Connections Between Vehicle Miles Traveled, Traffic, and Greenhouse Gases: Synthesis

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Request for Synthesis:

Anne Criss, Climate Change Program Lead, WSDOT, requested a synthesis on connections between vehicle miles traveled (VMT), traffic, and greenhouse gases (GHG).

Background:

This synthesis reveals that VMT, traffic, and GHGs have several complex relationships. VMT can be used to calculate vehicle emissions or as an indicator of traffic congestion. Congestion may increase emissions by increasing travel time and reducing fuel efficiency, while simultaneously inhibiting the growth of VMT.

Databases Searched:

- TRIS Online
- Google Scholar
- TRB Research in Progress

SYNTHESIS

A Wedge Analysis of the U.S. Transportation Sector
S. Mui, J. Alson, B. Ellies, and D. Gauss, 2007, Environmental Protection Agency. EPA 420-R-07-007

From page 9: Generally, three parameters determine the amount of GHG emissions from transportation sources: the choice of fuel, the vehicle activity level, and the energy efficiency of the vehicle. For the passenger vehicle category, emissions (E) can be described as the product of the carbon content of the fuel (C), vehicle activity in vehicle miles traveled (A), and fuel consumption (F) – conveniently described as the EFAC equation:

$$E = Emissions_{(Carbon)} = \underbrace{\left(\frac{Gallons}{Mile}\right)}_{Fuel\ Consumption} \underbrace{\left(\frac{miles\ traveled}{Vehicle}\right)}_{Activity} \underbrace{\left(\frac{mass\ C}{gallon}\right)}_{Carbon\ Content} = F \times A \times C$$

Consideration of the EFAC equation suggests that approaches that reduce emissions are ones that would, by definition, need to either lower the amount of fuel consumed, the carbon content of the fuel, or the vehicle's activity (or vehicle miles traveled, VMT).

http://www.epa.gov/otaq/climate/420r07007.pdf

Beyond Congestion: Transportation's Role in Managing VMT for Climate Outcomes
David G. Burwell, 2009, Reducing Climate Impacts in the Transportation Sector, Springer Netherlands

State DOTs interested in congestion reduction are convincing local governments to focus on traffic-generation implications of land-use decisions. And emissions reduction is increasingly part of the conversation. This shift allows transportation managers and climate advocates to cite VMT reduction as a common strategy to reduce congestion and protect the climate. Such focus increases cooperation, allowing for more effective efforts. VMT reduction will be necessary to meet emissions-reduction goals in part because future growth in VMT cannot be offset by improvements in fuel efficiency.

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Reducing Growth in Vehicle Miles Traveled: Can We Really Pull It Off?
Gary Toth, 2007, Driving Climate Change: Cutting Carbon from Transportation (Sperling and Cannon, ed.), Elsevier

In New Jersey, congestion growth is outpacing the rate of traditional relief efforts, adding lanes and bypasses. The DOT has implemented a program to instead reduce VMT through changing land use patterns. The New Jersey Future in Transportation program seeks to form partnerships with other agencies and municipalities, build travel alternatives, increase modal choices, lower design speeds, and provide pedestrian friendly streetscapes. Project examples include a waterfront redevelopment in Trenton and improved connectivity in four new residential areas and a shopping center in Manalapan.

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Vehicle CO2 emissions and the Compactness of Residential Development

Helen Fei Liu, December 2007, Special Studies, National Association of Home Builders

The article uses standard statistical methods to estimate gasoline consumption as a function of the geographic and household characteristics available in the NHTS data . . .

The results show that, controlling for the factors available in the NHTS data, gasoline consumption, and the associated CO_2 emissions decline as the compactness of subdivisions increases. The article also analyzes factors that determine gasoline consumption: VMT, efficiency of vehicles owned and the speed at which they are driven. The results show a clear “congestion” effect: as the compactness of subdivisions increases, vehicles tend to be driven at less efficient speeds. However, this congestion effect is not strong enough to totally offset the reduced VMT, so that the statistical methods employed still estimate that gasoline consumption and the associated CO_2 emissions will be lower in more compact development.

http://www.nahb.org/generic.aspx?sectionID=734&genericContentID=86266

The Case for Moderate Growth in Vehicle Miles of Travel: A Critical Juncture in U.S. Travel Behavior Trends
Steven E. Polzin, Center for Urban Transportation, April 2006, Prepared for U.S. DOT

This report explores the relationship between VMT and congestion and other influences. Congestion is a driver of travel demand and therefore an indirect driver of VMT (p. 15 of PDF). The adequacy of capacity as it impacts delay and reliability of travel significantly impact VMT. Historically increasing travel speeds, that enabled VMT to grow independently of time spent traveling, are ending. Reduction of system speeds (e.g., due to congestion) may constrain future VMT growth (p. 31 of PDF). Though VMT growth may slow, continued increase in travel may result in significant reductions in speed (p. 43 of PDF).

http://www.cutr.usf.edu/pdf/The%20Case%20for%20Moderate%20Growth%20in%20VMT-%202006%20Final.pdf

Transport and its infrastructure
Suzana Kahn Ribeiro et al, 2007, In Climate Change 2007: Mitigation, Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (B. Metz et al, eds)

A simulation of freight traffic over the Belgian network indicated that a policy of internalizing the marginal social cost caused by freight transport types would induce a change in the modal shares of trucking, rail, and inland waterways transport. Trucking would decrease by 26% and the congestion cost it created by 44%. It was estimated that the total cost of pollution and GHG emissions (together) would decrease by 15.4% . . .

In the City of London a congestion charge . . . contributed to a 30% decrease of the traffic by the chargeable vehicles in the area and less congestion, to higher speed of private vehicles (+20%) and buses (+7%), and to an increased use of public transport, plus more walking and bicycling. The charge has had substantial ancillary benefits with respect to air quality and climate policy. All the volume and substitution effects in the charging zone has led to an estimated reductions in CO_2 emissions of 20%. Primary emissions of NO_x and PM10 fell by 16% after one year of introduction (Transport for London, 2006). A variant of that scheme has been in operation since 1975 in Singapore with similar results; Stockholm is presently experimenting with such a system, Trondheim, Oslo, and Durham are other examples . . .

A mix of measures for Chile has been proposed, aimed primarily at local air pollution abatement and energy saving . . . Only congestion charges were expected to have substantial ancillary benefits for GHG reduction. (p. 379)

http://www.ipcc.ch/pdf/assessment-report/ar4/wg3/ar4-wg3-chapter5.pdf

Vehicle Miles Traveled, New Jersey DOT

The number of trips may be more indicative of vehicle emissions than VMT because the emissions from a car are much greater for the first few minutes after start-up, when the catalytic converter is still cold and the engine is running with a richer mixture (higher gas to air ratio).

http://www.nj.gov/dep/dsr/trends2005/pdfs/vehicle.pdf

Analysis of Metropolitan Highway Capacity and the Growth in Vehicle Miles of Travel
Robert B. Noland and William A. Cowart, November 1999, 79th annual meeting of TRB

From abstract: The effect of lane mile additions on VMT growth is forecast and found to account for about 15% of annual VMT growth with substantial variation between metropolitan areas. This effect appears to be closely correlated with percent growth in lane miles, suggesting that rapidly growing areas can attribute a greater share of their VMT growth to growth in lane miles.

http://www.cts.cv.ic.ac.uk/staff/wp1-noland.pdf

Congestion Trends in Metropolitan Areas
Peter Gordon and Harry W. Richardson, 1994, In: Curbing Gridlock—Peak-Period Fees to Relieve Traffic Congestion 2

This article reports that Hanks and Lomax (1992) developed a congestion index from regional VMT per lane-miles. Total freeway daily VMT (DVMT) and percentage of DVMT on the freeway were used as road-performance indicators by FHWA.

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<u>Literature Search</u>

Real-World CO2 Impacts of Traffic Congestion
Matthew J. Barth and Kanok Boriboonsomsin, January 2008, Transportation Research Board 87th Annual Meeting, Report No. 08-0436

From abstract: CO2 emissions can be lowered by improving traffic operations, specifically through the reduction of traffic congestion. This paper examines traffic congestion and its impact on CO2 emissions using detailed energy and emission models and linking them to real-world driving patterns and traffic conditions. Using a typical traffic condition in Southern California as example, it has been found that CO2 emissions can be reduced by up to almost 20% through three different strategies: 1) congestion mitigation strategies that reduce severe congestion, allowing traffic to flow at better speeds; 2) speed management techniques that reduce excessively high free-flow speeds to more moderate conditions; and 3) shock wave suppression techniques that eliminate the acceleration/deceleration events associated with stop-and-go traffic that exists during congested conditions.

From page 5: Roadway congestion is often categorized by the "level-of-service" (LOS) it provides to travelers. For freeways (i.e., uninterrupted flow), LOS is represented by the density of traffic (i.e. number of vehicles per mile of roadway), which is a function of speed and flow. Emission rates are highly dependent on speed; flow is a surrogate for vehicle miles traveled (VMT); and both emission rates and VMT are two major factors contributing to emissions. Therefore, LOS is a measure that can be rationally related to emissions.

From page 13: In other areas [than Los Angeles], the CO2 impact of traffic can be different depending on the following factors:

- *Local fleet mix*: Different fleet composition will cause different fleet-wide average CO2 emission factors. Therefore, the CO2-versus-speed curves are expected to have different magnitude, and possibly different shape.
- *Amount of VMT at congested speed*: As presented in the TTI's Urban Mobility Report, different metropolitan areas have experienced different levels of congestion and delay. Thus, the reduction in CO2 emission that could be achieved may be less in an area where congestion has not been much of a concern.
- *Amount of VMT at excessive speed*: The amount of driving occurring at excessive speeds is also area-specific. This depends on several factors such as speed limit and enforcement. An area with a lower freeway speed limit is likely to have less CO2 emission due to driving at high speed.

http://www.cert.ucr.edu/research/pubs/TRB-08-2860-revised.pdf

Traffic Congestion: Quantifying the Real World Impact on Greenhouse Gases [TRB Research in Progress]
Matthew Barth—Principal Investigator, Univ. of Cal. Transportation Center

A great deal of attention is now being applied to greenhouse gas emissions (primarily CO2) as a major contributor to global climate change. It is estimated that transportation as a whole accounts for 33% of U.S. CO2 emissions, of which 80% are from cars and trucks traveling on our roadway system. Policy makers are pushing for more efficient vehicles as well as alternative fuels to help reduce CO2. However, less attention has been placed on reducing traffic congestion as another means of CO2 mitigation. Using a large vehicle activity data set and a suite of modeling tools, it is proposed herein to carry out a comprehensive study on the impacts traffic congestion has on greenhouse gas emissions. This project will take advantage of a recently initiated vehicle activity data collection program (sponsored by the California Air Resources Board) and emissions modeling tools that have previously been developed by the principal investigator. The vehicle activity data set will be stratified by different roadway facility types and different levels of service (LOS); subsequently, these vehicle activity patterns will be applied to the emission models, providing greenhouse gas estimates. These results can then be used to quantify the CO2 impacts of various congestion mitigation programs.

http://rip.trb.org/browse/dproject.asp?n=15168

How Much Does Traffic Congestion Increase Fuel Consumption and Emissions? Applying Fuel Consumption Model to NGSIM Trajectory Data
Martin Treiber, Arne Kesting, and Christian Thiemann, January 2008, Transportation Research Board 87th Annual Meeting, Report No. 08-0016

Abstract: The fuel consumption of vehicular traffic (and associated CO2 emissions) on a given road section depends strongly on the velocity profiles of the vehicles. The basis for a detailed estimation is therefore the consumption rate as a function of instantaneous velocity and acceleration. This paper will present a model for the instantaneous fuel consumption that includes vehicle properties, engine properties, and gear-selection schemes and implement it for different passenger car types representing the vehicle fleet under consideration. The paper will apply the model to trajectories from microscopic traffic simulation. The proposed model can directly be used in a microscopic traffic simulation software to calculate fuel consumption and derived emission such as carbon dioxide. Next to travel times, the fuel consumption is an important measure for the performance of future Intelligent Transportation Systems. Furthermore, the model is applied to real traffic situations by taking the velocity and acceleration as input from several sets of the NGSIM trajectory data. Dedicated data processing and smoothing algorithms have been applied to the NGSIM data to suppress the data noise that is multiplied by the necessary differentiations for obtaining more realistic velocity and acceleration time series. On the road sections covered by the NGSIM data, we found that traffic congestion typically lead to an increase of fuel consumption of the order of 80% while the traveling time has increased by a factor of up to 4. We conclude that the influence of congestion on fuel consumption is distinctly lower than that on travel time.

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Study on Short-Term Induced Traffic and CO2 Emissions by Adding Highway Traffic Capacity
Yoshikazu Imanishi-Yoshikazu, Ishida-Haruo, and Kakehi-Fumihiko, January 2008, Transportation Research Board 87th Annual Meeting, Report No. 08-0436

From abstract: Although it cannot be denied that road developments do impact upon traffic volume, it is the contention of this study that this impact is less than is commonly thought, and that (1) increases in road traffic volume are largely due to changes in the socio-economic situation (in other words, overall traffic volume increases regardless of whether or not the existing roads are developed), that (2) increases in traffic volume on arterial roads are largely due to the diversion of traffic from minor roads to arterial roads and that (3) road improvements can actually either reduce CO2 emission volumes or at the very least hinder their growth. The relationship between road improvements, induced traffic volumes, and CO2 emission volumes requires analysis based on data observation. Existing research on induced traffic has tended to target certain arterial roads only, and has not taken into consideration the diversion of traffic. This study looks at phenomena that appear a relatively short time after the road has been improved and uses observational data to empirically determine whether and to what degree such development contributes to induced traffic volumes and CO2 emissions.

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Modelling Responses of Urban Freight Patterns to Greenhouse Gas Abatement Scenarios
Bureau of Transport and Regional Economics information, 2004, Accession No. 01003156

From abstract: This study examines the responses of urban freight patterns to greenhouse gas abatement scenarios. Using Sydney, Australia as the city for analysis, seven scenarios were examined: (1) improved fuel consumption (freight vehicles only); (2) less congestion; (3) better traffic management; (4) higher load factors (freight vehicles only); (5) real-time traffic information; (6) infrastructure improvement; (7) infrastructure improvement plus corresponding land use charges . . . [Despite having little effect in reducing emissions in trucks] assumed decreases in congestion did have a noticeable effect on car emissions (and hence the largest impact on the total vehicle fleet).

http://www.bitre.gov.au/publications/95/Files/wp62.pdf

Costs of Urban Congestion in Canada: A Model-Based Approach
David S. Kriger, Cristobal Miller, Mark Baker, and Fannie Joubert, 2007, Transportation Res. Rec. 1994: 94-100, Accession No. 01046138

From abstract: A recent research study developed methods to quantify congestion and its costs in the nine largest urban areas in Canada. Three components of congestion and its costs—delay, wasted fuel, and greenhouse gas emissions—were developed. The methods were based on the travel demand—forecasting models of each urban area . . . The approach used in the Canadian study has potential for metropolitan planning organizations, state departments of transportation, and other U.S. transportation planning authorities that seek to incorporate the analysis of congestion into their long-range transportation planning, programming, and budgeting processes.

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The Environmental Footprint of Surface Freight Transportation
John Lawson, June 2007, TRB information, Accession No. 01105180

This impact study for the Great Lakes region compares emission rates and congestion from freight transportation by ship, rail, and truck. CO2 and overall air-contaminant emission rates and congestion rates are lowest from ships and highest from trucks (Table 6 and Chart 3, p. 12; 19).

http://onlinepubs.trb.org/onlinepubs/sr/sr291_lawson.pdf

Emissions at different conditions of traffic flow
L.J. Sucharov, et al, 2002, Urban Transport VIII—Urban Transport and the Environment in the 21st Century 39: 571-80, ISSN: 1462-608X, Report No.: 1-85312-905-4

Abstract: Although it is widely assumed that congestion causes an increase in exhaust gas emissions, it has always been difficult to quantify this relationship. The project Emissions and Congestion investigated this relationship by simultaneously measuring traffic conditions and emissions. Emission factors were derived for different traffic conditions on motorways, ranging from free flow to heavy congestion. The results clearly indicate that there are significant differences in emissions and fuel consumption for different types of traffic flow. Heavy traffic dynamics, shortcut traffic, heavy congestion and high speeds lead to significant increases of regulated emissions and fuel consumption of motorway traffic. Efforts to reduce congestion and traffic dynamics (by traffic management measures) should be concentrated on specific routes or sections with frequent occurrence of heavy congestion and a large share of heavy duty traffic. These are the motorways in the conurbations. Tens of percents of reduction in emissions are possible. The resulting improvements on local air quality can be significant. Lowering the speed limit to 100 km/h on all sections of Dutch motorways can significantly improve emission levels (most of Dutch motorways have a speed limit of 120 km/h).

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Emission Levels for Different Traffic Conditions on Motorways
I. Wilmink, R. Gense, and J. Veurman, October 2001, 8th World Congress on Intelligent Transport Systems, Sydney

Abstract: Many roads in the Netherlands, especially in the densely populated area in the western part of the country, are congested in, and sometimes also outside, peak hours. Congestion has many adverse effects: loss of valuable time affecting road users most directly. Many traffic management measures have been introduced over the last years to reduce delays. These measures are often assessed in detail, not only with respect to delays. Effects on the environment are also important: do the measures result in decreased levels of emissions, noise, etc.? These are, however, difficult to quantify for traffic management measures. Emission factors for different pollutants (expressed in g/km traveled) generally only make a distinction between road types, not between traffic types. It is widely assumed that in a congested situation, vehicles produce more emissions than in calmer traffic. Also, at high speeds (>100 km/h), emissions rise sharply. Today, many motorways in the Netherlands have induction loops in the road surface at regular intervals, measuring speeds and traffic volumes. This offers possibilities for a more detailed analysis of emissions resulting from different traffic conditions. Also, there was a need to evaluate the many traffic management measures implemented on the Dutch motorway network. This was the reason for the Dutch Ministry of Transport and the Ministry of Housing, Spatial Planning and the Environment to commission a study into the possibilities of establishing different emission factors for different traffic conditions. The study consisted of two main elements: deriving emission factors for different traffic conditions, and applying these factors to detailed traffic data from specific road sections to calculate total emissions.

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Driving behaviour and congestion: environmental effects by passenger cars
P.J. Sturm et al, 1999, Proceedings of the Eighth International Symposium Transport and Air Pollution Including Cost 319 Final Conference, Graz, Austria, pp. 137-45

From abstract: Using Vito's on-board measuring system the influence of track, driving behaviour and traffic conditions on fuel consumption and emissions were studied for passenger cars. City traffic resulted in the highest fuel consumption and emissions. Fuel consumption was about two times higher than for ring roads, which generally gave the lowest values. This was even more pronounced for emissions. Depending on road type and technology, fuel consumption increased with up to 40% for aggressive driving compared to normal driving. Again, this was more pronounced for emissions, with increases up to a factor 8. Driving behaviour had a greater influence on petrol-fuelled than on diesel-fuelled cars. Traffic condition also has a major effect on fuel consumption and emissions. For city driving intense traffic increased fuel consumption by 20 to 45%. The increase in fuel consumption and emissions during rush hours were the highest on ring roads, with increases between 10% and 200%.

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Mobile-Source Emissions: Analysis of Spatial Variability in Vehicle Activity Patterns and Vehicle Fleet Distributions
C. Malcolm, T. Younglove, M. Barth, and N. Davis, 2003, Transportation Research Record (1842): 91-98, ISSN: 0361-1981, Report No.: 0309085756

From abstract: Accurately estimating mobile-source emissions requires a good understanding of vehicle activity and the characteristics of the on-road vehicle fleet. Spatial variability in vehicle activity patterns and vehicle fleet composition can have significant effects on the overall emissions inventory. Simply determining total vehicle miles traveled is insufficient for emissions inventory calculations from the new-generation models of mobile-source emissions. Improvements in emissions-control technology over the past 20 years have led to large decreases in the emissions of light-duty cars and trucks, resulting in large variations in vehicle emissions depending on model year and technology type. In addition, research indicates that the accurate characterization of vehicle activity is necessary in conjunction with better spatial resolution of vehicle fleet characteristics because of the differing modal behavior of the vehicles within various vehicle and technology groups . . . The results of the analysis show spatial and temporal differences in vehicle activity patterns and vehicle fleet characteristics; differences in speed and congestion affect the speed-acceleration profiles as well as associated emissions.

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Variability of Vehicle Emissions and Congestion Forecasting
M. Claggett et al, 2008, pp. 90-109, American Society of Civil Engineers, Report No. 9780784409602

Abstract: There is an increasing reliance on mobile source emissions analyses as part of the transportation planning process, including regional and hot-spot analyses to fulfill the requirements of the transportation conformity rule and project-level highway air quality assessments in response to the requirements of the National Environmental Policy Act. The general procedure of an emissions analysis is to employ the U.S. Environmental Protection Agency's MOBILE6.2 model to obtain on-road mobile source emission factors, and multiply by the vehicle miles of travel to construct emission inventories. Critical to the outcome of such studies are future predictions of vehicle activity. This is especially true in evaluating transportation alternatives to assess how well a proposed project may or may not mitigate vehicle congestion and reduce emissions. This paper investigates one aspect of vehicle congestion and emissions forecasting by applying different vehicle speed estimating methodologies used for sketch planning purposes and shows the variability of MOBILE6.2 emission factors as a function of travel demand and the associated capacity (i.e., volume-to-capacity ratio).

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Estimating Impact of Nonrecurring Congestion on Vehicle Emissions
Fengxiang Qiao, Lei Yu, and Linhua Li, January 2007, Transportation Research Board 86th Annual Meeting, Report No. 07-2263

From abstract: This paper is intended to develop methodologies and procedures for estimating idling emissions caused by nonrecurring congestions due to incidents. The paper provides two levels of estimations, the microscopic level and the macroscopic level, both of which are feasible approaches for estimating idling emissions due to incidents. The microscopic estimation focuses on the extra emissions caused by each individual incident while the macroscopic estimation attempts to estimate the change of emission factors for the entire region. Through a case study in the greater Houston area, it is found that the change of emission factors estimated by both methods falls into the same or close ranges. Both methods result in that the impacts of the nonrecurring congestion on the air quality due to incidents in the greater Houston area are significant.

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Evaluation of Impacts Caused by Traffic Congestion
Oh Koskinen and Aho J. Sauna, October 2007, Proceedings of the 14th World Congress on Intelligent Transport Systems (ITS), Beijing

Abstract: In this presentation traffic flows are disturbed by different congestion degrees and analyzed their impacts on the fuel consumption, pollutant emissions and finally varying vehicle operating costs. If these congestion costs could be eliminated by telematics, the benefit: cost ratio of telematics applications can be evaluated relative to the investment costs of these applications. The research method is a computer simulation of the vehicle motion. This is based on vehicle dynamics, engine maps of fuel and emissions, other technical data of vehicles and roads and driving technique. In the simulation process congestion is created synthetically on the Ring road 3 around Helsinki city in Finland. The survey is made for six different types of vehicles, which represent the standard vehicles categories. While the time use and costs were found to be inversely proportional to the average speed, they played a dominant role; especially in case of a coach, where there are several passengers. The shadow unit prices for the emissions (approved by the government) are so low that the emission costs assumed a negligible role. The fuel tax covered completely the emission "costs" as well as the infrastructure costs in all road and traffic conditions for all vehicle types.

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Road traffic characteristics, driving patterns and emission factors for congested situations
P.G. Boulter et al, June 2006, Published Project Report PPR109, TRL Ltd, Wokingham, UK, ISSN: 0968-4093, 1-84608-926-3

From abstract: The principal tasks of the Workpackage were to characterise driving patterns in four cities (Athens, Helsinki, London and Madrid), to improve existing emission databases for slow-moving and stationary traffic, and to develop a System module for assessing the effects on emissions of different levels of congestion. The report reviews existing emission models, and assesses their suitability for congested urban conditions. The review showed that although many emission and air pollution models utilise average speed emission functions, for the latest vehicle technologies average speed alone is not a reliable determinant of emissions on the street level, and some descriptor of driving cycle dynamics is also required . . . For driving cycles having the same average speed, cycle dynamics was found to have a notable effect on emissions for some vehicle types and pollutants, but the effects were not systematic. NOx emissions from petrol vehicles showed little dependence on speed. However, for a given speed range the level of driving dynamics was found to be important, with higher emissions being recorded over cycles having higher dynamics. In contrast, NOx emissions from diesel vehicles exhibited a general dependence on speed, with little contribution due to driving dynamics. Emissions from LPG vehicles were comparable to those from petrol vehicles. PM emissions from diesel vehicles over the OSCAR cycles tended to decrease with decreasing speed, and cycle dynamics appeared to have an effect . . . There was little evidence that changes in traffic density at a given average speed had a systematic effect on emissions.

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Flow improvements and vehicle emissions: Effects of trip generation and emission control technology
R.B. Noland and M.A. Quddus, January 2006, Transportation Research Part D 11(1): 1-14, ISSN: 1361-9209

From abstract: This paper examines whether road schemes that increase the availability of road space or which smooth the flow of traffic result in increased vehicle pollution . . . This paper uses a micro-simulation model (VISSIM), integrated with a modal emissions model (CMEM), to evaluate the overall strategic policy question of how changes in available road capacity affects vehicle emissions. The analysis examines alternative vehicle fleets, ranging from a fleet with no emission control technology to relatively clean Tier 1 vehicles. Results show emission break-even points for CO, HC, NOx, fuel consumption and CO2. Increased traffic is found to quickly diminish any initial emission reduction benefits.

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Fuel Consumption, Vehicle Emission, and Traffic Congestion Estimation at a Network Level: A New Approach
Chiu Liu and Zhongren Wang, November 2002, Conference Title: 12th World Congress on Intelligent Transport Systems, San Francisco, Sponsored by: ITS America

Abstract: A critical trip generation rate or population density in cities above which traffic congestion would be induced is derived. When the trip rate in a city exceeds the critical number, traffic congestion prevails. The effects of employing an intelligent transit system to mitigate traffic congestion and vehicle emissions are estimated based on an analytic framework. The benefits attained by employing the intelligent transit in gasoline consumption and reduction in trip time are estimated on an annual basis. The benefits are further demonstrated using a city like Sacramento of California. The model is of great practical importance when applied to match with transportation and urban development planning processes prepared by government agencies at various levels.

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Changing Speed-VMT Distributions: The Effects on Emissions Inventories and Conformity
K. Nanzetta, D. Niemeier, and J.M. Utts, March 2000, Journal of the Air & Waste Management Association 50(3)

From abstract: The emissions factor modeling component of the motor vehicle emissions inventory (MVEI) modeling suite is currently being revised by the California Air Resources Board (CARB). One of the proposed changes in modeling philosophy is a shift from using link-based travel activity data to trip-based travel data for preparing mobile emissions inventories. New speed correction factors (SCFs) will also be developed by CARB for the revised model. The new SCFs will be derived from vehicle emissions on 15 new driving cycles, each constructed to represent a typical trip at a specific average speed. This paper discusses how the new SCFs will affect transportation conformity and emissions inventory development, and evaluate the differences in total emissions produced by trip- and link-based distributions of speed and vehicle miles of travel (VMT). Both the link- and the trip-based speed-VMT distributions were simulated using travel data from the Sacramento and San Diego travel demand models.

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