Transportation, Air Quality, and Thinking Big

Pollution Control Requires a Holistic Approach

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Many transportation scholars and practitioners share a strong sentiment that cleaner vehicle technology promises Americans the ability to continue their love affair with the car while cleaning up the air. In recent years, these scholars and practitioners have called the air quality impacts of transportation a nonissue that will vanish with the mass introduction of cleaner vehicles.

Technology Trade-Off

Contrarians have responded that, depending on the technology, emissions attributable to transport will shift from mobile sources to point sources, perhaps yielding little reduction in pollution. For example, emissions are likely to increase from utility companies producing additional power for battery recharges or for devices that prewarm catalytic converters to eliminate the cold start.

These technologies probably will increase environmental lead from battery production and disposal. A well-known Carnegie Mellon Study (McMichael et al., 1995) found that producing and recycling lead batteries would increase lead in the environment, placing at risk the hard-fought reductions in children's blood lead levels. Recent advances in hybrid vehicle technology may reduce these projections of lead pollution; nonetheless, research indicates that the widespread use of lead batteries will have a substantial environmental cost.

Despite these and other limitations, cleaner vehicle technology is critical for any strategy to clean up the air. Citizens should be stampeding local, regional, state, and federal agencies to demand incentives for the production and purchase of ultra low emissions vehicles and zero emissions vehicles; these should be logical choices in the marketplace. But the motivation and expectations for such programs should be clear.

Advantages of Planning

Solving transportation-related air pollution solely through technology is like the heralded Maginot Line designed by France as a foolproof safeguard against German invasion. In other words, the technology-only solution may protect from one environmental threat by rendering society more vulnerable to another.

Transportation planners once were not able to estimate the actual costs and benefits of planned actions. With improvements in computing capacity and geographic information systems tools, it is now possible to address these and many other often overlooked considerations—for example, externalities such as air pollution, or secondary impacts such as land-use changes.

Although there have been great gains in the development of applied analytical tools that link transportation decisions with environmental considerations, the tendency is to choose the path of least resistance. Currently, the United States defines air quality without addressing greenhouse gas production, which increases with combustion, regardless of the power source.

Holistic Approach

Is it wise to solve air pollution by promulgating continued dependence on the automobile? Or would a longer-term strategy that also provides a holistic set of pricing, land use, technology, transportation investment, and other demand-management strategies hold greater promise?

In a Point of View in this issue (page 32), Don Pickrell posits that land-use planning is not a viable means for reducing vehicular travel or for solving air quality problems. However, several studies during the past decade have documented the association of increased levels of land-use mix, density, and connectivity with increased transit use (Cervero and Gorhman, 1995), with reduced vehicle miles of travel (Holtzclaw, 1995; Cambridge Systematics, 1994), and with reduced vehicle emissions per household (Schrooer and Anderson, 2000).

As Pickrell points out, we need more rational land use and better urban design. In a rigorous study of pedestrian travel patterns within 12 neighborhoods in the Seattle, Washington, region, Moudon and Hess found that street network design and other microscale urban designs produced higher levels of nonmotorized travel. In several regions, research is exploring the relationships between aspects of land use and microscale urban designs on physical activity, personal satisfaction, physical and mental health, and overall quality of life.

Land-Use Problems

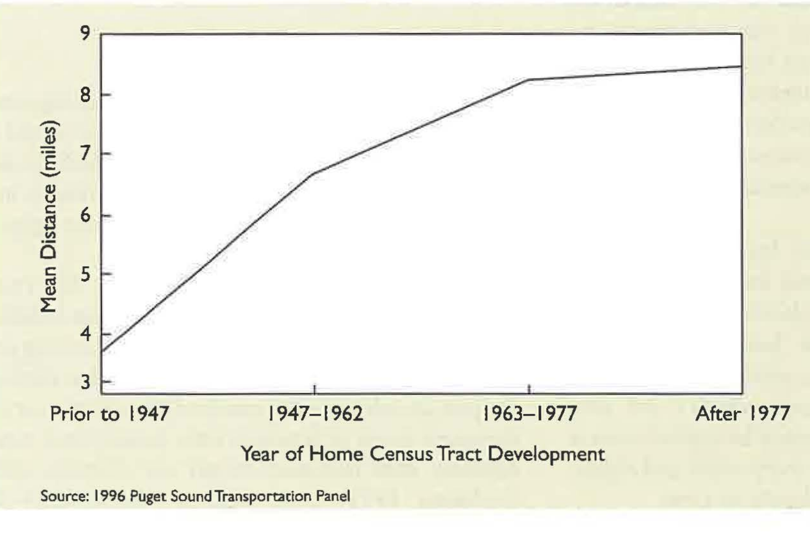
The National Behavioral Risk Factor Surveillance System at the Centers for Disease Control and Prevention has documented a dramatic and steady increase in obesity among Americans in recent decades. Concurrent with this trend is a steady decline in the provision of open space and recreational opportunities within communities and a reduction in the quality of walking environments.

The distances traversed to recreation by households in communities built in the 1970s is nearly two and a half times that for households located in communities developed before World War II (Figure 1).

Land use takes time to change and land-use planning is beset with political difficulties. Concentrating development can have benefits for regional air quality, but often is associated with increases in local traffic and local air pollution. This particularly happens when investments in the local pedestrian environment and in regional transit service are insufficient.

Therefore solving air quality problems through land use alone is as limited a vision as a technology-only solution. The considerations are complex and the results are often counterintuitive.

FIGURE 1 Distances traveled to recreation.



Source: 1996 Puget Sound Transportation Panel

Beyond Land Use

For example, a misinterpretation of the relative increases in per capita vehicle trip generation in urban neotraditional settings might predict the release of more oxides of nitrogen (NOx)—a precursor to ozone formation—from the increases in density, land-use mix, and street connectivity. However, careful modeling would reveal that NOx is more sensitive to distance of travel than to trip generation (Frank et al., 2000). Therefore neotraditional development in certain locations of a region may offer a mechanism to reduce household generation of NOx—which most often means less ozone formation.

In addition, recent studies have linked global warming with increased levels of greenhouse gas emissions. Carbon dioxide, or greenhouse gas, is the direct byproduct of combustion, regardless of the power source; therefore carbon dioxide likely will require more serious and aggressive strategies to bring cleaner power sources online and to reduce per capita levels of energy consumption.

Preference Surveys

Approaches to behavior modification, such as changing land use, are viewed as unacceptable forms of social engineering—telling people what they should or can do. But if the critics are sincere, they should support stated preference surveys of people's attitudes and values, to provide a credible basis for defining demand, and then work creatively to provide the preferred alternatives.

Observed demand argues that the home-buying public desires low-density single-family dwellings in single-use environments. This assertion provides no sensitivity to the lack of choices offering competitive alternatives to the car yet meeting the basic requirements of school quality, security, and open space.

The cities of Portland, Oregon; Seattle, Washington; and Calgary and Edmonton, Alberta (Canada), recently conducted stated preference surveys to understand the influences on residential location choice. According to the surveys, a significant segment of the public thinks that current developments fail to provide walkability and nearby services, resulting in too much time behind the wheel.

A recent study conducted by Jonathan Levine of the University of Michigan revealed that Bostonians were more satisfied than Atlantans with the form and physical layout of their communities and identified the level of walkability as the primary explanatory variable. Boston, Massachusetts, has a highly heterogeneous urban form with many different types of land-use patterns to choose from, facilitating a match between preferences and community type. Conversely, Atlanta, Georgia, is relatively homogeneous, with 82 percent of the population located in residential densities of fewer than four dwelling units per acre (see Figure 2). Moreover, Atlanta has very few environments that are accessible on foot (Bachman, Frank, and French, 2001).

Product Types

Equating observed demand with actual demand for residential product type—particularly within the context of a constrained choice set—is itself a form of social engineering. Current land-use practices limit the supply of product types that offer the ability to walk short distances and to concentrate trip ends, either at residential or employment locations—a prerequisite for support of regional public transport.

Chris Leinberger, managing partner of Robert Charles Lessor and Company and partner in Arcadia Land Company, maintains that there are a total of 21 real estate product types supported by Wall Street and eligible for conventional financing. Only three of these are not completely dependent on the automobile. However, the demand for an urban form that is less dependent on the automobile is no longer a secret; the radical increase in cost-for-quality, "inside the beltway" housing in the past decade strongly articulates the point.

Other Impacts

There are many other impacts often not factored into the typical transportation or land-use decision-making calculus. Among the most critical are the following:

1. Time use. Increased time driving each day eats into time available for familial and personal activities such as walking and other health-improving recreation. In a 1982 paper, Hupkes posited the "law of constant travel time," suggesting that time spent traveling is relatively consistent for nearly all Americans. Through a regional household travel survey, Keith Lawton of Portland (Oregon) METRO found that total reported travel time was consistent across differing land-use patterns and regional locations (urban, suburban, and exurban). Moreover, increases in time spent driving may result in less time spent walking.

2. Cost of infrastructure. Higher per capita costs of infrastructure have been associated with reduced-development densities. This is perhaps best documented in the two *Costs of Sprawl* studies by Burchell and Listoken of the Rutgers University Center for Urban Policy Research.

3. Increased consumption of raw land. The American Farmland Trust has conducted many studies demonstrating the economic and environmental impacts of converting raw land and productive farmland to urban use. The Turner Foundation has funded research on the environmental impacts of urban encroachment, particularly on the loss of habitats critical to endangered species.

Expanding the Art

Pedagogical gains are required to train future transportation planners in the art of assembling transportation investments, land use, and demand-responsive strategies into meaningful scenarios for a range of urban scales and conditions. Otherwise, the profession will become narrow, myopic, insensitive, and ineffective at problem solving. Transportation planning already is vulnerable to attacks on the environmental and social implications of plans and actions. Transportation decisions affect environmental justice, air quality, public health, and other concerns.

Improved information should enable problem solving in strategic and meaningful ways that show awareness and concern for a multitude of physical and social considerations. Unlike the French in World War II, transportation planners have a variety of advance information. However, planners also need strategies to address challenges from more than one direction. Narrowly focused solutions—whether relying solely on technology or solely on land-use planning—are likely to yield marginalized and perhaps even negative results.

FIGURE 2 Net residential density in Atlanta measured in square kilometers. (Source: Bachman, Frank, and French, Center for Geographic Information Systems, Georgia Institute of Technology)

Units / Acre	Res. Units	Sq. km
0-1	298869	8247
1-2	292682	1309
2-4	344500	920
4-8	164706	259
8+	46319	43