Moving Cooler
Study Findings

Rail-Volution
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Transportation leadership you can trust.
Transportation’s Contribution to U.S. GHG

U.S. GHG Emissions by End Use Economic Sector 2006

- Residential: 5%
- Commercial: 6%
- Agriculture: 8%
- Industry: 20%
- Transportation: 28%
- Electricity Generation: 33%

U.S. GHG Emissions Breakdown by Mode

- Light-Duty Vehicles: 59.3%
- Heavy-Duty Vehicles: 19.6%
- Other: 2.0%
- Rail: 2.7%
- Marine: 4.9%
- Aircraft: 11.5%

Policy Gap
Small Role for Transportation in Current Policy

- America’s Climate Security Act (2007)
- Climate MATTERS (2008)
- America’s Clean Energy and Security Act (2009)
Knowledge Gap
McKinsey – Pathway to a Low-Carbon Economy

Global GHG abatement cost curve beyond business-as-usual – 2030

Abatement cost
€ per tCO₂e

- Residential electronics
- Residential appliances
  - Retrofit residential HVAC
- Tillage and residue mgmt
- Insulation retrofit (residential)
- Cars full hybrid
- Waste recycling

- Gas plant CCS retrofit
- Coal CCS retrofit
- Iron and steel CCS new build
- Coal CCS new build
- Power plant biomass co-firing
- Reduced intensive agriculture conversion
- High penetration wind
- Solar PV
- Solar CSP

Note: The curve presents an estimate of the maximum potential of all technical GHG abatement measures below €60 per tCO₂e if each lever was pursued aggressively. It is not a forecast of what role different abatement measures and technologies will play.

Source: Global GHG Abatement Cost Curve v2.0
Filling the Gap
Moving Cooler
Analytic Team – Cambridge Systematics

Multiple Partners on Steering Committee

- U.S. Environmental Protection Agency
- U.S. Federal Highway Administration
- U.S. Federal Transit Administration
- American Public Transportation Association
- Environmental Defense
- ITS America

- Shell Oil
- Natural Resources Defense Council
- Kresge Foundation
- Surdna Foundation
- Rockefeller Brothers Fund
- Rockefeller Foundation
- Urban Land Institute
Objectives

- Examine the potential of travel efficiency strategies to reduce greenhouse gas (GHG) emissions
  - Consistent analysis across strategy types
  - Stand-alone strategies and synergies (bundles)

- Multiple parameters for analysis
  - Effectiveness in reducing GHG emissions
  - Cost of implementation
  - Externalities and co-benefits
  - Impacts on equity
Assumptions for Baseline

- **Travel continues to grow**
  - Vehicle miles traveled (VMT) growth of 1.4% per year
  - Transit ridership growth 2.4%/year

- **Fuel prices increase**
  - 1.2% per year, beginning at $3.70/gallon in 2009*

- **Fuel economy improves steadily**
  - Light-duty vehicles at 1.91% annually, to ~75 mpg by 2050
  - Heavy duty at 0.61%

* *AEO high fuel price scenario
Moving Cooler Baseline to 2050

Note: This figure displays National On-Road GHG emissions as estimated in the Moving Cooler baseline, compared with GHG emission estimates based on President Obama’s May 19, 2009, national fuel efficiency standard proposal of 35.5 mpg in 2016. Both emission forecasts assume an annual VMT growth rate of 1.4 percent. The American Clean Energy and Security Act (H.R. 2454) identifies GHG reduction targets in 2012, 2020, 2030, and 2050. The 2020 and 2050 targets applied to the on-road mobile transportation sector are shown here.
Wide Range of Strategies Examined

- Pricing, tolls, PAYD insurance, VMT fees, carbon/fuel taxes
- Land use and smart growth
- Nonmotorized transportation
- Public transportation improvements
- Regional ride-sharing, commute measures
- Regulatory measures
- Operational/ITS strategies
- Highway capacity/bottleneck relief
- Freight sector strategies
Deployment Levels

Category 1

Strategy 1
Strategy 2
Strategy 3
Strategy x

Level of Deployment

Geography
Timeframe
Intensity

Expanded Best Practices
Aggressive
Maximum
Evaluation of Implementation
Costs/GHG Reduction Effectiveness

- Estimates direct implementation costs and GHG effectiveness

- *Not* a full cost-benefit analysis – therefore not a complete basis for decisions
  - GHG benefits only
  - Direct agency monetary implementation costs
  - Vehicle operating costs (savings) – fuel, ownership, maintenance, insurance

- Allows comparison to McKinsey Report findings on fuels and technology
Range of Annual GHG Reductions of Six Strategy Bundles
(Aggressive and Maximum Deployment)

Total Surface Transportation Sector GHG Emissions (mmt)

1990 & 2005 GHG Emissions — Combination of DOE AEO data and EPA GHG Inventory data

Study — Annual 1.4% VMT growth combined with 1.9% growth in fuel economy

Aggressive Deployment Levels — Range of GHG emissions from bundles deployed at aggressive level

Maximum Deployment Levels — Range of GHG emissions from bundles deployed at maximum level

Note: This figure displays the GHG emission range across the six bundles for the aggressive and maximum deployment scenarios. The percent reductions are on an annual basis from the Study Baseline. The 1990 and 2005 baseline are included for reference.
Direct Vehicle Costs and Costs of Implementing Strategy “Bundles”

Note: This figure displays estimated annual implementation costs (capital, maintenance, operations, and administrative) and annual vehicle cost savings [reduction in the costs of owning and operating a vehicle from reduced vehicle-miles traveled (VMT) and delay. Vehicle cost savings DO NOT include other costs and benefits that could be experienced as a consequence of implementing each bundle, such as changes in travel time, safety, user fees, environmental quality, and public health.
# Summary of Bundle Results
## 2010 to 2050 – Aggressive Deployment

<table>
<thead>
<tr>
<th>Category</th>
<th>GHG Reduction (Gt)</th>
<th>Implementation Costs</th>
<th>Change in Vehicle Costs</th>
<th>Net Cost per Tonne</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Near Term/ Early Results</td>
<td>7.1</td>
<td>$676</td>
<td>-$3,211</td>
<td>-$356</td>
</tr>
<tr>
<td>2. Long Term/ Maximum Results</td>
<td>7.6</td>
<td>$2,611</td>
<td>-$4,846</td>
<td>-$293</td>
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<tr>
<td>3. Land Use/ Transit/ Nonmotorized Transportation</td>
<td>3.8</td>
<td>$1,439</td>
<td>-$3,270</td>
<td>-$484</td>
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<tr>
<td>4. System and Driver Efficiency</td>
<td>5.0</td>
<td>$1,870</td>
<td>-$2,214</td>
<td>-$69</td>
</tr>
<tr>
<td>5. Facility Pricing</td>
<td>1.4</td>
<td>$2,371</td>
<td>-$1,121</td>
<td>$891</td>
</tr>
<tr>
<td>6. Low Cost</td>
<td>7.5</td>
<td>$599</td>
<td>-$3,499</td>
<td>-$387</td>
</tr>
</tbody>
</table>
Economy-Wide Pricing

- Mechanisms – Carbon pricing, VMT fee, and/or Pay As You Drive (PAYD) insurance

- Strong economy-wide pricing measures added to “bundles” achieve additional GHG reductions
  - Aggressive deployment – additional fee (in current dollars) starting at the equivalent of $0.60 per gallon in 2015 and increasing to $1.25 per gallon in 2050 could result in an additional 17% reduction in GHG emissions in 2050

- Two factors would drive this increased reduction
  1. Reduction in VMT
  2. More rapid technology advances
Economy-Wide Pricing (continued)

Total Surface Transportation Sector GHG Emissions (mmt)

1990 & 2005 GHG Emissions – Combination of DOE AEO data and EPA GHG Inventory data
Study Baseline – Annual 1.4% VMT growth combined with 1.9% growth in fuel economy
Aggressive – GHG emissions from bundle deployed at aggressive level without economy wide pricing measures
Gallons of Fuel Saved at Aggressive Deployment

Cumulative (2010–2050) Percent Gallons Saved:
- Near-Term/Early Results: 10%
- Long-Term/Maximum Results: 11%
- Land Use/Transit/Nonmotorized Transportation: 5%
- System and Driver Efficiency: 7%
- Facility Pricing: 2%
- Low Cost: 9%

Graph showing the gallons of fuel saved from baseline (billions) over time (2010–2050). The lines represent different categories of results:
- Near-Term/Early Results
- Long-Term/Maximum Results
- Land Use/Transit/Nonmotorized Transportation
- System and Driver Efficiency
- Facility Pricing
- Low Cost
Near-Term and Long-Range Strategies

Some strategies are effective in achieving near-term reductions, reducing the cumulative GHG challenge in later years

- Near-term strategies include – speed limits, congestion pricing, eco-driving, expanded transit service

Investments in land use and improved travel options involved longer timeframes but would have enduring benefits

- Substantial investments and policy changes required
Implications of Report Findings

- Net costs per ton positive – transportation savings outweigh implementation costs
- Implementation costs are significant – funding needed for transportation strategies, not just planning
- System approach most effective – synergies of transit, land use, parking, pricing, etc.
- Both national level and state/regional/local strategies are important
- Strategies contribute to other social, economic, and environmental goals while reducing GHGs
Land Use/Transit/Nonmotorized Bundle

- Urban transit
  - Fare reduction
  - Increased transit service
  - Urban transit expansion

- High-speed rail/intercity passenger rail expansion
- HOV expansion
- Car sharing
- Signal enhancement
- Traveler information
- Urban consolidation centers (freight)

- Land use
- Pedestrian/bicycle
- Parking pricing/parking restrictions
- Congestion pricing
Public Transportation
Key Assumptions

- Fare measures – 25-50% decrease

- LOS improvements – signal prioritization, limited-stop service, and other enhancements improve travel speeds by 10-30%

- Increased service levels and fixed guideway expansion at rate of 2.4-4.7% annually

- Load factors increase from 10.5 passengers per bus in 2006 to 12 in 2030
  - Investments assumed to be targeted in areas of high population density/ridership potential
Total Additional GHG Reductions from Transit

GHG Reductions Compared to Baseline, mmt CO2e

- **Maximum**
- **Aggressive**
- **Expanded Best Practice**

- Year: 2010, 2015, 2020, 2025, 2030, 2035, 2040, 2045
Land Use

Key Assumptions

- 43-90% of new urban development occurs in “compact neighborhoods”
  - >4,000 persons per square mile
  - Walkable, mixed-use neighborhood centers

- VMT/capita 35% lower in compact versus “sprawl” neighborhoods; 60% lower for highest-density versus lowest-density census tracts

- Turnover rates – residential 6%/decade, commercial 20%/decade
Source: S. Polzin, et al. VMT forecasting model, Center for Urban Transportation Research at University of South Florida, based on 2001 National Household Travel Survey & 2000 Census.
Tract Density Ranges

Concord, MA: 500-2,000 ppsm

Lexington, MA: 2,000-4,000 ppsm

Watertown, MA: 4,000-10,000 ppsm

Somerville, MA: >10,000 ppsm

Image source: TeleAtlas and Google Earth.
Total “New” and “Redeveloped” Population

U.S. Metropolitan Population in 2030 and 2050 (versus 2015)
Assuming 10 percent/decade building turnover

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<thead>
<tr>
<th></th>
<th>2030</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Existing</td>
<td>13%</td>
<td>36%</td>
</tr>
<tr>
<td>Redeveloped</td>
<td>14%</td>
<td>22%</td>
</tr>
<tr>
<td>New</td>
<td>73%</td>
<td>42%</td>
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</table>

Millions

0  50  100  150  200  250  300  350  400
Land Use Results

- **VMT reduction (urban light-duty VMT)**

<table>
<thead>
<tr>
<th>Percent of New Development in “Compact” Neighborhoods</th>
<th>VMT Reduction</th>
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<tbody>
<tr>
<td>Incremental</td>
<td>2030</td>
</tr>
<tr>
<td></td>
<td>43%</td>
</tr>
<tr>
<td>Aggressive</td>
<td>90%</td>
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- **Total U.S. metro population by density (2050)**

  Current distribution – 43% in compact areas

  Aggressive change – 67% in compact areas
For More Information…

www.movingcooler.info

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