New York State Response to the Mandates of the Clean Air Act

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The Clean Air Act Amendments of 1977 require urban areas currently in nonattainment of national air quality standards to develop a control plan that will permit them to achieve the standards by 1982. The amendments also recommend consideration of 18 control strategies for those areas in violation of standards for transportation-related pollutants. This paper describes the approaches taken for seven upstate New York urban areas found to be in violation of air quality standards for transportation-related pollutants. It describes pollutant concentration monitoring, emissions modeling, and control strategy evaluation activities undertaken by the New York State departments of transportation and environmental conservation and the metropolitan planning organizations for these urban areas. Preliminary estimates of the effectiveness of the recommended mobile-source control strategies are given, as are discussions of the nonair quality impacts of the strategies.

The Clean Air Act Amendments of 1977 mandate that all states identify and notify the U.S. Environmental Protection Agency (EPA) of areas within their borders that are in violation of the national ambient air quality standards (NAAQS) (1). States that have such noncompliance areas must demonstrate that, through the incorporation of control strategies in their individual state implementation plans (SIPs) for achieving air quality, these NAAQS will be attained everywhere within their borders by 1982. If it is determined by a state that these standards will not be met by 1982 (even though all reasonably available emissions control measures will have been implemented through revised SIPs), that state may request from EPA an extension to 1987 of the deadline for achievement of the air quality standards.

Revised SIPs (or evidence that revised and effective SIPs are being developed) are to be submitted to EPA by the end of 1978 for approval. If a state fails to meet this requirement, the amendments provide for the imposition of a number of sanctions in the form of restricted or reduced federal funding for highways, loss of federal funding for state and local government air pollution control programs, and further restrictions of new sources and modifications to existing sources of air pollution in areas that are in violation of the standards. This paper summarizes the planning activities of the metropolitan areas of upstate New York to develop transportation elements of the SIP that will meet the requests of the act.

NEW YORK STATE'S APPROACH TO CONTROL STRATEGIES

The two major mobile-source pollutants are carbon monoxide (CO), and photochemical oxidants, generally referred to as ozone (O_3). For mobile-source (motor-vehicle-caused) pollutants, the Clean Air Act Amendments of 1977 require an investigation into the effects of 18 emission control strategies or reasonably available control technologies (RACTs). Broadly speaking, these RACTs may be classified as (a) those that involve vehicle and related modifications, (b) those that pertain to operational controls, and (c) those that relate to the encouragement of mode shifts (automobile to transit) and high-occupancy vehicles (HOVs) (see Table 1). Strategies that are shown to be effective in reducing mobile-source emissions and that are reasonably available for implementation are to be incorporated into control programs for the state's nonattainment areas.

The federal guidelines for the development of control programs (2) suggest that the metropolitan planning organization (MPO) in each urban area take the lead in evaluation of RACTs for mobile sources. The evaluation of control strategies by MPOs is to be considered a two-stage process: (a) the first stage is a preliminary examination of the RACTs by the MPOs by use of simplified assessment techniques (leading to local inputs to the SIP revision process in late 1978) and (b) the second stage is a closer look at those strategies that have the potential to reduce mobile-source air pollutants in an area (with the idea to further refine the SIP as necessary as new control information and techniques become known).

In order to gauge whether or not a control strategy could or should be implemented in an urban area, MPOs were required to assess the reduction effects of a strategy on air pollution. To assist MPOs in their appraisals, a task force of staff members from the New York State Department of Transportation developed preliminary methods to estimate the approximate air quality impacts of the various RACTs. These methods are detailed by Hartgen (3). Impacts other than those on air quality were also examined closely. These impacts include

1. Energy consumption effects,
2. Economic impacts,
3. Community effects,
4. Travel impacts,
5. Feasibility (social, economic, institutional, and political), and
6. Measures considered important in the individual urban areas.

In addition, MPOs determined how well strategies could work together in combination (i.e., packages) to effect pollutant reductions in their urban areas, and which of the RACTs are incompatible with each other and should not be relied on in certain combinations.

DETERMINING NONATTAINMENT AREAS

Subarea Monitoring

EPA determined in early 1978 that all of New York State (including the seven major upstate urban areas of Buffalo, Rochester, Syracuse, the Capital District, Utica-Rome, Binghamton, and Elmira) were in nonattainment of the federal O_3 standard, and that portions of Buffalo, Rochester, Syracuse, and the Capital District were also in violation of the CO standards.

A program of intensive air quality monitoring was initiated by the state department of transportation in early spring of 1978 to complement the CO data that are gathered at the long-term, continuous air monitoring station (CAMS) sites located across the state. The monitoring at these additional sites continued throughout the summer and fall of 1978 in an effort to better identify CO nonattainment areas and to define the degree of the state's mobile-source pollutant problem.

Monitoring air quality in the spring and summer rather than during the peak CO season (roughly October to February) is not ideal but is unavoidable. To compensate, a conservative factoring procedure was developed to arrive at estimates of the second highest 8-h CO concentration at the additional monitoring sites. The short-term measurements made at new sites were expanded by a factor made up of the ratio of the average

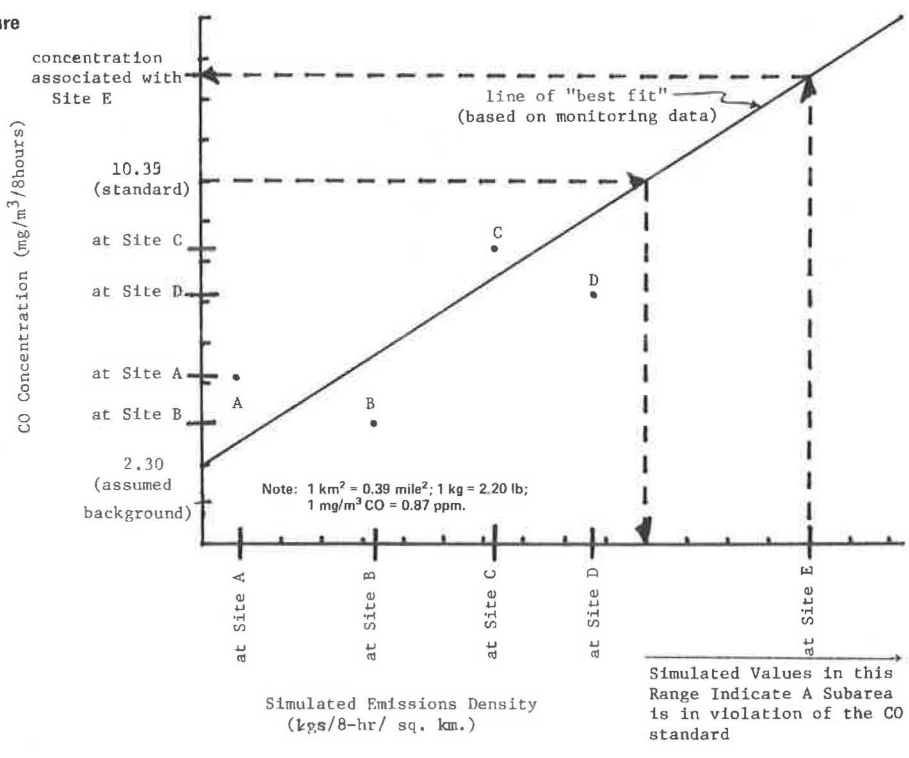
Table 1. Results of MPO strategy evaluations.

Control Strategy	Buffalo	Rochester	Syracuse	Capital District[a]	Utica-Rome	Binghamton	Elmira	Emission Reduction by 1982 due to Strategy (%)	
								CO	HC
Vehicle and related modifications									
0. Vehicle turnover	I	I	I	I	I	I	I	28-35	52.7-56
1. Vehicle inspection and maintenance program	I	I	I	I	I	I	I	9-13	2-4
16. Fleet fuel and power plant conversion	NA	P	NA	NA	NA	NA	NA	10-22	3-22
2. Control of fuel vapor emissions	X	X	X	X	X	X	X	X	X
17. Retrofit of uncontrolled vehicles	X	X	X	X	X	X	X	X	X
18. Control of extreme cold-start emissions	X	X	X	X	X	X	X	X	X
Operational controls									
15. Improvements in traffic flow	NA	I	IP	I	I	I	P	1.5-5.6	0.5-3.1
7. On-street parking controls	P	I	I	P	I	I	I	0-0.9	0-2.3
9. Establishment of pedestrian-only areas	I	I	I	NA	NA	NA	I	0-0.3	0-1
12. Staggered work hours	NA	I	P	P	NA	I	I	3.9-7.0	0.3-7.0
5. Road use restrictions	P	I	P	NA	I	NA	NA	0-6.0	0-0.3
14. Control of idling times	P	P	NA	NA	NA	NA	NA	1.5-4.9	0.6-2.1
Mode shifts and HOV encouragements									
8. Fringe and park-and-ride lots	I	I	I	I	NA	I	P	0.4-0.8	0-0.6
4. Exclusive lanes	I	I	NA	P	NA	NA	NA	0.1-5.0	0.1-0.2
4. Carpool programs		I	I	P	P	I	P	0-1.6	0.1-0.8
6. Long-range transit programs	I	NA	I	I	I	NA	P	X	X
11. Programs and facilities to encourage bicycling	NA	I	I	I	NA	I	P	0-1.3	0.5-1.2
10. Employer encouragement of pooling, transit and bicycle use, and walking	P	I	I	P	P	I	P	1.1-1.3	0.1-1.1
3. Improve public transit	IP	IP	IP					0.1-6.0	0.1-6.0
Increase service	NA			P	NA		NA		0-0.01
Decrease fare	NA			P	NA		P		0-0.04
13. Economic discouragement of single-occupancy automobile trips; congestion pricing	I	P	NA	NA	NA	NA	NA	0.3-2.6	0.15-0.4

Note: I = being implemented or studied, occurring naturally; P = potential shown, needs further study; NA = not available or inappropriate; X = insufficient data available to evaluate strategy at this time.

[a]Albany-Schenectady-Troy.

Figure 1. Procedure for determining highest CO concentration in an urban area.



short-term reading at an appropriate nearby CAMS site (made during the same short-term periods as those during which the new monitors were gathering data) and that CAMS site's second highest 8-h CO reading for the previous 12 months. That is

[estimated yearly 2nd maximum CO concentration (new site)] ÷ [measured average CO concentration over the short-term period (new site)]
= [measured yearly 2nd maximum CO concentration (CAMS site)] ÷ [measured average CO concentration over the same short-term period (CAMS site)] (1)

or

estimated yearly 2nd maximum CO concentration (new site)
= {[measured average CO concentration over short term (new site)] × [measured yearly 2nd maximum CO concentration (CAMS site)]} ÷ [measured average CO concentration over same short term (CAMS site)] (2)

Estimating Maximum Concentration

To determine which subareas in each city have the highest emissions density, the New York State Department of Transportation air quality system uses the results of the traffic simulation process as input to calculate the amount of each primary pollutant emitted on a link-by-link basis by vehicle type and hour of the day (4). The estimates of CO emissions density, obtained for each CO nonattainment area through the assignment process, were related to appropriate CO concentrations measured at the subarea level. The establishment of these relationships permitted the calculation of the maximum CO concentration in each area. Figure 1 illustrates, in general form, the workings of this procedure. Figure 1 shows that an area's greatest CO concentration is associated with the greatest CO emissions density (site E); if this concentration estimate is above the 8-h standard of 10.35 mg/m^3 (9 ppm), the corresponding portion of the urban area would presumably be in violation (5).

Results obtained through application of this procedure, the known conservative nature of the estimates used to identify nonattainment areas, and the expected impact of natural vehicle turnover leads to the conclusion that all upstate urban areas will be in attainment of the CO standards on a subarea basis by 1982. Air quality monitoring and modeling data will continue to be updated to measure progress in achieving the CO standard.

Work is currently under way by the MPOs and the New York State departments of transportation and environmental conservation to identify and develop refined procedures to eliminate possible CO hot spots. Hot spots are tentatively identified as localized areas that, because of traffic volumes, roadway configuration, meteorological conditions, and public exposure, exhibit CO concentrations that may warrant alleviation.

Since O_3 is not produced directly by motor vehicles, vehicular emission of hydrocarbons (HC) is the pollutant that is modeled, forecast, and proposed for control.

RACT IMPACTS

Estimates of air quality impacts are based on the principle that changes in the emission rates of CO and HC are functions of both changes in speed and changes in vehicle kilometers of travel. The relationship between vehicle kilometers of travel and emissions of both HC and CO is assumed to be one to one (i.e., a 1 percent change in vehicle kilometers of travel would lead to a 1 percent change in emissions). The relationship between speed and emissions is not linear but may be assumed so over short intervals; it is generally less than one to one. Changes in concentrations of photochemical oxidants (produced from HC) are not necessarily linear with changes in vehicle kilometers of travel and, therefore, the analysis for HC should be conducted on an emissions basis rather than on a concentration basis (3).

The range of maximum CO and HC emission reductions that follow is based on optimistic projections that assume favorable implementation conditions. Table 1 presents, in comparative form, the various MPOs' views of the RACTs (6-12). RACTs and the identifying numbers they were assigned in the Clean Air Act Amendments of 1977 are given.

Vehicle and Related Modifications

Vehicle Fleet Turnover (RACT 0)

Newer automobiles generally have much more tightly controlled emissions than do older ones. Thus, as newer automobiles replace older ones in the fleet, this vehicle turnover (commonly referred to as RACT 0) will result in a significant reduction in air pollutants. Estimates of effectiveness of vehicle turnover were done by the department of transportation through the air quality and traffic assignment modeling process. The results show that vehicle turnover is the single most effective air pollution control strategy available and requires no special implementation action on the state or local level. CO reductions in the range of 30-35 percent and HC reductions of 50-55 percent may be expected by 1982. However, an economic downturn that causes changes in the normal pattern of new vehicle purchases could upset this expected pollutant decrease.

Vehicle Inspection and Maintenance Program (RACT 1)

A vehicle inspection and maintenance program could reduce CO by 9-13 percent and HC by 2-4 percent. Because of potential economic, political, and institutional problems with this strategy, implementation is only considered possible on a state, regional, or national level. An inspection and maintenance program may force the vehicle owner to incur the cost of a yearly (or more frequent) vehicle inspection and possibly major expensive repairs in the course of reregistering an automobile or truck. The inspection may be done at yet-to-be-established state inspections garages in an effort to minimize the chance of fraud. Regardless of whether private or public facilities are used, some sort of state administrative system would have to be set up to run an inspection and maintenance program. These problems may make this strategy very difficult to implement politically in today's economic situation, even though it is a potentially effective measure.

Conversion of Fleet Vehicles to Cleaner Engines or Fuels (RACT 16)

Estimation of the air quality effects of this control strategy involves estimation of an area's fleet (usually taxi and truck) size, use (i.e., vehicle kilometers of travel), and contribution to pollution. Then, by application of this to new engine and fuel emissions rates, the benefits attributable to the conversion strategy can be calculated. Pollutant reduction estimates were calculated in the range of 10-22 percent for CO and 3-

22 percent for HC and, thus, this appears to be a very effective strategy. There are, however, many serious problems associated with this RACT. An area that requires such controls may find that its businesses will leave the area rather than comply. Hence this technique must be imposed on a regional or national level. The degree of conversion needed may not be physically or technically possible by the 1982 target year. MPOs generally have little enthusiasm for this RACT.

Control of Fuel Vapor Emissions (RACT 2), Retrofit of Uncontrolled Vehicles (RACT 17), and Control of Extreme Cold-Start Emissions (RACT 18)

These strategies are being studied for effectiveness and feasibility by the New York State Department of Environmental Conservation. If they prove to have potential benefits, implementation will have to be on a state, region, or national basis so as not to unduly penalize or otherwise hinder the economic well-being of any one area.

Operational Controls

Improvements in Traffic Flow (RACT 15)

The potential effectiveness of improvements in traffic flow can be estimated by determining the overall (increased) capacity afforded by the improvement. If the relationship between the new capacity of a facility and the traffic demand is known, increases in traffic flow speeds due to improvement can be calculated by use of techniques contained in the Highway Capacity Manual (13). This increase in flow speeds can then be translated into estimates of reductions in pollutant emissions.

The effects of improvements in traffic flow are dependent on each individual project; no generalizations can be made. CO reductions in the area of 1.0-5.5 percent and HC decreases of 0.5-3.0 percent may be expected for larger improvements projects (e.g., a computerized traffic signal system).

Flow-improvement air quality benefits may be expected to be short lived—as congestion is relieved and traffic flow speeds are increased, new traffic will eventually be induced to use the highway facilities. Generally, flow improvements projects are relatively low in cost and are already being studied and implemented in the urban areas. The air quality impact is only one of the many impacts considered in the evaluation of a potential project.

On-Street Parking Controls (RACT 7)

Elimination of parking on a facility increases the capacity of that facility. In turn, this capacity increase results in improved flow speeds over the facility, which can be translated into anticipated emissions reductions. Depending on the extent of the elimination of on-street parking, a reduction of up to 0.9 percent for CO and 2.3 percent for HC may be expected. However, on-street parking control programs have already been implemented in many upstate areas and further elimination of on-street parking may have little beneficial flow or air quality impacts.

If on-street parking in a small area is eliminated [as in the case of a central business district (CBD) or shopping district], provision of alternative, off-street parking facilities should be considered. Otherwise, undesirable economic effects (i.e., shift of business from the CBD shopping district to outlying shopping centers where parking is available) and political pressure may be expected.

Establishment of Pedestrian-Only Areas (RACT 9)

A literature search (prime source: Auto Restricted Zone by Alan Voorhees and Associates) (14) suggests that in typical automobile-free zones there would be a small diversion to transit (~1.5 percent of all work trips) and an increase in the number of total work trips (~5 percent) within five years. Calculations suggest a small reduction in area vehicle kilometers of travel and an increase in hot-spot vehicle kilometers of travel, but the major reason for building pedestrian malls is not to reduce air pollution. Air quality benefits of pedestrian-only areas range up to a 3 percent reduction in CO and up to a 1 percent reduction in HC.

There are serious political and financial obstacles to the introduction of automobile-free areas; thus implementation is somewhat difficult. Such areas are under consideration or have been implemented in a number of upstate areas: Buffalo, Rochester, Syracuse, and Elmira; however, it is unlikely that as-yet-unplanned pedestrian-only areas could be implemented by 1982. Because of negligible (or even negative) air quality effects, pedestrian-only, automobile-free areas should have as a foundation other community benefits in addition to air quality.

Staggered Work Hours and Four-Day Work Week (RACT 12)

The air quality benefit of staggered work hours results from an increase in vehicle speeds during the somewhat lengthened peak-hour periods. Once the speed changes are estimated, it is possible to determine the air quality impacts of this policy. The air quality benefits of a four-day workweek scheme are a function of the vehicle kilometers of travel saved through the elimination of one workday's worth of travel. Analysis of these strategies shows a maximum of 7 percent reduction in CO and HC emissions, assuming no additional travel on the extra day off or because of freer traffic flow during the peak hour brought about by staggered work hours. There is evidence that travel on the additional day off is reduced.

Results of work by Tannir (15) suggest that although there are user benefits, the effect of staggered work hours on the transportation system is not significant. Desimone (16) suggests that the four-day workweek would have a more significant impact on Los Angeles if it were widespread. A speed change of about 15 percent may be possible if the four-day workweek is widely used. Changes in the work schedule require the cooperation of employers and employees; employers should have about 500 or more employees and have an operation that permits shift splits. Air quality benefits tend to be of a localized nature. Transit service may be more efficient in that the peak load may be smoothed under a staggered-hours scheme; however, transit may lose some riders if employees under the new work hours find the bus schedule no longer convenient. Similar disbenefits may be seen in the area of carpooling: Existing carpools may disband as work schedules become varied within a firm or carpool-matching efforts made that much more difficult. Other carpools, however, may be formed.

Road Use Restrictions (Automobile Bans)(RACT 5)

The literature implies that there would be little or no diversion to transit if a street were closed but transit service were not improved. Estimates of the savings in travel distances and speed were made by running traffic assignments.

Maximum reductions are on the order of 6 percent for CO and 0.3 percent for HC under this strategy. Any air quality benefits would be very localized (i.e., on the street with the restriction) and areawide effects would be negligible. If provisions were not made to eliminate (through mode shift to transit) or adequately handle automobile traffic diverted around the restricted area, increases in vehicle kilometers of travel, congestion, fuel consumption, and air pollutant emissions would occur in the vicinity. This strategy may be politically and economically unfeasible because of the potentially adverse impacts on businesses and shops in the automobile-free areas. However, the potential also exists for taking advantage of the automobile-free nature of such a location—the result would be the creation of a very attractive, highly visible shopping area. Transit-only malls are being studied for Buffalo, Rochester, and Syracuse.

Control of Idling Times (RACT 14)

Truck fleet effects are more noticeable than those for taxi fleets. Besides possible air quality benefits, the control of fleet idling times may also result in fuel savings. The strategy may be difficult to enforce; convincing fleet operators of its necessity may also be difficult. It may induce cruising (especially by taxis) instead of stopping engines, and it may conflict with cold-start controls in wintertime.

Although this policy may be difficult to implement, estimates of its potential can be made. The approach is to determine the idling emissions rate (grams per minute) versus moving rate, then determine idling times for typical fleets. Finally, fleet sizes are computed and the maximum air quality impact is obtained by using the equation

$$\text{Grams CO or HC} = \text{fleet size} \times \text{idling hours per year (CO or HC idling rate)} \qquad (3)$$

Maximum potentials for this strategy are 1.5-4.9 percent reduction in CO and 0.6-2.1 percent reduction in HC.

Mode Shift and HOV Encouragements

Fringe and Park-and-Ride Lots (RACT 8)

Remote park-and-ride data were found for Rochester, Milwaukee, and Seattle; peripheral park-and-ride data were found for Albany and Atlanta. These data were used to determine average daily and peak-period ridership and bus trips per lot. Ridership figures were converted into the number of automobile trips saved by using diversion studies from the above areas. The number of automobile trips saved is then converted into vehicle kilometers of travel. The additional vehicle kilometers of travel used by the buses and the changes in the vehicle-capacity ratio for roads in the corridor are also taken into account.

The estimate of effectiveness for this strategy in the upstate areas is a reduction in CO emissions of 0.4-0.8 percent, and a reduction in HC emissions of up to 0.6 percent. Generally, few areawide air quality benefits can be expected from this strategy; any benefits would be seen mainly in the corridors served by the lots. The strategy is relatively easy and inexpensive to implement if use can be made of existing parking lots (e.g., at shopping centers). Depending on the size of an area's bus fleet, this strategy may require new equipment (and greater capital, and possibly operating resources) to serve the lots. Improvements in traffic flow may be seen as well as possible reductions in fuel consumption, travel time, and system vehicle kilometers of travel if automobiles left at home or in the lot are not used during the day.

Park-and-ride service may encourage undesirable sprawl or extended development patterns. Fringe lots around the CBD may increase automobile traffic (and the potential for worsensing air quality) in the area around these lots; however, these lots may also serve to concentrate activities and reinforce the attractiveness of the CBD.

Because of the lack of highway congestion or concentrated demand, this strategy may not be feasible in smaller areas; larger urban areas in upstate New York have already instituted this service and may find little potential for further implementation.

Exclusive Lanes and Carpool Programs (RACT 4)

Estimates of impact on travel distance and speed from the introduction of exclusive lanes are based on data contained in the literature. A 2.5 percent figure for potential reduction in peak-hour travel was used for several areas. The peak-hour traffic volumes were first obtained. The corridor vehicle kilometers of travel were obtained by multiplying the link volume by the link length. These vehicle kilometers of travel were reduced by the reduction factor. Speed changes were found to be very small. Maximum reductions were found to be in the range of 0.1-5.0 percent for CO and 0.1-0.2 percent for HC.

To estimate the potential associated with carpooling programs, carpool programs were reviewed for effectiveness and then changes in vehicle kilometers of travel and speed were estimated. An assumption of one-way-work-trips distance of 13.3 km (8.3 miles) and an initial vehicle occupancy of 1.2 persons/vehicle were used. The assumption was that carpooling could be increased by about 5 percent, a figure consistent with the experience in Knoxville, Tennessee. Potential maximum reductions estimated for this strategy are 1.6 percent for CO and 0.8 percent for HC.

Exclusive lanes have been operating or planned for specific needs in some of the upstate areas; however, evaluations show expansion of exclusive HOV lanes to be relatively unnecessary because of the lack of major congestion problems in the upstate urban areas. In some cases, the dedication of highway lanes to the exclusive use by HOV would create congestion problems; worsen the air quality situation; and increase fuel consumption, travel costs, and time. Improvements to facilities earmarked for HOV exclusive lanes would place an additional burden on local finances, further reducing the attractiveness and practicality of this strategy.

Carpools and buspools were found to offer potential air quality benefits as well as savings of fuel and finances, reductions in vehicle kilometers of travel, and easing of parking requirements. (These impacts are based on the assumption that the automobiles left at home are not used during the day.) Carpool programs should be directed toward areas outside of the transit service area so as not to effect a diversion of riders from transit use. Carpool programs and studies have already been instituted in some MPO areas. Because of differences in work shifts and locations of employment, this strategy may not be available to any great degree in some of the smaller urban areas.

Long-Range Transit Improvements (RACT 6)

The upstate areas are currently assessing the need for planning or implementing portions of long-range transit improvements programs. Programs may include new services to areas indentified through detailed corridor studies, extensive transportation system management improvements to the highway network in an effort to improve bus flows, transit malls, or new or innovative technologies. Air quality impacts will be a consideration in any decisions made regarding this strategy. However, any long-range transit planning will probably have little, if any, impact by 1982.

Encouragement of Bicycling (RACT 11)

Bicycles are a possible mode when vehicle trips are less than 6 min. Approximately 15 percent of all trips qualify and perhaps 5 of the 15 percent might actually be diverted to bicycles. Thus, the total vehicle kilometers of travel saved (in work trip travel) would be approximately the number of employees $\times 0.05 \times 0.15 \times$ 7 km, where 7 km is approximately the maximum length for a reasonable bicycle round trip. Maximum reductions in CO and HC emissions expected from this strategy are 1.3 and 1.2 percent, respectively.

In general, air quality benefits are expected to be seen in the corridors served by the bikeways. Bicycling as an alternative mode may not be possible for most of the year in the Northeast because of adverse climatic and weather conditions. The possibility of motor vehicle-bicycle accidents and the slowdown in traffic flow caused by motorists concerned about maneuvering in heavy bicycle traffic are potential disbenefits of this strategy.

Bicycle use may decrease fuel consumption in an area and may have general health benefits for riders. Bikeway networks have been implemented and are being studied or planned for in upstate New York areas.

Employer Encouragements of Pooling and Alternative Modes (RACT 10)

A literature review indicates that perhaps 2 percent of an area's work force might use vanpools and that a 10 percent increase in carpooling might be achieved. Estimates can quickly be obtained by making assumptions about the diversion and using known area figures for average trip length in order to obtain an estimate for total vehicle kilometers of travel saved. The upstate MPOs expect a maximum range of reductions of 1.1-1.3 percent for CO and 0.1-1.1 percent for HC to result from this strategy (assuming that automobiles left at home are not used during the day).

The potential to implement, maintain, expand, and benefit from such employer-involved programs is greatest in areas that have large companies; those areas that have smaller-scale employers, scattered work sites, or shift differences may show less promise. In general, no major problems with employer or employee cooperation in studies and matching programs are reported. Concern has been voiced about employers becoming involved in arranging and providing worker transportation to and from work. Extensive, successful employer encouragement efforts may require expansion of transit services that serve the work site and result in possible increased operating deficits or equipment needs.

Improved Public Transit (RACT 3)

Improved mass transit service has been proposed as a way to reduce emissions by encouraging diversion to bus. The approach was to use "backward" elasticities to estimate diversion to transit due to either a service increase or a fare decrease. Once the diversion was calculated, the average length of a bus trip was used to estimate the savings in vehicle kilometers of travel. Speed changes were estimated by using the Highway Capacity Manual (13). Additional bus vehicle kilometers of travel that result from increased service were added in to obtain a net effect.

Service increases and fare decreases of about 10 percent each show almost negligible air quality effects; reductions of only 0.01 percent for CO and 0.04 percent for HC were forecast. Additionally the upstate MPOs saw increases in costs (capital and operating) would be incurred locally if this strategy was implemented, which would make it potentially politically or economically infeasible.

Improvements to existing services and services to localized areas (identified through corridor studies) appear to be better than general increases in bus travel distances or fare decreases, given the desire to increase ridership, reduce emissions and fuel consumption, and minimize costs.

Single-Occupancy Discouragement and Congestion Pricing (RACT 13)

The parking price elasticity of travel demand is in the range of -0.2 to -0.6. The problem is that most elasticities in the literature have been obtained as forecasts rather than by use of actual data. When San Francisco instituted a 25 percent parking tax, the impact on retail business was minimal; of course, the transit system there was excellent. A reasonable assumption that could be used in upstate New York is that a $1.00 parking fee surcharge would result in a decrease in peak-hour work trips of at least 10 percent.

The upstate New York MPOs are concerned about the possible economic impact on the CBD of positive parking policies. If the CBD is to remain accessible, it may be necessary to greatly increase transit service. This may prove expensive and yet still not be able to restore potential lost business to the downtown area.

Entry restrictions or charges imposed on vehicles that try to drive into an area are also considered under the general strategy and also meet with the same potential obstacles to implementation as above. Further, the institutional problems (as well as negative air quality effects) involved in stopping vehicles and either turning them away or collecting tolls as they try to enter the controlled area may make this strategy infeasible.

A version of this strategy that attempts to minimize disbenefits is the one that imposes penalties (entry or parking) on automobile use during the (peak) hours of 7:00-10:00 a.m. This would maintain the attractiveness of the controlled area to the nonworker visitor (i.e., shoppers and other nonregular travelers) through improved parking availability and better flow. The workers (it is assumed) that have to travel to the controlled area every day would carpool or take transit to work rather than incur the penalties imposed on low-occupancy vehicles between 7:00 and 10:00 a.m.

OBSERVATIONS AND CONCLUSIONS

Our review of the upstate New York MPO RACT reports suggests the following:

1. The wide range of estimates of RACT effectiveness produced by the different MPO staffs is in most cases due to the differing characteristics of the seven upstate urban areas. In many cases, these strategies have been already implemented in some areas and thus incremental improvement is expected to be small.
2. Because areas are very different, spatially and demographically, RACT analysis must be done on an individual area basis in order to obtain approximate estimates.
3. Many strategies have negligible or even detrimental air quality effects. For example, increases in bus service may increase pollution if there is only a small increase in bus use. Similarly, exclusive bus lanes may increase congestion in the other lanes to a level that actually results in a decrease in air quality.
4. Most of the RACT proposals have potential merit not related to the improvement of air quality and have thus already been studied by MPOs because of these other potential advantages.
5. All upstate New York urban areas will be in attainment of air pollutant standards by 1982. Expected levels of vehicle turnover are enough to ensure attainment.
6. Strategies such as fleet conversion to alternate power sources and vehicle inspection and maintenance programs must be implemented on a regional or national level in order to reduce the possibility of severe local economic impact.

The RACT evaluation done by the MPOs does not commit or recommend any projects at this time based solely on the air quality potential that has been shown so far. The MPOs will use available EPA planning (section 175) funds to continue to investigate RACTs' potential.

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