17%	37	$1,100
Congestion Pricing: Existing Tolled Highways	-12,000	-0.06%	15	$1,300
Congestion Pricing: All Boston Area Highways	-48,000	-0.24%	135	$2,800
Clean Fuels Standard	-831,000	-4.20%	<1	$1

Strategy Summary



*Potential net revenue generator (implementation costs shown).

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Evaluation of EERPAT

Strengths

- Considers household-level demographics
- Much broader range of GHG policies than most modeling options
- Subregional accounting
- Induced travel & interactive effects
- Easy to apply once populated & calibrated

Limitations & Challenges

- Substantial effort to gather data, estimate submodels, & calibrate
- Policy levers vary in extent & sophistication
- Not suitable for project-level analysis
- Adaptation to NE geography

Follow Up

- Trained MassDOT staff and Massachusetts MPOs in EERPAT's use
- MassDOT conducting additional research and testing this summer
- FHWA sponsoring enhancements to EERPAT, including freight policy component