Global Climate Change: Transportation's Role in Reducing Greenhouse Gas Emissions

GREENHOUSE GAS REDUCTION STRATEGIES FOR SURFACE TRANSPORTATION

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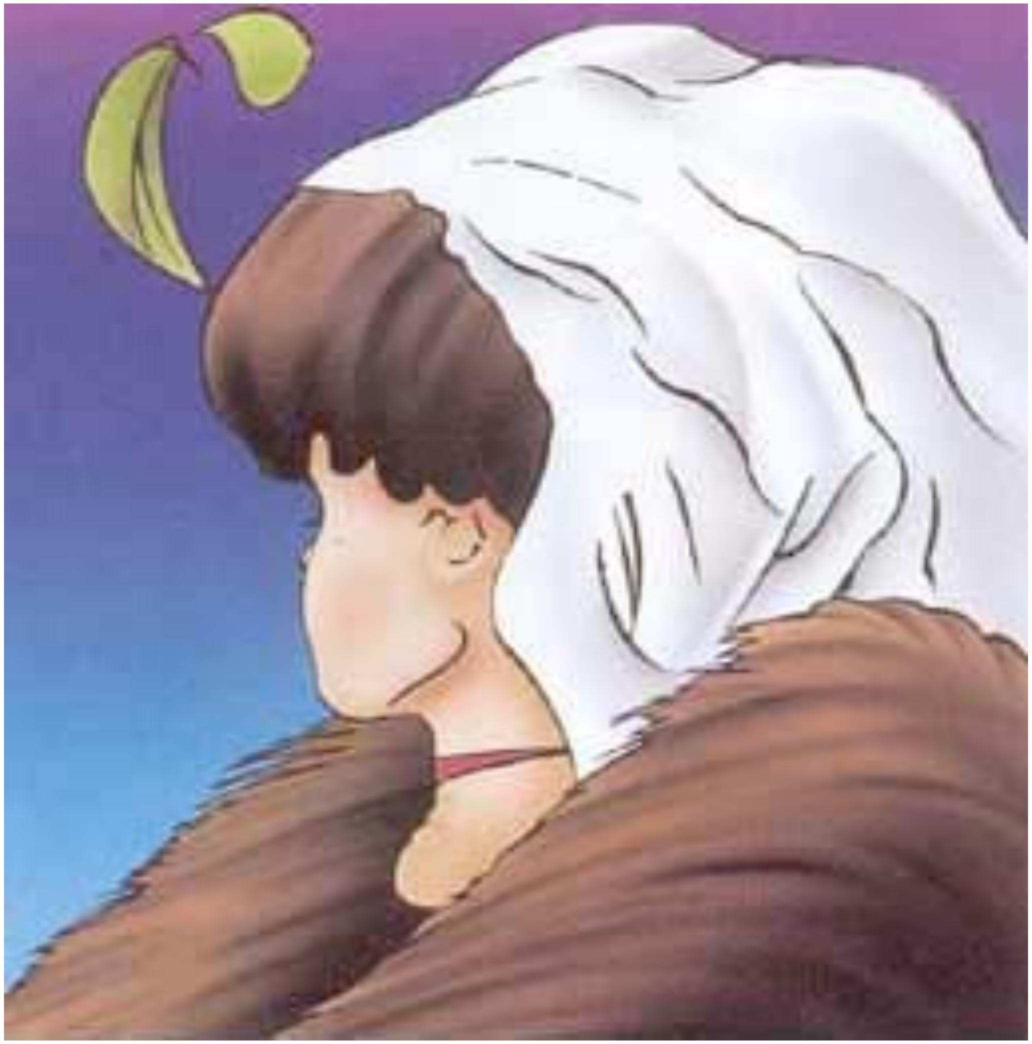
The Challenge

- Climate scientists recommend 60-80% GHG reductions worldwide by 2050
- Light duty vehicles (LDVs) represent 60% of transportation GHG and 18% of all U.S. GHG
- How can the U.S. achieve LDV GHG reductions of 60-80% by 2050?

The Answer Depends on your Perspective….



Or the Answer Depends on…

Your profession:

“If the only tool you have is a hammer, every problem looks like a nail.”

And how you use data:

“If you torture data long enough, they will admit to anything.”

Policy-Tinged Responses

- Climate skeptics: Climate change isn't happening, or isn't human-induced
- Environmental view: Transform land use, increase transit, and reduce VMT
- Techno-optimist view: Transform vehicle/fuel technology and improve highway/driver operations
- Pragmatic view: Combination -- mostly vehicles/fuels, some operational efficiency, plus modest role for land use, transit, and VMT moderation

State Climate Action Plans

- Highly “aspirational”
- Managed by state environmental agencies
- Steering Committees included multiple environmental advocates and rarely had transportation agency reps
- State DOT involvement was at a technical advisory level, whose input was often rebuffed

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State Climate Action Plans

- Many used cookbook analysis; many emphasized land use and VMT reduction
- Example: VT strategies would reduce 2030 VMT from 10.5 billion (base case) to 3.9 billion VMT
- Little consideration of cost or feasibility of strategies
- Some have been adopted by Governors; others (e.g. VT and MT) have merely been “accepted” but not adopted

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State Climate Plans – Transportation Elements

State	Year	Vehicle	Low Carbon Fuels	Smart Growth and Transit	Other
MN	2025	15%	35%	25%	25%
NC	2020	35%	12%	38%	15%
SC	2020	14%	55%	29%	1%
CT	2020	51%	38%	8%	2%
ME	2020	53%	25%	21%	1%
MD	2025	24%	12%	45%	20%
NY	2020	59%	11%	27%	4%
PA	2025	45%	36%	18%	0%
RI	2020	46%	10%	31%	14%
VT	2028	21%	14%	49%	17%

5 Ways to Reduce LDV GHG

- LDV GHG is a function of:
  1. Vehicle efficiency
  2. Fuels
  3. VMT
  4. Operational efficiency of drivers and highway systems
  5. GHG associated with construction and maintenance
- Achieving 80% reductions in LDV GHG will require change in all five areas
- But how much emphasis should we place on each?

Vehicle/Fuel Improvements Will be the Dominant Source of GHG Reductions for LDVs

By 2020-2030:

- 50% cut in GHG/mile is feasible from conventional technologies and biofuels
- Compare these GHG rates in U.S. and Europe:

380 grams/mile	2009 in the U.S.
250 grams/mile	2016 under new Obama standard
256 grams/mile	2007 actual in the E.U.
209 grams/mile	2012 under E.U. regulation
153 grams/mile	2020 under E.U. regulation

- LDV purchase cost will rise, but fuel savings will be greater than vehicle cost increase
- Win-win-win: reduces energy use, reduces GHG, saves money

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Even Greater Vehicle "Decarbonization" is Necessary

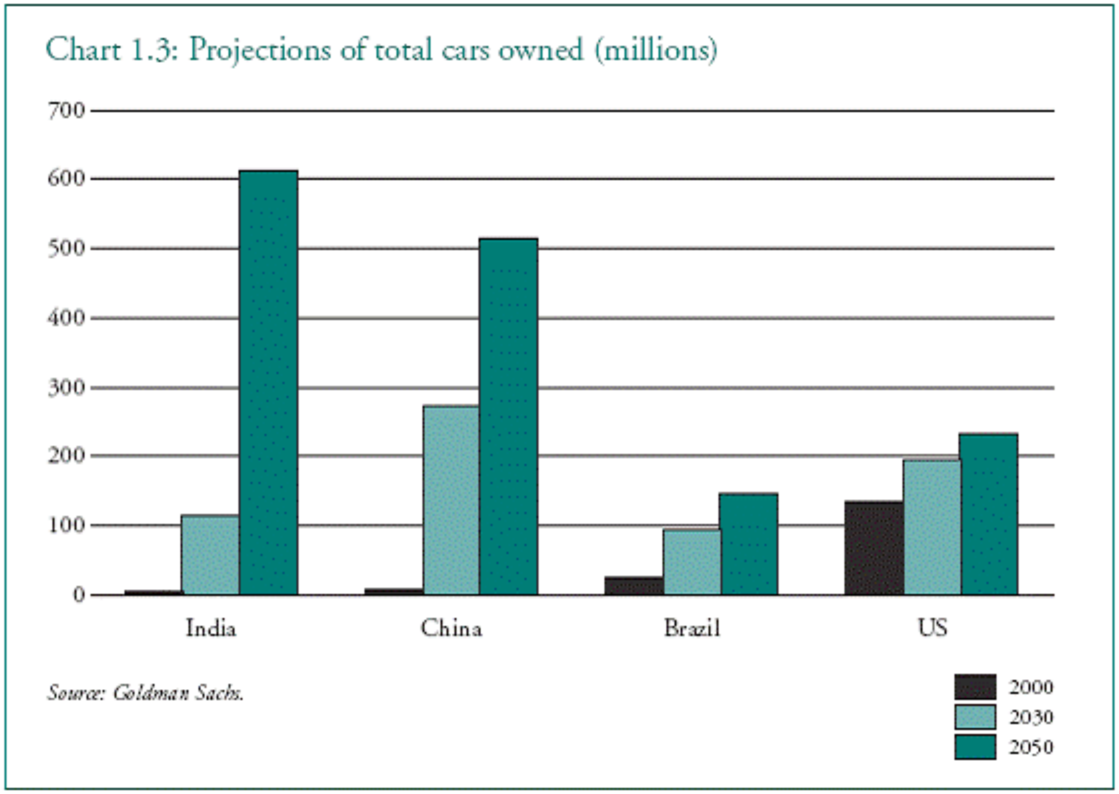
"In the long term, carbon free road transport fuel is the only way to achieve an 80-90% reduction in emissions, essentially "decarbonization."

--The King Review for the U.K. Government, by Professor Julia King, Vice-Chancellor of Aston University and former Director of Advanced Engineering at Rolls-Royce plc, March 2008

"[I]n the period beyond 2100, total GHG emissions will have to be just 20% of current levels. It is impossible to imagine this without decarbonization of the transport sector."

-- Sir Nicholas Stern, Stern Review to the U.K. Government, 2007

Global Trends Underscore Need for Decarbonizing LDVs



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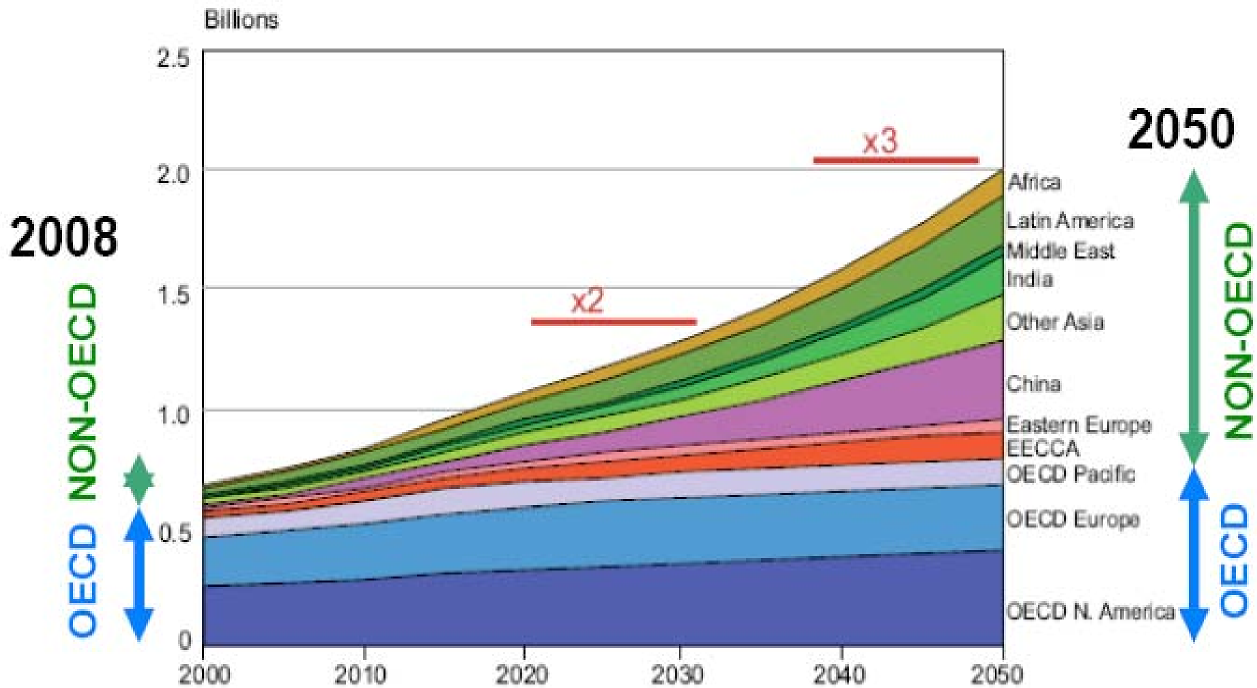

Figure 5.5: *Total stock of light-duty vehicles by region*

Source: WBCSD, 2004a.

Source: WBCSD, 2004a: Mobility 2030: Meeting the Challenges to Sustainability

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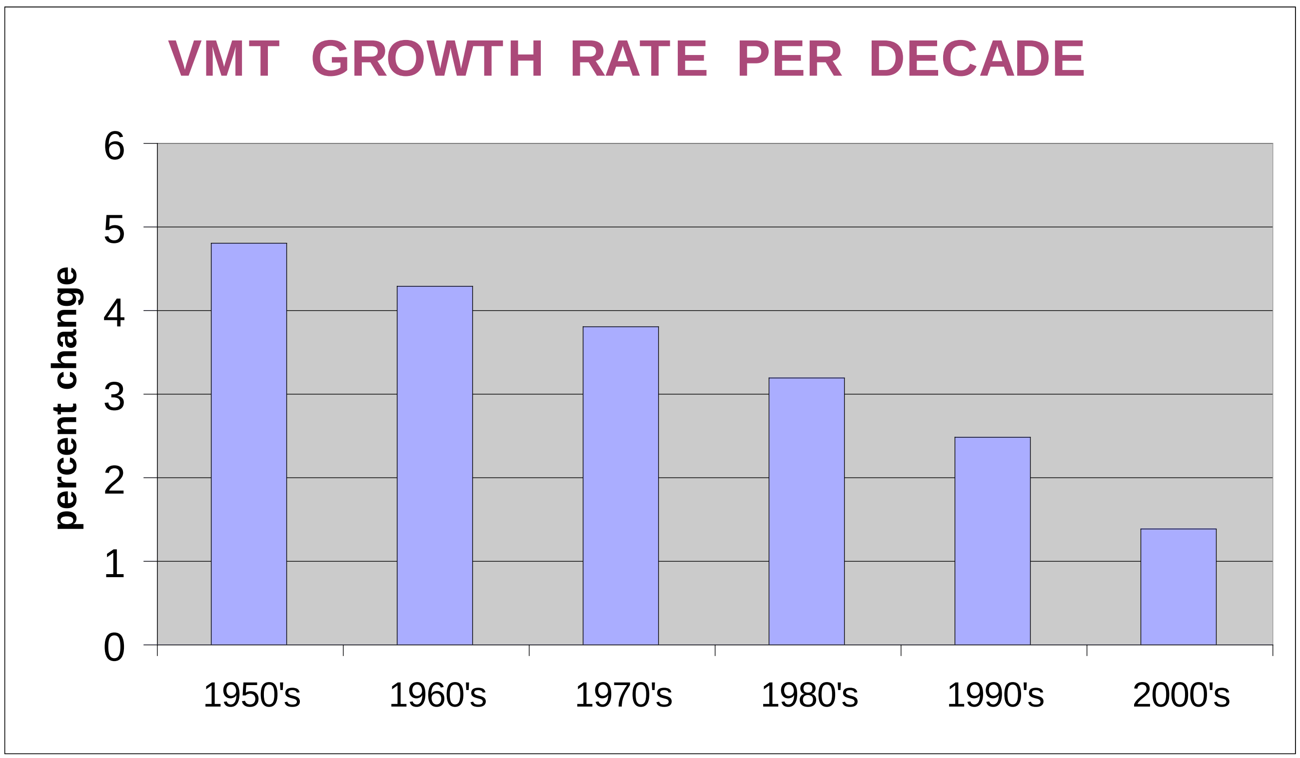
But more is needed

- Vehicle/fuel improvements can meet most GHG reductions, but may not suffice
- We also need near-term strategies
- Lowering VMT growth and improving operating efficiency of vehicles and highways are also needed

VMT Growth Trends

- VMT growth has been steadily declining since the 1950s
- VMT growth slowed to about 1.5% in early 2000s
- VMT growth was actually negative in 2008
- VMT is affected by population, economy, transportation prices, demographics, land use



Source: Alan Pisarski and Cambridge Systematics

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Many Strategies to Reduce LDV VMT*

- Economy-wide carbon cap and trade (raises fuel prices)
- Transportation pricing (PAYD insurance, parking pricing, tolls, higher user fees, cordon pricing, congestion pricing, etc.)
- Carpooling and vanpooling (currently carry 7 times as much work trip PMT as transit)
- Bike/ped and transit (but some transit is higher GHG than LDV)
- Trip chaining
- Tele-working, tele-shopping, tele-education, tele-medicine
- Compact land use

When VMT dropped in 2008, where did it go? We know <2% of the lost VMT went to transit, but don't know where the rest of the drop went.

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* Lower birth rate, lower immigration, and economic recession also reduce VMT but aren't considered desirable public policies

Strategies: Pricing

- Without price signals, trying to reduce VMT is swimming upstream
- Multiple pricing tools available: carbon/fuel prices, PAYD insurance, mileage fees, parking pricing, congestion pricing, etc.
- Pricing rewards prudent VMT choices, is cost effective, and produces revenue to invest in alternatives
- Key pricing opportunity: Federal or regional carbon prices or cap-and-trade programs

CO_2e Emissions Per Passenger Mile for Various Modes

NATIONAL AVERAGE	Energy Intensities		Load Factor	CO_2e
	(Btu or kWhr per vehicle mile)	(Btu or kWhr per passenger mile)	Persons Per Vehicle	(Estimated Pounds CO_2e Per Passenger Mile)
Single Occupancy Vehicle (SOV) LDVs	5,987	5,987	1.00	0.99
Personal Trucks at Average Occupancy	6,785	4,329	1.72	0.71
Transit Bus	37,310	4,318	8.80	0.71
Cars at Average Occupancy	5,514	3,496	1.57	0.58
Electric Trolley Bus	5.2	0.39	13.36	0.52
High Occupancy Vehicle (HOV) LDVs at 2+ Occupancy	5,987	2,851	2.10	0.47
Intercity Rail (Amtrak)	54,167	2,760	20.50	0.39
Light and Heavy Rail Transit	62,797	2,750	22.50	0.39
Motorcycles	2,226	2,272	1.20	0.37
Commuter Rail	92,739	2,569	31.30	0.36
Vanpool	8,048	1,294	6.10	0.21
Walking or Biking	-	-	1.00	0.00

REGIONAL EXAMPLE (SEATTLE/PUGET SOUND REGION)	Energy Intensities		Load Factor	CO_2e
	(Btu or kWhr per vehicle mile)	(Btu or kWhr per passenger mile)	Persons Per Vehicle	(Estimated Pounds CO_2e Per Passenger Mile)
Cars (64%) and Personal Trucks (36%) at Average Occupancy	5,987	4,468	1.34	0.74
King County Metro Diesel and Hybrid Buses	33,024	2,854	11.57	0.47
Sound Transit Buses	33,024	2,517	13.12	0.42
King County Electrically-Powered Trolley Buses	5.33	0.44	12.12	0.11

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Strategies: Transit

- Transit serves many different goals and there is broad support for increasing transit.

- But transit's potential GHG reduction is small
  - Transit serves 1% of PMT and 0% freight in the U.S.
  - DOE: Bus transit has higher GHG/passenger mile traveled than average auto use in the U.S. *(Increasing bus service will worsen GHG.)*
  - APTA studies: (a) Transit reduced GHG by 6.9 MMT in 2005; or (b) by 35 MMT in 2005. This is 0.3% to 1.7% of U.S. transportation GHG

- European Ministers of Transport caution: *"Modal shift policies are usually weak in terms of CO2 abated. They can not … form the corner-stone of effective CO2 abatement policy…."*

Strategies: Carpooling and Vanpooling

- There are 7 times as many work carpool/vanpool PMT as transit PMT
- Carpooling/vanpooling costs government little; saves transport costs for users
- Effective in all kinds of areas – rural, small urban areas, suburban, urban
- High potential to reduce GHG
- Nearer-term payoff than most transport strategies

Strategies: Land Use

- "Growing Cooler" finds compact mixed-use development can achieve 3.5-5% reduction in transportation GHG, 2007-2050
- GC's assumptions of land use change may be considered aggressive:
  - 67% of all development in place in 2050 will be constructed or rehabbed after 2005
  - 60-90% of that development is compact (comparable to 13.3 housing-units per acre)
  - Compact development has 30% less VMT than very sprawling development

Strategies: Vehicle/ System Operations

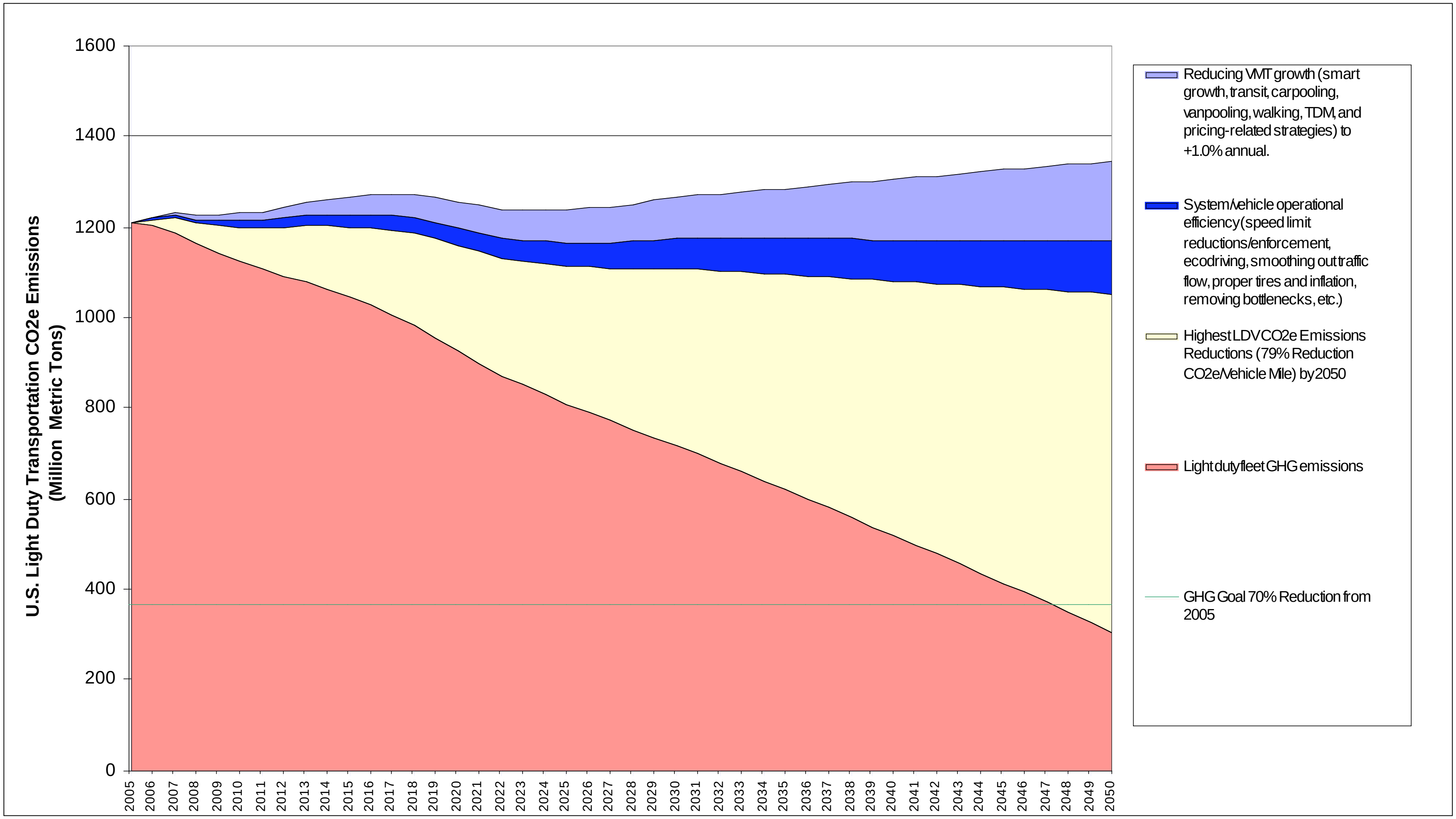
10-20% Light Duty Vehicle GHG reduction potential by:

- Managing speed (35-55 MPH is optimal; speed limits/enforcement could reduce fuel use 2-4%)
- Eliminating bottlenecks
- "Active" traffic management to smooth traffic flow
- Improving signal timing (could reduce 1.315 MMT CO_2/yr)
- Roundabouts (multiple benefits)
- Reducing car and truck idling
- "Eco driving" (priority in Europe)

Strategies: Construction, Maintenance, & Agency Operations

- Significant sources of GHG and energy use
- Many opportunities to reduce GHG and energy cost from current system:
  - LED traffic lights
  - Low carbon pavement
  - Energy-efficient buildings
  - Reduced roadside mowing
  - Solar panels on ROW
  - Alt fuels and hybrid vehicles in DOT fleets
  - Alt fuel buses

Strategy Combination: 1% Annual VMT Growth + 100 mpgge LDV Fleet + 10% Operational Efficiency (reduces LDV GHG 74%)



European View (ECMT, 2006)

- "The most effective measures available include *fuel taxes, vehicle and component standards, differentiated vehicle taxation, support for eco-driving and incentives for more efficient logistic organization, including point of use pricing for roads*. "

- "More integrated transport and spatial planning policies might contain demand for motorized transport."

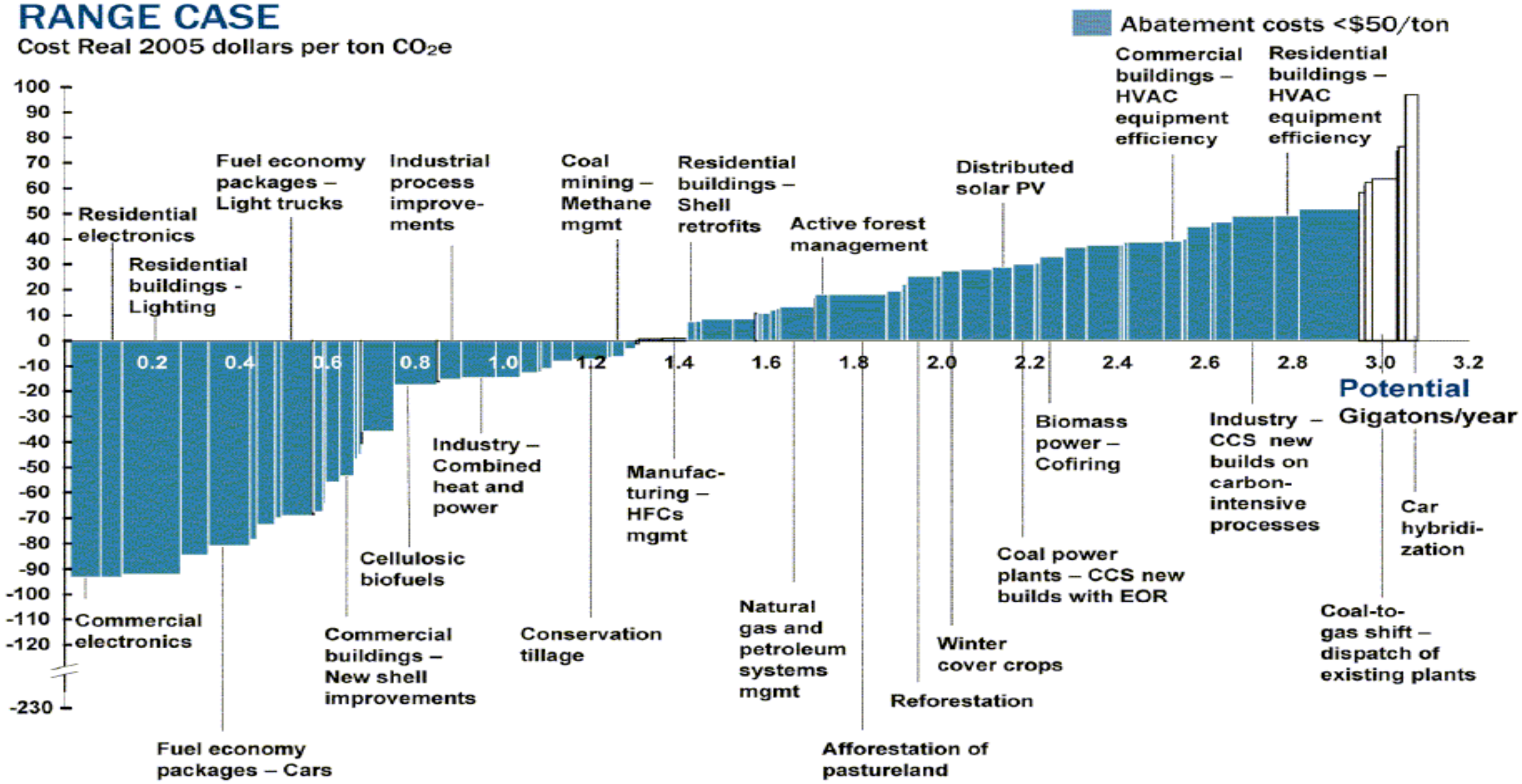
- Mode shifts … cannot … form the corner-stone of effective CO_2 abatement policy and the prominence given to modal shift policies is at odds with indications that most modal shift policies achieve much lower abatement levels than measures focusing on fuel efficiency."

- "Ultimately higher cost energy sources …. will be required if there are to be further cuts in transport sector CO_2 emissions."

How Much Will it Cost to Reduce GHG?

GHG REDUCTION OPPORTUNITIES WIDELY DISTRIBUTED - 2030 MID-RANGE CASE

Cost Real 2005 dollars per ton CO_2e



The analysis found that abatement options are highly fragmented and widely spread across the economy. Almost 40 percent of abatement could be achieved at "negative" marginal costs, i.e., the savings over the lifecycle of these options would more than pay for the incremental investment, operating, and maintenance costs. Realizing the potential of many negative-cost options would require overcoming persistent barriers to market efficiency.

-- McKinsey & Company

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CONCLUSION: Many Strategies Needed to Reduce Transport GHG

1. Maximize energy efficiency of current vehicles
2. Transform/decarbonize vehicles and fuels world-wide
3. Adopt pricing measures to reward conservation and tech innovation
4. Push “eco driving” and system/speed management
5. Adopt more efficient land use
6. Support carpools & vanpools, biking, walking, transit use, trip chaining, telecommuting
7. Adopt low carbon, energy-conserving strategies in construction, maintenance, and agency operations

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Thank you!

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