Health Benefits of the MassDOT Capital Investment Program

presented to

Moving Active Transportation to Higher Ground

presented by

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Policy Context

- Mode Shift Goal (2012) – Triple the share of travel in Massachusetts by bicycling, transit, and walking

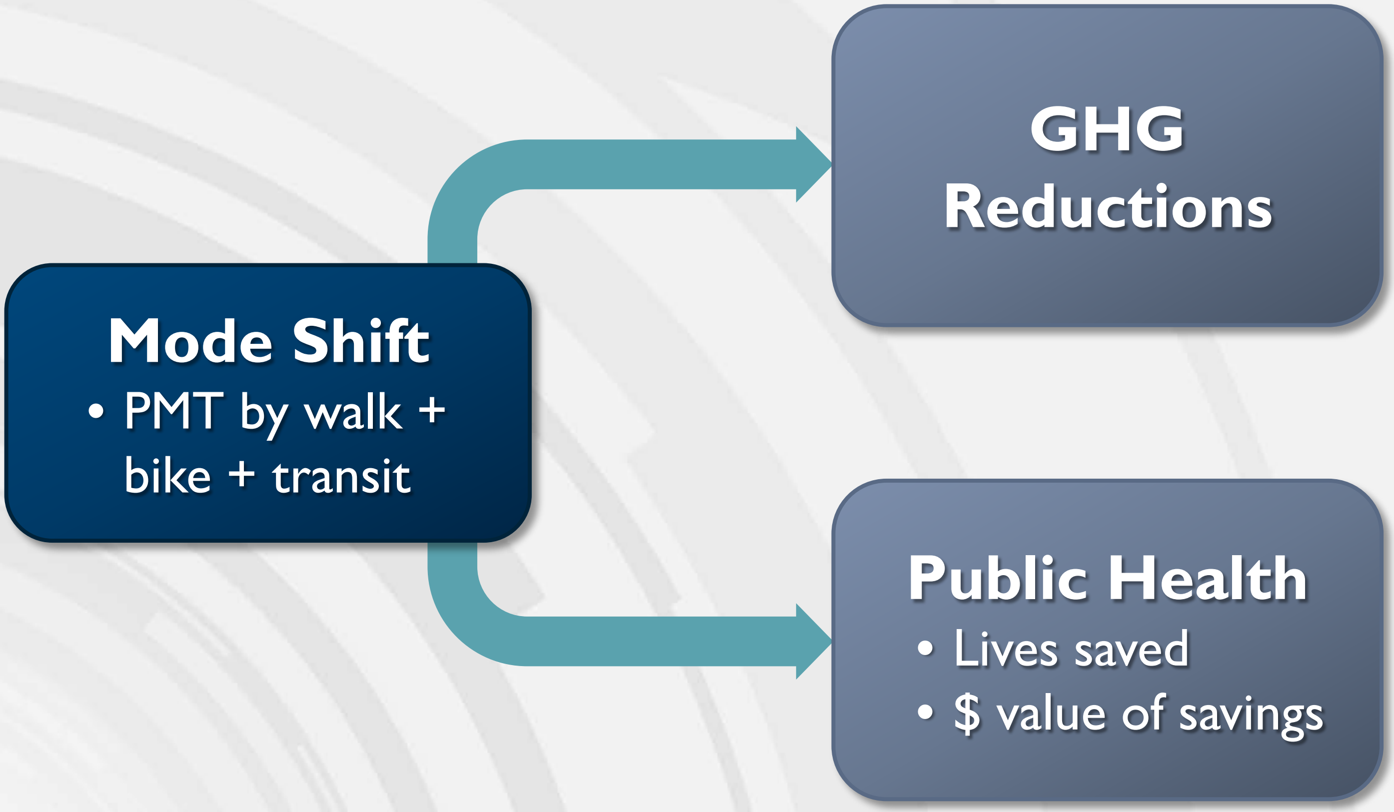
- Healthy Transportation Policy Directive (2013) – Formalizes MassDOT's commitment to transportation networks that serve all mode choices

- Consistent with GHG reduction & sustainability policies
  - » Global Warming Solutions Act (2008) – Reduce GHG emissions from all sources by 25% from 1990 levels by 2020
  - » GreenDOT (2010/2012) – Agency-wide sustainability policy and implementation plan

Planning Context

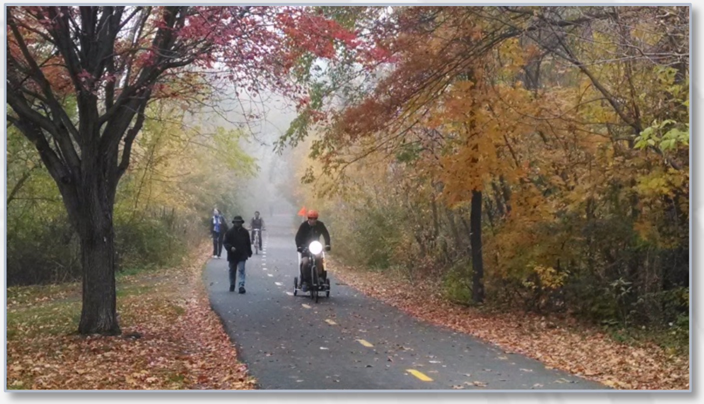
- weMove Massachusetts (WMM) 2040 Long-Range Transportation Plan
- 2014-2018 Capital Investment Program (CIP)
- Link sustainability goals with performance measurement principles compatible with MAP-21
- Expand beyond traditional measures to include other key benefits consistent with policy directives

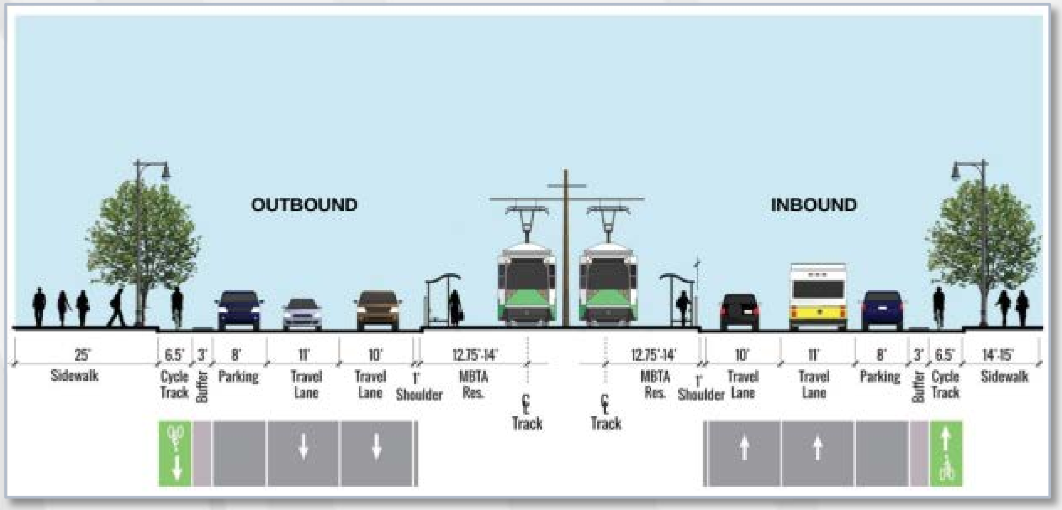
New Measures of Benefit



CIP Project Types Supporting Mode Shift

- Transit system expansion
- Shared use paths
- Road reconstruction (including Complete Streets improvements)





Mode Shift/PMT Estimates

- Transit Expansion
  - » Ridership estimates (project forecasts, average load factors)
  - » Prior mode of travel (59% personal vehicle – NHTS)
  - » ¼-mile walk access distance
- Shared Use Paths and Road Reconstruction
  - » Miles of new pathway or improved roadway per $ spent
  - » Annual new bicycle and pedestrian trips per mile of roadway or path improvement
    - Pedestrian travel – based on 4D elasticities
    - Bicycle travel – progress towards meeting build-out mode share
    - Different impacts in urban, suburban, rural areas

Example
Pedestrian Mode Shift (Suburban)

- Trip rate = 4.7 trips per day
- Population density = 3,000 persons per square mile
- Baseline walk mode share = 7.2 percent of all trips
- Change in pedestrian trips = 50% improvement in ped design * 0.15 elasticity = 7.5% increase
- Affected population = 1 mile x ½ mile (width of affected corridor) = 0.5 sq. mi. * 3,000 persons/sq. mi. = 1,500 persons
- Number of baseline pedestrian trips = 1,500 persons * 4.7 trips/day * 0.072 = 511 trips per day
- Number of new pedestrian trips = 511 * 0.075 = 38 trips per day
- New pedestrian PMT = 38 trips per day * 0.72 mi/trip = 26 miles per day = 10,100 miles per year

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Example
Bicycle Mode Shift

Factor	Urban	Suburban	Rural
Baseline bike mode share	1.7%	0.6%	0.6%
Buildout bike mode share (assumed)	10.0%	2.0%	1.5%
Bike mode share after CIP investment period (20% of buildout)	3.4%	0.9%	0.8%
Affected population[a]	1,887,000	2,766,000	1,894,000
New annual bike VMT[b]	124,400,000	30,756,000	13,539,000
Annual new bike miles per new facility mile[c]	2,474,000	126,000	55,000

[a]CS analysis of census data by tract.

[b]Using a trip rate of 4.7 trips/day and average trip length of 2.3 miles.

[c]Based on following miles of new/improved facilities: urban – 50, suburban – 245, rural – 247.

New Bicycle Miles of Travel per Facility Mile

Method	Urban	Suburban	Rural
LA Metro Model	35,000	5,000	200
"Build-out" Method	2,474,000	126,000	5,000
Ratio	70x	25x	25x

LA Metro Model – see Urban, M., et al, Transportation Research Record, 2016

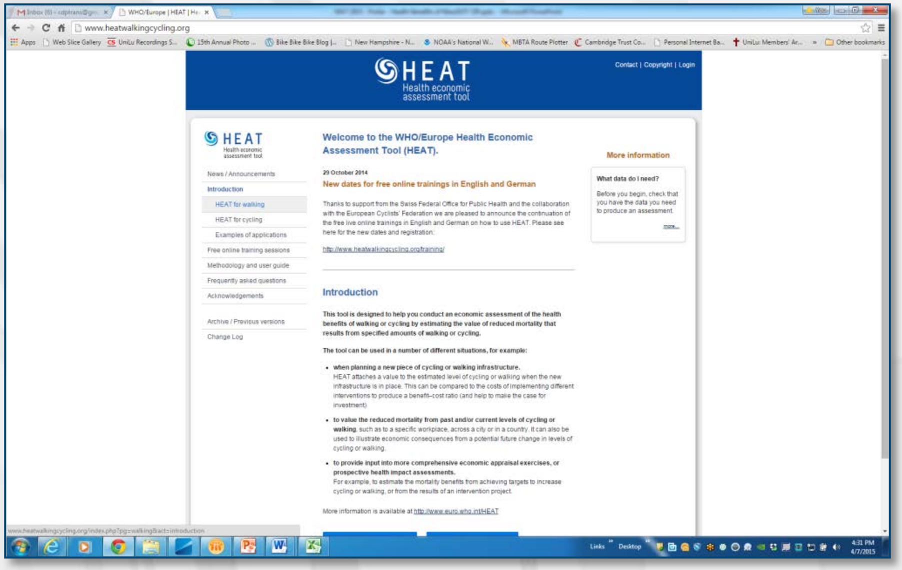
Mode Shift/PMT Results

Project Type	2014-2018 Spending (Millions)	Miles of Path or Improved Road	ΔPMT-Walk (Millions)	ΔPMT-Bike (Millions)
Rail and Transit System Expansion	$2,330		17.7	
Shared-Use Pathways	$143	191	2.4	22.3
Road Reconstruction	$514*	343	6.2	58.4
Total – New Utilitarian Travel			**26.2**	**80.7**
Increase Versus Baseline			18%	37%
New Recreational Travel			5.2	16.1
Total New Travel			**31.5**	**96.9**

*Does not include large highway projects.

Health Benefits
HEAT Mortality Reduction

- HEAT = Health Economic Assessment Tool
  - » Developed by World Health Organization
  - » Uses local mortality rates and estimated physical activity increase to estimate reduction in deaths
  - » Monetary valuation using Value of Statistical Life (VSL)



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HEAT Inputs

HEAT Input	Value/Derivation
Active travel trips/week per active traveler	6 (2/day * 3 days/week) = 156 days/year
Baseline daily walk and bike PMT per person	Total baseline walk/bike PMT spread across a population of 929,000 (pop = 6.5M * 14.2% = total walk/bike mode share) = 1.3 PMT walking and 1.9 PMT cycling per day
Additional walk or bike trips per active person	6 new one-way trips per week (2/day x 3 days = 156 days/year)
Increase in total PMT per person per active day	1.3 → 2.7 PMT walking 1.9 → 6.5 PMT cycling
Death rate	679 per 100,000 (Mass DOH, 2013)
Value of statistical life	$9.2 million (U.S. DOT, 2014)
Timeframe	5-year phase-in, 5-year full benefits, 5% discount rate

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HEAT Outputs

- Increase in walking prevents 55 deaths per year
- Increase in bicycling prevents 54 deaths per year
- Total = 109 deaths prevented per year
- Total benefit over 10 years = **$3.9 billion**

Alternative Estimate
Cost of Obesity

Cost Category	Annual Cost/Person – Obesity	Share of Total	Annual Cost/Person – Overweightness	Share of Total
Direct Medical	$1,618	20%	$380	72%
Wage	$1,031	13%	$0	0%
Short-Term Disability	$381	5%	$59	11%
Disability Pension Insurance	$76	1%	$0	0%
Sick Leave	$490	6%	$64	12%
Productivity	$393	5%	$0	0%
Gasoline	$24	0%	$10	2%
Life Insurance	$133	2%	$16	3%
Premature Mortality	$4,036	50%	$0	0%
Total	**$8,182**	**100%**	**$529**	**100%**

Source: Dor, Avi, Ferguson, Christine, et al. (2010), *A Heavy Burden: The Individual Costs of Being Overweight and Obese in the United States.*
Inflated from 2009 to 2014 dollars.

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Applying Costs of Obesity

Factor	Value for 1 Death Prevented	Value for 109 Deaths Prevented (CIP)
Annual U.S. Deaths due to Obesity	300,000	
Overweight or Obese Americans	216,000,000	
Deaths per Overweight + Obese (Affected) Individual	0.0014	
Obese/Overweight Individuals	721 (per death)	78,600
Annual Cost per Affected Individual	$4,432	NA
Annual Benefit of Obesity/ Overweightness Prevented	$3.2 million	$349 million
10-year Benefit	$32 million	**$3.5 billion**

Compare with $3.9 billion VSL from HEAT

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Conclusions

- Investments to promote walking and bicycling can produce very substantial health benefits
  » As measured in deaths prevented, value of statistical life, and obesity-related costs
  » Monetized health benefits outweigh costs of projects
- Uncertainty in estimates – but even if benefits are an order of magnitude smaller they are still significant

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Further Research?

- Need better methods/models for forecasting walking and bicycling impacts

- What is the best way to monetize/value health benefits?
  - » Avoid "back-calculations" – work towards direct estimation of annual and long-term impacts and benefits
  - » Complete accounting – not just mortality (HEAT) or obesity costs
  - » Time-dimension – accounting for benefits that may accrue over many years in the future
  - » Ideally translate into medical/health care and other "tangible" cost savings