ENVIRONMENTAL IMPACT OF GOODS MOVEMENT ACTIVITY IN NEW YORK CITY

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The amount of freight handled in the New York City metropolitan region is roughly 570 million tons per year. For the most part, this movement is inefficient: Trucks are too lightly loaded, travel too many miles when compared to their delivery schedules, run at low speeds, and operate during hours of the highest vehicular congestion. Furthermore, the rail and water networks have not been used to their fullest capacity. Many goods that now travel by truck could be shipped just as easily by rail or water. The products of this inefficiency are traffic congestion, increased energy consumption, air and noise pollution, broken and worn-out highway pavements, and high commodity cost. The 1970 Federal Clean Air Act mandates that certain environmental standards be met by 1975 in all cities in America. Air pollution caused by trucks in the New York City CBD is so great that trucks have been identified in New York as a major environmental villain. The New York City Department of Air Resources has embarked on an unprecedented effort to determine the true environmental impact of goods handling in New York City and to seek a solution that will facilitate goods movement and ensure maintenance of air quality standards. An investigation by the Department developed some candidate strategies for rationalization of goods movement combined with enhancement of environmental quality. The primary responsibility for implementation must fall on the goods movement industry and the public monitors and regulators of that industry.

•ACCORDING TO the conference on urban commodity flow (1, pp. 4-5), "Urban commodity flow can be viewed as the result of human activity that occurs within a defined space. To maintain that activity requires that materials be imported for consumption and processing and that manufactured goods be exported. In the process of importing and exporting commodities, an urban metabolism occurs. In the tri-state region in and around New York City, for example, it is estimated that each person annually accounts for 210 tons of fresh water, 7 tons of fuel, 4 tons of general freight, 1 ton of food, and 1 ton of disposable waste."

THE URBAN GOODS MOVEMENT PROBLEM

Water supply and sewage clearly dwarf all other needs [about 3.2 billion tons per year of fresh water for the tri-state region (2)] on a tonnage and bulk basis. The bulk of commodities carried are construction materials, fuel, and food. Conventional freight volume for the region is roughly 570 million tons per year (Table 1). This total includes goods carried into, out of, and within the region.

It is apparent from Table 1 that trucks are the major mover of freight out of the region, carrying 56 percent of the total volume. More importantly, trucks carry 77.4 percent of the freight volume within the region. The movement of goods in the region is, for the most part, characterized by inefficient operations. As a result, the 77.4 percent of the freight volume carried internally by the truck corresponds to about 97.4 percent of the cost of moving goods within the New York region (2). Excessive vehicle-miles traveled, low productivity, low operating speeds, and short work schedules that

coincide with the city's hours of worst traffic congestion are all conditions that characterize goods movement by truck. Trucks travel up to five times the actual pickup and delivery distances in their normal operations. On the average, trucks operating in New York City are loaded to less than 10 percent capacity. Average truck speeds in the city's CBDs are a mere 4 mph. In addition, most trucking occurs between 8:00 a.m. and 2:00 p.m. (3).

Cargo is carried on only about one-half (54 percent) of the trips made by an urban truck. Tools or equipment needed to perform services are carried on 23 percent of the trips, and the vehicle is empty on the remaining 23 percent (4).

Furthermore, the rail and water networks have not been used to their fullest capacity. Many goods that were previously shipped by rail and water now travel by truck. Rate structures have been set up so that it is often cheaper to use a truck where good rail or water connections exist. The Interstate Highway System has speeded up truck travel and further increased dependence on the truck.

The differences between intercity and intracity goods movements must be further emphasized. Whereas goods are transported between cities by truck, rail, air, water, and pipeline in large shipments, goods are transported within the urban area primarily by trucks in smaller shipments. Intercity freight operations are becoming more efficient (e.g., piggyback and container operations, some consolidation efforts, fuel for redistribution to Long Island received at the Northville Docks near Riverhead instead of being sent through the Port of New York), although they can still stand improvement. Local freight traffic operations, however, either are at a standstill or are becoming less efficient. Thousands of operators are involved, often duplicating services. Seventy percent of all trucks are single-vehicle operations, and less than 10 percent are in fleets of more than 20 trucks (4). When so many operators are involved, it is difficult to regulate them and to attempt to make their movements more efficient. These intracity movements appear to be the crux of the problem. The consequences of this inefficient goods movement operation are discussed below.

HIGH COMMODITY COST

In 1971 the nation's estimated freight bill was $101.8 billion, 9.7 percent of the gross national product. The nation's freight bill has been constantly increasing from year to year but has remained approximately 9 to 10 percent of the GNP. Fifty-four percent of the total cost of transportation goes for moving people and about 46 percent for moving goods. Seventy-nine percent of the $101.8 billion freight figure is attributable to transportation by truck (5). It is either difficult or impossible to further break down information on freight costs to show their direct impact on commodity costs or to attribute cost value to the socioeconomic effects of inefficient goods movement. However, some attempts have been made.

A detailed study of truck movement in a square mile of downtown Brooklyn was made by the Tri-State Transportation Commission in 1968 (6). The study showed that a large amount of waste exists in the present system. Approximately 4,000 trucks entered the area, more than 2,800 carried freight suitable for consolidation, and over 1,100 of these made more than one stop. These 1,100 trucks were analyzed, and the study states that, if consolidation were instituted, a potential savings of $3.3 million per year could be anticipated. It states further that, if other trucks with suitable freight were included, the savings achieved could reach as high as $8.1 million per year for the square mile area and $1 billion per year for the region.

An examination of pickup and delivery costs for New York City and the region shows the relationship between goods movement and the environment in which it occurs. Rough estimates indicate that costs for the middle Atlantic region are 19 percent higher than average, northern New Jersey 45 percent higher, and New York City 62 percent higher (7). The increasing effects of congestion, inadequate loading facilities, and so on are amplified closer to highly urbanized areas, which raises pickup and delivery costs and results in higher commodity costs.

A Canadian study estimated that the total cost of transportation in 1966 for all Canadian cities with a population of more than 100,000 was $530 per person per year. This

was broken down into $280 for goods trucking and $250 for person transport (with no value on unpaid time). It further estimated savings per person per year by the year 2001 at $190 to $230 if the system of moving goods were improved by consolidation, new technology, improved facilities, street and traffic improvements, and so on (1).

Whereas the accuracy of these studies or the assumptions made by them may be questioned, they serve to show the magnitude of the costs and savings involved. Again, costs do not include socioeconomic costs but only the costs of service performed.

INCREASED CONGESTION AND WEAR OF STREETS

Trucking has a strong impact on the physical and flow conditions of public highways. Blockage of traffic in narrow streets can be caused by the presence of parked trucks. The truck parking problem is exacerbated if elevators are inaccessible or internal building capacity is insufficient to accommodate shipments. In such places as the garment center of New York City, where many trucks are parked at curbside for hours while more wait for curbside access, vehicle speeds can drop to only 3 or 4 mph. Loading of large trailers in narrow streets can restrict traffic movements entirely, as in the narrow streets of lower Manhattan where the entire width of a street may be blocked.

The fact that trucks and automobiles have to share the same streets causes several problems. The overall vehicle flow is impeded because of different driver eye heights and ranges of vision and the slower acceleration and lack of maneuverability of trucks. Consider the case, for instance, of a tractor trailer and a Volkswagen trying to negotiate the same narrow urban street and not to collide with or sidewipe each other.

The poor quality of highways in areas of heavy trucking and congestion on narrow roadways raised the estimated cost of congestion in New York City to about $1 million a day in 1951 (8). An independent analysis of the cost of congestion in the garment center, prepared by the New York Trucking Association, estimates the annual cost of traffic congestion in midtown Manhattan at $150 million (9). Shipments are slowed down, higher costs for labor are incurred, and the costs are shifted on until the consumer is forced to pay.

Heavy vehicles require highways that are more structurally sound than those used exclusively for light-duty vehicles such as cars. Increased costs are incurred because of the necessity of providing strong subbases and more structural steel for roadway slab reinforcement and columns for elevated highways. Trucking necessitates the provision of stronger foundations to resist sidesway and bending moments of highway signs, lampposts, traffic signals, and bridge abutments. In short, the design of all roadways for all kinds of vehicles results in considerable additional expense above the cost of providing special roads for trucks and light-duty roads for automobiles.

Because of the damage of city streets caused by heavy trucks, the New York City Transportation Administration is developing legislation that will limit the dimension and weight of vehicles within New York City. Also, the Greater London Council has announced that it intends to ban heavy trucks from central London because they are "an inherent impediment and danger." Obviously, a reduction in truck traffic in central cities offers the potential for benefits other than reduced air pollution.

Increased Energy Consumption

The excess vehicle-miles traveled by trucks result in increased and wasteful consumption of fuel. As central city congestion worsens, fuel consumption is increased. This trend is further heightened by the fact that trucks, rather than rail, carry an increasingly greater percentage of the freight moved in the nation. Much freight that had previously been moved by rail is now being moved by truck. The replacement of one train by 200 trucks causes greater energy consumption, for the rail mode is inherently less energy-consuming and less polluting per ton-mile than the truck.

A report prepared by the Oak Ridge National Laboratory (13) indicated that transportation accounts for about one-quarter of the energy consumption in the nation. The report presents the following information on the relative energy consumption by mode:

Mode	Btu/Ton-Mile
Pipeline	450
Waterway	540
Railroad	680
Truck	2,340
Airway	37,000

This table shows energy use for the intercity truck and not the urban truck. It should be higher for the urban truck because of urban congestion and because intracity shipments are lighter than intercity shipments.

Increased Noise and Air Pollution

Whereas it has been generally accepted that transportation sources are the main contributors of air pollution in the city, it has not been known that trucks are a major source of air pollution (Table 2). It is currently estimated that 70 percent of all air pollution in New York City originates from transportation sources. In fact, however, in midtown Manhattan, trucks contribute almost 50 percent of the vehicle-related pollutants, and, in downtown Manhattan, they contribute more than 65 percent (Table 3).

At this point, it is difficult to quantify the effects of trucks on ambient noise levels. However, some data indicate that, whereas average noise levels on the busier city streets range from 70 to 75 dBA, trucks cause peaks of 88 to 97 dBA. Their contribution to New York City's air (and noise) problem could be minimized by improving operating efficiency. The New York City Department of Air Resources (DAR) estimates that, by cutting excess vehicle-miles traveled in half, by increasing the average load factor to 30 percent, and by increasing the average vehicle speed to 15 mph, the truck-caused pollution in the CBDs could theoretically be cut by 90 percent.

Involvement of the N.Y.C. DAR in the problem of urban goods movement has been caused by this last consequence of inefficient goods movement—increased air pollution.

FEDERAL MANDATE

The Clean Air Amendments of 1970 mandate that all areas of this nation meet primary and secondary air quality standards that are considered safe for public health and welfare by July 1, 1975. (This was later extended to July 1, 1977, for certain areas of the country, including New York City.) On April 30, 1971, the administrator of the Environmental Protection Agency published national air quality standards as required by the amendments. These include standards for six pollutants: sulfur oxides, particulates, carbon monoxide, nonmethane hydrocarbons, oxides of nitrogen, and oxidants. These standards are given in Table 4 (11).

Although according to the federal mandate the indicated standards may be exceeded only once per year, those standards most associated with motor vehicles, carbon monoxide and hydrocarbons, are exceeded regularly in New York City at levels from 5 to 50 times federal standards. It is estimated that the City can only meet these standards if passenger vehicles, including taxicabs, comply with federal standards; if heavy-duty truck emissions are dramatically lowered; and if much vehicle traffic is simply restricted. Data given in Tables 2 and 3 show the relative effect of trucks in Manhattan and its CBDs. Unless major improvements are made in trucking operations and in controlling emissions from trucks by 1977, very little change in mass emission will occur, and the truck's percentage contribution will increase dramatically.

The federal mandate also stipulates that the states are required to submit to the Environmental Protection Agency implementation plans describing how they will meet and maintain the standards. The Implementation Plan for the New York City Metropolitan Area was submitted in January 1972. EPA chose to accept the New York State plan with respect to those pollutants primarily associated with stationary sources (sulfur oxides and particulates) but rejected that part of the plan dealing with pollutants most commonly associated with mobile sources.

The New York City DAR and the New York State Department of Environmental Conservation are preparing a detailed plan for mobile source pollution, which is to be

Table 1. Use of conventional freight modes in tri-state region, 1965.

Tons Carried	Mode					Tons (millions)
	Water	Truck	Rail	Oil Pipeline	Air	
Into region	43.5	23.4	24.8	8.2	0.1	191.4
Out of region	18.2	56.3	13.2	11.9	0.4	79.5
Within region	21.2	77.4	1.3	0.1	—	298.1

Table 2. Motor vehicle emissions in Manhattan, 1970 (10).

Mode	Hydrocarbons		Carbon Monoxide		Oxides of Nitrogen	
	Tons	Percent	Tons	Percent	Tons	Percent
Automobile	26,868	58.9	189,312	55.3	10,445	45.7
Truck						
Gas-powered	9,867	21.6	85,789	25.0	1,218	5.3
Diesel	716	1.6	1,239	0.4	2,453	10.7
Bus						
Gas-powered	26	0.0	128	0.0	8	0.0
Diesel	1,153	2.5	2,197	0.6	4,231	18.5
Taxi						
F-M	3,562	7.8	32,789	9.6	2,625	11.5
NF-M	2,029	4.4	17,953	5.2	1,007	4.4
N-M	1,432	3.1	13,101	3.8	540	2.4
Total	45,653		342,508		22,841	

Note: F-M = fleet-owned medallioned type; NF-M = non-fleet-owned medallioned type; N-M = nonmedallioned type.

Table 3. Motor vehicle emissions in the downtown and midtown CBDs, 1970.

Mode	Midtown CBD						Downtown CBD					
	HC		CO		NO_x		HC		CO		NO_x	
	Tons	Percent	Tons	Percent	Tons	Percent	Tons	Percent	Tons	Percent	Tons	Percent
Automobile	1,531	13.6	12,807	13.8	510	10.9	1,472	17.1	12,598	19.0	495	14.9
Truck												
Gas-powered	5,293	47.3	40,710	43.9	578	12.3	5,859	67.9	45,069	68.0	641	19.2
Diesel	328	0.0	591	0.6	1,106	23.6	364	4.2	655	1.0	1,227	36.8
Bus												
Gas-powered	—	—	—	—	—	—	—	—	—	—	—	—
Diesel	231	0.0	437	0.5	845	18.0	170	2.0	329	0.5	637	19.1
Taxi												
F-M	2,044	18.3	20,556	22.2	1,051	22.4	410	4.8	4,125	6.2	211	6.3
NF-M	1,449	12.9	14,285	15.4	509	10.9	290	3.4	2,857	4.3	102	3.1
N-M	317	0.0	3,247	3.5	85	1.8	62	0.8	638	1.0	17	0.5
Total	11,193		92,633		4,684		8,627		66,271		3,330	

Note: See note on Table 2.

Table 4. Air quality standards as required by the Clean Air Amendments of 1970.

Pollutant	Averaging Time	National Standard	
		Primary	Secondary
Particulate matter	Annual G.M.	75 $\mu g/m^3$	60 $\mu g/m^3$
	24-hour maximum[a]	260 $\mu g/m^3$	150 $\mu g/m^3$
Sulfur dioxide	Annual average	0.03 ppm	0.022 ppm
	24-hour maximum[a]	0.14 ppm	0.10 ppm
	3-hour maximum	—	0.50 ppm
Carbon monoxide	8-hour maximum[a]	9 ppm	9 ppm
	1-hour maximum[a]	35 ppm	35 ppm
Photochemical oxidants	1-hour maximum[a]	0.08 ppm	0.08 ppm
Hydrocarbons	6 to 9 a.m. maximum[a]	0.24 ppm	0.24 ppm
Nitrogen dioxide	Annual average	0.05 ppm	0.05 ppm

[a]May be exceeded only once a year.

submitted to EPA after this paper goes to press. The plan sets forth specific strategies to be followed to achieve federal air quality standards by 1977. Furthermore, long-range planning is discussed in light of the fact that these standards must be met by 1977; but, more importantly, they must be maintained. The responsibility for strategy implementation falls under the jurisdiction of city, regional, and state agencies.

GOODS MOVEMENT PROGRAM OF THE NEW YORK CITY DEPARTMENT OF AIR RESOURCES

Before the strategies are discussed, it would be appropriate to discuss in more detail the program of the New York City DAR with respect to goods movement. To achieve the following goals, DAR conducted a 3-month study in which people who are involved in goods movement were contacted:

1. To obtain information on completed, ongoing, and proposed programs that relate to goods movement;
2. To solicit ideas for improving goods movement and opinions of those contacted on which ideas would be most productive;
3. To ask those contacted which ideas they felt would be best tested by a demonstration project;
4. To obtain information on goods movement activities and patterns by truck, rail, and other modes;
5. To determine the impediments to efficient goods movement; and
6. To collect relevant reports, studies, and other documents to form the basis of a goods movement library.

The interviews involved people in government and private industry including study groups, educators, unions, shippers, and rail operators. The most salient findings of the interviews are summarized below.

Consolidation and Other Ideas for More Efficient Operation

Although consolidation is viewed by most goods movement analysts and truckers as one of the most acceptable means of improving the movement of goods, there are a number of operational complications. Unregulated carriers, particularly, appear to want to keep separate brand-name identity on truck fleets. Consequently, the idea of surrendering one's identity to a neutral consolidator is frowned on and will remain an institutional impediment to that concept.

Along with the surrender of a certain amount of identity, consolidation will undoubtedly interrupt traditional door-to-door service arrangements of many carriers. Most retailers, besides being opposed to the concept of nighttime work hours, view the removal of door-to-door service as bordering on self-destruction. Moreover, with the ever-increasing problem of hijacking and theft, they are totally disagreeable to having to depend on another handling point (i.e., consolidator), thus running the increased risk of pilferage.

Labor cost is a crucial input when night shipping and delivery schemes are considered. Above all, differentials would have to be paid that could very easily make night operations uneconomical whether consolidated or not. If the concept of consolidation and/or night delivery is to be viable, participants will have to be assured increased security in goods movement.

In addition to consolidation and night delivery the use of partial condemnation was considered as a possible way for aiding in the reduction of congestion. Older warehousing blocks, especially in the garment district, are ill-equipped to efficiently handle the truck traffic and tonnage that flows daily into the area. Probably the greatest obstacles to efficient loading and unloading of goods are narrow street widths and the absence of off-street loading docks.

Partial condemnation involves having the city condemn the street or below-street grade area of a building's first floor in order to construct internal loading dock facilities (in coordination with a refined elevator network). Many existing buildings are deep (approximately 180 ft) and often have above-average ceiling height at grade; so conversion is not a physical problem.

Truckers and Shippers

Numerous truckers and shippers were contacted, and DAR obtained information on their day-to-day operations and problems. Several problems were continually mentioned: inadequate enforcement of traffic regulations for automobiles, poor docking and unloading facilities, narrow streets, and the waste of time looking for parking.

Many large freight operations are already consolidated to some degree. For example, E. J. Korvettes has a consolidation terminal in Bayonne, New Jersey, for all New York area goods. The U.S. Postal Service and United Parcel Service (having the two largest truck fleets in the city) have had to consolidate for operational efficiency.

These large shippers see the small truck operator as the problem, not themselves. This may indeed be the case. It turns out that most trucks are operated by individual owners or in small fleets. As mentioned before, 70 percent of all trucks are single operations, and less than 10 percent are in fleets of more than 20 trucks. It appears, too, that it is these small truck operators that operate their trucks with only a small percentage of capacity. The major shipper must and does operate his truck at near capacity because of economic reasons. It has been pointed out, though, that when a truck operator uses only a small portion of vehicle capacity it is because that is all he can deliver in 8 hours in a congested city.

Rail and Water Operations

At first glance, the public transit system appears to be a reasonable alternative to intraurban goods movement by trucks, and night use for freight purposes (i.e., off-peak passenger hours) seems logical. On further investigation, however, there are numerous impediments to the potential use of subways for goods movement. First, there are no facilities for vertical movement of goods from the street to the platform. Additional platform space for storage and loading and station sidings for unloading do not exist. The headways between trains appear to be too small to permit the unloading and loading of freight cars (although this might be offset by containerization). Furthermore, although the N.Y.C. Transit Authority has hundreds of stations, comparatively few business houses are immediately adjacent to them. The cost of transferring freight from a motor truck to a subway car and again to a motor truck would probably be prohibitive.

Most if not all of the new rail activity in New York City has been going on at the Brooklyn waterfront. For example, whereas most major railroads are getting out of the business of car floating and lighterage (or are charging for these services), the New York Dock Railway has provided an overwater rail connection between New Jersey and the Brooklyn waterfront through its own car floats. Container ports are being developed at the Northeast Terminal and Redhook facilities. American President Lines has moved its cargo operation from New Jersey to Brooklyn.

Attention should also be directed to the state of the Long Island Railroad's freight operation, an operation that goes millions of dollars into the red each year. Because of Interstate Commerce Commission and Public Service Commission regulations, the LIRR has poor rate divisions with other railroads, and the ICC and PSC have made it possible for railroads to give discounts to shippers who instead of using rail, truck goods from New Jersey, thus reducing business for the LIRR.

Government

It appears that the actions of local, state, and federal government have not been directed toward improved goods movement. Many truckers feel that they are getting little cooperation from the city government in an atmosphere where congestion makes goods movement a difficult undertaking. In particular, they feel that the traffic and police departments have been rather lax in their ticketing of illegally parked automobiles while enforcement against the trucking industry has been overzealous.

The Interstate Commerce Commission, the Public Service Commission, and the Federal Maritime Administration are responsible for establishing trucking, rail, lighterage, and car float tariffs. Before any inroad into improving goods movement is made, a dialogue must be set up with these organizations.

The insight and comments of those individuals involved in the day-to-day problems of goods movement are valuable and have been used in the formulation of a set of strategies for the New York City Metropolitan Area Air Quality Implementation Plan for transportation-related sources (12).

Involvement of the N.Y.C. DAR with goods movement did not end with completion of the study. Because of the complexities of the urban goods movement problem (i.e., its economic and social effects and the effects on the environment, transportation, and urban form) and because a number of N.Y.C. agencies promulgate rules and regulations and make judgments affecting the movement of goods, DAR promoted the formation of an interagency goods movement technical committee. The committee was formed in September 1972 with representatives from four City agencies: the Transportation Administration, the Economic Development Administration, the Department of City Planning, and the Environmental Protection Administration. Its formation means that, through an interagency approach, New York City can start to develop solutions to its complex goods movement problem.

The committee is currently working on a grant proposal with the City College of New York for improving goods movement (in light of the creation of an automobile-free pedestrian zone) in downtown Brooklyn. It will shortly be preparing a policy statement on goods movement and will participate in the review of the Air Quality Implementation Plan.

THE AIR QUALITY IMPLEMENTATION PLAN

The strategies of the Air Quality Implementation Plan for significantly reducing the contribution of mobile sources to air pollution are broken up into five groupings:

1. Vehicle emission control strategies,
2. Traffic control strategies,
3. Public transit strategies,
4. Goods movement strategies, and
5. Long-range strategies.

With the exception of the public transit strategies, all of the other strategies directly affect trucks and trucking activities. Before these are discussed in detail, one point should be mentioned: The private automobile and taxi also contribute to the goods movement problem, in that they slow down traffic and cause parking interference. Strategies for reducing the vehicle-miles traveled by these vehicles, as suggested in the Air Quality Implementation Plan, must be implemented. Methods of achieving this include strict enforcement of traffic regulations, reducing parking availability for automobiles, and regulating vehicle mix. Those strategies most directly affecting trucking activities are discussed below.

Retrofit of Heavy-Duty Gasoline-Powered Vehicles

Regulation of emission levels from new vehicles of over 6,000 lb gross vehicle weight (gvw) has lagged behind efforts to control light-duty vehicle emissions. In 1968, exhaust standards were promulgated to take effect with 1970 model heavy-duty vehicles. Included are smoke standards for diesel engines and CO and HC standards for gasoline engines. In September 1972, the Environmental Protection Agency promulgated more stringent standards to take effect with the 1974 model year; NO_x emissions from heavy-duty gasoline engines are regulated for the first time. As with light-duty vehicles, these heavy-duty vehicle regulations are later and less stringent than those adopted by California, the only state currently allowed by law to enact emission standards for new motor vehicles or engines. Until the 1974 model year, the standards were so mild that manufacturers had to make only minor engine adjustments to obtain certification. The result of this laxity of emission rate limitations coupled with inefficient operating characteristics is that these vehicles are a major pollution source in midtown and downtown Manhattan and in the CBDs of the other boroughs. Retrofitting pre-1974 trucks with emission control devices should help reduce truck emissions greatly, not only because of the uncontrolled nature of truck emissions but also because of their great contribution to vehicle-miles of travel in the CBD.

Heavy-Duty Vehicle Emissions Inspection

Motor vehicles over 6,000 lb gvw have been subject to minimal emissions control standards since the 1970 model year. These standards and the somewhat stronger standards enacted for 1974 models will be inadequate to control commercial vehicle emissions in New York City. Engine deterioration results in severe increases in the emission rates of vehicles in use. Periodic emissions inspection identifies vehicles that need maintenance to minimize emission rates. Inspection standards would be set according to vehicle age and size and would recognize three additional categories.

1. 1970 and later model vehicles would be inspected to ensure compliance with federal standards applicable when new and for the "useful life" of the vehicle, defined as 5 years or 50,000 miles. Earlier model vehicles would have to meet reasonable emission standards based on model year.
2. Retrofitted vehicles would be inspected to determine presence of approved control devices and compliance with relevant emission standards.
3. Vehicles for which retrofit was not mandated would have to meet emission standards established as consistent with reasonable maintenance of vehicles in the size, engine type, and age class.

Because the high mileage accumulation typical of commercial vehicles causes an annual emissions contribution out of proportion to their number, emissions inspection will be required twice yearly.

Consolidation of Trucking Activities

As stated before, urban trucks are loaded far below capacity, and thousands of operators are involved, often duplicating services. When so many operators are involved it is difficult, if not impossible, to regulate them and thereby to make their movements more efficient. Varying degrees of consolidation could be attempted, e.g., pooled delivery system for just one commodity like bread; consolidation for small geographic areas like Co-Op City; consolidation for all deliveries for midtown Manhattan. Such action requires the construction of large freight terminals where goods can be consolidated for delivery by vehicles operating with near-capacity loads.

Improvements in Goods Movement Technology and Management Systems

Technological and management solutions will provide some of the answers to the goods movement problem. For example, in order for the concept of consolidation terminals to work, the terminals will have to be carefully located and designed by using modern material handling and management techniques. Technology will help in the design of small containers for use in night deliveries. Management techniques will aid in the development of computerized pickup and delivery schedules for areas of the city requiring random truck movements. New techniques will be needed, and those already existing, e.g., container-on-flatcar (piggyback) and electronic sorting of packages need to be promoted. The subway system has potential for moving goods. Whereas it appears that the use of subways for moving goods on a general citywide basis is not feasible, it may be possible to use them in certain cases (e.g., to move goods from one urban subcenter to another, from one industrial park to another). From a long-range planning point of view, the creation of satellite goods distribution centers, tied closely with the development of urban subcenters and industrial parks, is desirable.

After-Hours Delivery to Stores and Office Buildings

After-hours goods delivery would take delivery trucks off the streets during peak congestion hours. Stores and office buildings would be required to remain open late 1 or more nights a week. An alternative to this approach, which eliminates the need for personnel to be on hand to receive shipments, is the use of night cargo drop facilities (on the idea of night mail drop facilities). Some food chains have used night goods delivery for a number of years, but there appears to be no other extensive use of night deliveries.

Provision of Off-Street Loading Facilities

Many warehousing blocks and commercial buildings are ill-equipped to efficiently handle their incoming and outgoing truck traffic and tonnage, and so streets often become blocked by trucks parking on the street to load and unload. Furthermore, truck drivers spend excessive amounts of time searching for parking. The best example of this situation in New York City is the garment district in Manhattan (a study by the N. Y. C. Transportation Administration to formulate solutions to the goods movement problem in this area will soon be under way). Vacant lots or the ground floors of certain buildings can be used to provide off-street loading facilities. Using the ground floors of certain buildings would involve renting some vacant storefronts and then modifying them or, in the long range, condemning the street or below-street grade area of the building's first floor in order to construct such facilities. New buildings are required by zoning regulations to have off-street loading facilities. Off-street loading docks can also be provided by requiring that present off-street parking facilities for automobiles no longer be used for automobiles but as unloading areas for trucks. This pertains to street-level parking lots and to underground facilities with necessary modifications.

Use of Rail for Transporting Commodities

The increased use of alternate modes of transportation, as well as the improvement of truck operating efficiency, will reduce the vehicle-miles traveled by trucks. Replacing 200 trucks by one train, for example, would reduce congestion, air and noise pollution, and energy consumption and, with more favorable rate structures, would reduce the cost of commodities. New York City (and the nation) has seen the opposite trend: the replacement of one train by 200 trucks with its negative effects. Much freight that had been moving by rail previously is now moving by truck with the consequence that there are a number of good rail connections that exist in the New York area that are underused. A perfect example of this situation is the movement of freight from New Jersey to Long Island. Many goods end the rail part of their journey in yards in New Jersey and are then trucked through New York City out to Long Island. Several alternatives become apparent.

1. Goods could be car floated from New Jersey to the Brooklyn waterfront and then shipped by rail to Long Island;
2. Goods could be sent by rail from New Jersey to the Selkirk Yards near Albany and then south over the Hellgate Bridge to Long Island; and
3. By using smaller freight cars Penn Central's tubes from New Jersey could be used at night (off-peak passenger use).

However, because of technical or economic problems these alternatives are not pursued. The condition of rail service in this country grows continually poorer; railroads are finding themselves in the position of discontinuing services and routes, and they charge for services that were previously free (e.g., lighterage) in order to survive economically. These present trends are environmentally unsound and must be reversed.

Development of Waterfront Facilities

Just as the rail network has been underutilized for freight movement, so has our water system. A revival of waterfront operations, similar to what is being done at the Brooklyn waterfront (e.g., car floating, container ports, dock railway operations) is needed. In addition, the location of alternate ports on Long Island for the delivery of goods to that area must be investigated.

Development of Special Trucks for Urban Service

A new design of trucks can make it easier and quicker for goods to be delivered. (In addition, new designs could be electrically powered, thereby eliminating the vehicle emissions.) For example, United Parcel Service trucks are specially designed by them for ease in loading and unloading. Because many trucks are loaded to only an average

of 10 percent capacity, it appears that many businesses should be using smaller trucks. Vehicle owners must be made to justify the size of their trucks at registration time. A variable registration fee schedule should be designed to encourage the use of smaller trucks.

Liaison With a Local University

Inefficient movement of goods and people is a large urban problem, yet it is poorly understood. Little work on the problem has been done by anybody, including educational institutions. By establishing a relationship with a university more can be learned about the problem, and perhaps other universities can be stimulated to pursue it. The U.S. Department of Transportation has established a university research program designed to increase the contributions of universities to the solution of national, state, and local transportation problems. It has designated a separate fund for giving grants to universities for research under this program. The City College of New York has made contact with the N.Y.C. Transportation Administration to determine what transportation projects the latter would like to see done. Suggestions for projects are being submitted to the City College through the Goods Movement Technical Committee. A permanent liaison for goods movement at the college could be established through this program. Goods movement studies are just one area for possible joint city-university study.

These other strategies were developed after the N.Y.C. DAR made estimates of air quality levels if, to meet federal standards, vehicle owners in time replaced their automobiles with newer, "cleaner" ones through trade-ins. Estimates showed that pollution levels in the CBDs would still exceed the 1977 standards. Furthermore, if standards are met in 1977, the continually increasing use of motor vehicles will cause them to be exceeded again in the future.

IMPACT OF STRATEGIES ON AIR QUALITY

In preparation of the Air Quality Implementation Plan, estimates were made of the effect the strategies would have on air quality.

The effect on air quality of retrofitting heavy-duty gasoline-powered vehicles will vary with location in the city. The impact will be greatest in CBDs where truck use is heaviest, in particular, downtown Manhattan, the Bronx, and Queens. In such areas, projected air quality improvements (16) by 1977, as compared to 1970, are CO, 25 percent; HC, 20 percent; and NO_x, 5 percent. Borough-wide projected improvements are as follows:

Borough	CO (percent)	HC (percent)	NO_x (percent)
Bronx	5	4	2
Brooklyn	7	5	3
Queens	8	6	3
Staten Island	15	12	5

If heavy-duty vehicle inspection is considered as a strategy distinct from mandatory retrofitting, citywide air quality improvements are estimated to be 1 to 2 percent for CO and HC, and CBD improvements are estimated at 5 percent for CO and somewhat less for HC. It should be noted that any retrofit program is dependent on periodic inspection and maintenance, inasmuch as controls will not generally compensate for engine malfunction.

Specific estimates of impact on air quality of the remaining strategies are difficult to quantify and, in general, require more study. However, a few points can be made. The effect of the consolidation of trucking activities should be approximately proportional to the number of trucks removed from the streets. Improvements in goods movement technology and management systems will affect air quality depending on the level of operating efficiencies achieved, the extent of the diversion of truck use to alternatives (rail and water), and so on. The effect of using rail and water for moving

commodities will also depend on the extent of the diversion of activities from trucks. The impact of new truck design is equally difficult to estimate although an electric vehicle fleet could, for example, have dramatic impact in the garment district. No estimates of the impact of the provision of off-street loading facilities and the after-hours delivery of goods have yet been made; more study is essential.

It should be pointed out, in passing, that strategies for rationalizing the movement of goods not only will improve air quality but will result in time and cost reductions for shipper, carrier, consignee, and ultimately the consumer.

CONCLUSIONS AND SUMMARY

Although there have been some improvements in the intercity and international shipment of goods, there have been virtually no improvements in the intracity movement of goods. Excessive vehicle-miles traveled, low productivity, low operating speeds, and short work schedules that coincide with the city's hours of worst traffic congestion are all conditions that describe urban goods movement. Furthermore, rail and water movement, which is environmentally superior to trucking, has been allowed to deteriorate.

The increasing reliance on the truck for the movement of goods has produced a number of adverse effects: vehicular congestion, increased energy consumption, increased noise and air pollution, broken and worn-out pavements, and high commodity costs.

The problem of the urban truck and its impact on air quality can be resolved in two ways: by making changes in the vehicle itself and by making changes in the physical environment in which the truck operates (i.e., the methods of moving goods in an urban area). The Department of Air Resources has shown that without comprehensive measures of trucks and trucking activities and by reliance solely on the turnover of vehicles, federal air quality standards will not be met. In addition, because emission control standards are far more stringent for automobiles than for trucks, trucks will be contributing an even greater share of motor vehicle pollution in the future. In fact, without such controls, they will be the single greatest source of air pollution in the city's CBDs.

The strategies suggested for New York City have application in virtually every other urban area in the country. The rationalization of goods movement in a dense urban area like Manhattan can allow other cities with dense central cores to remain viable.

RECOMMENDATIONS

Strategies that will reduce the negative environmental impact of trucks operating in the urban environment have been outlined. However, further study is still required before those strategies can be successfully implemented. The following indicates the subject of study for each strategy:

1. Heavy-duty vehicle retrofit—completion of retrofit device evaluation is required by the Department of Air Resources along with full cost-benefit analysis.
2. Heavy-duty vehicle emissions inspection—a complete test procedure must be developed by the EPA and the N.Y.C. DAR. An emissions survey is needed to establish standards.
3. Consolidation of trucking activities—a preliminary study is required to determine the location best suited for demonstration. A plan for the metropolitan area is required, which should be integrated with the plan for New York City and the development plan for industrial parks.
4. Improvements in goods movement technology and management systems—a study is required to investigate the range of alternatives and evaluate their applicability within the metropolitan area.
5. After-hours delivery to stores and office buildings—the concept must be evaluated and those areas of the city that require nighttime delivery to reduce congestion should be determined.
6. Provision of off-street loading facilities—completion of the Garment Center Transportation Study is required. A further study to determine locations in the city where impact would be greatest would also be necessary.

7. Use of rail for transporting commodities—the metropolitan area should be analyzed in detail to develop a list of potential projects and to examine their feasibility.
8. Development of waterfront facilities—a detailed analysis to determine the feasibility of waterborne freight movement in the metropolitan area is required.
9. Development of special trucks for urban service—a study is required to develop vehicle specifications and market potential.
10. Liaison with a local university—general goods movement research and development are required.

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