Dr. İsmail Çağrı Özcan

ESCARUS
[TSKB Sustainability Consultancy]

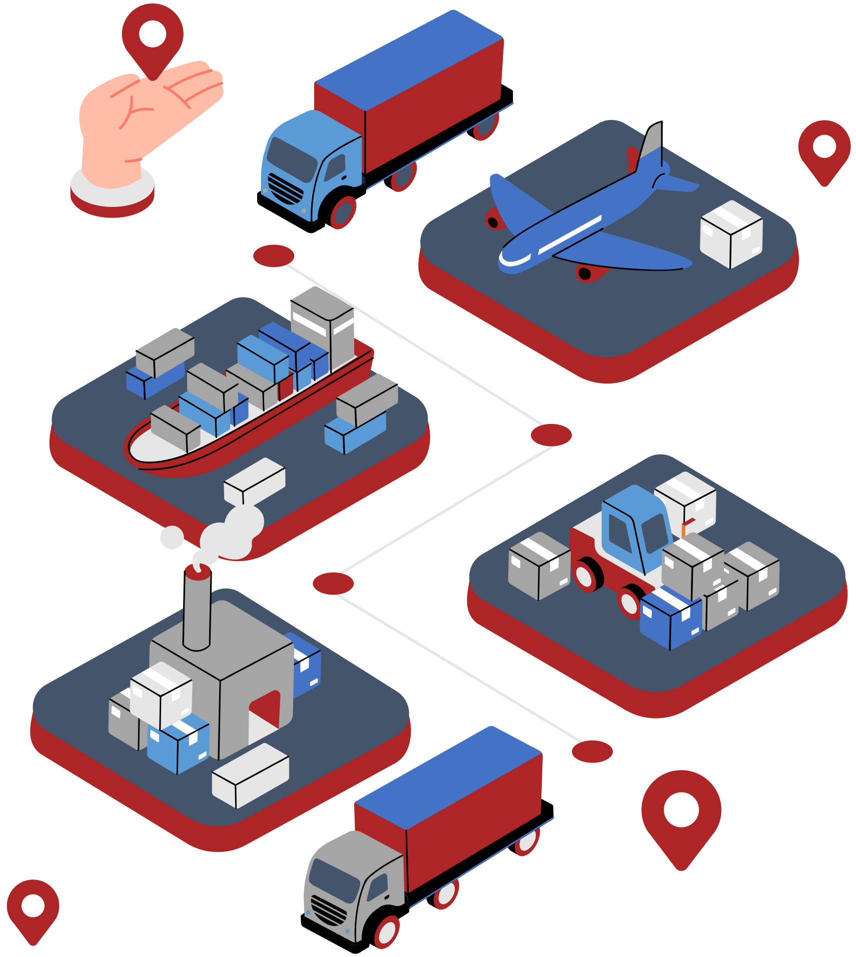
COMCEC

20th Meeting of the COMCEC TCWG

Measuring the Environmental Impacts of Transport Infrastructures in OIC Member Countries Project:

The United States Case Study

03.05.2023



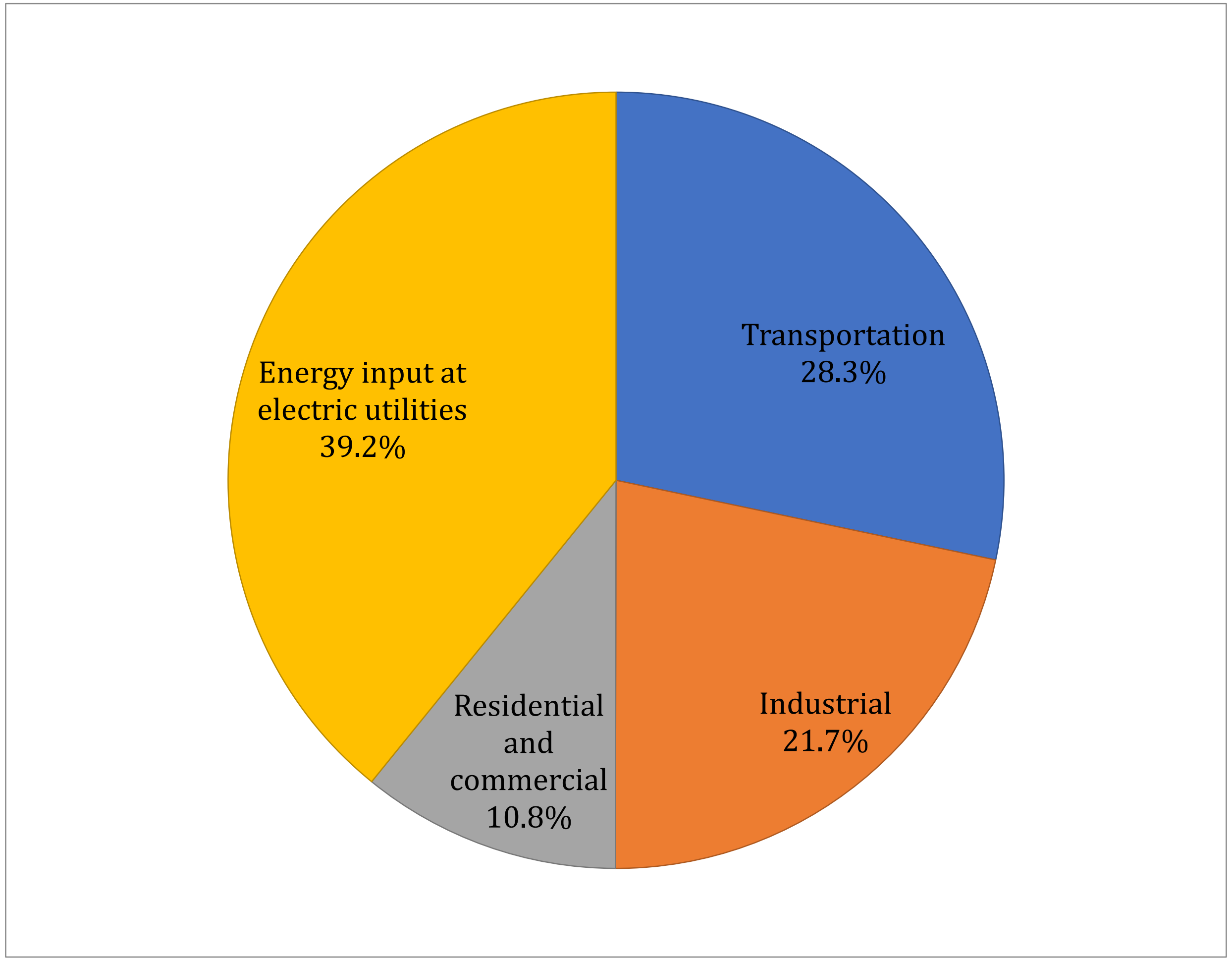
Measuring the Environmental Impacts of Transport Infrastructures in OIC Member Countries Project

Contents

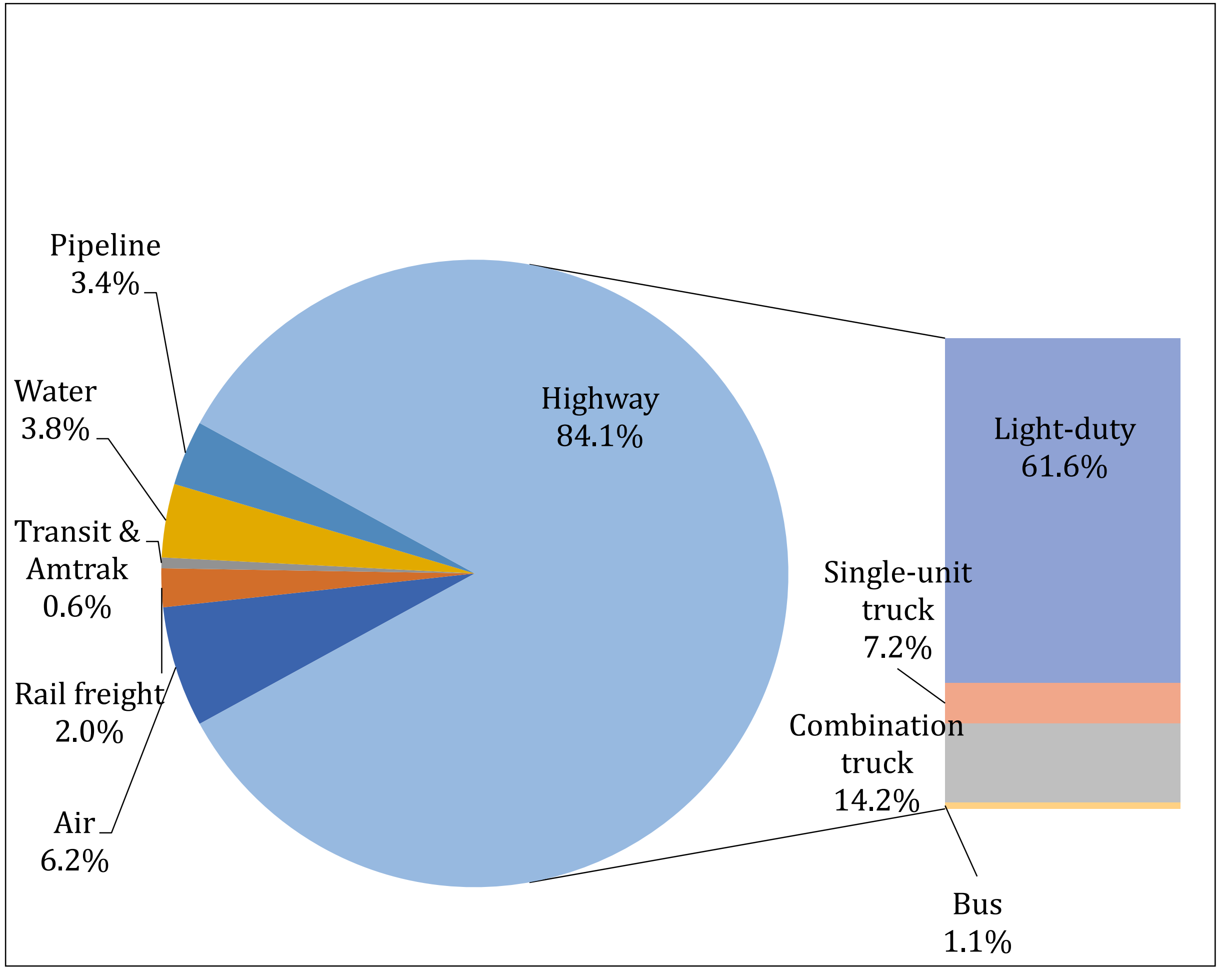
01 A Quick Look at the Transport-Environment Linkage in the US

A Quick Look at the Transport-Environment Linkage in the US

US Energy Use by Sector (2015)

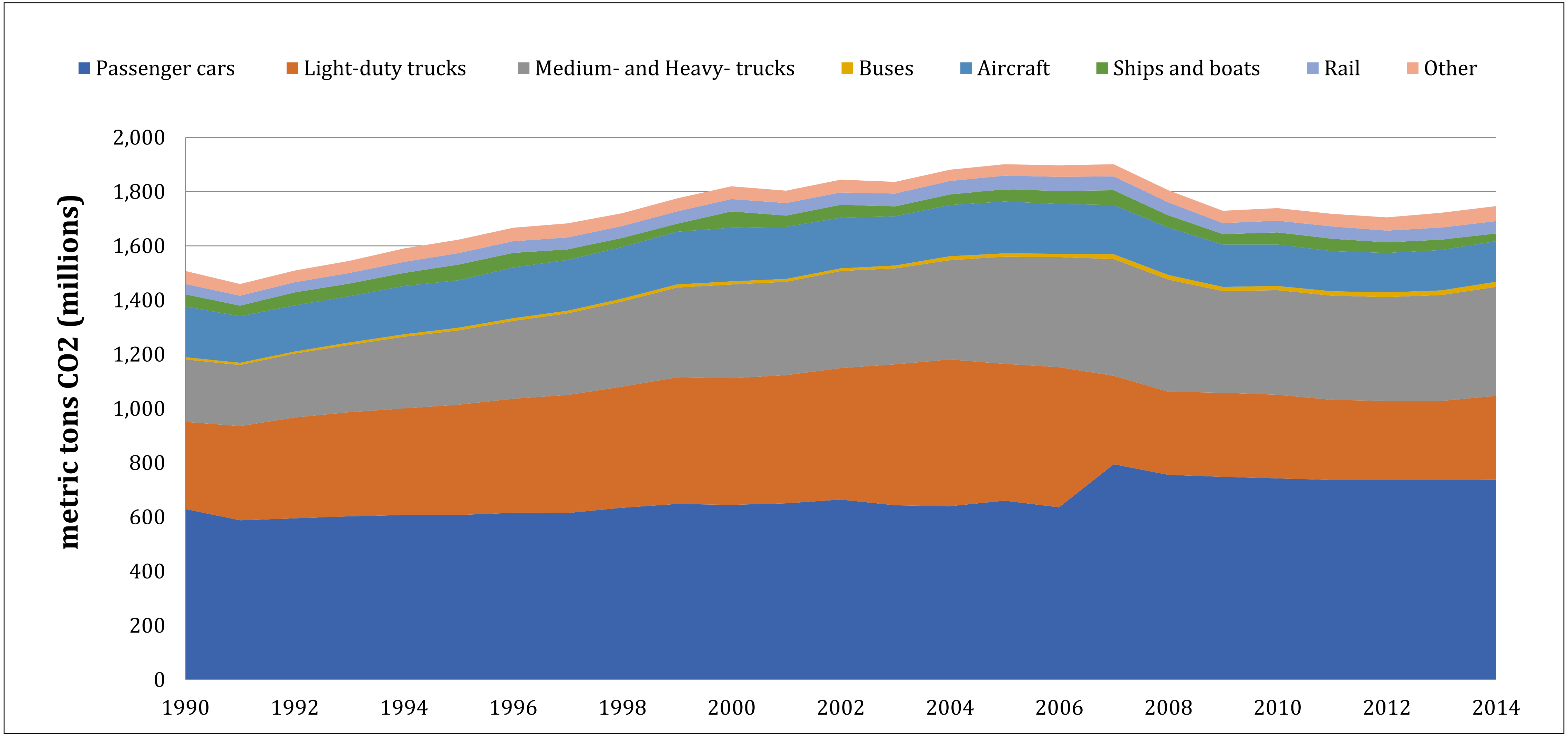


Energy Use by Mode of Transportation (2014)



A Quick Look at the Transport-Environment Linkage in the US

CO2 Greenhouse Gas Emissions by Mode: 1990-2014



02 The government agencies involved

The government agencies involved

Government Agency	Task/Role/Activities
Federal Aviation Administration	Environmental Review Process for Licensed/Permitted Commercial Space Transportation Activities
	Environmental Assessments
	Environmental Impact Statements
Federal Highways Administration	Air Quality
	Noise
	Alternative Fuel Corridors
	Bicycle and Pedestrian Program
	Sustainable Transportation (Energy and emissions)
	Environmental Justice
	Natural Environment
Federal Railroad Administration	Environmental Assessments / Environmental Impact Statements
	Locomotive Emissions Regulation
Federal Transit Administration	Environmental Assessment
	Environmental Impact Statement
United States Maritime Administration	International Environmental Standards and Regulations
	Carbon Emissions and Energy Conservation

03 The major guidelines, handbooks, programs, and methodologies

The major guidelines, handbooks, programs, and methodologies

GHG Tool	Developer/Sponsor Agency	Year of Inception/Update1
Emission Factor Models/Tools		
MOVES	U.S. EPA	2015 (update)
EMFAC	CARB	2017 (update)
GREET	Argonne National Labs	2017 (update)
VISION	Argonne National Labs	2017 (update)
Mobile Combustion Version 2.6	WRI	2015 (update)
Emission Factors from Cross-Sector Tools spreadsheet	WRI	2017 (update)
Inventory and Forecast Accounting/Support Tools		
GreenDOT	ICF Intl.	2010
ClearPath	ICLEI	Ongoing
Local Greenhouse Gas Inventory Tool	U.S. EPA	2018 (update)
PATHWAYS	E3	2008+ updates
Simplified GHG Emissions Calculator	U.S. EPA	2018 (update)
Tools to Evaluate Agency Construction, Maintenance, and Operations Activities		
Infrastructure Carbon Estimator	FHWA/MnDOT	2010/2019 (update)
Pavement Life-cycle Assessment Tool (PaLATE)	UC Berkeley	2013
Greenhouse-Gas Assessment Spreadsheet for Capital Projects (GASCAP)	Rutgers University for New Jersey DOT	2014
Inventory of Carbon and Energy (ICE)	Circular Ecology	2005
Waste Reduction Model (WARM)	U.S. EPA	2016
U.S. Environmentally Extended Input-Output Model (USEEIO)	U.S. EPA	Ongoing
Smart Location Calculator	U.S. EPA	2017
Construction Carbon Calculator G4C	Good Company	
General GHG, Energy, and VMT Reduction Strategy Analysis Tools		
VisionEval	Oregon DOT and FHWA	Ongoing
Energy and Emissions Reduction Policy Analysis Tool (EERPAT)	FHWA	2016
Rapid Policy Analysis Tool (RPAT)	Strategic Highway Research Program 2 (SHRP 2)	2015
Regional Strategic Planning Model (RSPM)	Oregon DOT	
Impacts 2050	NCHRP	2014
SB1 Grant Programs Emissions Calculator	Caltrans	2017 (update)
CMAQ Emissions Calculator Toolkit	FHWA	Ongoing
CCAP Transportation Emissions Guidebook Emissions Calculator	CCAP	2007
Climate Action for Urban Sustainability	World Bank	2017
Limited Focus/Strategy-Specific Analysis Tools		
Envision Tomorrow	Fregonese Associates Inc.	2018 (update)
CommunityViz	City Explained, Inc.	2018 (update)
UrbanFootprint	Calthorpe Analytics	2018 (update)
Sketch7	Sacramento Area Council of Governments	2012
Conserve by Bicycling and Walking Benefits Calculator	Florida DOT	2009
Transit Greenhouse Gas Emissions Estimator	U.S. DOT	2016
Alternative Fuel Life-Cycle Environmental and Economic Transportation (AFLEET)	Argonne National Lab	2017 (update)
Heavy-Duty Vehicle Emissions Calculator (HDVEC)	Argonne National Lab	2017
Diesel Emissions Quantifier (DEQ)	U.S. EPA	2018 (update)
Market Acceptance of Advanced Automotive Technologies (MA3T)	Oak Ridge National Lab	2019 (update)
Other Tools		
Infrastructure Voluntary Evaluation Sustainability Tool (INVEST)	FHWA	2018 (update)
Greenhouse Gas Equivalencies Calculator	U.S. EPA	2017 (update)

41 Transportation GHG Analysis Tools

Congestion Mitigation and Air Quality Improvement (CMAQ) Program

1. Adaptive Traffic Control Systems (ATCS)
2. Alternative Fuel Vehicles and Infrastructure
3. Bicycle and Pedestrian Improvements
4. Carpooling and Vanpooling
5. Congestion Reduction and Traffic Flow Improvements
6. Diesel Idle Reduction Strategies
7. Diesel Truck and Engine Retrofit & Replacement
8. Dust Mitigation
9. Electronic Open-Road Tolling (EORT)
10. Electric Vehicles and EV Charging Infrastructure
11. Locomotive & Marine Engine Retrofit and Replacement Tool
12. Managed Lanes
13. Non-Road Construction and Intermodal Equipment
14. Transit Bus Upgrades & System Improvements
15. Transit Bus Service and Fleet Expansion
16. Travel Advisories

Congestion Mitigation and Air Quality Improvement (CMAQ) Program: Calculation of Emission Reductions of a Bicycle and Pedestrian Improvements Program

CMAQ Emissions Calculator Toolkit

Bicycle and Pedestrian Improvements

This calculator will estimate the reduction in emissions resulting from improvements to bicycle and pedestrian infrastructure and associated mode shift from passenger vehicles to bicycling or walking, including but not limited to sidewalks, dedicated bicycle infrastructure, improved wayfinding, mid-block crossing installations, bike share systems, and bike parking improvements.

Navigator

Bicycle and Pedestrian Improvements

INPUT

User Guide

Reset Interface

(1) What is your project evaluation year? - Select from list -

(2) Estimate the shift in daily motorized passenger vehicle trips to non-motorized travel due to the bicycle and pedestrian project.

Daily Passenger Vehicle Trips		
Before	After	Change

(3a) Select the data type used for entering the typical one-way trip distance of passenger vehicles below:

Trip Distance Source: - Select from list -   <- Fill National Values

(3b) If you selected “Average” above, enter the typical one-way trip distance. If you selected “Distribution” above, enter the typical distribution of one-way trip distances.

Typical Trip Distance (miles one way)

Distribution of Trip Distances (daily fraction per mileage bin)

x < 1	1 ≤ x < 2	2 ≤ x < 3	3 ≤ x < 4	4 ≤ x ≤ 5	Sum

OUTPUT

Calculate Output

EMISSION REDUCTIONS

Pollutant	Total
Carbon Monoxide (CO)	0,000
Particulate Matter <2.5 µm ($PM_{2.5}$)	0,000
Particulate Matter <10 µm (PM_{10})	0,000
Nitrogen Oxide (NOx)	0,000
Volatile Organic Compounds (VOC)	0,000
Carbon Dioxide (CO_2)	0,000
Carbon Dioxide Equivalent (CO_2e)	0,000
Total Energy Consumption (MMBTU/day)	0,000

*Units in kg/day unless otherwise noted

Congestion Mitigation and Air Quality Improvement (CMAQ) Program: Calculation of Emission Reductions of a Bicycle and Pedestrian Improvements Program

Example

Assume that a local government proposes the construction of a protected bicycle infrastructure to shift a part of the motorized trips to bicycle use and walking. The parameters of a proposed program are as follows:

- Evaluation year: 2030
- Total daily work trips: 65,000
- Estimated modal shift: 10%
- Percentage of personal car use: 95%
- Trip distance source: Distribution
- Distribution of Typical trip distance: $x < 1$ = 33%; $1 \leq x < 2$ = 23%; $2 \leq x < 3$ = 28%; $3 \leq x < 4$ = 14%; $4 \leq x \leq 5$ = 2%
- Typical trip distance – Passenger vehicles: 1.79 mi (derived from the distribution above)

Clicking the "Calculate Output" button outputs the table at the right hand-side.

Emission Reductions of the Proposed Bicycle and Pedestrian Improvements Program

Pollutant	Total
Carbon Monoxide (CO)	26,021
Particulate Matter <2.5 μm ($PM_{2.5}$)	0,101
Particulate Matter <10 μm (PM_{10})	0,491
Nitrogen Oxide (NOx)	0,846
Volatile Organic Compounds (VOC)	0,898
Carbon Dioxide (CO_2)	3630,685
Carbon Dioxide Equivalent (CO_2e)	3648,268
Total Energy Consumption (MMBTU/day)	49,054

Congestion Mitigation and Air Quality Improvement (CMAQ) Program: Calculation of Emission Reductions of a Carpooling and Vanpooling Program

U.S. Department of Transportation
Federal Highway Administration

CMAQ Emissions Calculator Toolkit

Questions or Feedback?

CMAQ_toolkit_help@dot.gov

Carpooling and Vanpooling

This tool provides emission reduction estimates from carpooling and vanpooling projects funded by CMAQ programs, particularly where the project decreases single-occupancy vehicle use and vehicle miles traveled. Carpooling and vanpooling encourage participants to commute together to and from their workplace.

Emissions rates are primarily based on a national-scale run of the EPA MOVES model. Emission estimates from tools in the CMAQ Toolkit are not intended for use in State Implementation Plans (SIPs) or transportation conformity analyses and do not meet the same requirements necessary for SIP and conformity reporting.

Carpooling | Vanpooling

Version date: 8.2019

CMAQ Emissions Calculator Toolkit

Carpooling

Navigator

Carpooling

Vanpooling

This calculator will estimate the reduction in emissions resulting from carpooling.

INPUT

User Guide

Reset to Default

(1) What is your project evaluation year? — Select

(2) Are the pick-up/drop-off locations centralized? — ☑ Yes

(2a) What is the average round-trip distance participants drive to the central locations? — 0 — *Enter as roundtrip mileage*

(3) Please choose one of the following questions to answer:

(3a) What is the population of commuting workers? — 0 — ◉

(3b) What is the number of vehicles participating in the carpool program? — ○

Default values based on national averages

(4) What share of commuters participate in pool? — 9,4% — *Input as a percentage*

(5) On average, how many passengers are there per carpool vehicle? — 1 — *Driver not included*

(6) What is the average commute distance? — 25,2 — *Enter as roundtrip mileage*

OUTPUT

Calculate Output

EMISSION REDUCTIONS

Pollutant	Total (kg/day) kg/day
Carbon Monoxide (CO)	0,000
Nitrogen Oxide (NOx)	0,000
Particulate Matter <10 µm (PM_{10})	0,000
Particulate Matter <2.5 µm ($PM_{2.5}$)	0,000
Volatile Organic Compounds (VOC)	0,000
Carbon Dioxide Equivalence (CO_2e)	0,000
Total Energy Consumption (MMBTU)	0,000

Congestion Mitigation and Air Quality Improvement (CMAQ) Program: Calculation of Emission Reductions of a Carpooling and Vanpooling Program

Example

Assume that the parameters of a proposed carpooling program are as follows:

- Average round-trip distance participants drive to the central locations: 5 miles
- The total number of people who participated: 120 (including the drivers)
- The average number of passengers in each car: 3 passengers per car (excluding the drivers)
- Total number of participating cars: 30 cars
- Average commute distance: 30 miles

When the above parameters are imputed, the spreadsheet-based tool produces the following output table for the year 2023.

Output Table: Emission Reductions of the Proposed Carpooling Program

Pollutant	Total (kg/day)
Carbon Monoxide (CO)	3,902
Nitrogen Oxide (NOx)	0,079
Particulate Matter <10 µm (PM_{10})	0,018
Particulate Matter <2.5 µm ($PM_{2.5}$)	0,237
Volatile Organic Compounds (VOC)	0,041
Carbon Dioxide Equivalence (CO_2e)	693,256
Total Energy Consumption (MMBTU)	9,128

Congestion Mitigation and Air Quality Improvement (CMAQ) Program: Calculation of Emission Reductions of a Diesel Idle Reduction Technologies Program

Diesel Idle Reduction Technologies

This calculator will estimate the reduction in emissions resulting from use of idle reduction methods, including diesel and battery auxiliary power units (APU), direct-fired (D-F) heaters, truck stop electrification (TSE), and engine-off idling. This tool is specific to long-haul combination trucks.

INPUT

User Guide

Note: Inputs for this tool should be specific to the vehicles for which idle reduction method(s) will be applied.

Reset to Default Values

(1) What is your project evaluation year? Select

(2) What type of activity data will you provide for the project? Please select either operating hours or truck population and input annual activity. You may use the optional Activity Calculator to the right to determine activity by model year group based on national defaults (for use in Question 3).

- (●) Annual Operating (Driving) Hours
- ( ) Annual Truck Population

Annual Activity Enter hours or trucks

ACTIVITY CALCULATOR (optional)

Model Year Group	Default Activity
2006 or earlier	0
2007-2009	0
2010-2012	0
2013-2020	0
2021-2023	0
2024-2050	0

Calculate Default Activity Distribution

(3) Use the check boxes to select the types of hotelling operating mode(s) associated with the project. Populate the table with annual activity by model year group. If you are providing activity in terms of operating hours, please provide data for the entire fleet, not per truck.

NOTE: Use the "Fill with Default Activity Distribution" button to use the default activity from the calculator. If splitting the activity between hotelling operating modes, enter the activity manually.
NOTE: Select the "Check Hotelling Activity Distribution" button before proceeding to Q4.

Model Year Group	Diesel APU ☐	Battery APU ☐	D-F Heater ☐	TSE ☐	Engine-off ☐	Extended Idle ☐
2006 or earlier						
2007-2009						
2010-2012						
2013-2020						
2021-2023						
2024-2050						
TOTAL	0	0	0	0	0	0

Fill with Default Activity Distribution

Check Hotelling Activity Distribution

(4) Indicate what annualization to apply to the analysis: default (365 days) or your own value. The annualization indicates the number of days per year that the project will operate.

- (●) Default (365 days)
- ( ) Enter my own value

days

OUTPUT

Calculate Output

FLEET PERFORMANCE

Annual Activity for Idle Reduction Project

Metric	
0	**Total Hotelling Hours**
0	**Number of Hours Operated**
0	**Total Vehicle Miles Travelled**

Last Updated: 4.25.2023 6:24:38 PM

EMISSION REDUCTIONS

Pollutant	Total kg/day
Carbon Monoxide (CO)	0,000
Particulate Matter <2.5 µm ($PM_{2.5}$)	0,000
Particulate Matter <10 µm (PM_{10})	0,000
Nitrogen Oxides (NOx)	0,000
Volatile Organic Compounds (VOC)	0,000

Carbon Dioxide CO_2 (kg/day)	0,000
Carbon Dioxide Equivalent, CO_2e (kg/day)	0,000
Total Energy Consumption (MMBTU/day)	0,000

Note CO_2, CO_2e and Total Energy Consumption not calculated for projects with direct-fired heaters.

Congestion Mitigation and Air Quality Improvement (CMAQ) Program: Calculation of Emission Reductions of a Diesel Idle Reduction Technologies Program

Example

Assume that the parameters of a proposed diesel idle reduction program, which aims at switching from idling the main propulsion engines to alternative power sources, are as follows:

- Project Evaluation Year: 2025
- Type of Activity: Operating Hours
- Annual Activity: 250,000 hours

Once these parameters are inputted, we click the "Calculate Default Activity Distribution" button. This estimates a distribution based on US national averages. The output table for Activity Distribution is shown at the right above.

- Hotelling Activity Type – Engine-off

After the Hotelling Activity Type is determined, the values in the Activity Distribution Table are inputted into the "Activity Calculator".

Clicking the "Calculate Output" button will produce the following tables.

Activity Distribution Table

Model Year Group	Default Activity
2006 or earlier	10.979
2007-2009	7.831
2010-2012	12.545
2013-2020	119.631
2021-2023	60.040
2024-2050	38.975

Emission Reductions

Pollutant	Total kg/day
Carbon Monoxide (CO)	22,352
Particulate Matter <2.5 μm ($PM_{2.5}$)	0,409
Particulate Matter <10 μm (PM_{10})	0,444
Nitrogen Oxides (NOx)	30,477
Volatile Organic Compounds (VOC)	2,164
Carbon Dioxide CO_2 (kg/day)	3.999,516
Carbon Dioxide Equivalent, CO_2e (kg/day)	4.009,51
Total Energy Consumption (MMBTU/day)	51,463

Benefit-Cost Analysis Guidance for Discretionary Grant Programs: Emissions Reduction Benefits

Recommended Monetized Value(s)

Emission Type	NO_X	SO_X	$PM_{2.5}$**	CO_2
2022	$16,600	$44,300	$796,700	$56
2023	$16,800	$45,100	$810,500	$57
2024	$17,000	$46,000	$824,500	$58
2025	$17,200	$46,900	$838,800	$59
2026	$17,500	$47,800	$852,100	$60
2027	$17,900	$48,700	$865,600	$61
2028	$18,200	$49,500	$879,400	$62
2029	$18,600	$50,400	$893,400	$63
2030	$18,900	$51,300	$907,600	$65
2031	$18,900	$51,300	$907,600	$66
2032	$18,900	$51,300	$907,600	$67
2033	$18,900	$51,300	$907,600	$68
2034	$18,900	$51,300	$907,600	$69
2035	$18,900	$51,300	$907,600	$70
2036	$18,900	$51,300	$907,600	$72
2037	$18,900	$51,300	$907,600	$73
2038	$18,900	$51,300	$907,600	$74
2039	$18,900	$51,300	$907,600	$75
2040	$18,900	$51,300	$907,600	$76
2041	$18,900	$51,300	$907,600	$78
2042	$18,900	$51,300	$907,600	$79
2043	$18,900	$51,300	$907,600	$80
2044	$18,900	$51,300	$907,600	$81
2045	$18,900	$51,300	$907,600	$82
2046	$18,900	$51,300	$907,600	$84
2047	$18,900	$51,300	$907,600	$85
2048	$18,900	$51,300	$907,600	$86
2049	$18,900	$51,300	$907,600	$87
2050	$18,900	$51,300	$907,600	$88

Example

Assuming that a new transportation project will lower each of the four emission by 10 metric tons annually; the emission reduction benefit for the year 2040 will be calculated as follow:

NOX *Reduction Benefit* = *Quanity Reduced x Monetized Value in given year* = 10 *metric tons in* 2040 *x* $18,900/*metric ton* = $189,000 *in* 2040

SOX *Reduction Benefit* = *Quanity Reduced x Monetized Value in given year* = 10 *metric tons in* 2040 *x* $51,300/*metric ton* = $513,000 *in* 2040

PM2.5 Reduction Benefit = *Quanity Reduced x Monetized Value in given year* = 10 *metric tons in* 2040 *x* $907,600/*metric ton* = $9,076,000 *in* 2040

CO2 *Reduction Benefit* = *Quanity Reduced x Monetized Value in given year* = 10 *metric tons in* 2040 *x* $76/*metric ton* = $760 *in* 2040

TOTAL EMISSION REDUCTION BENEFIT = $189,000 + $513,000 + $9,076,000 + $760 = $9,778,760 *in* 2040

Benefit-Cost Analysis Guidance for Discretionary Grant Programs: The Measurement of Pedestrian and Cycling Facility Improvements

Improvement Type	Recommended Value per Person-Mile Walked (2021 $)
Expand Sidewalk (per foot of added Width)2	$0.11
Reducing Upslope by 1%	$1.05
Reducing Traffic Speed by 1 mph (for speeds ≤45 mph)	$0.09
Reducing Traffic Volume by 1 Vehicle per Hour (for ADT ≤55,000)	$0.0009

Improvement Type	Recommended Value per Person-Mile Walked (2021 $)
Install Marked-Crosswalk on Roadway with Volumes ≥10,000 Vehicles per Day	$0.18
Install Signal for Pedestrian Crossing on Roadway with Volumes ≥13,000 Vehicles per Day	$0.48

Facility Type	Recommended Value per Cycling Mile (2021 $)
Cycling Path with At Grade Crossings	$1.49
Cycling Path with no At Grade Crossings	$1.87
Dedicated Cycling Lane	$1.77
Cycling Boulevard/"Sharrow"	$0.28
Separated Cycle Track	$1.77

Example

Take a project which will extend a two-mile sidewalk by five feet. The daily average pedestrian trip is 3,000. The monetary value of the benefit to pedestrian walking will be calculated as follows:

Benefit per Mile Walked = *Sidewalk Value per Foot of Added Width x Additional Width* = $0.11 *per Foot of Added Width x* 5 *Feet* = $0.55 *per Mile Walked*

Benefit to Pedestrians = # *of Daily Users x Block Length x Value per Mile Walked x* 365 *Days*= 3,000 *Pedestrians x* 2 *Miles x* $0.55 *per Mile Walked x* 365 *Days* = *$1,204,500 per Year*

Benefit-Cost Analysis Guidance for Discretionary Grant Programs: The Measurement of Pedestrian and Cycling Facility Improvements

Improvement Type	Recommended Value per Person-Mile Walked (2021 $)
Expand Sidewalk (per foot of added Width)2	$0.11
Reducing Upslope by 1%	$1.05
Reducing Traffic Speed by 1 mph (for speeds ≤45 mph)	$0.09
Reducing Traffic Volume by 1 Vehicle per Hour (for ADT ≤55,000)	$0.0009

Improvement Type	Recommended Value per Person-Mile Walked (2021 $)
Install Marked-Crosswalk on Roadway with Volumes ≥10,000 Vehicles per Day	$0.18
Install Signal for Pedestrian Crossing on Roadway with Volumes ≥13,000 Vehicles per Day	$0.48

Facility Type	Recommended Value per Cycling Mile (2021 $)
Cycling Path with At Grade Crossings	$1.49
Cycling Path with no At Grade Crossings	$1.87
Dedicated Cycling Lane	$1.77
Cycling Boulevard/“Sharrow”	$0.28
Separated Cycle Track	$1.77

Example

Assuming that a new on-street cycling lane will be built on a 2-mile street with 100 daily cyclists and having no other parallel facility currently in use. Estimating that an additional 50 daily cyclist trips will be induced after the introduction of the new cycling lane, the daily benefit will be as follows:

Existing User Benefits = *# of Cyclists x Bike Lane Value per Cycling Mile x Distance* = 100 *Cyclists x* $1.77 *per Mile x* 2 *Miles* = $354

Benefits to Additional Users = 1/2 *x # of* new *Cyclists x Bike Lane Value per Cycling Mile x Distance* = 1/2 *x* 50 *Induced Cycling Trips x* $1.77 *per Mile x* 2 *Miles* = $88,5

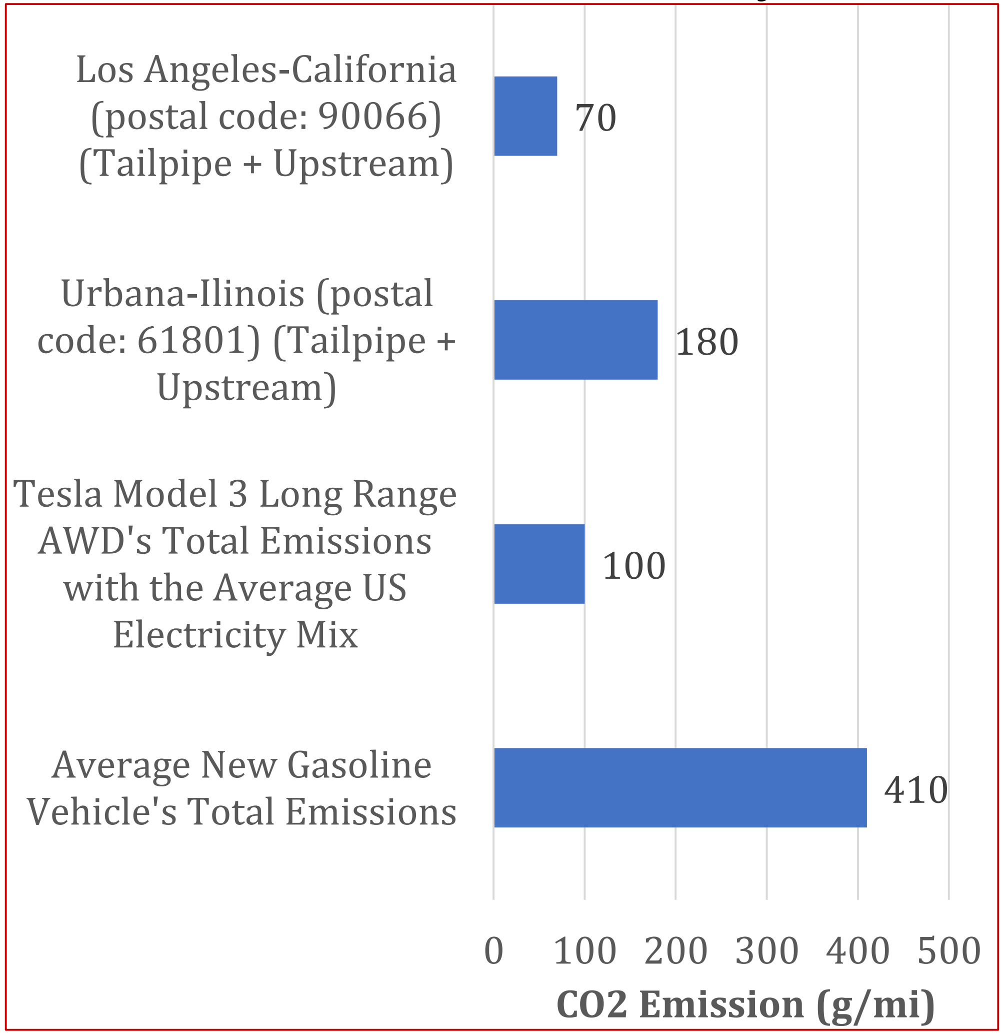
Total Annual Benefits = 365 *x* (354 + 88,5) = $161,512,5

04 The current efforts to deal with the environmental effects

The current efforts to deal with the environmental effects: Hybrid and Electric Cars

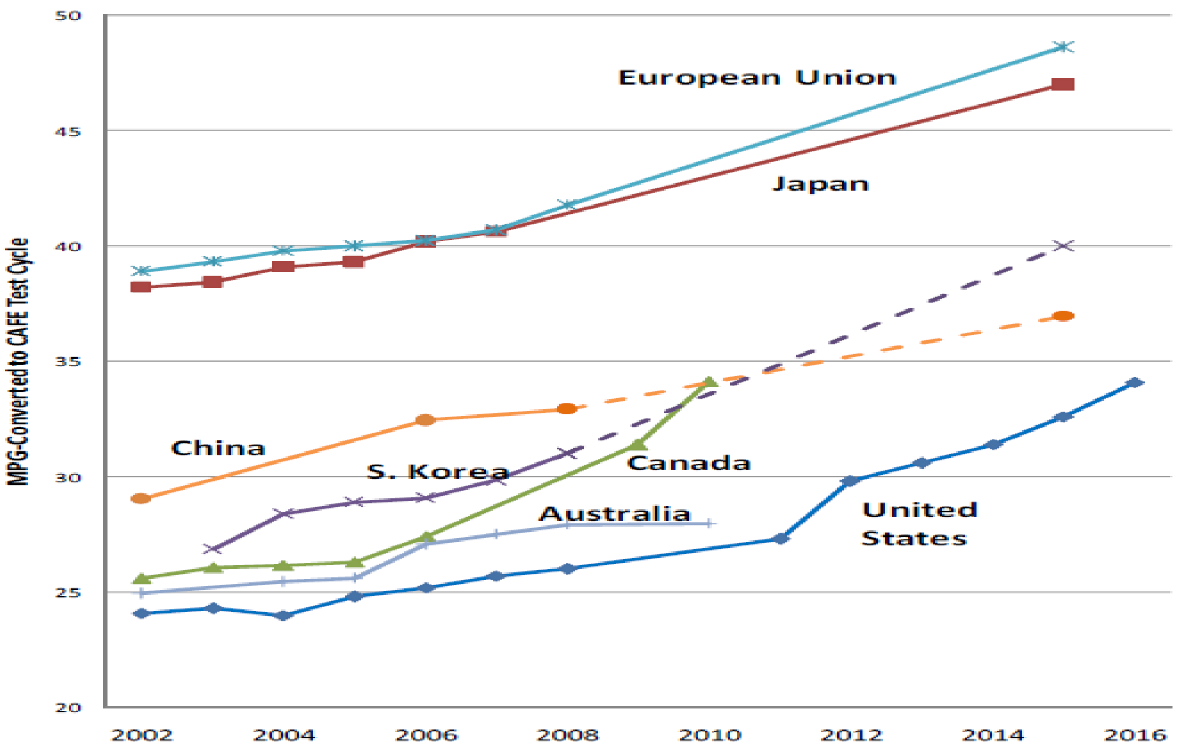
https://fueleconomy.gov/feg/Find.do?action=bt2

Fuel Economy Comparison Based on the Electricity Mix

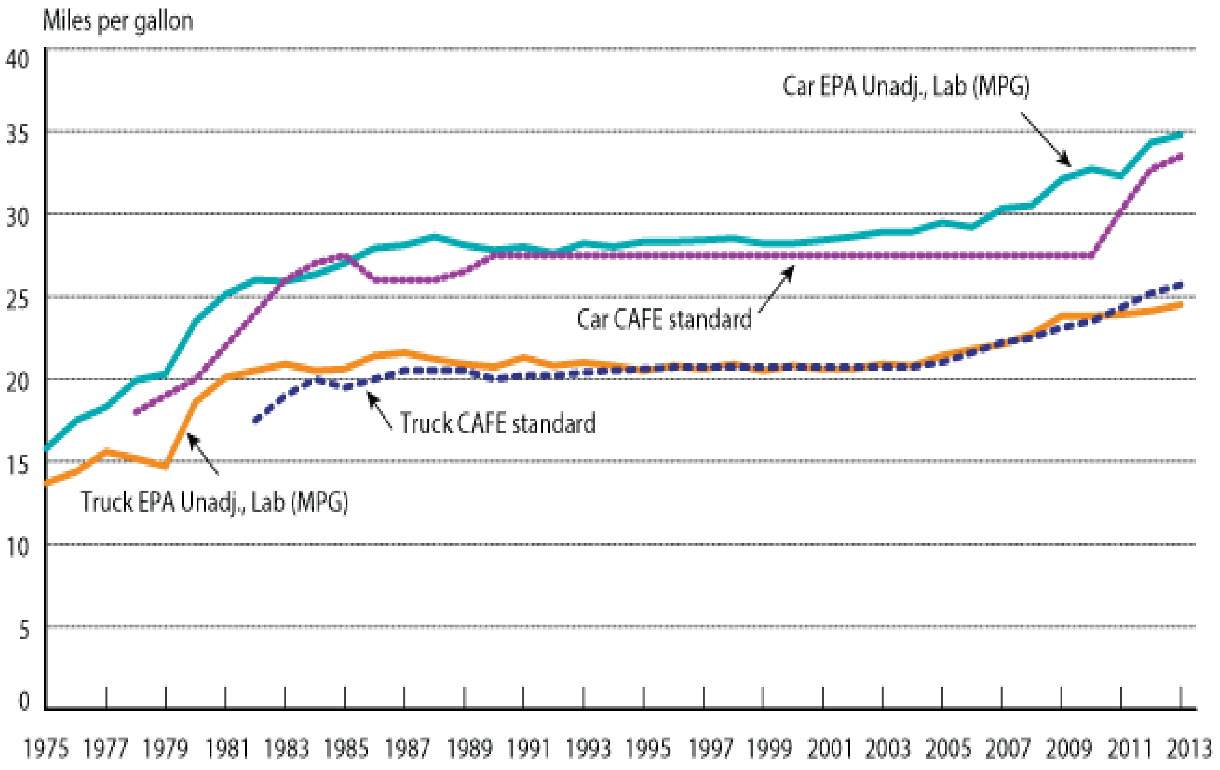


The current efforts to deal with the environmental effects: Fuel Standards and New Vehicle Technologies

Fuel Economy Standards for New Passenger Vehicles by Country/Region



Car and Truck Corporate Average Fuel Economy (CAFE) and Miles per Gallon (MPG): Model Years 1975-2013



The current efforts to deal with the environmental effects: Airspace Redesign and New Route Developments

escarus

Thank You.

Do you have any questions?

Youtube LinkedIn Twitter Escarus

info@escarus.com |

escarus.com |

ESCARUS (TSKB Sustainability Consultancy)
Meclisi Mebusan Cad. Karun Çıkmazı Sok.
No: 2, 34427 Fındıklı, Beyoğlu
İstanbul, Türkiye

info@escarus.com
+90 212 334 54 60
www.escarus.com