

Transportation and Central Cities: Environment and Quality-of-Life Issues

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Environmental protection and quality-of-life issues are an important part of the public policy agenda in the United States. Issues such as air and water pollution, exposure to toxic chemicals, and threats to endangered species have dominated the public discourse on the environment over the past several decades. Nevertheless, it has long been recognized that the urban, built environment is also critical to quality of life for most Americans, and recently, urban environmental and quality-of-life issues are beginning to command more attention.

In this paper, transportation and its relation to environmental and quality-of-life issues faced by large cities, in particular the central cities of the largest metropolitan areas of the United States, are examined. Our changing conceptions of environmental quality and its relation to human well-being are briefly examined. Environmental and quality-of-life issues that commonly arise in the central cities of large metropolitan areas are outlined. Emerging initiatives for addressing these issues in a manner that reflects the growing understanding of the interrelationships among social factors, the economy, and the environment are reviewed. Possible research initiatives and other next steps are proposed.

CHANGING CONCEPTIONS OF ENVIRONMENTAL QUALITY

Early conceptions of environmental problems typically focused on the contamination of specific media—air, water, soil—or on threats to human health, to plants and wildlife, and to sensitive lands such as coastal zones. Programs were structured accordingly, to reduce air pollution emissions, regulate discharges into waterways, control solid waste disposal, protect species, and so on.

Programs for environmental protection established in the 1970s and 1980s have accomplished a great deal. For example, new vehicle emissions have been reduced by 60 to 90 percent, significantly reducing the exposure of the American population to unhealthy air despite substantial growth in vehicle use. Far more bodies of water are swimmable, fishable, and drinkable than was the case 30 years ago. Wetlands and waterways—once routinely filled for

some transportation facilities, dredged for others—are now protected by increasingly sophisticated design processes involving the best of engineering and biology and extending to important restoration projects.

However, as our understanding of ecological processes has deepened, our characterization of environmental issues has changed. First, our list of environmental issues has expanded; in addition to the issues listed earlier, today's list would add several items and reformulate others. Figure 1 (1) presents one such list; a brief examination shows that it reflects an expanded view of environmental problems along several dimensions:

- Time frame: from obvious and immediate to indirect and long term;
- Scale: from local to regional; from regional to global; and
- Scope: from direct to secondary and tertiary; system effects.

We also have deepened our understanding of the interrelationships of environment, economy, and society. In earlier times, social, economic, and environmental impacts were treated as largely separate issues; environmental protection was often discussed as requiring a trade-off with economic development, and the challenge for planners was to find an acceptable balance between the two objectives (i.e., to optimize economic benefits given specified environmental and social constraints). Now we increasingly understand that social, economic, and ecological systems are linked in complex and dynamic ways and that simple trade-off analyses or optimizations largely miss the point.

Our emerging understanding of the functioning of these systems indicates the following:

- System conditions or states are not constant, and change is not gradual or continuous, but episodic.
- Spatial organization is patchy, and as a consequence, scaling up is nonlinear.
- Multiple forms of organization can coexist. Many systems have multiple equilibria.
- Movement between multiple equilibria can help maintain diversity or can result in severe disruption, depending on what is valued and how systems are managed.

These findings on systems characteristics and functions suggest that policies and programs for the management of environmental effects will do better if we move away from approaches that call for the development and implementation of a single “optimal” plan.

- Emissions of air pollutants, including NO, hydrocarbons, CO, and particulates
- Emission of ozone-depleting gases and substances
- Emission of greenhouse gases
- Acid deposition and changes in soil and water chemistry
- Permanent alteration of physical landscape by infrastructure
- Loss or displacement of wildlife and habitat at or near the site of new facility; increased incidence of road kills
- Changes in hydrology and resulting changes in fires, flood regimes, nutrient and seed flows
- Habitat fragmentation and barriers to essential movements (feeding, reproduction)
- Introduction of exotic species/pests due to releases or creation of new corridors (canals, highways, etc.)
- Sedimentation and eutrophication of streams due to runoff
- Contaminants in roadside soils and nearby drainage channels and receiving waters
- Contamination of groundwater and receiving waters over larger watershed
- Physical evidence of damage to some roadside vegetation
- Decline in sensitive aquatic species within larger watersheds or drainage basins
- Chemical releases and spills into soils and water due to accidents and leaks
- Noise
- Vibrations
- Shadowing / reduced light
- Loss of views
- Wind tunnel effects

FIGURE 1 Some environmental effects of transportation (1).

Instead, a flexible, adaptive, and experimental approach that can operate at different scales and respond to dynamic situations is far preferable (2).

ENVIRONMENTAL AND QUALITY-OF-LIFE ISSUES IN CENTRAL CITIES

The emerging systems concept of the environment as a social-economic-ecological system helps make sense of the environmental and quality-of-life issues in central cities. Certainly, there are substantial differences in cities' and regions' natural and built environments as well as in their historical development, population characteristics, regional and local economies, growth rates, and so on. Nevertheless, the following issues face many central cities of large metropolitan regions:

- High densities of development and a substantial mix of uses—conditions that create markets for diverse services but that also concentrate adverse effects.
- Heavy presence of major transportation facilities (freeways, transit, rail yards, ports, trucking facilities, warehouses, airports)—creating high levels of connectivity but with resulting noise, congestion, and exposure to emissions and other externalities of transport operations.
- Heavy transportation and other service demands imposed by a large daytime population of employees.
- Special transportation and other service needs resulting from concentrations of poverty, non-English-speaking immigrants, elderly households, and so on.
- Special needs for transit and paratransit (taxi, shuttles, etc.) resulting from high levels of intercity and international tourist and business travel.
- Substantial dependence on transit stemming from the confluence of residents, visitors, and workers without automobiles, even in regions with very high automobile ownership and use levels.
- Parking problems: the high cost of providing parking in thriving areas; shortfalls of parking in older districts; reliance on on-street parking for both commercial and residential uses; vast surface parking lots in areas with weak land markets.
- Through traffic and nonresident parking spillover in residential neighborhoods.
- Worn out or obsolete infrastructure (roads, transit facilities, sewer, water, power systems).
- Brownfields and abandoned or obsolete industrial and commercial land uses.
- Shortage of open space and recreational facilities.
- Problems of housing affordability in some neighborhoods, need for rehabilitation in others.
- Continuing problems of housing discrimination and segregation by race, ethnicity, income, and class.
- Lack of jobs for lower-skilled city residents, necessitating training programs, reverse commuting services, and so forth.
- Land use and taxation policies that limit market-based redevelopment, provision of affordable housing, and so forth.
- Crime or fear of crime.
- Concerns about school quality, measured by physical plant, class size, course offerings, and test scores.
- Concerns about the quality and cost of urban services (garbage collection, street cleaning, graffiti removal, etc.).

These issues do not fall neatly into social, economic, and environmental categories, but instead span them, overlap, and interact with one another. Some are largely local issues, but many connect to the role of the central city in the larger region. Some could probably be solved through local action, at least if more money were available, but others would require a concerted regionwide effort to deal with underlying social and economic factors. In short,

the issues call for a multifaceted and flexible approach, accompanied by ongoing monitoring and adjustment in direction as necessary.

STRATEGIES FOR ADDRESSING ENVIRONMENT AND QUALITY-OF-LIFE ISSUES IN CENTRAL CITIES

A number of strategies for addressing the intertwined issues of transportation, land use, environmental quality, economic development, and quality of life in central cities have emerged in recent years. Five strategies that appear to have wide potential are presented briefly here, ordered from the simplest to the most complex. The five are mapping and modeling based on geographic information systems (GIS), traffic calming, livable communities and brown-fields programs, community-building initiatives, and sustainable development programs.

GIS-Based Mapping and Modeling

GIS have the potential to serve as a powerful planning tool, both by organizing data in new ways and by allowing the visualization of relationships that otherwise might not have been apparent. GIS applications are increasingly used in studies of environmental equity; for example, GIS analyses have been used to investigate the relationship between toxic releases and income and racial-ethnic composition of the population at the census tract level (3, pp. 44–50). Other recent applications of GIS in environmental analysis and impact display include

- Mapping air pollution levels, congested traffic links, and noise exposures by population and employment characteristics of an area;
- Mapping prime agricultural lands and habitat for endangered and threatened species in support of analyses of regional transportation plan alternatives and their effects;
- Mapping of brownfields at the parcel level, with an analysis of their effects on adjacent property values;
- Analyses of transit service levels versus community income levels, race, and other socioeconomic characteristics; and
- Use of GIS as a platform for urban land use and location choice modeling.

The availability and quality of GIS systems currently is spotty at both the metropolitan level and among central cities. The lack of staff with the requisite skills to develop and use GIS effectively is one reason for this, but in most cases the problem really comes down to money: if funds were available, GIS could and would be set up and used. Costs could be substantial in the first year or two, to get the basic system established; after that the continued application of GIS to environmental and other planning issues would be relatively straightforward.

Traffic Calming Programs

Traffic calming refers to a set of strategies including street designs and retrofits, changes in operations, and traffic controls, designed to reduce adverse traffic effects such as speeding and excessive volumes and to improve safety and amenity (Figure 2). Traffic calming is often applied on existing streets, but the basic concepts are being incorporated into the design of new streets and the layout of new developments.

More than 350 U.S. cities and counties are reported in the literature to have tried traffic calming over the past 30 years. A 1997 survey found that the principal objective for traffic calming is improved safety, especially of children and pets in residential neighborhoods, but a substantial number of cities also use traffic calming as a crime prevention measure and have

- Stop Signs
- Speed Limit Signs and Speed Zoning
- Turn Prohibition Signs
- One-Way Street Designation
- Traffic Signals
- Access Controls
- Truck Restrictions
- Parking Controls
- Lateral Bar Pavement Markings
- Lane Reduction
- Chokers
- Traffic Circles
- Median Barriers
- Semidiverters (Half-Closures)
- Diagonal Diverters
- Cul-de-Sacs
- Pavement Undulations (Speed humps)
- Raised Intersections
- Traversable Barriers
- Complete Street Closures
- Play Streets
- Private Streets

FIGURE 2 Tools for neighborhood traffic control.

incorporated traffic calming as one element in their community policing programs. Still others use traffic calming to respond to neighborhood complaints about traffic violations and rude driver behavior [racing to catch a light, littering, doing “donuts” (spinning a car) in an intersection]. A number of respondents reported that traffic calming stemmed from a general interest on the part of the city in quality of life, neighborhood livability, and, in some cases, neighborhood empowerment (4).

Traffic calming strategies are effective ways to reduce cut-through traffic and speeding in residential neighborhoods and may have applications in neighborhood commercial districts. Hence they are good candidates for reducing common traffic problems in inner cities and older suburbs. However, unless coupled with major efforts to promote the use of alternative modes (transit, walking, biking), they do little to reduce overall traffic volumes and in fact may worsen congestion on major arterials to which through traffic is redirected. In addition, some traffic calming schemes increase fuel use and emissions by making routes more circuitous or increasing stops and starts. Most jurisdictions recognize these trade-offs but believe the benefits in neighborhood quality of life outweigh the detriments.

Funding for traffic calming is a problem for many jurisdictions. Most localities pay for traffic calming out of the general fund, where traffic calming must compete with many other worthwhile projects. Many jurisdictions report that funding constraints restrict their traffic calming programs in both scope and strategy, permitting only a portion of their highest-priority projects to be implemented. In addition, many would use different (more expensive) designs if more money were available. For example, speed humps are often used because they are cheaper than other traffic calming devices, even though they may not be the preferred choice aesthetically or from a traffic operations perspective. Finally, funding shortages have led some jurisdictions to respond to complaints on a spot basis, whereas with more money the city would have done neighborhoodwide planning instead.

A number of other funding sources have been used to supplement local general funds, including gasoline tax subventions, local sales tax revenue dedicated for transportation, and revenue from city and county license plate fees. In addition, a number of jurisdictions are now making the evaluation of neighborhood traffic effects a formal part of their develop-

ment reviews and are assessing fees or requiring specific actions for traffic calming. Also, one city in three requires residents to pay for all or a part of the cost of traffic calming installations. Some believe this requirement serves as a useful test of resident commitment to the planned changes, but others are concerned that such a payment deters poorer neighborhoods from seeking needed changes.

Very few jurisdictions have used federal money for traffic calming, and those that have are more likely to have received it from the Department of Housing and Urban Development than from the Department of Transportation. Intermodal Surface Transportation Efficiency Act (ISTEA) flexible funds have been used in a few jurisdictions, but most have not even looked into ISTEA funding for traffic calming, citing other pressing needs for the money as well as concerns that the pursuit of federal funds would be too time-consuming and costly.

Livable Communities Initiatives

A burgeoning set of initiatives aim to revitalize neighborhood and commercial districts through a combination of infill and redevelopment projects, traffic management, and improvements to transit, pedestrian, and bicycle facilities. These initiatives are being implemented under a variety of names: livable communities, transit-oriented development, pedestrian-oriented development, and neotraditional town plans, among others. The initiatives share the belief that higher-density and mixed-use developments and coordinated transportation facilities can bring a new vibrancy to city districts, making them attractive places to live and work and at the same time reducing transportation requirements below what they otherwise would be.

Livable communities initiatives vary widely in scale and scope, from individual projects around transit stations to regionwide efforts such as those embodied in Portland, Oregon's 2040 plan. One fairly typical example is the Metropolitan Transportation Commission's Transportation for Livable Communities (TLC) program, established in 1997. Initially the TLC program is focusing on inner-city and older suburban neighborhoods in San Francisco and the East Bay and is providing seed money for community-based planning efforts plus "on call" technical assistance in working with developers on project concepts and designs. First projects include (a) a plan for new vendor stalls, bus shelters, community art, and a building providing community and commercial space at San Francisco's 16th Street Bay Area Rapid Transit (BART) station, and (b) a West Oakland neighborhood transportation plan intended to better connect residents to neighborhood shopping, downtown Oakland, the West Oakland BART station, and other key points. Both projects involve partnerships with developers and community groups as well as joint funding by several government agencies.

Brownfields redevelopment programs are another variant on the livable communities theme. Brownfields are abandoned or underused parcels of land located primarily in urban areas. They contain or are suspected to contain some level of contamination, but they are not considered degraded enough to be listed by the U.S. Environmental Protection Agency (EPA) as "Superfund" sites. Brownfields may range from the former site of a refinery or steel plant to an abandoned dry cleaning establishment.

EPA and several states have recently embarked on programs to encourage brownfield redevelopment. Proponents argue that the reuse of urban brownfield sites is important both to mend the urban fabric and to reduce pressures for development on the suburban fringe. They contend that the full costs of brownfield development are usually lower than those of "greenfield" development, since transportation, utilities, schools, and roads are already in place for the brownfield sites. The most commonly proposed uses for brownfields are light commercial or industrial, but a California study found that some parcels also could be used for housing, community gardens, parks, open space, and recreation (5). Indeed, endangered species have been identified on several brownfield sites.

Skeptics raise a number of questions about the efficacy and feasibility of both livable communities initiatives and brownfield redevelopment programs. The critics question the size of the market for infill development as well as its political feasibility given typical neighborhood

concerns about traffic and other effects. They doubt that developers will be interested in most of the sites or products being proposed, at least without a subsidy. They also challenge claims made by proponents that automobile use will be substantially lower among inner-city dwellers. Brownfield programs in addition face pressing concerns about the costs, feasibility, and long-term performance of cleanup efforts. Current programs attempt to alleviate these concerns through a variety of assurances and releases by assisting with planning, helping to secure project financing, and so on. But federal and state agencies have limited funds to help with site cleanup, and buyers, lenders, and developers often remain reluctant to invest in a site when cleanup costs are uncertain and liability risks may remain. In addition, as with other redevelopment projects, there often are concerns that the market for a particular site is too weak to justify investment, especially if developers have different ideas of what uses might be appropriate from those of environmentalists, area residents, or local government.

Proponents of livable communities and brownfield redevelopment efforts have attempted to respond to these challenges through program design and partnership building. Active promotion of redevelopment, facilitation of stakeholder participation and dispute resolution, assistance in the development of a cleanup program if necessary, market assessments of development or reuse options, recruitment of potential developers, and assistance in putting together a finance package are among the elements of the most aggressive of these programs. In addition, the emphasis on partnerships is intended in part to build support for implementation and to overcome barriers that might otherwise arise through a lack of understanding of the options.

Community-Building Initiatives

Community-building is a term that has come to be used to describe a variety of efforts being undertaken in inner cities and older suburbs to improve K-12 education; expand housing opportunities; revitalize commercial districts; create jobs and provide job training; rebuild streets, transit, and other infrastructure; clean up and redevelop brownfields and abandoned and obsolete land uses; and restore urban creeks, beaches, and parks and recreational facilities. Community-building efforts thus address a full range of social, economic, and environmental issues with the aim of improving the quality of life for city residents.

Like the livable community and brownfields initiatives discussed previously, community-building initiatives emphasize the development of partnerships between local government, federal and state agencies, community-based nonprofits, and area businesses. The Department of Housing and Urban Development has provided support for these efforts, but other federal agencies including EPA, the Departments of Commerce and Education, and the Federal Transit Administration have also been major contributors. In addition, urban universities often play an important role in community-building efforts through their professional schools, where fieldwork, applied research, teaching, and professional practice or clinical experience are important parts of the educational experience.

Effective community-building efforts can take a number of forms, reflecting the size and characteristics of the community, the specific issues to be addressed, and the partners' previous experiences with one another. Sockett (6) presents a typology of partnerships in which one-directional service relationships are the simplest, followed in increasing complexity by exchange relationships involving sharing of resources, cooperative relationships involving joint planning, and finally transformational relationships in which the participants are fundamentally changed by their joint efforts. Other authors view only the latter types of relationships as partnerships per se. In particular, Wolshok (7) argues that mutual self-interest and common goals for the relationship; a willingness to share decision-making authority over the agenda, priorities, and resources; a willingness to make a long-term commitment to joint efforts; and real money on the table to support the partnership's efforts are all critical elements in successful community-building. Rubin et al. (8, p. 18) also identify mutual individual or collective benefit as the indication of a true partnership; in their view, a major objective is to build the capacity to tackle complex issues that no one partner could address

alone. Gruber (9) has further described these actions as creating social, intellectual, and political capital—the trust and relationships that make cooperation possible; shared learning and an enlarged pool of knowledge about the community, its wants and needs, and workable strategies for intervention; and the ability to turn agreed-upon objectives into solid accomplishments.

Long-term community-building initiatives have been under way in St. Louis, Detroit, Oakland, Boston, and New Orleans, among other cities. In the case of Oakland, the University-Oakland Metropolitan Forum provides an example of both the potential and the limitations of the community-building approach. The forum is a long-term collaborative effort among the University of California, the city of Oakland, and four other colleges; it combines university and community resources to address a wide range of concerns—academic, economic, social, environmental. Over the years the forum has convened citywide leadership groups, evaluated major city initiatives, provided technical assistance, conducted research, and designed and implemented community projects in cooperation with city agencies and nonprofit organizations. The forum maintains networks in the community and among the participating universities, develops proposals, raises funds, and mobilizes students and faculty to work on needed topics. Work is done through a variety of methods including studio courses, internships, and funded research and action projects. Support has come from foundations; federal, state, and city contracts; and special funds from UC Berkeley.

The forum's earliest initiatives focused on education, aiming to improve the quality of schools through a variety of actions including teacher training, student mentoring, tutoring programs, specialized academies, and job placement programs. More recently, the UC Berkeley/Oakland Joint Community Development Program, carried out with funding from the U.S. Department of Housing and Urban Development, has worked on neighborhood commercial revitalization, community networking efforts, a neighborhood environmental watch project, a nonprofit management technical assistance program, a housing rehabilitation program, and a job network pilot project.

Participants in the forum programs meet together as a group every few months to share experiences, discuss problems and opportunities that have arisen, and brainstorm about future directions. From these sessions, a picture of accomplishments has emerged. Participants are proud of the direct results produced by their collaborative efforts—the trees planted, facades renewed, plans developed, training completed, and so forth. They also are convinced that the collaborative efforts have helped them learn and grow as individuals and organizations, and that they have accomplished more through group action than their individual efforts could have produced. Still, the participants are concerned about funding for the longer term and about how to move from the largely project-level focus to a neighborhoodwide and city or regional perspective. They also are concerned that whereas efforts have been effective at the small scale, more active involvement of elected officials and other key community leaders will be necessary to have a greater effect.

A related issue is that community expectations sometimes run higher and faster than community-building projects can produce, especially when volunteer efforts are a major part of the resource base. Those expecting a quick, concrete product may become impatient and dismiss the effort as ineffective or drop out before ideas can jell and programs get under way. An important part of the benefits of community-building may be intangible and indirect, for example, increasing the level of trust among participants, which in turn increases their longer-term capacity to be productive. But these results are not easily measured or observed, and reviewers who overlook the less immediate or obvious products of collaboration may underestimate the benefits. Moreover, both participants and reviewers may underestimate the time and work needed to build organizational capacity and undertake institutional change, or they may downplay the difficulties of status and resource differences among partners and thus paper over rather than deal with the issues of power and powerlessness that often come to the table along with the participants. Designing processes that generate enthusiasm and build hope and confidence without becoming oversold is a difficult challenge for most partnerships.

Sustainable Development Initiatives

Concerns about environmental quality, social equity, economic vitality, and the threat of climate change have converged to produce a growing interest in the concept of sustainable development. Whereas a variety of definitions of sustainability have been proposed (Figure 3), definitions that encompass the full set of community and environmental issues that are at stake are increasingly being put forward.

Sustainable development initiatives have been motivated in large part by concerns about global climate change—the greenhouse effect. Scientists generally agree that increasing concentrations of greenhouse gases (water vapor, carbon dioxide, methane, nitrous oxide, halocarbons) in the atmosphere are causing the average temperature of the earth to rise, though the timing, magnitude, and consequences of this temperature increase are not fully understood or agreed upon and doubters are vocal. Most analyses have predicted that warming could be on the order of 1°C to 4°C within a century. Average temperature increases of this magnitude could produce marked changes in precipitation patterns, with accompanying disruptions in other natural systems.

The United States, the largest energy user in the world, is also the largest emitter of carbon dioxide, currently accounting for almost one-fourth of the total. U.S. carbon dioxide emissions come from transportation activities, residential and commercial activities, and industrial processes in roughly even shares. Surface transportation alone is 25 percent of the U.S. total. Three-quarters of that 25 percent, or about 16 percent of greenhouse gas emissions, currently are from personal vehicle use.

The Kyoto Protocol hammered out in 1997 was a significant step toward the reduction of greenhouse gas emissions over the next decades. The protocol sets forth targets for industrialized nations averaging out to about 5 percent below 1990 levels by the 2008–2012

Sustainability. Meeting the needs of the present without compromising the ability of future generations to meet their own needs

- World Commission on Environment and Development 1987

Sustainable Transportation: Transportation that does not endanger public health or ecosystems and meets mobility needs consistent with use of renewable resources below their rates of regeneration, and use of non-renewable resources at below the rates of development of renewable substitutes

- OECD

Sustainability: Relationship between human economic systems and larger dynamic, but normally slower-changing ecological systems, in which (1) human life can continue indefinitely, (2) human individuals can flourish, and (3) human cultures can develop; but in which effects of human activities remain within bounds, so as not to destroy the diversity, complexity, and function of the ecological life support system.

- Costanza 1991

Ecological sustainability: refers to ecosystems and maintenance of their integrity. *Economic sustainability:* refers to the market-based perspective that is premised on the fundamental assumption of maximizing rather than foregoing growth and consumption. *Social sustainability:* refers to the ability of people to take collective actions to strive for fair access to the benefits of human progress

- Berke and Kartez, 1995

Sustainable Transportation: Allows the basic access needs of individuals and societies to be met safely, and in a manner consistent with human and ecosystem health, and with equity within and between generations; is affordable, operates efficiently, offers choice of transport mode, and supports a vibrant economy; limits emissions and waste within the planet's ability to absorb them, minimizes consumption of non-renewable resources, reuses and recycles its components, and minimizes the use of land and the production of noise.

- Centre for Sustainable Transportation (Canada), March 1998

FIGURE 3 Definitions of sustainability and sustainable transportation.

period. For the United States, the target level is a 7 percent reduction by about 2010; additional reductions would follow in later decades.

Finding ways to achieve such a reduction in greenhouse gas emissions is a major challenge, particularly in light of the fact that, absent strong new action, emissions are projected to increase substantially over the next several decades. In the U.S. transportation sector, for example, after accounting for projected growth, reductions of as much as 40 percent from projected baseline levels would be required by about 2010.

Strategies to reduce transportation greenhouse gas emissions could involve substantial changes in vehicles and fuels, strenuous demand management, or both. Figure 4 shows some of the strategies most commonly suggested; the list is similar to ones produced for energy conservation in earlier decades and for current transportation–air quality and traffic mitigation planning. Drawing on experiences and studies of these measures, scenario testing (1) has produced estimates that the following greenhouse gas reductions might be achieved in the United States:

- From aggressive demand management and land use planning strategies, 6 percent reduction by 2020, 15 percent by 2040;
- From a 1.5 percent annual increase in average new vehicle fuel efficiency, 15 to 20 percent reduction by 2020, 35 percent by 2040;
- From higher fuel prices amounting to a 3 percent increase per year, 20 percent reduction by 2020, 40 percent by 2040; and
- From the introduction of new low-emissions vehicles (5 percent of fleet by 2020, 35 percent by 2040), no significant change by 2020, 30 percent reduction by 2040.

If these estimates are approximately correct, meeting the Kyoto Protocol reductions would require either aggressive changes in vehicles (fuel efficiency levels, technologies) or their fuels or a combination of vehicle, fuel, and demand management strategies. Considerable uncertainty about implementation feasibility attaches to each of the scenarios, suggesting that further consideration of the full range of options is a prudent strategy.

National policy directions are still under development and are moving fairly slowly at the time of this writing. On the other hand, local initiatives are under way: in the last 5 years sustainability initiatives have been undertaken in several dozen cities and regions here and abroad. Among those in the United States are the Maryland Smart Growth Initiatives, the Portland (Oregon) 2040 Plan, Sustainable San Francisco, Sustainable Seattle, and The Bay Area Alliance for Sustainable Development. There also are important examples from the Netherlands, France, and Germany.

These efforts largely follow on the Brundtland Commission report and in the United States on the PCSD report, “Sustainable America—A New Consensus,” which argued that sustainable development can only be achieved by building sustainable communities. Reflecting the recommendations and action items in those precedent documents, the local and regional efforts typically focus on the interrelationships among transportation, housing and employment trends and policies, and the resulting consequences for the environment (especially air quality), energy use, economic prosperity, and social equity. Indeed, it is an interest in this broader set of issues rather than a concern about climate change alone that has stimulated most of these efforts.

The leaders of the sustainability efforts, like those in community-building efforts, put considerable emphasis on developing partnerships for planning and implementation. Consequently the plans typically involve a wide range of interests (business leaders, environmentalists, social justice advocates, etc., as well as public officials and agency staff members). Agreements on roles and responsibilities, including commitments to implementation, are often negotiated as part of the planning process, and the indicators for monitoring progress and performance are developed.

Critics of sustainability efforts raise doubts about the need for action, the efficacy of the measures that can be implemented, and the feasibility of those that appear effective. Proponents counter that the difference between current and past efforts is that the new

Emissions

Vehicle / Fuel Technological Changes:

1. Improved Efficiency of Conventional Vehicles

- Manufacturer Innovations / Supplier Offerings
- Responses to Consumer Demand
- Responses to Government Regulation and Incentives: CAFE Standards, R&D Partnerships, Taxes, Rebates, Subsidies

2. New Vehicle Technologies

3. New Fuels

Road/Vehicle Operations Improvements:

1. Conventional Traffic Flow Improvements

- Traffic Signal Timing, Ramp Metering, Flow Metering, Bottleneck Removal

2. Intelligent Transportation System Improvements

- Smart Highways
- Smart Vehicles
- Accident/Incident Management
- Routing and Scheduling Enhancements

3. Driver Education

4. Improved Logistics and Fleet Management

Demand Management:

1. Modal Substitution

- Transit, Paratransit, Ridesharing, Walking, Biking Improvements and Incentives
- Rail Substitutes for Truck

2. Telecommunications Substitutions

- Telecommuting
- Teleshopping
- Teleconferencing
- Distance Learning
- Information Technology-Enhanced Routing and Scheduling (Passengers, Freight)

3. Pricing Incentives / Disincentives

- Gas Tax Increases
- Vehicle Sales Tax Based on Fuel Efficiency and Expected Life
- Vehicle Registration / License Fee Based on Fuel Efficiency, Use (Measured or Estimated)
- Other Impact Fees Based on Use
- Subsidies for Preferred Modes, Telecommunications Substitutes, etc.

4. Land Use-Transportation Strategies

- Compact Development
- Mixed Use Development
- Higher Development Densities
- Transit, Pedestrian, Bike Friendly Development

FIGURE 4 Strategies for reducing transportation greenhouse gas emissions.

processes are devoting considerable attention to implementation issues, in contrast to earlier planning efforts, which merely produced a technical plan. It is still too early to tell whether their efforts will prove successful.

OPPORTUNITIES FOR RESEARCH AND ACTION

The environmental and quality of life issues faced by central cities in the largest metropolitan areas of the United States are complex and changing, reflecting the web of connections among social, economic, and ecological systems. Specific concerns range from noise, air, and water pollution to issues of development policy and social equity. All are deeply dependent on community values.

Programs to address central city environment and quality-of-life issues are beginning to reflect this broader understanding of system effects and the need for flexible, adaptive, and experimental management approaches. Among the promising initiatives are GIS-based mapping and modeling, traffic calming programs, livable communities and brownfields redevelopment initiatives, community-building initiatives, and sustainable development programs. The latter programs, in particular, emphasize the development of partnerships for planning and decision making, which, in contrast to earlier technically focused plans, offer important new prospects for effective implementation.

Future work could profitably evaluate the efficacy of the various initiatives and explore their interrelationships. The extent to which partnership approaches are successful in fostering implementation is a topic that deserves special attention. Finally, if the evaluations are favorable for some of these programs, it would be worthwhile to develop mechanisms to put the successful programs on a stable financial footing.

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