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Urban Air Pollution

South Asia Urban Air Quality Management Briefing Note No. 3

How Can Urban Bus Policy Reduce Air Pollution?

*Buses are essential to everyday life in South Asia. They affect urban air quality both **directly** by emitting air pollutants and **indirectly** by reducing the congestion and emissions caused by the many smaller vehicles which they replace. Buses must be not only clean but also attractive and affordable in comparison with other modes of transport. Fuel or emission standards are a necessary policy element. But unless such standards are introduced in the context of a general policy framework which makes the provision of clean bus services financially viable for the supplier and affordable to the user, they may inadvertently destroy service with adverse consequences both socially and environmentally. That policy framework must include measures to give buses priority in the use of scarce road space, to mobilize competition to enhance efficiency, and to target subsidies effectively to secure social and environmental objectives.*

Bus services provided by public enterprises in South Asia often appear to contribute significantly to urban air pollution. That appearance may be misleading. It is important to establish first how significant urban public transport is as a source of air pollution (see Briefing Note No. 1 in this series).

Where buses are identified as major polluters, the problem often appears to be associated with the use of old, often overloaded, vehicles in order to meet a burgeoning demand. Liberalizing entry to allow the private sector to supplement the public operators has in some cases even made things worse by increasing congestion. So it has been argued that the only option for environmental improvement is the enforcement of high technological standards on vehicles and fuels.

The Limitations of Technological Mandates

That argument is beguiling. If all else remained the same, forcing the use of cleaner buses and fuels would indeed improve air quality without any loss of other aspects of service quality. But the "if" is a big one, for things do not usually remain the same.

The reason is simple. *Transport users'* decisions are primarily motivated by the desire to maximize their own welfare, and are therefore sensitive to the time, money and inconvenience costs of transport alternatives. Similarly, *transport supply agencies*, whether publicly or privately owned, must plan their activities within the constraints of limited resources. As a consequence, when governments impose standards (whether on fares, services or technology) on traditional formal sector buses without paying due regard to the economic costs of those standards, they may make the services too costly for the operators to operate at existing fares, yet too costly for many poor users to use at financially sustainable fare levels.

The usual effect is that informal operators enter the market using smaller vehicles, often very old and polluting. For example, in South Asia, the autorickshaw provides useful point-to-point service for middle income people and is an important source of employment for the poor. But it contributes to air pollution directly, particularly when powered by a two-stroke gasoline engine, and indirectly, by contributing to congestion and reducing average traffic speeds. Moreover, informal sector services are not always cheap, and poor bus users in particular may pay the price for the attempt to reduce emission levels. During the last decade, conventional bus systems have failed completely in many countries in Africa, Central Asia and elsewhere as a result of attempting to enforce socially desirable fare and service quality policies.

Imposing stringent environmental standards on bus operators without regard to their financial consequences puts the burden on the poor.

It is therefore critically important to recognize that bus transport policy affects urban air pollution both *directly*, through bus vehicle emissions, and *indirectly* through its effects on the use of smaller vehicles whether they be autorickshaws, minibuses or private cars. Policy for buses

must therefore aim *simultaneously* to minimize their direct air pollution impacts by making them clean, and to maximize their indirect benefits by making them sustainable and attractive in comparison with other modes.

The key to achieving this is to recognize that policy for buses must be *both* environmentally sensitive *and* consistent with public and private affordability. The most important message is that while fuel or emission standards for buses may help, they will not work unless supported by policies to make bus transport economically sustainable.

Making Clean Technology Economically Viable

Imposition of stringent emission and other vehicle standards tends to increase capital costs without offering any compensating reduction in operating costs and tends to reduce the amount of financially viable service. So how can public road passenger transport policy be shaped to improve the environment without harming poor users?

Giving priority to buses

Mixing public transport vehicles, whether buses or autorickshaws, with other vehicle categories reduces the speed of both. Cars are impeded by buses. And buses are impeded by cars, typically moving at only about two-thirds the speed of cars because of delays in stopping and re-entering the traffic flow. Given the limited density of bus networks, buses also involve longer walking times than the private car. Overall, bus journeys usually take longer than those by smaller public transport vehicles and at least twice as long as equivalent car journeys which can offer something nearer to door-to-door service. This results in a shift to small vehicles. But, paradoxically, the net result of such a shift is that total traffic volume, congestion, and average travel times are all increased.

While fuel or emission standards for buses may help, they will not work unless supported by policies to make bus transport economically sustainable.

Bus priorities—dedicated lanes or totally segregated busways—counteract this effect. The simplest measures are *priority lanes*, which exist for buses in several Asian cities such as Manila, Kuala Lumpur and Bangkok. But they have major limitations. They make roadside access to premises more difficult. When they are operated *in the same direction as the main traffic flow*, they are susceptible to invasion by other traffic (bus lanes in Dhaka suffer from cycle-rickshaws), and hence need a strength of enforcement which they rarely receive. Operation *against the direction of flow*, as in some lanes in Bangkok, is more self-enforcing but can increase pedestrian accidents.

The limitations of bus lanes can be overcome by *segregated busways*. Physical separation limits violations by other traffic. By using central lanes, along with protected pedestrian crossings at stations, the problems of accidents and access to roadside premises can be reduced [1]. And by developing busways as trunk links in a physically and commercially integrated network, the travel time and cost of bus transport can be made more competitive with the private car. Although dedicating existing road space to public transport may be opposed by car users, experience in Curitiba (Brazil) and Bogotá (Colombia) has demonstrated that, with good traffic management to minimize car delays, the approach can be politically popular as well as giving environmental and efficiency benefits (see Box 1).

Box 1. TransMilenio: Bogotá´s bus rapid transit system [2]

In less than three years between January 1998 and December 2000, the municipality of Bogotá, Colombia developed and implemented a bus rapid transit system called Transmilenio. The system consisted of exclusive busways on central lanes of major arterial roads, roads for feeder buses, stations, and complementary facilities. Trunk line stations are closed facilities with one to three berths varying from 40 meters (m) to 180 m in length, located every 500 m on average. Trunk lines are served by articulated diesel buses with 160 passenger capacity, while integrated feeder lines are served by diesel buses with capacity of 80 passenger each.

To maximize capacity, trunk lines accommodate express services stopping at selected stations only, as well as local services stopping at all stations. This combination allows the system to carry up to 45,000 passengers per hour per direction. Services are operated by private consortia of traditional local transport companies, associated with national and international investors procured under competitively tendered concession contracts on a gross cost basis.

By May 2001, TransMilenio carried 360,000 trips per weekday, without operating subsidies at a ticket cost of US$0.36. Productivity was high, with 1,945 passengers per day per bus and 325 kilometers (km) per day per bus. Fatalities from traffic accidents had been eliminated, particulate emissions in the corridors reduced by up to 30 percent, and user travel time reduced by a third.

The first possibility is by combining higher environmental standards with the provision of priority to buses in the use of scarce urban road space. For example, operators of the Bogotá Transmilenio system were required to buy new high quality vehicles to compete for franchises, but claim that the increased efficiency of movement has allowed them to improve service vastly and to increase their profitability without any increase in fares.

Improving internal efficiency

In most public sector bus companies the combination of public ownership and statutory monopoly status gives little incentive to improve and allows them to be run more in the interests of their staff than their customers. Their performance can be usually improved in many ways, including more efficient design of route networks, better cost control and better control of performance on the road.

While there are some scale economies in staff training, supply procurement and management information systems, international experience indicates that these are not of a magnitude to justify monopoly operation of large urban systems. The advantages of integrated systems planning, also frequently considered to justify monopoly, can be equally well achieved by separation of planning from the operation of services which can be competitively procured by the planning agency. The most critical requirement is usually the need for internal incentives to improve efficiency. That is what commercialization and competition can provide.

Introducing effective competition

It is often argued that competition, particularly from informal sector operators, is the enemy of environmental quality. It has been associated with excessive supply (as in Santiago, Chile), the use of old polluting vehicles (as in Lima, Peru) or dangerous operating practices (as in Delhi, India). Unregulated competition "in the market" can be dangerous and inefficient.

But that is not inevitable. Several countries, including Denmark, Sweden and the United Kingdom, have organized a different form of competition—competition "for the market." This consists of the award of exclusive franchises of limited duration and scope on the basis of a competitively bid tender. This approach allows the authorities to control the main policy-sensitive variables, such as fares and service structures, while mobilizing competition to get the desired level of service produced at the lowest possible cost. This has shown reductions in cost per bus kilometer between 20 percent and 40 percent. For that reason, competition for controlled exclusive franchises has usually been preferred in large cities [3].

The replacement of competition "in the market" by competition "for the market" in Santiago allowed the authorities to get the economic benefits of competition without environmental damage by the simple device of setting minimal pollutant emission standards as a condition for holding any franchise, as well as by using environmental quality above the minimum as one of the criteria on which competitively tendered franchises are awarded (see Box 2).

For this approach to be effective, a franchising authority must be technically and administratively able to design and award franchises with sensible environmental conditions, and to monitor performance—including vehicle emissions—effectively. There is now a wealth of experience in doing this, both in industrial countries (for example, in Copenhagen and London) and developing countries (in such cities as Santiago de Chile and Bogotá).

Box 2. Addressing the environmental impacts of bus competition in Santiago, Chile

At the end of 1977 public road passenger transport in Santiago was provided by a public sector operator with 710 large (90- seat) buses, a number of strictly regulated private associations operating 3,167 regular (78-seat) buses and 1,558 (40-seat) "midi"-buses. The public operator lost money and service was mediocre. Between November 1979 and June 1983, both entry to the market and fares were deregulated. The public sector operator was driven out of the market and total capacity more than doubled. But by 1985 regular bus fares had tripled and the average age of buses increased from 7 to 11.6 years. Competition concentrated on routes to the center of the city which became congested and polluted by poorly occupied buses.

Initial attempts to rectify the situation included banning 20 percent of the bus fleet from operation on each day of the week and banning buses more than 22 years old. But these measures gave little relief. So, in the early 1990s, the government introduced a system of competitive tendering for franchises to operate buses on routes entering the city center. The capacity was thus constrained by the authorities. The fare to be offered was a main criterion in selecting franchisees, as were the environmental characteristics of the vehicles offered. Congestion, air pollution and fares all fell dramatically so that by the mid-1990s, the improved service which was the benefit of competition was retained while its disbenefits had been largely eradicated.

Attracting passengers from cars is more difficult. Maintaining higher and more regular frequencies might help. But, given the poor image of ordinary buses, those who can avoid them will, whatever the fares and frequencies. For that reason, regulatory reform to encourage express or air-conditioned buses to attract higher income patronage is likely to be even more effective than giving subsidies, as experience has shown in cities of varying average income levels such as Dhaka, Bangkok, Buenos Aires and Seoul.

Effective competition usually depends on the commercialization or full privatization of the incumbent parastatal, as private operators are reluctant to compete with an agency that can rely on deficit finance from its owner to ensure that it retains its position in the market. The cities that have most satisfactorily reconciled efficient and clean operations with low budget burden are those that have confronted the need to develop effective competition.

Focusing public transport subsidies

Many industrial country cities subsidize public transport fares, sometimes arguing that this will attract passengers from cars. While this may be desirable on distributional grounds, it is not generally cost-effective as an environmental policy. First, there is strong evidence that up to half of any subsidy "leaks" to benefit employees in the industry rather than passengers. Second, because most car owners' use of their vehicles is not sensitive to public transport fare levels, subsidy is not particularly effective in shifting travelers from private to public transport. Third, because the modal shift is small, but the subsidy is paid to all, general bus subsidy is not a cost-effective way to reduce urban pollution. Subsidizing cleaner vehicles and/or fuels is a more direct approach.

Recognizing all the relevant factors

However, the need to ensure the financial sustainability of the cleaner technology still applies. The cleaner vehicles must be capable of being operated reliably and economically. This may require not only an initial capital subsidy but also substantial investment in training and maintenance facilities for the new technology, as well as fiscal effort to keep the price of the fuel attractive (for example, it is estimated that the price of compressed natural gas, CNG, would need to be about half that of diesel to make CNG operation financially competitive). If that is the case, then it is necessary to ask what other policies (for example, investment in busways) might have been introduced at the same cost as that of the fuel duty loss.

Conclusions

Worldwide experience on the environmental implications of urban buses thus offers some valuable lessons:

- Imposing high vehicle standards without attention to the financial sustainability of bus operations can undermine their viability with counterproductive effects.
- Improving the efficiency of bus operations is critical to the sustainable environmental improvement of bus transport.
- Priority in use of road infrastructure, and particularly the creation of segregated busway systems, is a most effective basis for sustaining environmental standards for buses.
- Competition for franchises also significantly reduces costs and can be designed to support environmental improvement.

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