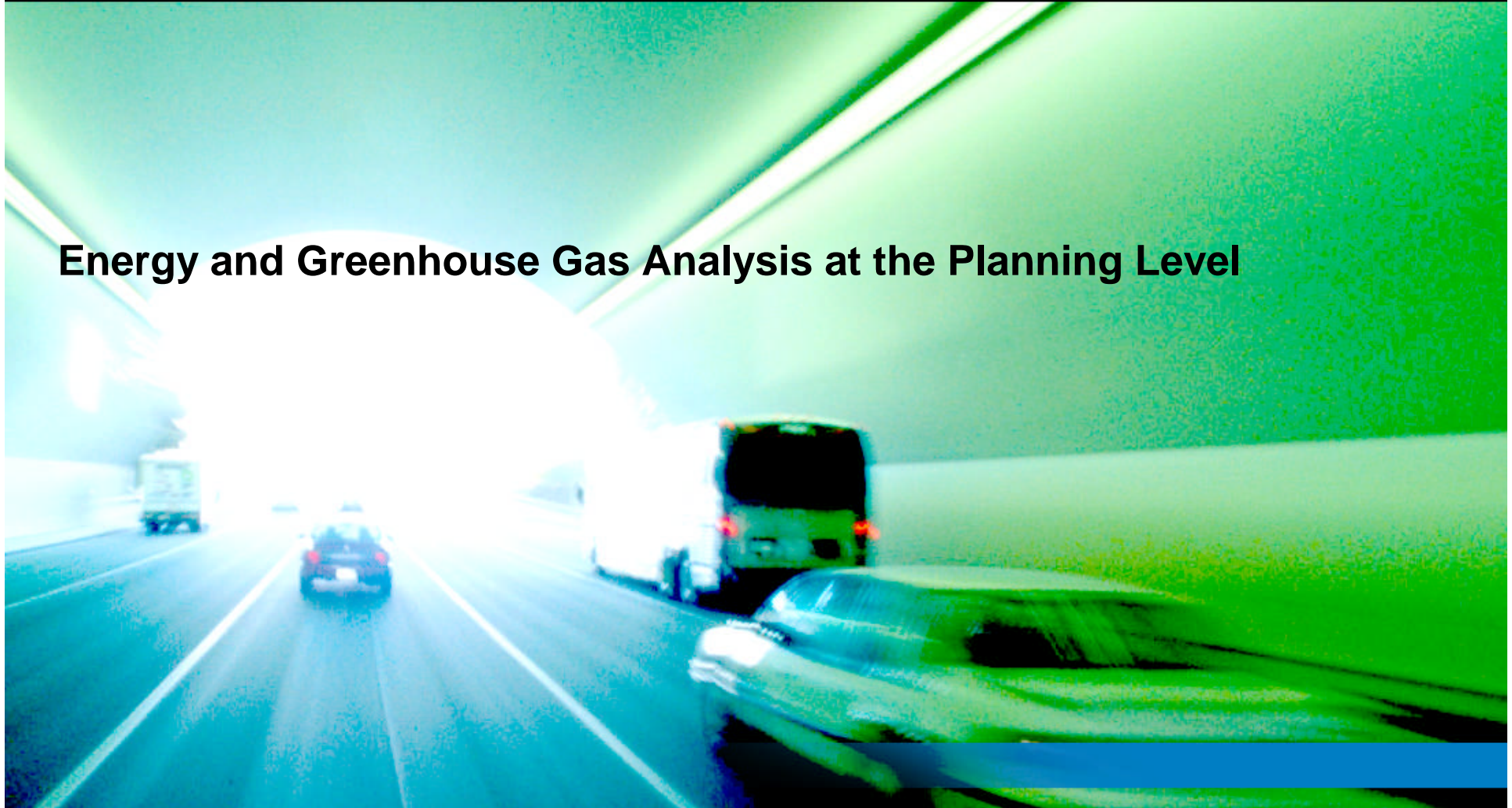


Energy and Greenhouse Gas Analysis at the Planning Level



Federal Policy (Susan's questions)

- **Where is Federal policy now?**
- **Where do things seem to be going?**
- **Anticipated timeframe for compliance with Federal rules?**
 - What will be in the next transportation bill?
- **What will MPOs be required to do?**
 - Reporting targeted upstream or downstream?
- **What will NEPA require?**

Energy/GHG Analysis

- **Currently no Federal requirement to conduct a greenhouse gas analysis for transportation plans or projects**
- **However, energy analysis is required for EIS's by the CEQ regulations and the FHWA NEPA Technical Advisory**
 - FHWA adopted very detailed Caltrans guidance – 28 years ago
 - Current practice is much less rigorous

USDOT climate activities

- **DOT Climate Center codified in 2007 Energy Bill**
 - Research, best practices, tools
 - <http://www.climate.dot.gov/>
- **Policy options being considered**
 - Near-term
 - Reauthorization
- **Many, many questions to be resolved**
 - Plan, project level, or both?
 - Requirements, recommendations, or best practices?
 - Mitigation, adaptation or both?
 - Which tools are best?

Example: CCAP proposal from 2008 TRB meeting

National Climate Policy

- Use allowance auction revenues to support transit, smart growth, capacity building
 - » Lieberman-Warner climate bill adds about \$1 billion per year for transit
 - » Important to include \$for smart growth, bike/ ped
- Opportunity to set the stage for climate-friendly transportation bill
 - » State, regional, local capacity building on smart growth planning: data, tools, scenario analyses
 - » Blueprint planning grants, learning networks (like CA)

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Example: CCAP proposal from 2008 TRB meeting

Green-TEA Key Principles

- **Contribute to national GHG reduction targets**
 - » E.g., **30 by 30**: 30% below 1990 levels by 2030
- **Tie funding to GHG performance**
 - » Reward low GHG plans, programs, modes, smart growth, TDM, TOD
 - Same match, requirements for transit and road
 - » Effective and equitable formulas need to be developed
- **Increased planning support, capacity bldg**
 - » Improved travel and land use data
 - » Improved travel models
 - » Support for regional scenario analyses

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Example: CCAP proposal from 2008 TRB meeting

Green-TEA

New Regulatory Approaches

- **Require alternative transportation and land use scenario analyses in TIPs and long range transportation plans**
 - » Include scenarios consistent with US GHG goals
- **Set State and/or MPO VMT/GHG Targets**
 - » Consistent, in aggregate with national GHG goals
 - » Informed by vehicle & fuel policies

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Example: CCAP proposal from 2008 TRB meeting

Initial Thoughts on VMT/GHG Targets: National/State/MPO/Local

- Nested responsibilities
 - » Federal, state, regional, local
- USEPA and USDOT could work with states & MPOs to develop targets (like CA SB 375)
- Targets should take into account existing VMT/capita, mode split, growth projections
 - » Different reductions appropriate for different regions
- Reward efficient behavior and help those places that need more help

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What are other states doing?

- **Build/no-build?**
- **Are we only concerned about VMT?**
- **What about construction?**

Emerging Local Requirements--States Are Already Acting

- **35 states have climate or energy plans**
- **14 of these have a transportation analysis component**
 - New York – energy and GHG analysis required in plans, TIPs, and some projects
 - Oregon – requires GHG analysis when transportation plans are updated
 - Florida – recommends that GHG emission reduction strategies be incorporated into transportation planning

Planning-level Analysis

- **New York (required)**
- **Oregon (required)**
- **Washington (proposed requirement)**
- **Colorado (proposed requirement)**
- **Florida (proposed requirement)**
- **Maryland (proposed requirement)**
- **Minnesota (proposed requirement)**
- **California (lawsuits)**
- **Voluntary analysis performed or underway in Philadelphia, Dallas, Salt Lake City, Missoula, Portland, Sacramento, San Francisco**
 - (Philly and SLC are energy analyses, not GHG)

Project-level Analysis

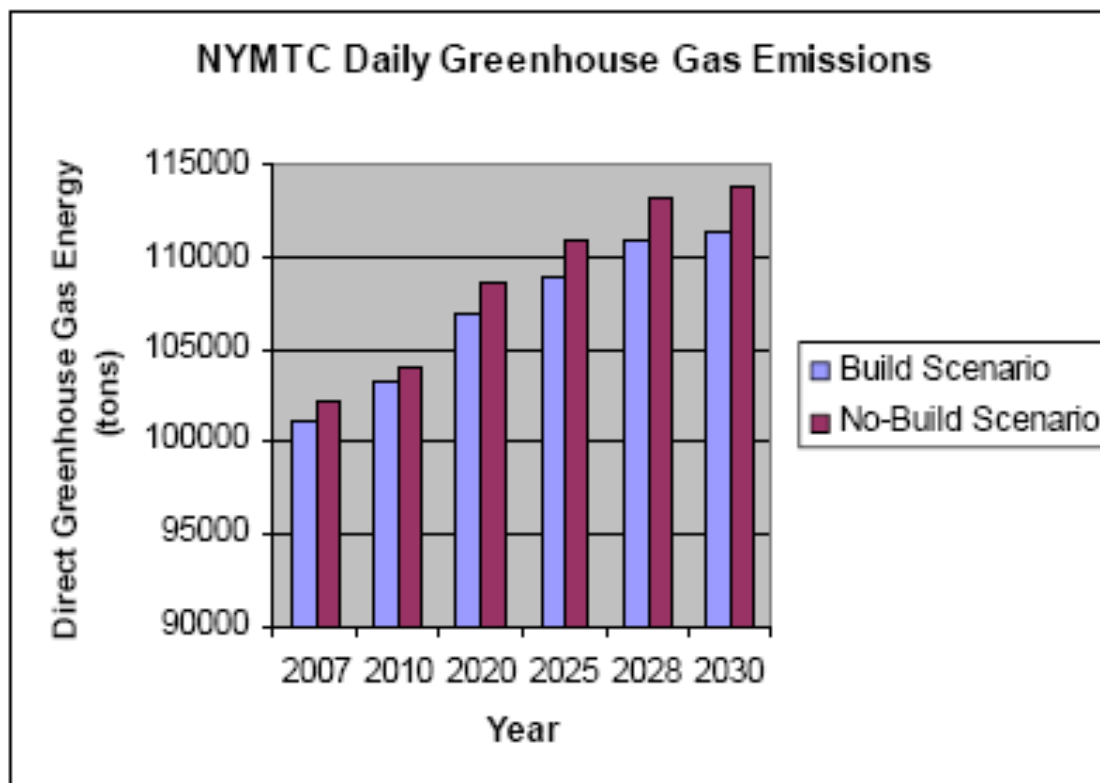
- **New York (required)**
- **Massachusetts (required)**
- **Montana (required)**
- **Vermont (required)**
- **California (“optional” procedures posted)**
- **Seattle, WA (required—for developments, not roadway projects)**
- **Minnesota (proposed requirement)**
- **Comments raised on projects in Colorado, Maryland, New Hampshire, North Carolina, Tennessee, Texas, Vermont, Virginia, Washington, and Wisconsin**

New York

- **Energy and CO2 analysis required for plans and TIPs**
- **Analysis includes direct (operational) energy and indirect (construction) energy for roadway and rail projects**
 - Build/no-build analysis
 - Analysis years are 2010, 2020 and last year of plan
- **Plan/TIP narrative must discuss CO2, energy goals of state energy plan and how adoption of plan/TIP furthers these goals**
 - Plan/TIP should evaluate progress toward meeting SEP goals for reducing GHGs and increasing renewable energy use
 - Depending on outcome of analysis, MPO should consider modifying plan/TIP to reduce GHGs from projects or include additional projects that reduce GHGs

New York Examples: New York City

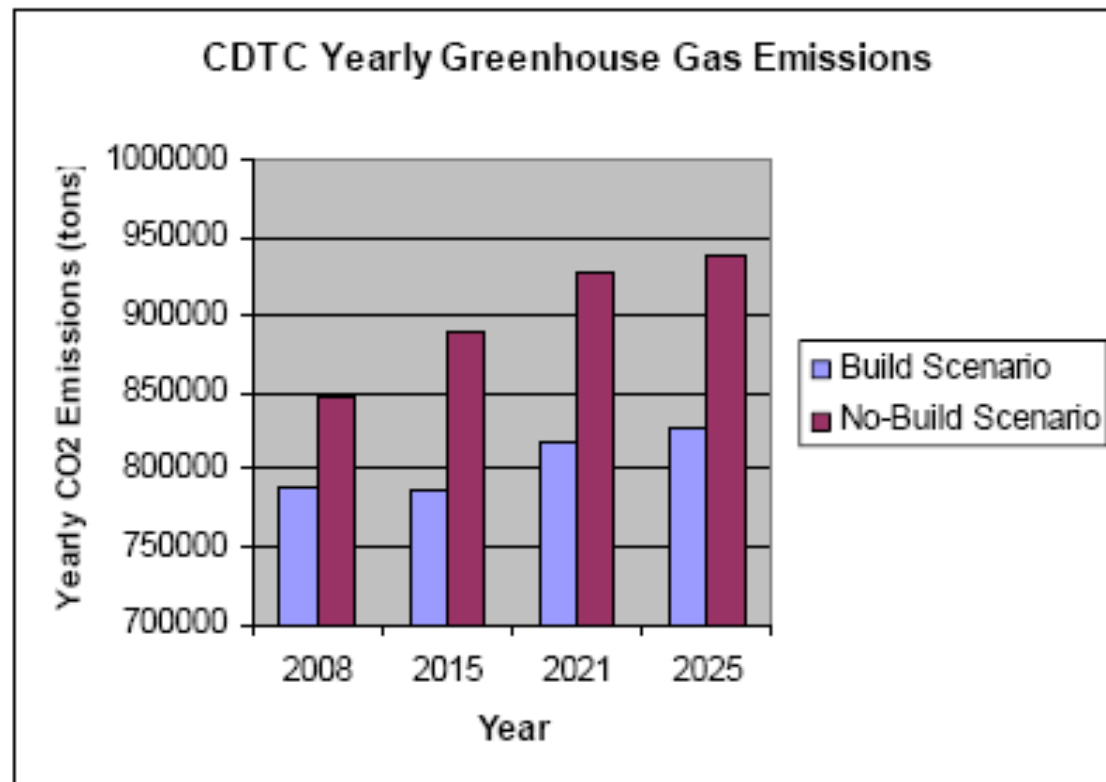
(2% reduction
in 2030)



Source: NYMTC

New York Examples: Albany

(13% reduction
in 2025)



Source: CDTC

Salt Lake City 2030 Transportation Plan Analysis (MPO and FHWA)

	2004	2012	% change from 2004	2022	% change from 2004	2030	% change from 2004
VMT	24429999	29610459	21	36422260	49	41065728	68
Lane Miles	8530	9237	8	10115	19	10511	23
Fuel Consumption, gal/yr	5899399	7158984	21	7710626	31	8439710	43
CO2, tons/yr	583353139	704836226	21	755409813	29	821809140	41

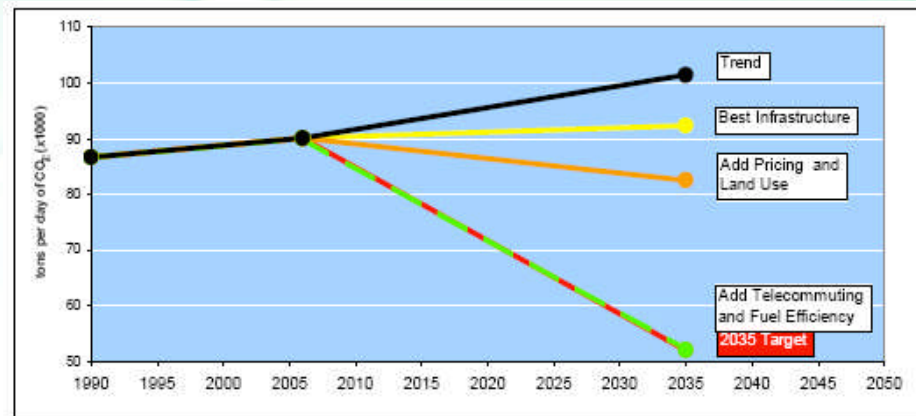
- Lane miles increase more slowly than VMT (congestion increases)
- Fuel consumption and CO2 increase at a lower rate than VMT
 - VMT increases 68% 2004-2030; CO2 increases only 41%
- MPO reports a 5.9% energy reduction in 2030 compared to 2030 No Action

DVRPC (Philadelphia) Visioning Exercise (MPO and FHWA)

Scenario	MPO data			MPO-reported Results			EMIT Results		
	Speed	VMT/day	% change	fuel/day	% change	MPG	fuel/day	% change	MPG
Existing 2025 Plan	27.8	138963900		2973800		46.73	6770800		20.52
Recentralization	30.3	137492300	-1.07	2942300	-1.07	46.73	6308723	-7.32	21.79
Sprawl	29.7	141895900	2.07	3036600	2.07	46.73	6599809	-2.59	21.50
In-Migration	27.8	142088700	2.20	3040700	2.20	46.73	6923051	2.20	20.52
Out-Migration	30.7	137448200	-1.10	2941400	-1.10	46.73	6251624	-8.30	21.99

- MPO analysis does not take speeds into account; changes in fuel consumption identical to changes in VMT
- Results are different when speeds are considered; notably, “sprawl” scenario reduces fuel consumption somewhat due to higher speed

San Francisco MTC 2035 Performance-Based Analysis



- **Performance-based goal: Reduce CO2 to 40% below 1990 levels by 2035**
- **Packages of infrastructure improvements and policy changes evaluated**
- **No combination of infrastructure and policy could meet the goal**
 - 14-17% reductions available through these actions
- **Light-duty vehicle fuel economy equivalent to 50 mpg needed to fully meet the 40% reduction goal**

2035 Thousands of Tons CO ₂ /Day	Infrastructure Packages			
	No New Investments	Freeway Performance	HOT & Local/Express Bus	Regional Rail & Ferry
No Policy Changes	101.4	92.4	97.0	99.1
Pricing Sensitivity	93.4	86.7	88.9	91.0
Land Use Sensitivity	93.4	86.8	90.5	91.8
Combined Pricing & Land Use	87.2	82.5	84.2	85.4
Combined Pricing, Land Use, and Telecommuting	n/a	79.6	80.9	n/a
Combined Pricing, Land Use, Telecommuting and Fuel Efficiency	n/a	n/a	52.0	n/a

Cost Effectiveness (dollars per thousand tons reduced per year) (4%Discount Rate)

Policy Packages	Freeway Performance	HOT & Local/Express Bus	Regional Rail & Ferry
No Policy Changes	\$ 22,000	\$ 818,000	\$ 18,859,000
Combined Pricing & Land Use*	\$ 11,000	\$ 210,000	\$ 2,711,000

* Does not include cost to implement alternative land use

Sacramento 2050 Blueprint/2035 Plan

- **Long range growth and transportation visioning exercise for Sacramento region**
- **CO2 emissions one of many impacts evaluated**
- **Preferred 2050 alternative:**
 - Reduces per-capita VMT by 26% compared to 2050 base case
 - Reduces CO2 and particulate emissions by 15% compared to base
 - AND reduces total transportation capital costs through 2050 by 12%
- **Draft 2035 Transportation Plan begins to implement the Blueprint**
 - Preferred alternative reduces CO2 by 6% in 2035
 - 13 explicit mitigation measures proposed

State of available tools

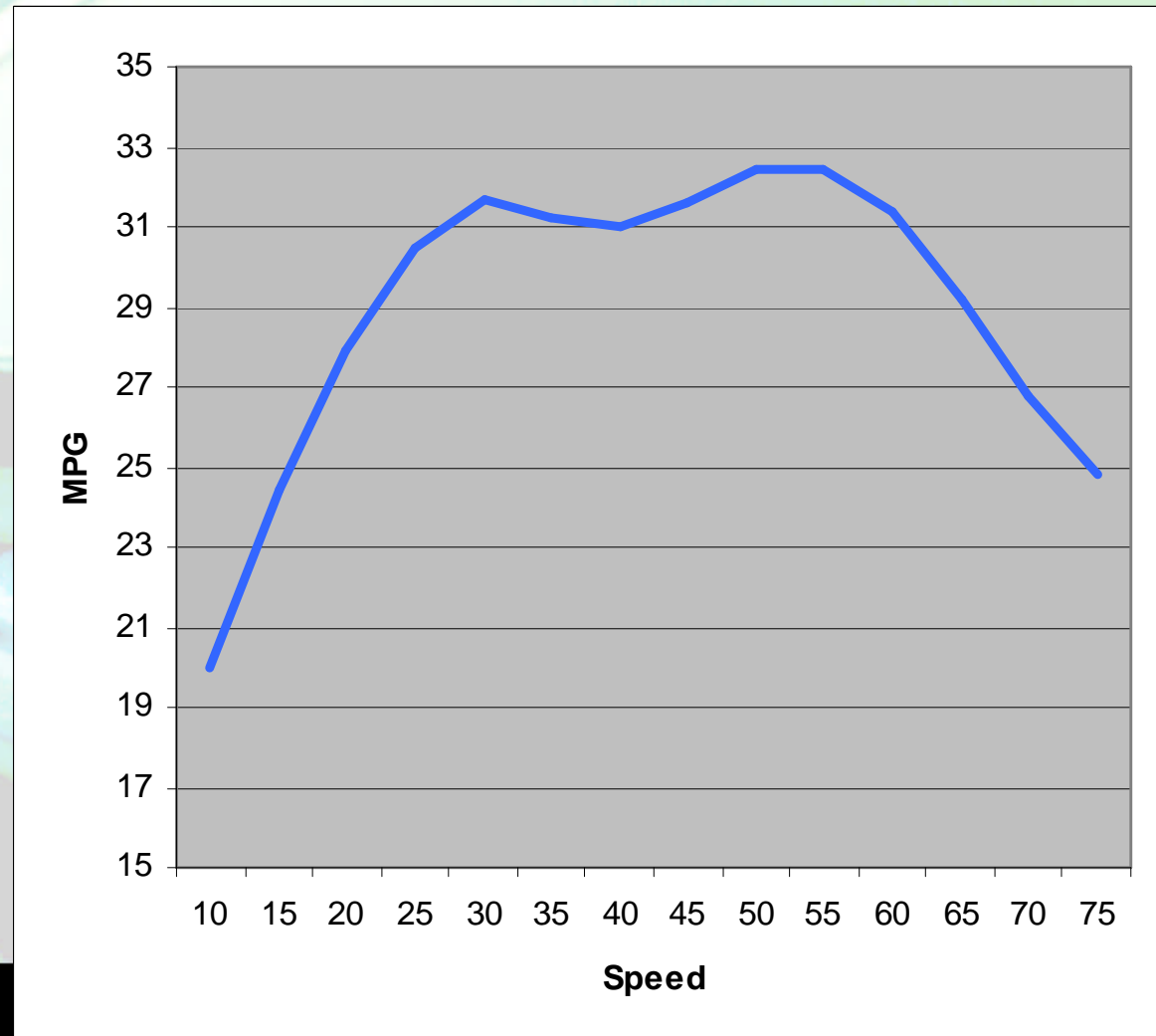
- **What default data are incorporated?**
 - Vehicle type and age
 - Hybrids
 - Fuel profiles and usage
- **Are environmental parameters like temperature important?**

Factors that Influence GHG Emissions from Projects

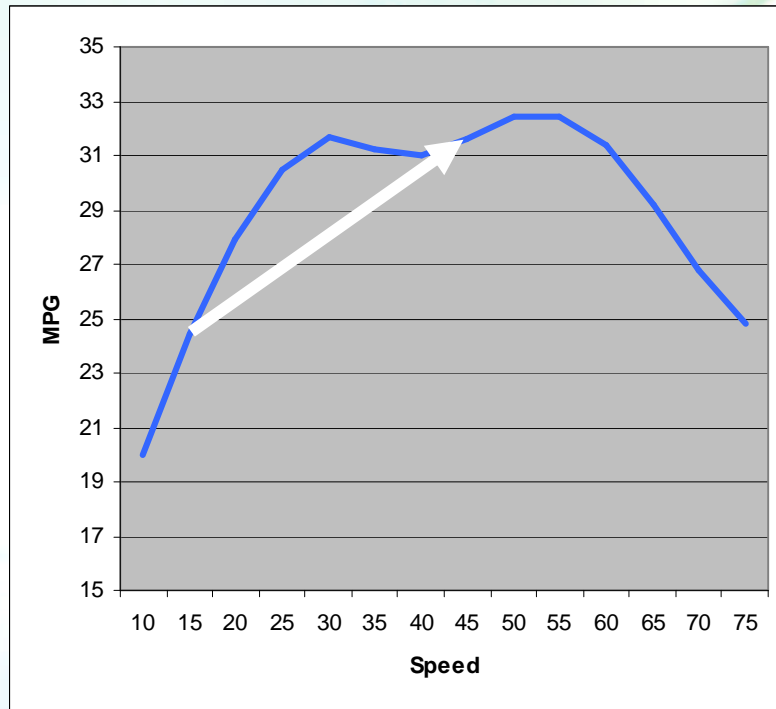
- **CO2 emissions are a direct function of energy consumption**
- **Direct (operational) emissions**
 - VMT, fleet mix (vehicle types and ages), speed, fuels used
- **Indirect emissions**
 - Changes in travel activity on other roadways, mode shift
 - Induced/displaced land use
- **Construction and maintenance emissions**
 - Extent of activity (earthwork, tunneling, grade reduction)
 - Materials (amount of steel and concrete, recycled vs virgin materials)
- **Upstream/downstream emissions**
 - Well-to-pump analysis for fuels
 - Manufacture and disposal emissions for vehicles

Why Is Speed Important?

- **Fuel consumption (fuel economy) varies with speed, so projects that increase (or decrease) speeds impact GHG emissions rates even if VMT stays the same**

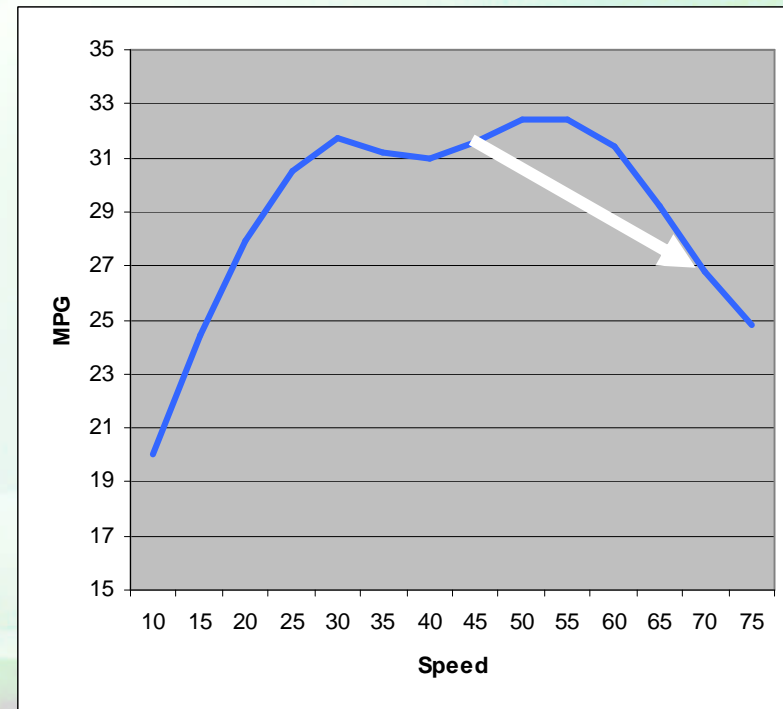


Source: 1997 FHWA/DOE study



Project increases speed from 15 to 50 mph:

Fuel economy improves,
Fuel consumption decreases, and
GHG emissions decrease



Project increases speed from 45 to 70 mph:

Fuel economy declines,
Fuel consumption increases, and
GHG emissions increase

Analysis tools/methodologies

Tool	VMT/ Fleet mix?	Speed?	Fuels?	Construction?
VMT/mpg approach	Yes	No	No	No
MOBILE6.2	Yes	No	No	No
NY method	Yes	Yes	No	Yes
CA method	Yes	Yes	No	No
MOVES	Yes	Yes	Yes	No
Life-cycle Analysis	Yes	Yes	Yes	Yes

Analyzing Different Factors

- **Direct (operational) emissions**
 - Can be modeled with MOBILE6.2 or MOVES
 - Speed impacts not reflected in MOBILE6.2
- **Indirect emissions**
 - Changes in activity can be analyzed with local travel model
 - Emissions can be modeled with MOBILE6.2 or MOVES
- **Construction and maintenance emissions**
 - Some basic information available but no model
 - Addressed by New York's spreadsheet methodology
- **Upstream/downstream emissions**
 - Can be modeled with MOVES

Current Practice for Energy Analysis

- **Most analyses use VMT as a surrogate for energy consumption or CO2 emissions. Examples:**
 - 1) **Use BTU per mile and/or CO2 per mile rates from FTA New Starts guidance and apply to project VMT estimates**
 - 2) **Divide project VMT estimates by some fuel economy estimate (miles per gallon) to get gallons of fuel consumed**

Both approaches ignore speed changes due to alternatives, future fuel economy and fleet mix changes, etc.

EPA's MOVES model

- **Eventual replacement for MOBILE6.2**
 - Draft version fall 2008, final version fall 2009
- **Demo version currently available**
 - Models energy and GHGs
 - Far greater capabilities than MOBILE6.2
 - Interface is cumbersome for inventory analysis (will be improved for future versions); speed lookup tables easy to generate
 - Runtimes reasonable for lookup tables but long for inventories
- **FHWA/EPA overview workshops available Spring 2008**

Accuracy of Energy/CO2 Analyses

- **CO2 calculations involve conversion factors for energy use that are widely accepted and easy to measure**
- **Most error/uncertainty arises from limitations in the scope of analysis, rather than available tools**
 - Not considering changes in speed
 - Not considering VMT/speed changes on other roads
 - “study area” versus “affected network” approach for projects
 - Limiting analysis to operational energy/emissions only

Typical Error Bounds

- **MOBILE6.2/MOVES**
 - Measuring and modeling energy consumption more straightforward than criteria pollutants or MSATs
 - Fuel consumption estimates from MOBILE and MOVES have been validated against national fuel sales data—error is 1-4%
 - State border issues, onroad/nonroad issues
- **Speeds**
 - Not considering speeds at all: up to 60% error
 - Use of daily average rather than hourly speeds: MSAT work shows that up to 25% error possible (hourly speeds capture congestion)
- **Construction**
 - Not considering construction: maybe 5% error for typical projects
 - Most important for projects with substantial construction (large new roads and bridges, tunnels)

Summary: Planning-level Analysis

- **Current practice is poor in some areas (speed changes not considered)**
- **MOVES would produce more reliable results**
 - Basic regional analysis methodologies already developed for MOVES
 - Use of MOVES for energy/GHG analysis would give MPOs a head start on using MOVES for SIPs and conformity
- **Changes in planning scenarios we have examined can be significant**
 - Emissions increase over time, but not as fast as VMT
 - 2-5% decrease in Build compared to No-build for typical planning scenarios
 - 6-17% decrease in California scenarios designed with GHG emissions reduction in mind

Summary: Planning-level Analysis

- **Regional analysis captures entire captures VMT reductions/speed improvements over the whole network**
 - Can capture impacts of land use associated with new infrastructure
- **Currently difficult to quantify construction- or maintenance-related energy consumption**
 - New York method is the best available, but improvements/updates would be useful
- **Can also measure potential for reducing GHG emissions based on different emissions reduction strategies**