ITS and the Environment

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The Air-Quality Problem

NOx, VOCs, Conformity -- these formerly obscure or unknown topics are now the focal points in many discussions of Intelligent Transportation Systems (ITS) and the environment.

Apparently, they are also becoming common knowledge at surprisingly high levels of government. Early in 1994, the governor of Ohio, George Voinovich, wrote to President Clinton about the threat of a "wholesale shutdown" of Ohio's transportation programs due to Clean Air Act conformity requirements. The Governor launched into a thorough explanation of the problem, beginning with the statement, "As you know, NOx emissions tend to increase as speed increases."

It's reassuring to know that both the governor of Ohio and the president are aware of the nitrogen oxides (NOx) phenomenon because it has important implications for many ITS strategies and for transportation in general. Here's why:

- The 1990 Clean Air Act Amendments require that transportation plans and programs "conform" to state air-quality plans in nonattainment areas -- more than 100 areas, most of which are major metropolitan areas.
- Environmental Protection Agency (EPA), with the concurrence of the Department of Transportation, issued regulations on Nov. 24, 1993, spelling out the prerequisites for conformity, including this requirement: ozone nonattainment areas must calculate both the NOx and volatile organic compounds (VOC) emissions for all highway vehicles under two scenarios -- the "build" program and the "no-build" approach. With very limited exceptions, if either NOx or VOC is higher by any amount under the "build" than under the "no-build" case, then the "build" program may not advance.
- As Gov. Voinovich correctly pointed out in his letter to the president, NOx does indeed increase with speed. According to EPA's models, NOx increases gradually with speed after 44 kilometers per hour, and increases more dramatically after 76 km/h. On the other hand, VOC decreases with speed until about 88 km/h, when it starts to increase dramatically. And, unfortunately, based on current models and technologies, both VOC and NOx increase with increased use of vehicles (distance traveled), when all other factors are held constant.

A Basic Guide to NOx, VOC, and Ozone

Like most air-quality issues, however, the chemical relationship between NOx, VOC, and ozone is complicated. Depending on the proportions of NOx and VOC in the atmosphere, reductions in NOx may increase, decrease, or have no effect on an area's ozone level. Also, while there may be no effect in the area where NOx is generated, NOx may be transported long distances to adversely affect other areas.

Potential Effects of ITS

Are ITS strategies likely to increase or decrease VOC and NOx emissions? The answer depends on the specific ITS strategies planned for a particular area. The ITS strategies that accommodate increased travel and support higher speeds are problematic because the models will predict higher NOx emission levels. This can create conformity problems for the entire transportation program -- not just ITS projects.

Nonconformity is already a real problem for dozens of metropolitan areas. Some of these areas have developed transportation programs, which may include ITS strategies, that are forecast to improve speed, accommodate more travel, and reduce VOCs. However, they also show NOx increases, often by very

small amounts. Nevertheless, a NOx increase of any amount is a "no-go," and the program may not be approved until the projected NOx is lowered.

On the upside are ITS strategies that help divert single-occupancy vehicle (SOV) drivers to ridesharing, transit, biking, and other alternatives. These strategies tend to decrease emissions. There are complications, however. Ironically, it is possible that NOx will increase as a result of reducing SOV trips. The reduction in traffic density may result in increased speeds by automobiles and trucks. (If this seems like a Catch-22, it is.)

How can ITS help meet the NOx and VOC challenge? To offset model predictions of increased NOx and VOC, areas are turning to a variety of actions, many of which may draw on ITS technologies -- making transit "smarter" and more efficient; expanding and improving ridesharing programs; beefing up speed limit enforcement, especially for high-emitting trucks and buses; adopting traffic flow improvements that give preference to buses and other high-occupancy vehicles; and providing better information on transit, ridesharing, and bicycle/pedestrian access to potential users.

Don't expect these strategies to have significant effects on VOC or NOx. Even relatively ambitious projects have very small impacts on the overall emissions of a metropolitan area, but very small differences are usually enough to overcome nonconformity problems.

Other, more promising ITS-related strategies include use of onboard vehicle diagnostics and remote-sensing devices at the roadside to detect high-emitting vehicles and refer them for corrective maintenance of their emission controls. These are important because various studies suggest that about 50 percent of emissions are generated by just 10 percent of the vehicles on the road. If these vehicles can be detected and fixed, significant emission reductions are possible. The Federal Highway Administration (FHWA) is funding ITS operational tests of remote sensing in Colorado, Idaho, and Minnesota.

ITS strategies for commercial vehicles also have significant potential to affect emissions. This is because heavy-duty diesel trucks and buses generate significantly more emissions than personal passenger vehicles. For example, heavy-duty diesel vehicles (HDVs) generate 40 percent of all the NOx from the highway sector even though they represent only about 6 percent of the vehicles. The ITS commercial vehicle strategies may improve commercial operations by reducing trips, accelerations, and mileage of HDVs within nonattainment areas.

One other set of strategies to reduce NOx and meet conformity requirements is noteworthy. Some areas in Texas and Pennsylvania are deleting new highway projects from their plans and programs so that the rest of their program can proceed. And at least one area (Houston) is considering downgrading planned highway projects from freeways to arterials because arterials generate lower speeds, which generate less NOx according to the emissions model. These measures may appear drastic to transportation professionals, but environmentalists may applaud them -- not only for air-quality reasons but for a whole host of other environmental and social goals.

Clearly, if traditional highway construction projects are being deleted or revised to meet air-quality requirements, ITS projects may face the same fate. In fact, the EPA recently wrote FHWA to suggest that the suitability of signalization projects in Washington, D.C., be reconsidered because the models showed that the projects contributed to an overall projected NOx increase of 211 kilograms per day in the year 2000.

A Key Modeling Gap Affecting ITS

> The air-quality models, like transportation models, are far from perfect in replicating reality. In the real world, emissions from post-1980s cars are quite sensitive to the pattern and extent of vehicle accelerations. For example, under high acceleration conditions, emissions from new cars can approach the emission rates of precontrolled, 1960s-vintage vehicles. But, just as transportation models leave out the "induced demand" effect of transportation improvements, the air-quality models assume one pattern of driving, omitting from the analysis the effect of ITS improvements that reduce accelerations and decelerations.
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> This is an important gap in the model that may penalize ITS strategies that smooth out traffic flow. EPA's models assume one particular driving cycle -- pattern of acceleration, speeds, deceleration, etc. -- under both the build and no-build scenarios. To the extent that an ITS strategy smooths out the area's driving pattern, reducing the extent of accelerations, it reduces NOx and other emissions. But this will not show up in the build/no-build comparison because EPA's models don't provide for it. So, even though the model results are legally binding for conformity purposes, they should be treated with caution until EPA undertakes more research and refines their models.

Other Concerns

The overriding emphasis on air quality is unfortunate for ITS. It is easy to get lost in the technical air-quality issues, and air quality has tended to obscure the much larger environmental challenges and opportunities for ITS. These other challenges and opportunities include:

- Preserving open space, scenic vistas, agricultural land, endangered species, wetlands, habitat, and water quality.

- Strengthening communities, improving neighborhood livability, preserving historic and cultural resources, and reinvigorating central cities.

- Advancing "environmental justice" by improving environmental and economic conditions for minorities and low-income groups.
- Minimizing consumption of energy resources and other natural resources, and reducing generation of toxic and hazardous wastes.

For most people, these environmental values are at least as important as further improvement in their area's air quality, but they have been eclipsed by air-quality requirements.

ITS can support, detract from, or have negligible impacts on all of these laudable goals. The effect of ITS depends on the mix of strategies, exactly how they are applied, and -- perhaps most of all -- on the yardstick of values and expectations that one uses to measure the impacts.

Different Values, Different Expectations

For many transportation professionals, ITS offers substantial environmental benefits. ITS can accommodate the public's demand for mobility and access to goods and services with a mix of better choices and with few or none of the construction impacts of traditional transportation projects. Wetlands, endangered species, historic and scenic properties, water runoff, ecological habitat, and open space should not be major issues for most ITS strategies. Moreover, ITS promises less congested highways, greater safety, more efficient freight movement, and more efficient and accessible transit, along with other benefits.

But many environmentalists measure the potential impacts of ITS with a different yardstick of values and expectations. For them, the goal is to reduce auto dependence and to improve community livability. Their concern is that ITS will merely perpetuate the status quo and accommodate an auto-dominated transportation system, enabling more vehicles to flow faster and allowing "sprawl" to creep even further out on the fringes of metropolitan areas.

Reconciling the Differences

How can these fundamentally different perspectives be reconciled? The key to reconciliation lies not in technical fine tuning or analysis but in accepting the subjective nature of the differences and in encouraging most of the reconciliation to occur at the state and local levels of government.

Acknowledging the subjective nature of the differences is essential so that the participants in the debate can focus on working out a balance. Objective, data-intensive analysis of ITS and the environment is relevant, but it will never resolve differences in determining community livability or desirable balance between economic growth and protection of natural resources.

Similarly, most of the debate and decision making should occur at the state and local levels. The environmental impacts and values of a particular set of ITS strategies in Houston will be far different from the same set of ITS strategies in Portland, Ore. (Less strikingly, there will even be differences between Seattle and Portland and between Houston and Dallas.) A core goal of the Intermodal Surface Transportation Efficiency Act of 1991 is to provide flexibility in transportation programs so that state and local governments can make the best decisions for their citizens. Also, the results of the 1994 elections seem to suggest a strong preference for shifting public decision making to state and local governments. Thus, it is better for everyone to shift much of the ITS/environmental dialogue to state and local levels.

Of course, it isn't quite as simple as that. National decisions are needed to determine federal funding for ITS and the balance of emphasis in promoting different ITS strategies. Also, environmentalists would probably argue that, in most areas, the state and local transportation decision-making process is currently tilted against environment and community values. Thus, continued federal support is needed so that ITS decisions (and all federally assisted transportation decisions) respond to the needs and values of area residents and to federal interests in interstate commerce.

Conclusion

What can ITS suppliers, supporters, and decision makers do to improve the environmental viability of ITS strategies? They can insist on evaluating the environmental impacts of ITS in a local context. They can work with individual areas to develop specific ITS strategies that balance environmental, economic, safety, and equity goals for that area.

To put it differently, the ability of ITS advocates to meet environmental concerns is only partially a technical or analytical challenge. It is predominantly a challenge to engage in a broad-based discussion with environmentalists at the state and local levels. The success of that discussion hinges on strengthening the state and local transportation planning and decision-making process and on building trust and acceptance for the outcomes of that process.

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