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FHWA Initiatives Addressing Energy and Emissions Analysis

Southern Transportation Air Quality Summit
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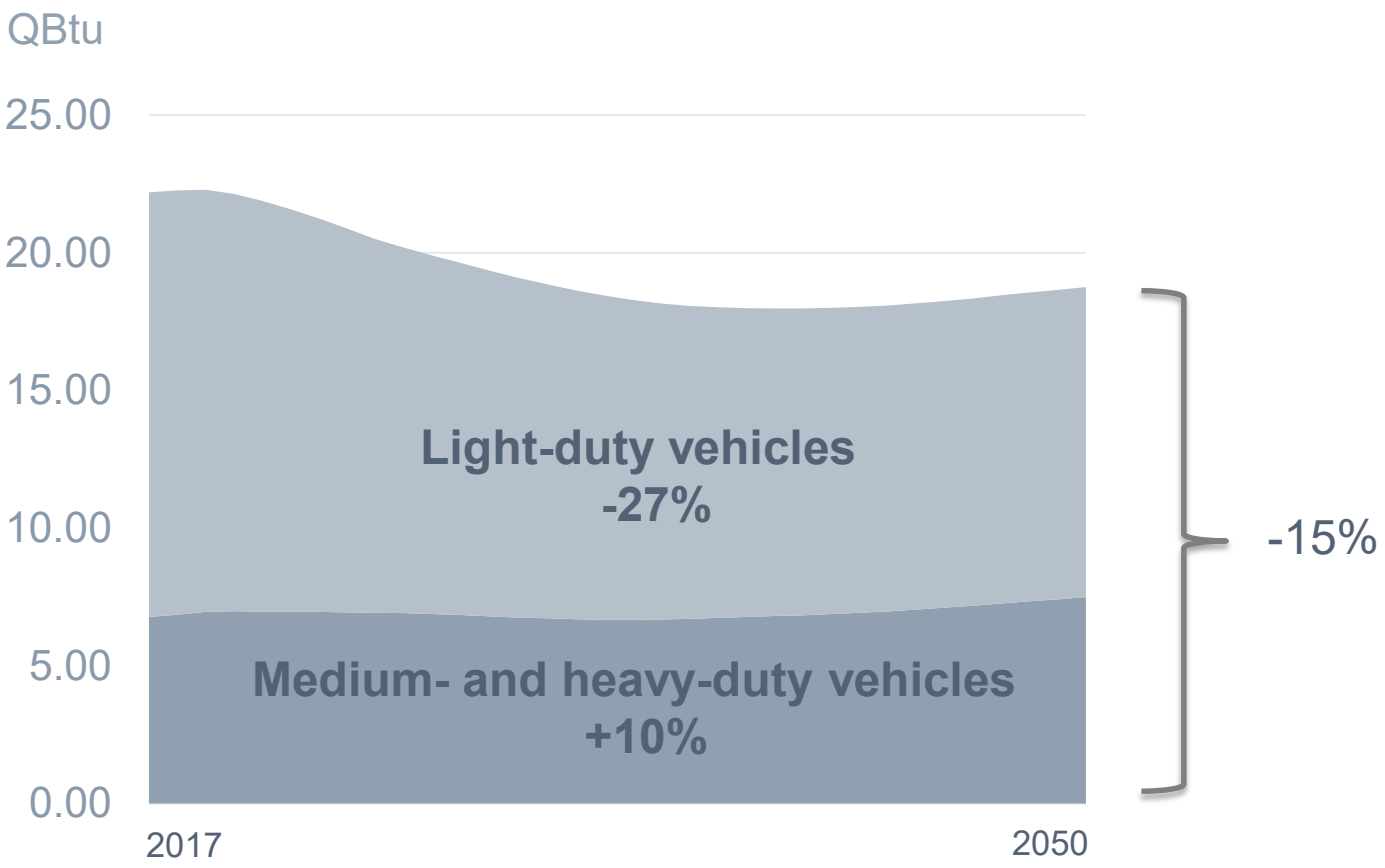
Overview

- What is unique about energy and CO2 analysis?
- A few relevant projects supported by FHWA and its partners…
  - Infrastructure Carbon Estimator (ICE)
  - Strategic policy analysis tools (EERPAT and VisionEval)
  - Addressing institutional capacity (NCHRP 25-25 56)

Baseline Forecast of On-Road Energy Consumption, 2017 to 2050



Source, Annual Energy Outlook 2019 Table 7

Reflects the impact of:

- Federal fuel economy standards (light-duty and medium/ heavy-duty)
- State ZEV standards
- Market-driven changes in vehicle efficiency
- Change in travel activity

DISRUPTIVE TECHNOLOGIES COULD HAVE A SIGNIFICANT IMPACT BEYOND BASELINE CONDITIONS AND POLICIES

"Bookend" Forecast of the Energy and CO2 Impacts of Connected and Automated Vehicles

Source: U.S. Department of Energy, Smart Mobility Program

Factors that could *increase* energy consumption and associated emissions

- Reduced travel costs
- Increased VMT
- Zero-occupancy vehicles
- Access for New User Groups
- Faster driving speeds
- Increased freight movement
- Increased vehicle features

Factors that could *decrease* energy consumption and associated emissions

- Platooning, drafting and eco-driving
- Congestion management
- Emerging mobility service models
- Improved crash avoidance
- Zero-emission vehicles and power train efficiencies
- Less hunting for parking
- Vehicle right-sizing

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Lifecycle Energy / CO2 Considerations are also important in understanding impacts

On-road energy

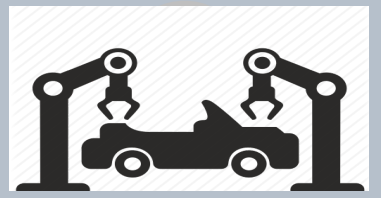
- Vehicle operating energy consumption and emissions

Upstream fuel cycle

- Extracting petroleum, mining for electricity, growing and harvesting biofuel plants, transport, refining, and distribution
- Disposal of products

Infrastructure

- Upstream energy and fuel used in raw material extraction & production of construction materials
- Energy and fuel used by construction vehicles
- Fuel used by maintenance vehicles



Vehicle Cycle

- Raw material extraction, processing, transport; manufacture; assembly, distribution
- Maintenance
- Disposal of vehicles

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Infrastructure Carbon Estimator (ICE)

- Simple tool for estimating the energy consumption and CO2 emissions from
  - building and maintaining transportation infrastructure,
  - Implementing sustainable pavements and construction practices
- Being used by NYSDOT, WSDOT and MNDOT to estimate energy and CO2 impacts in NEPA.
- Available at www.fhwa.dot.gov/environment/sustainability/energy/ tools/carbon_estimator/index.cfm

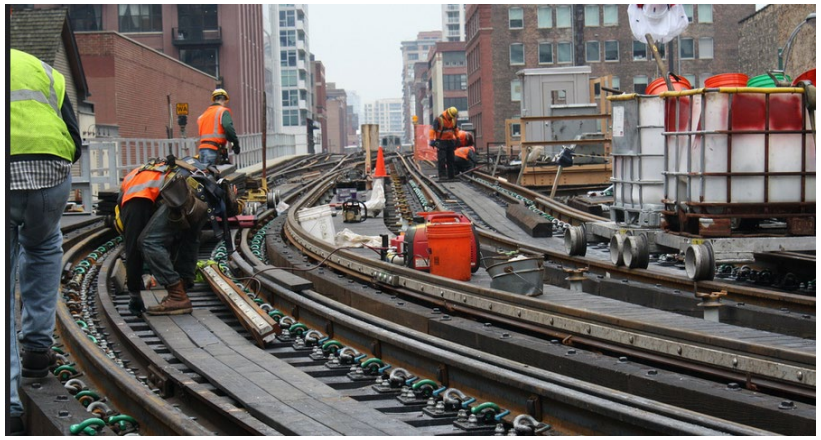
Infrastructure Types Covered by the Tool

Roadways and parking facilities

Bridges

Bicycle and pedestrian facilities

Public transportation



Construction
Resurfacing
Rehabilitation
Routine Maintenance

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Construction and Maintenance Activities Covered by the Tool

Upstream Energy & Emissions

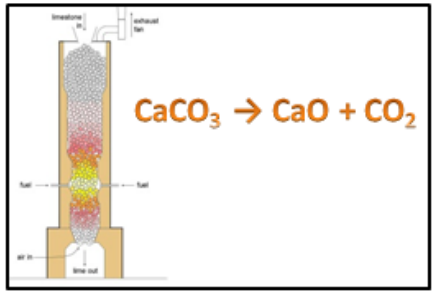
Direct Energy & Emissions

Materials

Raw materials extraction

Raw materials transport

Raw materials production



Chemical reactions-materials production

Construction Equipment

Transport of materials to site

Construction equipment

Routine Maintenance

Vegetation management

Snow removal

Sweeping, striping, litter, bridge deck repair

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Project Inputs

Roadway Projects							
	Roadway Construction					Roadway Rehabilitation	
Facility type	New Roadway (lane miles)	Construct Additional Lane (lane miles)	Re-Alignment (lane miles)	Lane Widening (lane miles)	Shoulder Improvement (centerline miles)	Re-construct Pavement (lane miles)	Resurface Pavement (lane miles)
Rural Interstates	0	0	0	0	50	0	10
Rural Principal Arterials	5	0	0	10	0	0	30
Rural Minor Arterials	0	0	20	0	0	0	0
Rural Collectors	0	0	0	20	0	0	0
Urban Interstates / Expressways	0	0	0	0	40	20	30
Urban Principal Arterials	0	0	0	0	0	0	10
Urban Minor Arterials / Collectors	0	0	0	0	0	0	0

Mitigation Strategies (pavement)

Strategy	Baseline deployment	Planned deployment	Maximum potential deployment	Applied to
In-place roadway recycling				
Cold In-place recycling	0%	0%	99%	Asphalt and fuel use by construction equipment in roadway resurfacing and BRT conversions
Full depth reclamation	0%	0%	99%	Base stone and fuel use by construction equipment in roadway reconstruction and BRT conversions
Warm-mix asphalt				
Warm-mix asphalt	45%	90%	100%	Asphalt use in all projects
Recycled and reclaimed materials				
Use recycled asphalt pavement as a substitute for virgin asphalt aggregate	0%	0%	25%	Asphalt use in all projects
Use recycled asphalt pavement as a substitute for virgin asphalt bitumen	0%	0%	40%	Asphalt use in all projects
Use industrial byproducts as substitutes for Portland cement	0%	0%	33%	Concrete use in all projects
Use recycled concrete aggregate as a substitute for base stone	0%	0%	100%	Base stone use in all projects
Preventive maintenance				
Preventive maintenance	0%	0%	100%	Materials and construction fuel use in roadway resurfacing and reconstruction projects

Energy and CO2 Estimates

	Annualized energy use (mmBTUs), per year over 20 years					
	Unmitigated					
	Roadway - new construction	Roadway- rehabilitation	Roadway - total	Bridges	Rail, bus, bicycle, ped.	Total
Upstream Energy Materials	89,975	152,838	242,813	24,643	178,067	**445,523**
Direct Energy Construction Equipment	33,942	27,079	60,021	10,747	61,606	**132,374**
Routine Maintenance						**158,585**
Total	**123,917**	**179,917**	**302,834**	**35,390**	**239,673**	**736,482**
	Annual [redacted] emissions (MT CO2e), per year over 20 years					
	Unmitigated					
	Roadway - new construction	Roadway- rehabilitation	Roadway - total	Bridges	Rail, bus, bicycle, ped.	Total
Upstream Emissions Materials	5,626	9,276	14,902	2,065	12,507	**29,474**
Direct Emissions Construction Equipment	2,402	1,975	4,377	784	4,491	**9,652**
Routine Maintenance						**11,564**
Total	**8,028**	**11,251**	**19,279**	**2,849**	**16,998**	**50,690**

ICE 2.0

- Pooled fund effort led by the Minnesota DOT, with participation from California, Colorado, Iowa, New York, Texas, Washington. FHWA is also supporting the project.
- What to expect:
  - New roadway elements
  - New research on infrastructure energy and embodied CO2e embodied emissions
  - Improvements to tool interface
  - Ability to estimate on-road operating energy / CO2 based on simple estimates of vehicle miles traveled and travel speed
  - Project expected to be completed in late 2019

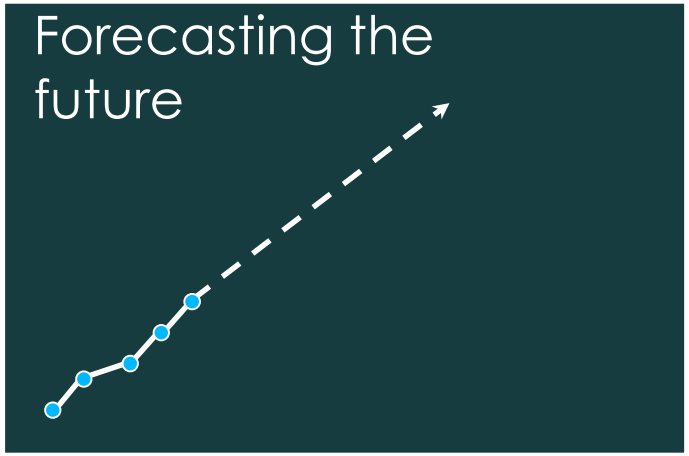
Strategic Planning Models – Differences from Conventional Travel Demand Models

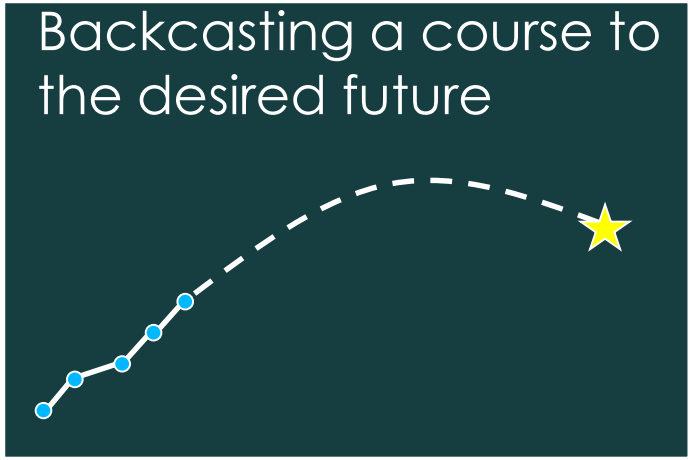
Conventional Travel Demand Models
(4-step and Activity-Based)

- Originally developed to evaluate transportation capacity (especially roads and capital-intensive transit projects)
- Detailed representation of the transportation system
- Very useful for evaluating incremental changes to a transportation system and related policies

Strategic Planning Models

- Detailed representation of households and factors influencing behavior (similar to activity-based)
- Simplified representation of transportation system
- Easier to develop and calibrate (but less precise)
- More flexible, and can address a broader policy space more easily
- Run quickly, and can be used to evaluate dozens of policy combinations

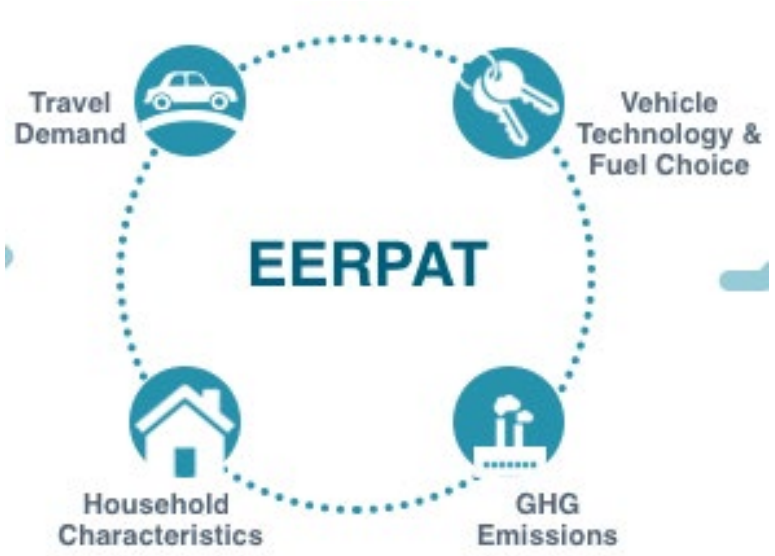




Graphics courtesy of Brian Gregor, Oregon System Analytics

Strategic Planning Models

- The Energy and Emissions Reduction Policy Analysis Tool
  - Based on the GreenSTEP model created by the Oregon Department of Transportation.
  - Enhanced to address well-to-pump energy and emissions and better represent freight flows and related strategies
  - FHWA is planning to pilot test the new freight component of EERPAT
  - Models have been developed in WA, UT, CO, VT MA, and MD
- VisionEval is a pooled fund effort intended to improve the GreenSTEP family of models



visioneval

Thank you.

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