Testimony
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Chairman Wu, Ranking Member Smith, Vice Chairman Lujan, and distinguished members of the Subcommittee.

My name is Larry Rilett and I am a Professor of Civil Engineering and the Director of the Mid-America Transportation Center at the University of Nebraska-Lincoln. It is an honor to participate in this hearing and to provide my views on the role of research in addressing climate change and transportation infrastructure.

The Mid-America Transportation Center (MATC) was designated as the USDOT Region VII University Transportation Center following the 2006 competition. Our consortium partners include Kansas State University, University of Iowa, University of Kansas, Missouri University of Science and Technology, Lincoln University and Prairie View A&M University. The Center's theme is improving safety and minimizing risk associated with increasing multi-modal freight movements. Our advisory board includes the research directors from all region VII state DOT's, USDOT personnel, and participants from the rail, trucking, and waterway industries. Consequently the MATC research program is not only multi-modal but also significantly representative of public and private sector transportation interests of the Midwest.

The states that comprise Region VII (Iowa, Kansas, Missouri, and Nebraska) have many commonalities and their respective transportation agencies face many of the same issues in providing a safe, efficient, and effective transportation infrastructure. For example, the majority of the region's roadway networks are primarily rural, although there are a number of major cities interspersed throughout the area that face traditional urban transportation problems. Because the region's roadways, railways, and waterways are located at the crossroads of the nation's transportation system, the four states share the challenge of an enormous amount of freight traffic.

Within Region VII, Interstates I-70 and I-80 are vital east-west corridors, and Interstates I-35 and I-29 are major north-south corridors. The two largest Class 1 railroads in the US have significant portions of their networks in Region VII. Given the region's diverse economy, and the growing trade with China, Mexico, and Canada, freight traffic is increasing every year, which profoundly affect the region's infrastructure. Congestion on the roadways, railways, and waterways caused by this additional freight traffic is having an increasingly detrimental effect on the safety and health of the region's traveling public, its economy, and its transportation infrastructure. These challenges to the transportation system of Region VII appear to be indicative of transportation problems faced by the nation at large.

I have broken down my comments into four critical areas that I believe need to be addressed in order to develop a successful research program related to infrastructure and the environment.

1: Transportation Modeling and Mobile Source Emissions Modeling

In order to estimate the amount of pollution emitted from mobile sources on the US roadway system (both passenger and commercial trucks) the Environmental Protection Agency recommends using the MOBILE suite of emissions models of which the latest version is MOBILE 6. This model can estimate emissions for a variety of pollutants including: volatile organic compounds (VOC), carbon monoxide (CO), and nitrogen oxides (NO_x). The composite emission rate for a given pollutant type, vehicle class, model year and speed is derived as the product of the basic emission rate and a number of correction factors that are related to the model years and operating characteristics of the vehicles. The correction factors (by vehicle class and model year) include among other variables fuel volatility, refueling, running loss, crankcase and other evaporatives, speed, loading factor, air conditioning factor, trailer towing factor, humidity factor and cold start / hot start adjustment factors.

While the MOBILE model is used extensively across the US for emissions modeling, there are a number of research issues that need to be addressed. For example, MOBILE requires, among other inputs, vehicle kilometers of travel (VKT) for each vehicle class as a function of average speed. This information traditionally has been obtained from macroscopic planning models whereby the average speed on a given length of roadway is the same for all vehicle classes. This makes it challenging to examine the effects of changes in policy (e.g. commercial carriers reducing their average fleet speed in response to diesel prices) and the effects of changes in various driver behaviors (e.g. some drivers having excessive accelerations and decelerations which lead to correspondingly higher emissions). This is problematic when analyzing the effects of demand management proposals such as HOV/HOT lanes, congestion pricing, etc.

Related to the above point is that over the past ten years there has been a shift from macro level transportation modeling to a more simulation-based approach. One example is the TRANSIMS model, which can simulate the daily activities of every individual in an urban environment – and hence their transportation choices including mode, route, time of travel, etc. These types of models allow for detailed spatial and temporal analyses of policy decisions at an individual traveler level. However, the current mobile source emission models cannot take advantage of these improvements because their inputs are based on averages. In fact, it can be shown that when the simulation data is aggregated and input to the MOBILE model the resulting emission estimates can vary up to twenty percent depending on how the modeler wishes to aggregate the data. EPA's recent development of the MOVES emission model, which is more disaggregate, is a step in the right direction.

In addition to the advancements in simulation modeling techniques, the advent of Intelligent Transportation Systems (ITS) has opened numerous possibilities for capturing detailed transportation-related information. The capabilities of modeling and observing individual driving behavior has increased substantially over the past few years. This increase in fidelity should lead to better understanding of emissions related to transportation infrastructure.

The tools used to model spatially distributed transportation networks have become increasingly simulation based. This means that detailed analyses of activities and decisions (where to live, where to work, what mode to choose) of the population can be made over networks that are spatially and temporally distributed. However, significant research is required to ensure that the relationship between the transportation supply (e.g. physical network) and the transportation demand (e.g. activities of private citizens and businesses) is modeled accurately – particularly with respect to factors that affect emissions such as speed profiles (e.g. acceleration, deceleration) In addition, the mobile source emission models that can take advantage of these new capabilities need to be further developed and adopted. It is my belief that these changes cannot be done in isolation as the linkage between the transportation and mobile source emission models will be critical to the success of the research.

2: Data and Information Needs

While transportation models are becoming more sophisticated (e.g. modeling urban cities down to the individual citizen) there is a corresponding requirement for significant amounts of data for calibrating and validating these models. In addition, it is imperative that detailed emissions data be provided if the mobile source emissions models are to be updated so that they can take full advantage of the new transportation model capabilities.

Given today's computer and communication technologies, the ability to obtain detailed transportation-related information has never been greater. Unfortunately this data has not always been made available to researchers and/or was saved in a form that was not conducive to research. For example, speed data is collected in most metropolitan areas of the US and this type of data is useful for both transportation and mobile source models. While the data is often saved it typically has a significant error which, while adequate for transportation operations applications, does affect its use for other applications such as model development. In addition, the data is often saved in aggregate form (e.g. average five minute speeds) while disaggregate data will be much more useful. For example, the distribution of speeds is often much more informative than average speed with respect to environmental modeling. If two links have the same average speed of 55 km/h they may still have markedly different emissions if one has greater variability in speed. Currently, however, mobile source emission models cannot differentiate between these two scenarios.

Compounding this problem of insufficient meaningful traffic data is the dearth of empirical information on transportation-related emissions. Portable Emission Measurement Systems have shown potential for obtaining emissions readings from tailpipes. This type of information would be useful for emission model development and analysis.

With the recent advances in Intelligent Transportation Systems, both in the private and public sectors, there is a significant amount of data available for research. Unfortunately this data is not readily available researchers and/or is not in a form conducive to research. Both transportation models and environmental modelers will need this information for model development, model calibration and model validation. A comprehensive and internally consistent data set of vehicle data, activity data and emissions data is required.

In addition, because of the non-linear relationship between pollutants and their causal factors (e.g. CO emissions and vehicle speed) the statistics used in both empirical measurements and modeling will, in all likelihood, be non-parametric. Which techniques are best is still an open research topic. Traditional statistical analyses based on average conditions and/or normality assumptions, however, have been shown to be inadequate for analyses related to environmental effects.

3: Private Sector Initiatives

Needless to say the negative health effects associated with poor air quality are continuing to gain prominence as a national issue. The U.S. Environmental Protection Agency (EPA) has designated numerous counties across the nation as nonattainable in terms of various environmental standards. These designations have prompted authorities in the nonattainment areas to implement a wide range of emissions control strategies. As an example, one such strategy is to reduce idling of light and heavy duty vehicles. Over the past twenty years, as vehicle and fuel technologies have improved, the relative contribution of truck idling to total mobile source emissions has increased substantially. The basic approaches to reducing long term idling include 1) legislation to limit long-term idling, 2) provision of alternate power sources at fixed locations, and/or 3) providing on-board auxiliary power units (APUs).

Drivers decide to let their trucks idle for various reasons which may be categorized into two distinct groups. The first is for what the EPA refers to as "hoteling." The U.S. Department of Transportation (USDOT) mandates that a truck driver must rest for eight hours after eleven hours of driving. During this down time, many truck drivers will leave the truck idling to provide a suitable environment for rest (air conditioning or heating to the sleeper cab), to keep the engine and fuel warm in cold weather, to operate appliances, and to maintain vehicle battery charge while appliances are in use. The second category of truck idling occurs when trucks are waiting to either pick up or drop off a load. This type of idling can occur at congested border crossings, busy intermodal terminals, ports, etc. where the drivers can wait upwards of several hours.

It is important to note that there are multiple dimensions to these types of environmental policy decisions. For example implementing long term idling restrictions while simultaneously requesting truck drivers to take longer rest breaks may result in drivers not getting the rest they require which could impact safety. Reducing truck driver hours of service has resulted in an inadequate supply of large truck parking spaces (at rest areas, truck stops, etc.). The short term impact is illegal parking of heavy vehicles and the long term issue is an increase in parking infrastructure to support this increased demand. Lastly, even environmental policy decisions can be in "competition". For example, the recent policies to reduce large truck NOx emissions have resulted in lower fuel efficiencies. However, fuel usage has an approximately one to one correlation to carbon dioxide emissions which means that some of the recent policies for reducing NOx emissions simultaneously increase green house gas emissions.

The research agenda should be multi-disciplinary and be comprehensive enough so that all impacts of any proposed action are understood by the decision maker. For example, safety policy measures should include the effect on the environment while environmental policy decisions need to include the effect on other priorities such as driver safety. The interaction, and mitigation strategies, of potentially conflicting policies of various US federal agencies should be a focus of the research agenda.

Because the logistics industry is extremely competitive, many companies have adopted fuel saving technologies and strategies which has the desirable effect of lower emissions, all else being equal. As in the previous example of policies made to reduce long term idling, many trucking firms are now providing an APU in each of their cabs because of the cost in fuel savings. Other fuel saving technologies such as more aerodynamic trailers, single unit tires, etc. also have been adopted by the industry. It should be noted that it is still unclear whether recent improvements in vehicle technology affect fuel consumption, and hence emissions. Quantitative information on these benefits, based on solid statistical analyses, is critical if the traveling public and logistics companies are going to be able to make rational decisions about whether to adopt these new technologies. This information will also be essential to mobile source emission models.

Potential research in fuel saving technologies include 1) trailer design research to decrease aerodynamic drag and improve fuel efficiency, 2) transport refrigeration unit (TRU) research aimed at the next-generation of TRU's (using main engine power as a supplement, and 3) advanced battery/energy generation sources to power new components at reduced energy consumption/idling levels. In addition, many trucking companies have adopted real-time communication technologies whereby they can control their fleet in order to increase fuel efficiency, which results in lower emissions. Consequently, increased research in productivity in freight movements, across all modes, is critical to reducing congestion and energy dependence. With the increased use of Intelligent Transportation System technologies in the public and private sector, this goal has become increasingly achievable.

There is great potential for public-private partnership in reducing emissions related to the logistics industry. The freight and logistics industries have a vested interest in reducing their fuel use – which has a strong positive correlation with reducing emissions. The EPA SmartWay program is an excellent example of this type of collaboration and there is potential for public-private sector partnerships in other fuel saving technologies and operations-related research to reduce congestion in urban environments.

Issue 4: Sustainability

While transportation is essential for the economic well-being of any society, the negative externalities associated with transportation, including the erosion of non-renewable resources and environmental pollution, are considerable. The challenge, therefore, is to develop the transportation system in a sustainable manner. Regardless of the specific definition of sustainability chosen, transportation professionals are increasingly challenged to incorporate sustainability concepts into the planning, design and operation of transportation networks. To assess whether a particular strategy is moving towards or away from sustainability it is important to monitor key performance indicators. If policy makers are to make good decisions relating to sustainable development and sustainable transportation, they need reliable information on the state of the environment and the factors that impact upon it.

It is important that the transportation research agenda related to environmental impacts considers sustainability. The definition of sustainability, how this definition will impact decision making, and which metrics should be used are all open research questions. The trade-offs between the various goals of safety, congestion relief, minimal environmental impact etc. need to be explicitly and empirically accounted for in the decision making process – particularly when the goals of various agencies and/or policies conflict.

Concluding Remarks

In summary, I believe there is a definite need for research related to transportation infrastructure and the environment. Principal areas of research include the following:

- Make the transportation and emission models fully compatible and able to model the individual user. This would allow policy decisions, particularly at the project level, to be more accurately analyzed.
- Develop comprehensive traffic, emissions and activity databases so that the transportation-emission models can be developed, calibrated and validated.
- Encourage public – private partnerships for developing and testing fuel saving / emission reduction technologies.
- Develop a sustainability research program so that the policy decisions can be analyzed simultaneously across various (and sometimes competing) objectives.

The results of such research would enable policy makers to understand in advance of implementation what effects their policies will have on the environment, on safety, on the economy, etc. These problems are complex, and research into their solutions will need to be multi-disciplinary and broad enough to include all aspects of the transportation system. Given the scope of the challenges faced by the U.S. transportation system, all stakeholders, including universities, the USDOT University Transportation Centers, federal agencies, and the private sector will have to be involved in order to maximize the effectiveness of the research.