CONFERENCE I RESOURCE PAPER

Linkages Between Transportation Planning and the Environment

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Transportation investments have in the past been among society's most important contributors to environmental improvement, but today transportation programs and projects are more often of concern as sources of major environmental problems. Over the past 30 years, since the enactment of the National Environmental Protection Act (NEPA) and the first Clean Air Act amendments, the relationship between transportation planning and environmental policy making has continuously become more complex and problematic.

Until about 1835, when early public transport was just being introduced into many cities, virtually everyone resided within walking distance of where he or she worked, whether on a family farm or in an urban area. The limited capacities of transportation systems determined that most people traveled very little and experienced tightly bounded environments. By the beginning of the 20th century, transportation had evolved rapidly from horse carts to horse-drawn omnibuses to street railways, and cities expanded dramatically in response to increasing mobility. But cities were still mostly crowded, dirty, dense, congested places, beset by a myriad of environmental problems and limited in size by their transportation systems.

The first national conference on city planning and the problems of congestion was held in Washington, D.C., in 1909. The conference was characterized by many speeches in which intellectuals of the day insisted that the environmental challenges of their time—the disease, poverty, darkness, and vice of the North American city—were caused by the scourge of high-density living and that it was the job of urban transportation planners to build public transit routes to outlying areas for the explicit purpose of lowering density and improving living conditions.

Mary Kingsbury Simkhovich, for example, the only woman to address the first annual conference on city planning, urged that new immigrants to New York City should be whisked to low-density suburbs before they had a chance to settle in lower Manhattan and be destroyed by the urban densities, vices, and diseases induced by squalid urban environments. Subways to new outlying communities were urged, combined with low flat fares, so that low-income people could afford to live at low density at the edge to benefit from environmental improvement and to avoid the pitfalls of inner-city living. The transportation system was the key to environmental betterment. The relationship between transportation and the environment at this time was an intimate one, as it is now, but there was greater emphasis on policy discussions about transportation as a provider of environmental benefits instead of a source of environmental pollutants.

Similarly, the arrival of the automobile was understood to be an environmental blessing of enormous proportions. The city could be freed from environmental insults of horse manure, diseases carried by horse flies, and the need to regularly remove from the

streets tens of thousands of carcasses of dead horses that had expired on the job. No wonder newspapers and magazines, before 1920, described the emerging transportation system based on the internal combustion engine as a clean and environmentally benign improvement.

How times have changed during these last 100 years. At the turn of the century, urban densities were considered too high, and "spreading the city" was seen as a solution. Today, the vast majority of urban critics believe suburbanization is a problem, and the reversal of sprawl is the solution. When the automobile was new it was widely considered to be an environmental savior. Today, it is often labeled an environmental disaster.

As times change so does our understanding of the facts about the linkage between transportation systems and the environment. The goals of public policy on transportation and the environment similarly evolve. A succession of laws has been enacted that reflect our changing understandings, as well as the many competing interests that make up our society—from the trucking, petroleum, and auto industries to cyclists and lung associations. These laws encapsulate our current understanding and our hopes about the relationship between the environment and the transportation system. A series of regulations have also been promulgated by which we attempt to implement these laws. At this Conference on Refocusing Planning for the 21st Century, we are discussing the latest of these laws, TEA-21, and possible changes in the regulations that govern metropolitan transportation planning in the context of transportation and environmental requirements that have been enacted over several decades.

I started addressing this important topic with a brief reference to history because I am always both amazed and humbled by historical facts and analyses. Our current problems often appear so complex and insurmountable, and the solutions we passionately espouse to current problems are so very important to us, until we set them in their proper historical context. Only a brief examination of history shows that our current understanding of the transportation-environment relationship is partial, is constantly changing, and is largely mistaken. History also demonstrates that our commitments to particular policy solutions are highly subjective and are strongly influenced by well meaning fads as much as by scientific certainties.

This paper briefly examines several trends and emerging themes in urban and regional transportation planning. The emphasis here is on breadth instead of depth, and each theme is offered as a subject for elaboration and consideration at the conference workshops. For emphasis, and as a resource for easy reference for use in the workshop sessions, recommendations for planners and policy makers follow each theme.

Environmental Quality with, Not Against, Mobility

When the environmental movement took the transportation community by storm, we were in the midst of building a vast national highway system that some consider as being a great force for national unification and economic growth. Others, in comparison, see the postwar interstate era as a monument to greed and pork barrel politics. It could well be both of these, but the magnitude and extent of the highway program of the fifties, sixties, and seventies were enormous, and the bureaucracy of institutional machinery that was built to support it was equally as impressive. It is therefore not surprising that the environmental movement was at first largely an opponent of the highway program instead of a component of it. NEPA and the Clean Air Act amendments were in a sense reactions more than they were initiatives. Their proponents were contending with the prohighway forces and were attempting to put a brake on what many in the transportation business thought of as progress. Many transportation officials have referred to the Clean Air Act requirements as "the tail that wagged the transportation dog." Interestingly, and appropriately, that perspective is voiced with decreasing frequency as we approach the new century.

Today, the situation is rather different. Although there are some individuals in the transportation community who believe they are besieged by environmentalists and there are some environmentalists who continue to consider transportation officials as their enemies, for the most part, a successful working relationship has been forged that aims at providing mobility in combination with environmental responsibility. A broad cross section of the public is committed to congestion relief and environmental responsibility. The Surface Transportation Policy Project and the American Association of State Highway and Transportation Officials (AASHTO) actually do talk with one another and find grounds for compromise.

Given this evolution of feelings and understandings, it is possible today to urge that we adopt regulations and procedures based on the principle that mobility and environmental quality are not mutually incompatible, but that it is our mission to serve both of these masters. In fact, to go further, many of us would even assert that the principal purpose of transportation investments is to respond to society's environmental goals, whereby the environment is perceived broadly as a combination of the social, economic, and natural contexts within which we live. In other words, over time, we have all become environmentalists to some extent, and the planning of transportation systems and facilities is observed to be a component of shaping the environment. The environment is no longer an afterthought or a checklist of fac-

tors and questions asked of otherwise completed transportation plans; our transportation planning is becoming a fundamental determinant of and an ingredient in the way we think about the environment.

Recommendation: Transportation planning, environmental regulations and procedures, and project and program funding should become more integrated and less opposed to one another over time.

Growing Complementarity Between Transportation and Information

The single most influential social trend that is having an ever-greater influence on transportation over time is the growing role of information processing and telecommunications in modern society. During the first decades of the approaching century, the impacts of this relationship will be as influential as was the invention of the automobile and the telephone in the early part of the 20th century. The development of a telecommunications-transportation linkage will probably be even more influential over the next few decades than was the construction of the national highway network during midcentury. At the very least, our ability to expand mobility will increasingly depend on our ability to use telecommunications and information processing in concert with the transportation system.

Even though fully automated highways are probably decades away, on-vehicle collision-avoidance systems, the provision of "real-time" information on the arrival of transit vehicles, widespread use of electronic toll collection to finance highways, the capability to navigate around traffic congestion, and the ability to reserve in advance a time slot to cross a congested bridge are closer at hand. Larger shares of transportation budgets will undoubtedly be spent on telecommunication enhancements that expand and manage the capacity of existing facilities than will be spent on the construction of extensive new facilities. We must develop planning methods that include the capability to evaluate telecommunication enhancements to current facilities in programs for congestion relief as easily as they presently include evaluations of new transportation facilities.

Recommendation: Regional transportation agencies must develop the capability to understand and forecast the environmental consequences of intelligent transportation system improvements on existing facilities as well as on new facilities. Over time these systems will become important strategies that will help regional agencies to achieve their transportation goals.

The use of computers and other information-processing devices is also changing the amount of hours we work and the places at which we work, and consequently, it is changing the spatial and temporal patterns of travel and the spatial patterns of cities. The pressure for continued decentralization will be hard to minimize given the availability of information-exchange devices. Although relatively few people are literally telecommuting by working full days at home, more are working at multiple locations during day and at unusual times of day because of information-processing opportunities at home and at night. E-mail and the Internet are changing travel patterns dramatically.

We are already experiencing a great increase in nonwork travel in proportion to all travel, in part because of the new telecommunication devices and as the result of other social changes. For the same reason, we are already observing heavier peaks of traffic at midday and on weekends at many locations other than at the traditional morning and evening weekday rush hours. We are less certain of the environmental consequences of these changes than we are of the travel consequences, but they will be significant and must be addressed in the development of transportation planning and environmental regulations and procedures if those procedures are to truly accommodate emerging societal needs. If we fail to incorporate considerations of information processing into transportation planning for the coming two or three decades, we will be planning transportation systems to meet yesterday's needs.

Recommendation: While we expend great amounts of money forecasting travel and its environmental consequences at the metropolitan level, we should be developing similar capacities to forecast information transfers from one locale to another; to incorporate information flows as significant, causal determinants of regional travel patterns; and to estimate environmental consequences of these changes in telecommunications patterns and of the changes in urban form and travel patterns that they will engender.

Environmental Consequences of Transportation

To the extent that our society has progressed in the reduction of the harmful impacts of transportation systems on the natural environment, the last 30 years have indicated that technological changes have been responsible for far more of these impacts than have regional plans or facility changes. Air pollution has decreased primarily as a result of more demanding tailpipe-emission standards and longer periods during which new cars are required to meet those standards, as well as the

implementation of inspection and maintenance programs to ensure that they do so. Thus, air pollution has declined substantially in cities that have the most severe problems, including even Los Angeles, despite increased driving, increased suburbanization, worsening traffic congestion, and failed efforts to achieve more environmentally responsible travel behavior.

It is difficult to attribute recently measured improvements in air quality to transportation control measures or to behavioral changes by travelers. Because of failure to use even a significant portion of the capabilities of these measures, some states are attempting to reconvert high-occupancy vehicle (HOV) lanes to mixed flow, while transit use continues to decline nationally at the same time that a proportion of all travel and ridesharing is at a 20-year low. Efforts to induce transit-oriented development have met with some limited success, but the national trend toward lower density for most people in most places remains dominant, even as some central city, urban residential communities grow and prosper.

Despite important implications for policy on investments in both technology and infrastructure, vehicle-technology improvements have been emphasized in the preparation of state implementation plans (SIPs) for air quality, whereas land use and transportation-capacity measures have been emphasized in the development of long-range regional mobility plans.

During the coming decades, the most cost-effective ways to reduce pollutants from the air, water, and land that are attributable to transportation systems will continue to be through technological changes in vehicles, engines, fuels, lubricants, and telecommunications capacities that are linked with transport instead of through transportation control measures and other efforts to induce behavioral changes (e.g., major shifts from driving to public transit, cycling, or walking). Goods-movement vehicles and off-road mobile sources are not yet as tightly regulated for environmental pollutants as are light-duty passenger vehicles, but they are expected to come under closer scrutiny for regulation and technological change in the first decade of the new century.

> *Recommendation:* Regional plans to meet federal air quality requirements should integrate more effectively technological measures with land use, travel-demand management, and transportation-capacity measures. In nonattainment areas the timing of and organizational responsibility for the preparation of SIPs, which emphasize technological improvements, are not sufficiently integrated with the preparation of the long-range regional mobility plans, which tend to emphasize transportation facilities. These two planning processes are often far too independent of one another. They are frequently implemented in a competitive mode among agencies that have separate responsibilities for air quality and regional transportation planning. There is a need to rethink these planning processes so that SIPs and regional long-range transportation plans are more integrated in substance and content and that their preparation is more synchronized with time (*1*).

Travel-Behavior Change by Policies, Not by Facilities

Traditional transportation planning at the regional level has emphasized the construction of transportation facilities and the analysis of the environmental impacts of their construction and of forecasted flows on those facilities. It is likely that in the coming decades transportation plans will consist, to a decreasing extent, of facilities plans, and that, to a greater extent, both mobility and environmental objectives of transportation planning will be addressed by a mix of policies that are much broader than facility construction.

For example, strategies such as the promotion of higher-density residential communities and mixed land uses in residential and commercial areas are being promoted as environmentally responsible. Some believe that these approaches to planning will reduce the geographic expansion of metropolitan areas, reduce the rate of urbanization of agricultural land, promote more walking and transit use, and require less automobile travel. While I personally believe that the general trend will continue toward lower densities and metropolitan areas of growing expansiveness, it is possible to envision a trend within the larger trend toward nodes of greater density and more deliberate attempts to create mixed-use developments. Although most new development will undoubtedly take place at the urban edge, it is reasonable to think that we will simultaneously witness the redevelopment of urban brown fields and the conversion of older industrial and military sites to new commercial and residential uses.

The increase of reliance on telecommunications and the complementarities between telecommunications and travel will permit a wider variety of living environments, and it is certainly appropriate for communities to experiment with a wider variety of arrangements of land and public transit. Thus, it will be necessary to develop theories, empirical evidence, and mathematical models to support the assessment of the traffic generation and the environmental consequences of a wider range of types of urban development.

Similarly, in addition to alternative land use and development patterns, some predict a wider range of policies in the future that is intended to influence travel behavior on existing facilities rather than to construct

new capacity. For example, urban areas and metropolitan planning organizations (MPOs) have proposed, and in some cases already implemented, the addition of electronic toll collection to existing toll roads, the addition of high-occupancy toll lanes to existing HOV lanes (i.e., lanes in which single-occupant vehicles can use an HOV lane by paying a toll), the conversion of some free lanes to toll operations, and the institution of congestion pricing. The methods of analysis that are currently used to measure the environmental impacts of transportation facilities were not developed to be directly or easily applicable to the evaluation of the environmental impacts of such a wide range of policy alternatives, and efforts to extend them to the analysis of such policies have revealed many limitations.

> *Recommendation:* Federal planning regulations should foster and encourage a wider variety of approaches to urban development and the management of travel. There is a need to monitor the environmental impacts of transportation strategies that involve variations in development densities, land use mixes, highway and transit-pricing changes, and other policies that do not involve traditional capacity expansions. In addition, it is necessary to develop methods for estimating and forecasting environmental consequences of such policies.

Shift in the Focus of Environmental Analysis of Transportation Impacts

Reactive Organic Gases, Oxides of Nitrogen, and Particulates

For the last 30 years the single most pressing environmental concern that affected regional transportation institutions has been air quality at the local and regional levels. With regard to air quality, emphasis has been placed on the reduction of lead, oxides of nitrogen (NO_x), reactive organic gases (ROG), and carbon monoxide (CO). For several different but complementary reasons, it is predicted that in the new century attention to other environmental consequences of transportation systems will increase, both in terms of air quality and other areas. In part, this increased attention is the result of the substantial progress that has already been made in addressing the environmental hazards of lead, ROG, NO_x, and CO. Even with the implementation of increasingly stringent ozone standards, the control of these pollutants will be accomplished, to a greater and greater extent, largely through national emissions standards for vehicles, inspection and maintenance programs, and the retirement of grossly polluting vehicles instead of through regional transportation plans, land use initiatives, or transportation control measures. But this progress will not solve the environmental problems that are associated with modern urban transportation systems.

There is increasing awareness that the measures used to reduce pollutants that are derived from mobile sources have been far less effective at controlling particulates, which are an increasingly recognized health hazard. Environmental requirements that are related to the reduction and filtering of fine particles are quickly becoming a pressing and dominating problem for regional air quality and transportation planners. Because heavy-duty diesel trucks are estimated to account for about three-fourths of highway-related emissions of particulate matter [diesel engines associated with off-road activities are another major source of pollutants (2)], it would appear that technological controls will continue to be an important strategy by which to meet newly revised particulate standards. This will involve more stringent control of both on-road and off-road vehicles and will place a much heavier burden of regulation and compliance on the goods-movement industry. It should also result in increased attention to the efficiency of goods movement within regional transportation plans and is one of the motivations, for example, for the inclusion of trucks-only lanes and even trucks-only highways in the latest regional transportation planning effort in Los Angeles. It should be noted that a substantial proportion of fine particles, such as entrained road dust, are caused by wind and water erosion instead of by engine emissions.

> *Recommendation:* Attention to the reduction of fine particles will become a more dominant part of the process of addressing the environmental impacts of the transportation system. We are not yet sufficiently well equipped in terms of scientific understanding of the phenomena to address these problems effectively in plan making, and a great deal of research is needed before particulate pollution can be more fully understood and properly managed.

Growing Importance of Greenhouse Gases

Similarly, we are just now understanding of the risks of producing greenhouse gases, and global warming is increasing in salience as a transportation planning and policy problem. It has been estimated that transportation is responsible for about 20 percent of worldwide carbon dioxide (CO_2) and that motor vehicles in the United States account for 20 to 25 percent of worldwide transportation emissions (or about 5 percent of the total of worldwide greenhouse gases that are pro-

duced by people as opposed to natural sources) (*3*, pp. 210–211).

Long-term environmental consequences of the greenhouse gas buildup remains uncertain, and a great deal of current research is aimed at reducing that uncertainty. Nevertheless, with public awareness rising and the risks of greenhouse gas accumulation substantial, transportation will continue to be the focus of research on this topic, and transportation strategies are certain to be included in policies aimed at reducing greenhouse gases.

Most strategies are aimed at either reducing the amount of motor vehicle travel or substantially changing the amount and type of fuel that is used to produce motor vehicle travel (*3*, p. 212). Once again, because so many other trends that tend to increase instead of reduce travel exist, technological changes in fuels and vehicle-propulsion systems are expected to play the larger role, and changes in travel behavior are expected to play a limited role in addressing this emerging problem. Yet, it should be noted that although regional long-range transportation planning in the United States is a rather unimportant contributor to today's efforts to control greenhouse gas emissions, there are major disagreements among sectors of the professional community as to the role that it could play. The extent and nature of regional transportation planning could be a major topic for discussion in the conference workshops.

> *Recommendation:* There is a need to research the contributions that regional transportation planning and investment strategies can make to the control of greenhouse gases and to address the reduction of CO2 emissions in the regional transportation planning process.

Water Quality

Transportation facilities can dramatically alter the nature of water systems. Highways and transit routes often alter the courses and volumes of flows in waterways and can change natural drainage patterns. The pavement of large areas of ground surface in airport and highway projects also affects runoff patterns and can result in flooding or in major changes in drainage patterns. Vehicles, highways, and transit routes are also sources of substantial amounts of liquid, solid, and gaseous pollutants that can settle on water surfaces or be carried by runoff into water courses.

Over time we have come to realize that an indeterminate but large proportion of surface and groundwater pollution originates in or is modified and affected by the transportation system. The construction process is itself a source of water pollution, and the operation of transportation facilities will continue to produce water pollution for many years to come.

The U.S. Army Corps of Engineers has jurisdiction over navigable waterways in the United States and must review and provide permits for transportation projects that will affect the character and content of flows on those waterways. Also, provisions of the Clean Water Act and regulations of the U.S. Fish and Wildlife Service can and often do limit the routing and design of transportation facilities.

In recent years it has become more common that transportation agencies have had to mitigate the impacts of their projects and programs on wetlands and waterways. At times when irrevocable intrusions into wetlands and waterways are necessary to complete transportation projects, mitigation measures may involve replacements or rejuvenation of damaged wetlands or waterways that are located away from the project itself. For example, consideration is now being given to expanding the runways at the San Francisco International Airport by filling in several hundred acres of the San Francisco Bay.

To mitigate the effects of the proposed San Francisco project, some suggest that several thousand acres of commercial salt ponds, located elsewhere on the Bay, be acquired and returned to their more natural historical character as marshlands. These areas could provide habitats for a large number of local species of animals, fish, and birds, as well as stopping points for migrating species. Some environmentalists portray this move as a win-win proposition for the Bay Area. The transportation agency, however, is reluctant to accept responsibility for projects that involve major wetlands restoration in areas away from its own facilities, and some environmentalists continue to oppose intrusion into the Bay by the transportation agency, even if the marshlands would be restored in a compensatory project. These situations are becoming more typical in transportation planning.

> *Recommendation:* Regional transportation planning methods must be improved so that we can integrate more effectively concerns for water quality into the siting and design of transportation projects. This integration requires basic and applied research on the relationships between transportation systems and water quality, and it also requires use of planning processes that recognize the environmental significance of the impact of transportation systems on water quality.

Biodiversity

The impact of transportation investments on biodiversity is emerging as a major concern of environmental organizations that monitor transportation programs and participate in public debates on transportation planning

and programming. Highways, ports, airports, and rail transit lines can affect biodiversity by, for example, fragmenting habitats, placing barriers between sheltered habitats and sources of food and water, placing barriers in the way of normal animal or insect migration routes, or polluting local water courses. No requirement now exists that addresses biodiversity in the regional transportation planning process, but of course the issue of species habitats is addressed at the level of project planning because it is one of the critical components of an environmental impact statement (EIS). The decision to address biodiversity at the project level can vary greatly with the scale and location of the project and with knowledge of local conditions.

A survey of state highway and transportation departments revealed that in 21 of the 32 responding states, the issue of biodiversity had been raised during highway-development processes. Although the issue had been raised in general because of the concerns of environmental groups and citizens' associations, it has also, in a few instances, been a point of contention over specific species at specific locations. Only four states reported in this survey that they had conducted scientific studies of the biodiversity impacts of particular transportation projects, and three others described specific highway location decisions or transportation agency investments that involved planting or grading specifically to support biodiversity (*4*).

Progress has been made in the development of tools and techniques for assessing the potential impacts of transportation facilities on biodiversity. In particular, West Virginia, Pennsylvania, and Maine have all developed approaches that vary considerably from qualitative assessments to more quantitative data-collection tools (*5*).

What role should considerations of biodiversity play in regional level transportation planning? While specific evaluations of the impacts of alternative routes or project designs are part of the environmental impact review of specific projects, it would appear that, in an environmentally responsible regional transportation planning process, the protection of areas with special ecological significance and habitats of endangered or highly valued species should be among the key considerations of preliminary regional network analysis and should be a part of the formulation of basic alternative transportation system designs. I project that considerations of biodiversity and habitat protection will become increasingly important in the regional transportation planning process.

> *Recommendation:* Consideration should also be given to defining an appropriate role for federal requirements and planning regulations in the protection of threatened species and in recognition of the significance of biodiversity in the development of transportation plans. States and MPOs should take the lead in developing methods and procedures for the inclusion of biodiversity considerations in regional transportation planning.

Dissatisfaction with Regulatory Complexity

One of the hallmarks of the transportation-environment relationship during the past 30 years has been bureaucratic complexity. This complexity arose from a well-meaning commitment to environmental protection but has certainly imposed high costs and significant delays. As noted earlier, the complexity of the regulatory framework by which the transportation-environment relationship is managed arose because the provision of mobility and the protection of the environment were, until quite recently, opposing public policy goals that were almost always in tension with one another. This opposition naturally gave rise to a system of opposing checks and balances, with organizational structures and procedures that reflected and balanced the distinct interests associated with each and the need to mediate between them. Costly and time-consuming litigation is similarly the frequent result of multiple and overlapping statutory and regulatory responsibilities that are perceived to be needed to protect competing interests.

If, however, we are truly approaching a period of cooperation between transportation and environmental interests and if we are are moving toward a planning and policy-making context in which there is a genuine commitment to the provision of both mobility and environmental quality, we should be able to simplify the process by which transportation systems are planned and projects are approved.

In the conference report that accompanied TEA-21, Congress clearly stated its concerns with the "delays, unnecessary duplication of effort and added costs often associated with current practices for reviewing and approving surface transportation projects." (*6*, p. 3) In Section 1309 of TEA-21, Congress called for "a coordinated environmental review process for highway construction and mass transit projects." The language of the law specifies that this process "shall insure that, whenever practicable...all environmental reviews, analyses, opinions, and any permits, licenses, or approvals that must be issued or made by any Federal agency for the project concerned shall be conducted concurrently and completed within a cooperatively determined time period." (*7*, p. 141)

The goal of this section of the law is clearly the creation of a more unified project development, environmental review, and permitting process that will encourage federal, state, and other agencies to work together to ensure both greater effectiveness and faster

environmental decision making. In support of this coordinated review process, TEA-21 provides further language about process elements, time limits for review processes, the participation of appropriate federal and state agencies, dispute resolution procedures, and funding for process implementation. Congress apparently intends that planning regulations be revised to facilitate these goals without devolving decision authority from the Secretary of Transportation.

Under the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA), transportation capital investments at the corridor or at the major project level were required to be the outcomes of a major investment study (MIS), which was similar to the earlier requirement that transit capital investment projects be supported by "alternatives analysis" studies. In Section 1308 of TEA-21, Congress revised this requirement, directing the secretary of transportation to promulgate regulations that eliminate the MIS process as a separate requirement. It specified instead that the evaluation of alternative projects designed to meet major transportation needs should be carried out as part of the process that is generally performed in the development of the regional long-range transportation plan and the programming that results in the preparation of the Transportation Improvement Program (TIP) (7, p. 141).

AASHTO encouraged and supported this revision, arguing that some of the "good principles of MIS should be retained: the lead agency should continue to be proactive in building a cooperative relationship between the many public agencies that must be involved in evaluating projects at the corridor level, the planning agency should vigorously pursue the active participation of affected citizens and interest groups, the alternatives that are evaluated at the corridor level should be multi-modal in nature, and the evaluation of alternatives should incorporate the financial capacity of the agencies involved to actually deliver the projects." AASHTO advises, however, that new regulations developed by the U.S. Department of Transportation (USDOT) should "integrate MIS principles into metropolitan planning requirements only to the extent that is actually required by statute," and also urges that the integration of MIS principles into existing planning and programming procedures should not "in any way apply more broadly than the existing MIS requirements, and to the extent allowable by statute, should be less prescriptive." (6, p. 9) This conference may wish to consider whether AASHTO's preference for limiting environmental review in this way is consistent with a planning process that gives appropriate weight to both the provision of mobility and the responsiveness to concerns over environmental quality.

MPOs do not all operate in exactly the same way, but development of the long-range regional transportation plan does not always require detailed, project-level evaluation of design alternatives. The type of detailed evaluation of alternatives that is included in the MIS process must, however, usually be completed before the inclusion of the project in TIP. If the MIS process is a useful exercise, contributing in some degree to the efficient expenditure of public funds, we must ask where in the planning process should the equivalent evaluative functions be placed by the revised planning and programming regulations envisioned by Congress? And what should be the relationship between this evaluation and the assessment that is required to fulfill the requirements of NEPA?

Under ISTEA the agency that performed the MIS process was allowed to choose between two different evaluation processes by which it could approach the MIS and EIS processes. It could treat the MIS and EIS requirements separately by first selecting the major characteristics of the preferred project alternative during the MIS review, and then subjecting the preferred version of the project to environmental evaluation. Although this two-step process would appear to focus and simplify the reviews by making them sequential, the NEPA evaluation itself requires broad consideration of social, economic, and environmental concerns and requires the comparison of the recommended alternative with other possible courses of action. This would imply that, to some extent at least, the two-step approach to MIS and NEPA reviews was required to be duplicative by the prevailing regulations and laws.

The other evaluation alternative was for the agency to integrate the MIS review with the NEPA review, performing them simultaneously and presumably integrating into its evaluation criteria those reviews that are related to transportation effectiveness and cost efficiency and those that are related to the potential social, economic, and environmental impacts of the project alternatives. Although it might appear less efficient to require an agency to thoroughly evaluate a large number of more broadly defined alternatives, it appears to ensure a more thorough evaluation of a wider range of alternatives.

Can we envision a planning process that is more streamlined and efficient, while ensuring that a broad set of multimodal alternatives is thoroughly evaluated according to transportation effectiveness and efficiency criteria as well as environmental criteria? In a paper presented at the Transportation Research Board's (TRB's) annual meeting in January 1996, Frazier and Henneman outlined a planning process developed for the Pennsylvania DOT that aims to do just that (8). In this case the researchers are trying to satisfy both conformity requirements on the one hand, a planning process conducted at the regional level and similar in nature to the development of the long-range

regional transportation planning process, and on the other hand, trying to satisfy project-specific NEPA requirements.

In this process, the regional planning process for conformity analysis characterizes the emissions of criteria pollutants that are associated with a potential project as being at a certain "benchmark" level. An early identification is conducted of the potential mitigation techniques that can be used at the detailed project evaluation and design stage to keep the project within the benchmark level of emissions, which was determined in the conformity review. This benchmark level is then tracked through the later NEPA project-level review process.

The project-level benchmark of emissions is considered a firm requirement in detailed project design, engineering, and evaluation. Failure to meet the benchmark pushes a region out of compliance. This process encourages planners to be realistic at the conformity review stage and also to view the benchmark as a requirement when later conducting detailed project development and evaluation (*8*). I cannot specifically advocate this benchmark process because I am not intimately familiar with its operation in practice, but I can say that the integration of MIS requirements that are required by Section 1308 of TEA-21 suggests that processes having similar characteristics to this process are applicable or appropriate.

In the spirit of "environmental streamlining," AASHTO has also suggested to the secretary of transportation that new regulations on the implementation of TEA-21 should provide greater flexibility in the format of environmental documents. Currently, Federal Highway Administration and Council on Environmental Quality regulations prescribe the format for EISs. AASHTO asserts that the prescribed format is "topic oriented rather than process oriented or decision oriented," and that this format makes it difficult for the reader to understand and follow the evolution of the proposed project through its various phases (i.e., purpose, need, analysis of alternatives). AASHTO recommends an EIS format that would be "process and decision oriented" and would "document the various stages of a proposed project, the consensus reached, and decisions made." (*6*, p. 7) Although I am not certain that AASHTO's recommendation is ideal for each and every case, I certainly concur that use of greater flexibility and probably greater variety in EIS formats would be desirable.

> *Recommendation:* Planning regulations and guidelines should be streamlined in character to avoid duplication and delay, focused on meeting regional mobility and conformity requirements, and responsive to the environmental consequences of individual transportation improvements.

Development of Appropriate Technical Capacity

The development of regional transportation plans is a data-intensive activity that uses relatively standardized models to estimate traffic flows and their environmental consequences under alternative growth scenarios and for alternative proposed mixes of transportation improvements. Analytical requirements that are placed on the planning process by federal regulations should reflect reasonable expectations about the ability of standard methods to provide an accurate picture of the environmental consequences of alternative future urban development and transportation strategies.

The capabilities of some of the most widely used mathematical modeling packages are disappointingly shallow. A major law suit, for example, was brought by a consortium of environmental groups in the San Francisco Bay Area that challenged the adequacy of the regional transportation plan and suggested that the plan should not be found to be conforming because the quality of the Metropolitan Transportation Commission's estimates of the pollution reductions of alternative transportation control measures did not enable the agency to confidently implement some measures in its own plan (*9*). A TRB committee examined the capability of current models on the basis of existing databases to estimate the effects of transportation control measures on air quality, specifically on conformity analyses, as well as the effects of new highways that are proposed to accommodate projected growth in population and travel. The committee's pessimistic conclusions are as follows:

> After examining the considerable literature on the relationships among transportation investment, travel demand, and land use, as well as the current state of the art in modeling emissions, travel demand, and land use, the committee finds that the analytical methods in use are inadequate for addressing the regulatory requirements. The accuracy implied by the interim conformity regulations issued by the EPA, in particular, exceeds current modeling capabilities. The net differences in emission levels between the build and no-build scenarios are typically smaller than the error terms of the models. Modeled estimates are imprecise and limited in their account of changes in traffic flow characteristics, trip making, and land use attributable to transportation investments. The current regulatory requirements demand a level of analytic precision beyond the current state of the art in modeling. (*10*, p. 5)

In part, the limitations of the models that are currently in use can be traced to the inability of data-

collection methods and theories to determine causal relationships among land use patterns, transportation facilities, travel volumes, and the production of pollutants. Beyond this, many models in widespread use have not been updated for years and have often been used inappropriately by inexperienced staff members. The committee concluded that the addition of highway capacity to alleviate congestion, in most instances, would have beneficial impacts on air quality. However, it acknowledged that there were significant differences of opinion on this question and that results could differ from case to case, depending on geographic conditions and particular contexts. Nevertheless, the committee's judgment was tentative, and it acknowledged that the models currently in widespread use are often inadequate to make a confident determination (*3*, p. 8).

Since the committee issued its report, there have been a number of efforts to strengthen relevant modeling capabilities, and Howett (*1*) recently stated that the models in use have shown substantial improvement over the past few years. A new "emissions factor" model is coming into use, and on a much broader scale, USDOT has initiated a travel-model improvement program to upgrade over 5 to 7 years the capabilities of models that are generally used at MPOs for integrated land use, travel-demand, and air quality analyses. Still, there continues to be enormous variability among metropolitan areas and among consulting firms that are retained in land use, transportation, and air quality modeling capabilities. Many smaller MPOs lack the capability to conduct sophisticated analyses that are more frequently required as the basis of conformity determinations.

> *Recommendation:* Because critical estimates of the travel outcomes and conformity implications of alternative land use and transportation plans require rather sophisticated mathematical modeling, and the ability of MPOs to perform such analysis is extremely uneven, it may be necessary for the federal government to develop, package, and disseminate advanced software packages that would permit MPOs to conduct appropriate and accurate forecasting as part of the regional planning process. Such a program might be coupled with a federally sponsored training program in land use, transportation, and emissions modeling and with peer review of the modeling capabilities of designated MPOs.

Conclusion

Relationships among land use, economic development, travel, and environmental quality are inherently multifaceted and complex. Our understanding of these relationships has increased dramatically since the passage of the first Clean Air Act and the enactment of NEPA. Federal planning and environmental regulations have evolved over time as planning and policy priorities have shifted. On one hand, federal requirements reflect our current understanding of these complex relationships. On the other hand, they motivate efforts to refine and deepen that understanding. The new regulations that will emerge in response to the passage of TEA-21 will serve, like past regulations, as a reflection of current priorities and the current knowledge base. They will also motivate research and experimentation to improve our knowledge base and refocus our regulatory requirements.

I hope that my analysis and suggestions will help the participants at this conference to develop meaningful proposals for refocusing the regional transportation planning process. I believe that now is the time to make regional planning guidelines more flexible and to promote a planning process that is less time consuming. If, at the same time, a broader range of environmental factors and potential impacts is to be incorporated into the transportation planning process, increasing flexibility is needed so that the planning process can be appropriately tailored to differences among regions and to the most pressing issues that are brought to the table by local and regional interests.

If regional transportation and environmental planning is to be effective, however, it is necessary for federal requirements and funding programs to recognize that transportation planning and analyses of the environmental consequences of transportation can be integrated to a far greater extent than they have been in the past. In addition, by focusing on improved methods, data-collection techniques, and technical training for those persons involved, it may be possible to improve the quality of the judgments produced by the process while allowing and encouraging greater flexibility.

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