FHWA Infrastructure Carbon Estimator

Talking Freight Webinar

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U.S. Department of Transportation
Federal Highway Administration

Today's Speakers

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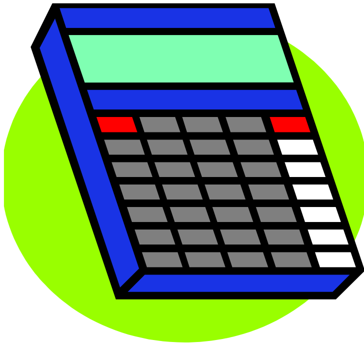
Why Address Infrastructure GHG Emissions?

- Traditional transportation air quality analysis has only considered localized impacts of short-lived pollutants (e.g., concentrations of carbon monoxide near roads)
- Focus has been on operational emissions (exhaust from vehicles using roads)
  - construction emissions are temporary (once construction is over, the emissions don't matter anymore)
  - maintenance vehicle emissions are accounted for in operation estimates
- Unlike traditional pollutants—
  - the impacts of GHGs are based on cumulative emissions (construction, operation, and maintenance emissions all have the same impact); and
  - The location of the emissions doesn't matter (they impact atmospheric concentrations regardless of where they occur)

GHG Emissions Analysis – Current State of Practice

- Approximately 32 states have Climate Action Plans
- Most large MPOs conduct GHG and/or energy analysis of long-range transportation plans
  - Required by law in CA, NY, OR, and other states
- Some states also require project-level analysis
- Only NY MPOs consider construction and maintenance emissions in analysis
- Pending guidance from White House CEQ may require the estimation of construction-related GHG emissions for some large proposed projects

Objectives of FHWA's Construction and Maintenance GHG Calculator



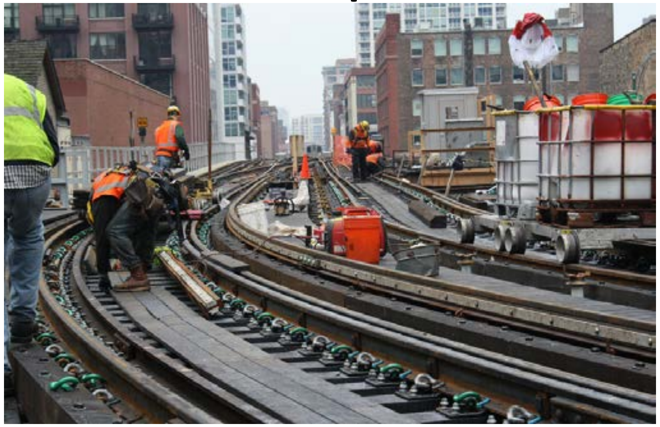
- Create a simple, user-friendly sketch tool to
  - Provide estimates of energy and GHG emissions from transportation infrastructure (roads, parking, bike / ped, transit)
  - Address construction and maintenance activities
  - Estimate energy and emissions benefits of alternative construction and maintenance practices, including their incremental costs
  - Use information available during long range planning / analysis (as opposed to detailed material quantity and construction activity estimates)

Capabilities

Roadways and parking facilities

Bridges

Public transportation



Bicycle and pedestrian facilities

Lifecycle Approach: Indirect Energy/Emissions

Upstream Energy and Emissions

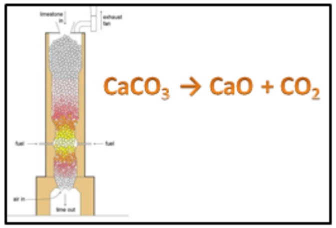
Materials

Energy and fuel used in **raw materials extraction**

Energy and fuel used in **raw materials transportation**

Energy and fuel used in **materials production***

Chemical reactions in **materials production****



Lifecycle Approach: Direct Energy/Emissions

Direct Energy and Emissions

Construction Equipment

Fuel used in **transportation of materials to site**

Fuel used in **construction equipment**

Routine Maintenance

Fuel used in **snow removal equipment**

Fuel used in **vegetation management equipment**

Fuel used in **other routine maintenance *****

Mitigation Strategies

User can apply the following strategies to reduce energy and emissions from construction and maintenance activities:

- Alternative fuels and vehicle hybridization
- Alternative vegetation management
- Alternative snow management
- In-place roadway recycling
- Warm mix asphalt
- Recycled and reclaimed materials
- Preventive maintenance

Using the Tool: Step 1

- **Step 1:** Input general information about your project/plan.

Project location (state)	AK
Project lifetime (years)	20

Roadway Routine Maintenance	
Total existing centerline miles	50000
Total existing lane miles	200000
Total newly-constructed centerline miles	1.75
Total newly-constructed lane miles	7

Rail, Bus, and Bicycle Routine Maintenance	
Total existing track miles of light rail	30
Total existing track miles of heavy rail	50
Total newly-constructed track miles of rail	0
Total existing lane miles of bus rapid transit	20
Total newly-constructed lane miles of bus rapid transit	0
Total existing lane miles of bicycle lanes	50
Total newly-constructed lane miles of bicycle lanes	1

Using the Tool: Step 2

- **Step 2:** Input information about construction and maintenance activities

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

Using the Tool: Step 3

- **Step 3:** Input information about construction delay

Total project-days of lane closure	
Average daily traffic per directional segment for facilities requiring lane closure	
Percentage of facility lanes closed during construction	50%

Using the Tool: Step 4

- **Step 4:** Input mitigation strategies

Energy / GHG reduction strategies				
Strategy	**Baseline deployment**	**Planned deployment**	**Max potential deployment**	**Applied to**
Alternative fuels and vehicle hybridization				
Hybrid maintenance vehicles and equipment	0%	10%	44%	Fuel use by maintenance equipment
Switch from diesel to B20 in maintenance vehicles and equipment	0%	10%	100%	Fuel use by maintenance equipment
Switch from diesel to B100 in maintenance vehicles and equipment	0%	10%	100%	Fuel use by maintenance equipment
Combined hybridization/B20 in maintenance vehicles and equipment	0%	10%	44%	Fuel use by maintenance equipment
Vegetation management				
Alternative vegetation management strategies (hardscaping, alternative mowing, integrated roadway/vegetation management)	No	Yes	N/A	Fuel use by vegetation management equipment
Snow fencing and removal strategies				
Alternative snow removal strategies (snow fencing, wing plows)	No	Yes	N/A	Fuel use by snow removal equipment
In-place roadway recycling				
Cold In-place recycling	0%	0%	99%	Asphalt and fuel use by construction equipment in roadway resurfacing and BRT conversions

Using the Tool: Step 5

- **Step 5:** View impacts of construction and maintenance activities

	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 GHG 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**

Using the Tool: Step 6

- **Step 6:** View impacts on vehicle operations

Construction delay	Result	Energy use (mmBTUs)	GHG emissions (MT CO2e)
Total project-days of construction/lane closure	20		
Project lifetime (years)	20		
Additional energy use / emissions due to delay (per project-day)		2.8	0.2
Total energy use / GHG emissions due to construction delay		56	5
Annual energy use / GHG emissions due to construction delay, per year		**2.8**	**0.2**
Pavement smoothness	**Result**	**Energy use (mmBTUs)**	**GHG emissions (MT CO2e)**
Total lane miles of roadway reconstruction / resurfacing	100		
Project lifetime (years)	20		
Reduced Energy use / GHG emissions due to smooth pavement		28	2
Annual energy / emissions savings due to pavement smoothness		**1.4**	**0.1**
Total		**Energy use (mmBTUs)**	**GHG emissions (MT CO2e)**
Total Annualized Delay and Pavement Smoothness Impacts		**1.4**	**0.1**

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Case Study: Hypothetical Port Access Project

- Improve access to a small, recently expanded port (500 trucks/day)
  - Because of deficient bridges, trucks travel an indirect route through town to access port
  - Space restrictions at port mean that trucks have to idle along city streets while waiting for access
- Project would:
  - Widen existing southern access roadway
  - Reconstruct two bridges to handle heavy trucks
  - Build 100 spaces of truck parking at port, which would require relocation and extension of ½ mile of rail access line
- Changes in truck exhaust CO_2 emissions (from shorter access route and less idling) modeled with EPA's MOVES emissions model
- Infrastructure CO_2 emissions calculated with FHWA ICE tool

Port: No Build scenario

Port: Build scenario

Port example: results

- ICE construction and maintenance analysis:
  - No Build: 56 tons CO_2/year (maintenance of existing system)
  - Build: 223 tons CO_2/year (construction of new infrastructure, plus maintenance of existing and new infrastructure)
  - Net difference: 167 tons/year
- MOVES analysis (truck emissions) (average between 2020 and 2040):
  - No Build: 4913 tons CO_2/year
  - Build: 723 tons CO_2/year
  - Net difference: -4190 tons/year
- Project payback period (when do truck emissions savings offset construction & maintenance emissions?)
  - Total net C&M emissions = 167 tons/year x 20 years = 3340 tons
  - On-road emissions benefit = 4190 tons/year
  - Payback period ~ **10 months**

For more information

- ICE tool, users guide and research report posted on FHWA's climate change web site:
  - www.fhwa.dot.gov/environment/climate_change/mitigation/publications_and_tools/carbon_estimator/

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