4

Rethinking Urban Transport

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The automobile once promised a dazzling world of speed, freedom, and convenience, magically conveying people wherever the road would take them. Given these alluring qualities, it is not surprising that people around the world enthusiastically embraced the dream of car ownership. But societies that have built their transport systems around the automobile are now waking up to a much harsher reality. The problems created by overreliance on the car are outweighing its benefits.

These problems are numerous and widespread. Traffic congestion and air pollution plague all major cities, and oil dependence makes economies vulnerable. Cities with streets designed for cars instead of people are increasingly unlivable. In developing countries, automobiles serve only a small elite and leave the vast majority with inadequate transport. In Eastern Europe and the Soviet Union, recent reforms could add the problems of automobile dependence to overwhelming economic and environmental crises.

A new, more rational approach to transportation is needed, one that puts the automobile in its rightful place in a city as one among many options for travel. Buses and trains are more appropriate than private cars as the centerpieces of transportation systems, particularly in the world's most congested urban areas. At reasonable occupancy rates, public transport uses space and energy many times more efficiently than cars do, and creates much less pollution.

In this new transport environment, walking and bicycling would also play important roles, complementing public transport with the convenience of individual mobility. These nonmotorized forms of travel have the potential to provide a considerable share of transportation—as long as cities cater to the needs of pedestrians and cyclists.

Getting away from automobile dominance also requires gradually restructur-

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ing cities and suburbs to lessen the need for driving. Development can be planned to create compact cities in which jobs, homes, and services are consolidated and near public transport. In both industrial and developing countries, careful urban planning can help meet future transportation needs by minimizing the demand for travel.

From Servant to Master

Perhaps more than any other invention, the automobile embodies author Jacques Ellul's observation about all technologies: it makes a good servant but a bad master. Yet obeying the demands of the private car has become a passive routine for many of the world's cities. Automobile access has dictated the very character of urban life, most obviously in the design of the modern city. Vast roads and parking lots distort cityscapes into proportions that dwarf and intimidate humans. Once all available surface space has been surrendered to private cars, engineers turn to space overhead and underground. In a final gesture of submission, entrepreneurs in Yokohama, Japan, recently opened a floating parking lot in the local bay.[1]

Growth in the world's 400-million-strong auto fleet makes it clear that if societies fail to regain mastery over this servant, car-related problems will become global crises. The average annual rate of growth in car ownership has slowed from 5 percent in the seventies to 3 percent in the eighties because of saturation in the industrial countries, which account for about 80 percent of the global fleet. But while the world fleet is no longer growing as quickly as it did before 1970 (now taking two decades to double instead of one), the absolute number of cars added is huge; currently, a net total of 19 million cars is added to the world fleet each year.[2]

Along with the increase in the automobile's numbers come ubiquitous problems. Traffic congestion, now a fact of life in major cities, has stretched daily rush hours to 12 hours or longer in Seoul and to 14 in Rio de Janeiro. In 1989, London traffic broke a record with a 53-kilometer backup of cars at a near standstill. Roaring engines and blaring horns cause distress and hypertension, as in downtown Cairo, where noise levels are 10 times the limit set by health and safety standards. Half of U.S. business leaders surveyed in 13 major cities said that traffic conditions affected their employees' morale, productivity, punctuality, and emotions.[3]

Careful urban planning can help meet future transportation needs by minimizing the demand for travel.

Motor vehicles are the single largest source of air pollution, creating a haze of smog over the world's cities. The main component of car-induced smog is ozone, a gas formed as nitrogen oxides and hydrocarbons react with sunlight. Ozone and other pollutants—including carbon monoxide, nitrogen oxides, and hydrocarbons—aggravate bronchial and lung disorders and are often deadly to asthmatics, children, and the elderly. Automobiles also emit carbon dioxide, the greenhouse gas responsible for over half the global warming problem. Passenger cars account for more than 13 percent of the total carbon dioxide emitted from fossil fuels worldwide, or more than 700 million tons of carbon annually.[4]

The economic and political vulnerability of a car-dependent society be-

comes painfully clear whenever there is an oil crisis. The United States, which devotes 43 percent of its petroleum use to run cars and light trucks and imports half its oil, was sharply jolted in August 1990 when Iraqi troops invaded Kuwait, claiming control over nearly 20 percent of the world's proven oil reserves. Even when the current crisis subsides, the Middle East may never again be counted on for a stable supply of oil. (See Chapter 2.)[5]

The enormity of these auto-related problems defies mere technical fixes. Without alternatives to cars, progress in fuel economy and emissions reduction can be offset by increased driving. In the United States, for example, dramatic reductions in hydrocarbon and carbon monoxide emissions made possible by catalytic converters have been partly offset by greater use of cars, which are now logging an additional 120 billion kilometers each year. In 1989, 96 metropolitan areas—home to more than half the people in the country—failed to meet the U.S. Environmental Protection Agency's ozone safety standard, and 41 areas violated the carbon monoxide standard.[6]

While some technical changes hold great promise, they do not address all the problems of automobile use. Improving new-car fuel economy could ease dependence on oil, and together with stricter emissions standards and improved exhaust controls could also reduce air pollution considerably. But these changes do nothing to ease traffic congestion. Even electric cars, which could greatly reduce fossil fuel consumption and pollution, would still get stuck in traffic jams.

Moreover, no automobile technology can fully address the negative societal consequences of a car-dominated society. Traffic deaths are an example. In the United States, some 49,000 people died in motor vehicle accidents in 1988—more than from all other accidents combined. Worldwide, despite safety improvements, more than a quarter of a million people were killed in road accidents in 1988, and several million more were injured or permanently disabled. The greatest danger of road accidents is in the Third World's dense, chaotic mix of motorized and nonmotorized traffic, where road fatality rates are 20 times those in the industrial world. A study of 15 developing countries found that road accidents were second only to intestinal diseases as the leading cause of death.[7]

Finally, no new car technology will serve the majority of humanity who will never own an automobile. A Fiat minicar in China sells for roughly $6,400—a moderate sum in wealthy countries, but equal to about 16 years' wages for an ordinary worker there. In much of the developing world, higher sales figures just mean that a small elite is improving its travel options, while the vast majority's mobility and accessibility remain impaired. Even in the cities of car-oriented industrial countries, those who either cannot afford a car or are unable to operate one often have no way to get to jobs, schools, health centers, and other important destinations.[8]

Creating sustainable urban transport systems that meet people's needs equitably and that foster a healthy environment requires putting the automobile back into its useful place as a servant. With a shift in priorities, cars can be part of a broad, balanced system in which public transport, cycling, and walking are all viable options.

Getting on Track

Public transport plays a central role in any efficient urban transport system. In developing countries, where at least 16

cities are expected to have more than 12 million people each by the end of this decade, failing to give priority to public transport would be disastrous. But neither the exploding Cairos and Delhis nor the relatively stabilized New Yorks and Londons can sustain future growth in automobile use. As the nineties begin, a new oil crisis, mounting pollution and congestion, and global warming all call for a greater commitment to public transport.[9]

The term "public transport" covers many different types of vehicles, but most commonly it refers to buses and trains. Buses take many forms, from minibuses to double-length vehicles with pivoting centers. Rail services fall into four major categories: rapid rail (also called the underground, tube, metro, or subway), which operates on exclusive rights-of-way in tunnels or on elevated tracks; streetcars (or trams), which move with other traffic on regular streets; light rail (or trolleys), quieter, more modern versions of streetcars that can run either on exclusive rights-of-way or with other traffic; and suburban or regional trains, which connect a city with surrounding areas.

The concept of public transport also includes organized car pools and van pools. For U.S. commuters in areas with inadequate bus and train service, this is the only "public" transport option. But even where other systems are comprehensive, there is vast potential for car pooling; recent research shows that in cities the world over, private cars during commuting hours on average carry just 1.2–1.3 persons per vehicle.[10]

Public transport modes vary in fuel use and emissions and in the space they require—but if carrying reasonable numbers of passengers, they all outperform one-occupant private cars on each of these counts. Although energy requirements vary according to the size and design of the vehicle and how many people are on board, buses and trains require far less fuel per passenger for each kilometer of travel. In the United States, for example, a light-rail vehicle carrying 55 passengers needs an estimated 640 Btus of energy per passenger per kilometer; a city bus with 45 passengers would use some 690 Btus per passenger-kilometer; and a car pool with four occupants, 1,140 Btus. A single-occupant automobile, by contrast, burns nearly 4,580 Btus per passenger-kilometer.[11]

The emissions savings from public transport are even more dramatic. (See Table 4–1.) Since both rapid and light rail have electric engines, pollution is

Table 4-1. United States: Pollution Emitted During Typical Work Commutes[1]

Transport Mode	Hydrocarbons	Carbon Monoxide	Nitrogen Oxides
	(grams per 100 passenger-kilometers)		
Rapid rail	0.2	1	30
Light rail	0.2	2	43
Transit bus	12	189	95
Van pool	22	150	24
Car pool	43	311	43
Auto[2]	130	934	128

[1]Based on national average vehicle occupancy rates. [2]Based on one occupant per vehicle.
SOURCE: American Public Transit Association, "Mass Transit: The Clean Air Alternative," pamphlet, Washington, D.C., 1989.

measured not from the tailpipe, but from the power plant, which is usually located outside the city, where air quality problems are less acute. For typical U.S. commutes, rapid rail emits 30 grams of nitrogen oxides for every 100 passenger-kilometers (that is, for every 100 kilometers each rail passenger travels), compared with 43 grams for light rail, 95 grams for transit buses, and 128 grams for single-occupant automobiles. Public transport's potential for reducing hydrocarbon and carbon monoxide emissions is even greater.

Although diesel buses—especially in developing countries—can be heavy polluters, existing technologies can control their exhaust. In Athens, some buses are fitted with traps to prevent particulates from being emitted into the air. Buses can also run on less polluting fuels such as propane (used in parts of Europe) and natural gas (used in Brazil and China). Test buses in the Netherlands that run on natural gas are estimated to emit 90 percent less nitrogen oxides and 25 percent less carbon monoxide than diesel engines do.[12]

In addition to reducing fuel consumption and pollution, public transport saves valuable city space. Buses and trains carry more people in each vehicle and, if they operate on their own rights-of-way, can safely run at much higher speeds. In other words, they not only take up less space but also occupy it for a shorter time. Thus, comparing ideal conditions for each mode, an underground metro can carry 70,000 passengers past a certain point in a single lane in one hour, surface rapid rail can carry up to 50,000 people, and a trolley or a bus on a separate lane, more than 30,000. By contrast, a lane of private cars—even with four occupants each—can move only about 8,000 people an hour.[13]

The cost of providing public transport is, understandably, the overriding factor for many governments faced with these dramatic differences in mobility and efficiency. But many public officials fail to make a full accounting. A fair comparison must consider the full costs of all systems, including the environmental impacts and social consequences, and which approach can move the most people. With public transport's lower impacts, higher capacities, and greater affordability for the general public, governments could get more for their money.

Similarly, drivers would find public transport more attractive if they kept the full costs in mind. Few U.S. drivers realize that, when the costs are factored in—including fuel, maintenance, insurance, depreciation, and finance charges (but excluding the portion of their taxes that goes toward driving subsidies)—they pay $21 per 100 kilometers of driving, or about $1,700 annually just to commute to work. By contrast, the average public transport fare is under $9 per 100 kilometers. In highly car-dependent cities, a viable public transport option for commuting could save some families from having to buy a second or third car.[14]

The availability and use of public transport vary widely in cities around the globe, from infrequent, near-empty buses that lumber across sprawled U.S. urban areas to Tokyo's crowded, minute-to-minute subways, where hired "pushers" pack passengers into the train so the doors can close. Since variations in distances and city densities affect the total kilometers of travel, the annual number of trips each person takes by public transport provides a better standard for comparing its importance in various cities. The frequency of public transport use ranges from more than 700 trips annually per person in Moscow to 22 trips a year per person in the auto-oriented city of Dallas, Texas. (See Table 4–2.)[15]

Cities in the Soviet Union and Eastern

Table 4-2. Dependence on Public Transport, Selected Cities, 1983

City	Population	Mode[1]	Trips Per Person Per Year
	(million)		
Moscow	8.0	bus, tram, metro	713
Tokyo	11.6	bus, tram, metro, rail	650
East Berlin	1.2	bus, tram, metro, rail	540
Seoul	8.7	bus, metro	457
West Berlin[2]	1.9	bus, metro	389
Buenos Aires[3]	9.0	bus, metro	248
Kuala Lumpur[4]	1.0	bus, minibus	224
Toronto	2.8	bus, tram, metro	200
Nairobi	1.2	bus, minibus	151
Abidjan	1.8	bus, boat	132
Beijing	8.7	bus, metro	107
Chicago[3]	6.8	bus, metro, rail	101
Melbourne[5]	2.7	bus, tram, rail	95
Dallas[3]	1.4	bus	22

[1]In this table, "rail" refers to suburban rail. [2]1982. [3]Metropolitan area. [4]Excludes cycle rickshaws and private minibuses. [5]1980.

SOURCES: Worldwatch Institute estimates, based on Chris Bushell and Peter Stonham, ed., *Jane's Urban Transport Systems: Fourth Edition* (London: Jane's Publishing, 1985); Peter Newman and Jeffrey Kenworthy, *Cities and Automobile Dependence: An International Sourcebook* (Aldershot, U.K.: Gower, 1989).

Europe provide extensive and comprehensive public transport options, including buses, tramways, metros, and suburban trains. Although quality varies along with public spending constraints—from showpiece metros in the largest cities to undependable, overcrowded systems elsewhere—the various transport modes offer widespread service to the many people who do not own cars. Of the roughly 300 streetcar and trolley systems in the world, about 110 are in the Soviet Union and another 70 in Eastern Europe.[16]

Urban public transport has long been a government priority in Western Europe. Although all major European cities contend with automobile traffic, well-developed bus and rail systems are available for those who choose public transport. While high car ownership makes for stiff competition, public transport in large cities in Western Europe typically accounts for between 20 and 30 percent of passenger-kilometers. In recent years, several large West European cities have stepped up their commitment to public transportation, combining further investments with complementary policies to restrict auto use.[17]

High-income Asian countries also make extensive use of public transport. Japanese cities are particularly rail-oriented; authorities since the sixties have primarily used commuter railroads to link expanding suburbs with urban centers. In Tokyo, 95 percent of all passenger-kilometers by public transport are on trains. Metro lines in Tokyo, Seoul, and other Asian cities not only move mil-

lions of passengers within the city but also lend their tracks to through-trains from surrounding suburbs. In Hong Kong, public transport accounts for about 9 million out of the 10 million daily passenger trips.[18]

Public transport also plays an important role in urban areas of the Third World. In many cities in Asia, Latin America, and Africa, buses—in their various forms—make 50–80 percent of all motorized trips. Buses are sometimes hopelessly overcrowded; it is not uncommon to see several riders clinging to the outside. Yet most Third World cities have lower public transport use per person than those in Western Europe, reflecting the inability of meager bus fleets to keep up with population growth.[19]

Cities in car-infatuated California are leading the trend toward reviving rail transport.

Private bus operators often take up where publicly owned systems leave off, and in many cases provide the bulk of all service. In Calcutta, for example, private companies hold roughly two thirds of the market; three quarters of public transport trips in Buenos Aires are made by some 13,000 private buses, or *colectivos*. Flexible, informal forms of public transport—including minibuses, jeepneys (converted jeeps), vans, pickups, shared taxis, and cycle rickshaws—give crucial service, especially in the parts of cities that are hard to get to.[20]

Over the past two decades, some 21 large cities, including Mexico City, Shanghai, and Cairo, have built metro systems. These projects have greatly improved transportation in dense city centers but at great financial cost, raising widespread doubts about their economic viability in developing countries. Still, in several cities of such extreme density that even greatly expanded bus service cannot cope with demand, new metros are being planned despite the cost.[21]

Among the world's major cities, those in Australia and the United States make the least use of alternatives to the private car. Although less than 5 percent of U.S. work trips are by public transport, ridership is heavy in New York City, Chicago, and other places that provide extensive service. Indeed, nearly one quarter of the entire country's public transport trips are in New York City. But several large and medium-sized American cities, having reached the limits of automobile dependence, are either building or considering light-rail systems, and others are adding light rail to their existing lines.[22]

Cities in the car-infatuated state of California are leading this trend toward reviving rail transport, with projects such as an expansion of San Diego's highly successful trolley and a light-rail line in San Jose. Even Los Angeles has an extensive new rail system under way, expected to include 240 kilometers of light and rapid rail when completed.[23]

The recent trend in many cities is toward light rail over "heavy" rapid-rail systems. Whereas metros require exclusive rights-of-way, which often means building costly and time-consuming elevated or underground lines and stations, light rail can be built on regular city streets at lower cost. The capital costs of recently constructed light-rail lines range from $5 million per kilometer for San Diego's surface trolley to $39 million per kilometer for a tunnel light-rail line in Hannover, Germany. By contrast, the underground metro in Santiago, Chile, cost $40 million per kilometer; a metro extension in Osaka, Japan, needed $64 million; and the new underground line in Caracas, Venezuela, rang up a bill of $117 million per kilometer.[24]

One increasingly popular transport al-

ternative is to upgrade old suburban rail systems, improving their speed and convenience for much less than the cost of a new metro. For example, Hong Kong completely modernized and rebuilt its suburban rail system and added new vehicles for $13.2 million per kilometer, a little more than 10 percent of the cost of the city's underground Island Line. Rail upgrading projects are now under way in at least 50 major cities, including London, Jakarta, Melbourne, and São Paulo.[25]

Cities for People

Walking and cycling are the most common forms of individual transport. Because they are economical and clean, save space, and require no fuel other than a person's most recent meal, they are also the most appropriate way to make short trips. Yet nonmotorized transport is often ignored as part of transport systems. Few cities, if any, adequately address the needs of pedestrians and cyclists.

In both rich and poor countries, serving the needs of people who do not have cars is crucial for creating a sustainable transport system. There are several ways to make cities for people, not just for cars. Among them are providing various facilities to improve the access of bikers and walkers to points throughout the city, giving them priority in city centers, and integrating cycling and walking with public transport.

The most effective way to make cities safer and more convenient for nonmotorized transport is to keep motor traffic from commandeering urban space. Because of their mass and speed, cars automatically take over streets, intimidating and endangering people on foot or on bicycles. For cycling and walking to be viable means of transport, people must be able to move safely throughout the city under their own steam. This calls for separate lanes and paths in some situations (where motor traffic is heavy and traveling quickly), but more often it requires making motor vehicles share regular streets with other travellers.

It takes active restrictions on cars to make some streets safe for slower traffic. Many European cities use these restrictions, known as "traffic calming," to turn streets into places for people who live, work, and shop there, instead of for drivers just passing through. Traffic calming's chief contribution is to safely accommodate pedestrians and cyclists on city streets without shunting them to often-inferior lanes or paths.

For more than two decades the Dutch have calmed traffic by changing the layout of the residential street, transforming it into a *woonerf*, or "living yard." In the *woonerf*, cars are forced to navigate slowly around carefully placed trees and other landscaping. Since motor traffic cannot monopolize the entire breadth of the street, much of the space becomes more open to walking, cycling, and children's play. Automobiles are free to enter the *woonerf*, but only as "guests," while nonmotorized traffic has priority. Experience with traffic calming has shown that it is most effective if widely implemented, so that motor traffic problems are not simply diverted to nearby streets.[26]

West Germany's similar *Verkehrsberuhigung* schemes multiplied into the thousands throughout that former country since they were started in the seventies. Originally intended for residential areas, the technique is now spreading over whole cities. Traffic calming greatly improves the quality of life in neighborhoods where it is implemented, and so is gathering popularity in many countries, including Italy, Japan, Sweden, and Switzerland. Such restraints are so well-

received in Denmark that local residents themselves are often willing to pay for the measures.[27]

Another way to give street space to nondrivers is to restrict cars in city centers. Several West European cities have successfully restrained traffic in the core by dividing it into cells. In Göteborg, Sweden, for example, the city center is divided into five pie-shaped zones, all accessible by a large ring road on the periphery. Automobiles are not allowed to cross the zone boundaries, but public transport, emergency vehicles, bicycles, and mopeds may. Since this system was instituted in 1970—along with reserved lanes for buses and trams, and some streets closed to all but pedestrians—the city has had fewer accidents and improved public transport service. Traffic cells are also found in Bremen, Germany (where they originated); Besançon, France; the Dutch city of Groningen; and Tunis, the capital of Tunisia.[28]

Making bicycling practical depends largely on creating continuous routes throughout a city, which may require some separate cycle lanes and paths. But simply providing these facilities is not enough; traffic planners need to analyze data on movement patterns and accident potential when designing such paths. It is important for bicycle paths to be sufficiently wide and smooth—otherwise they create safety hazards.

The most dangerous situations arise at intersections where bicycles and motor vehicles cross paths. Some cities provide separate overpasses and underpasses for nonmotorized traffic at such junctions. But what many cities call "safety improvements" often mean overhead skywalks, isolated bike paths, and other physical schemes that merely clear children, cyclists, and pedestrians from space meant to be the sole domain of cars. Although these separate facilities are sometimes necessary, it is usually preferable to restrain the motor traffic so that people can cross safely. This can be done with special traffic lights, for example, or by designating space for cyclists to stop ahead of cars at an intersection, together with a light that allows them to proceed first.[29]

Where separate lanes or paths for nonmotorized traffic are provided, the trick is to avoid using them as justification for restricting pedestrians and cyclists from regular streets. In the Netherlands, where some 30 percent of work trips and 60 percent of school trips are made by bicycle, some cities have combined traffic measures on regular roads with separate paths where necessary—thus seeking to create direct, uninterrupted bicycle routes, rather than to just keep cyclists out of the way of drivers. Chinese cities often provide pedestrian/cyclist lanes and bridges for the country's 300 million cyclists, along with restrictions on turns by motor vehicles at dangerous junctions.[30]

Another effective way to make streets more amenable to pedestrians and cyclists is to restrict car parking downtown. Such limits not only free space for nonmotorized traffic but also encourage people to choose transport options other than driving. Paris Mayor Jacques Chirac, apparently impressed by the reduced traffic resulting from temporary parking restrictions for France's 1989 bicentennial, announced plans to remove permanently more than 100,000 street parking spaces in central Paris. Geneva prohibits car parking at workplaces in the central city, motivating commuters to use the city's excellent public transport system.[31]

Belying conventional wisdom, research in 10 major German cities has shown that parking spaces do not always attract more shoppers to commercial areas. In fact, too much parking can even hurt business by creating an atmosphere unfriendly to pedestrians. Bicycle parking is much less expensive to provide

and brings in quieter, safer, nonpolluting traffic.[32]

Copenhagen's city council has reduced car traffic in the city center by banning all on-street parking in the core, replacing parking spaces in public squares with landscaping, and increasing the amount of bicycle parking at commuter train stations. Public policy in Harare, Zimbabwe, requires merchants to provide bike parking downtown. Although bicycle parking is relatively simple to supply, it must be designed carefully to be secure. High theft rates naturally deter potential cyclists. Perhaps the most effective security measure is guarded bicycle parking, common in many Asian countries, including China and Vietnam, and at rail stations in industrial countries, including Denmark, Japan, the Netherlands, and Germany.[33]

City centers benefit greatly from the creation of auto-free pedestrian zones. Nearly all major European cities devote part of their centers to people on foot. Munich's impressive 85,000-square-meter pedestrian zone owes much of its success to easy access via public transport. Third World cities with heavy concentrations of foot traffic and street vendors could enhance safety and improve traffic conditions with such schemes. After pedestrian streets were established in Lima, Peru, attracting both street traders and shoppers on foot, traffic flow through the center improved dramatically.[34]

Although cycling and walking are often used for short journeys, they can serve for longer trips if integrated well with trains and buses. This requires safe access to transit stops and stations for cyclists and pedestrians. Station entrances can also be made more accessible to passengers who do not arrive by car through the placement of bicycle parking, bus lanes, and car parking. For example, a Dutch national railway program seeks to give the highest priority at station entrances to pedestrians, followed in descending order by bicyclists, bus riders, taxi passengers, people dropped off by car, and, finally, those who park a car at the station.[35]

"Bike-and-ride" facilities, which encourage commuters to cycle to rail stations instead of drive, are increasingly popular in Japan and Western Europe. For years, Japanese commuters have preferred bicycles over slow feeder buses for getting to suburban rail stations. Japan's 1980 census showed that 7.2 million commuters, or about 15 percent of the total, rode bicycles to work or to commuter rail stations. In Europe, the portion of rail passengers in suburbs and smaller towns who bicycle to the station varies from 10 to 55 percent. Stations often have spaces for hundreds of bicycles, and many public transport systems allow cyclists to bring their bikes on the bus or train.[36]

In the Netherlands, some 30 percent of work trips and 60 percent of school trips are made by bicycle.

For many people in developing countries, nonmotorized travel is essential because auto ownership is out of the question. Motorcycles and mopeds are increasingly popular in much of the developing world, but in addition to being heavily polluting, they are often too costly for those with low incomes and require expensive, scarce fossil fuels. Even buses are out of reach for many; it is estimated that people in one fourth of the households in Third World cities cannot afford public transport.[37]

Governments that are overwhelmed by the costs of expanding public transport can greatly improve people's travel options for less investment by subsidizing bicycle purchases. In countries such

as Tanzania, where a bike can cost seven or eight times the average monthly wage, cycling can be a luxury. Some city governments in China have bought some time to expand bus service by paying commuters a monthly allowance for cycling to work. Credit schemes to help people acquire bicycles, rickshaws, and other nonmotorized vehicles are in place in India, Ghana, and other countries; city employees in Harare receive low-cost loans for buying bicycles.[38]

Cities can thus address many of their transportation problems by facilitating cycling and walking. They can take steps to displace car travel for short trips, make public transport more convenient, and provide high-quality mobility and accessibility to people for a fraction of the cost of motorized transport. At the same time, the quality of life will improve in cities that are oriented to people, not just motor vehicles.

The Road Not Taken

A city's potential to expand public transport and to facilitate cycling and walking depends on much more than providing buses, trains, and safe streets. The layout of a city helps determine whether or not these transport options are appropriate or even feasible. Many urban areas are designed around the automobile, with planners using road building to combat the inevitable traffic congestion. The result is a treadmill effect in which new roads fill to capacity as soon as they are completed; cities begin to look like Los Angeles, where two thirds of urban space is paved over for cars.[39]

Instead of further catering to autos, cities can step off the road-building treadmill by changing land use patterns to reduce the need for driving. For the long haul, reducing automobile dependence calls for a fundamental rethinking of the very shape of cities.

Although all major urban areas struggle with traffic congestion to some degree, those with the least sprawl are most able to promote alternatives to driving. In a study of 32 of the world's major cities, Australian researchers Peter Newman and Jeffrey Kenworthy found that low urban densities (fewer than 40 people and jobs per hectare of land) and dependence on the automobile go hand-in-hand. Sprawling cities in the United States and Australia are highly car-oriented; medium-density cities in Western Europe and Canada have greater use of public transport; and highly concentrated metropolises in Asia have more commuters who walk and cycle. (See Table 4–3.)

Newman, Kenworthy, and other researchers have concluded that strong land use policies to increase urban densities are crucial in fostering viable alternatives to automobile dependence. Very high densities are not necessary; even having 60–100 people and jobs per hectare, as is typical in many European capitals, can greatly enhance travel options. The difference that land use controls make is striking when development patterns in Japan or Western Europe, which have strict regulations encouraging compact development, are compared with those in the United States or Australia, where loose planning has promoted sprawled suburban growth. In most European cities a greater share of people in cities live in the center instead of the periphery. Even Europe's suburbs are more concentrated than those in the United States and Australia, and they are nearly always provided with public transport.[40]

While many cities have evolved compactly because of clear constraints on space, others with plenty of available land have purposely contained sprawl in the interest of efficiency. Sweden's cit-

Table 4-3. Urban Densities and Commuting Choices, Selected Cities, 1980

City	Land Use Intensity	Private Car	Public Transport	Walking and Cycling
	(people and jobs/hectare)	(percent of workers using)		
Phoenix	13	93	3	3
Perth	15	84	12	4
Washington	21	81	14	5
Sydney	25	65	30	5
Toronto	59	63	31	6
Hamburg	66	44	41	15
Amsterdam	74	58	14	28
Stockholm	85	34	46	20
Munich	91	38	42	20
Vienna	111	40	45	15
Tokyo	171	16	59	25
Hong Kong	403	3	62	35

SOURCE: Peter Newman and Jeffrey Kenworthy, *Cities and Automobile Dependence: An International Sourcebook* (Aldershot, U.K.: Gower, 1989).

ies—compact centers surrounded by vast stretches of rural, largely forested land—demonstrate the success of the country's strong urban land use policies. The Soviet Union also makes efficient use of urban space despite its great size.[41]

European governments have long recognized the need to let societal gain, not individual profit, determine how urban space will be used. Columbia University professor Kenneth Jackson cites the example of a large German city: "When truck farmers tend their crops within 2,000 yards of the skyscrapers of Düsseldorf, the richest city on the continent, [it is] not because alternative land uses would not yield a higher return, but because the government rejects the very possibility of development." In much of Europe, development of private land is guided by zoning, tax incentives, bans on low-density projects, and other measures. Urban planners try to position new developments within cycling or walking distance of public transport stops.[42]

Although the term "high density" evokes images of towering apartment buildings and little open space, dense developments can be pleasant and livable if planned well. A more compact urban form, far from precluding green spaces and structures on a human scale, can actually facilitate them. According to a study done for the U.S. Environmental Protection Agency, a compact development can mix two- to six-story apartments and town houses with clustered single-family homes, and still leave 30 percent of the area for open space and parks. In a typical low-density sprawl community, according to the study, only 9 percent of the land is devoted to open space.[43]

Land use controls should do more than simply increase density; ideally, they should mix different land uses. Zoning can be used to foster a mix of homes and commercial uses instead of separat-

ing them and thus creating long commutes. University of California researcher Robert Cervero points out that in much of the industrial world there is no longer a strong case for separating homes from jobs, because today's workplaces are not the smokestack factories and slaughterhouses of the industrial era. The original purpose of separating the two was to prevent nuisances springing from proximity. But today, according to Cervero, "the 'nuisance' facing most suburban areas seems . . . more one of traffic congestion."[44]

The issue is not whether to reject or accept growth, but how to use it to reduce dependence on cars and make communities more livable.

Stockholm is a good example of a decades-old scheme to mix land uses and integrate development with transport. The capital is ringed with satellite communities of 25,000–50,000 people each, linked closely with a rail network and expressway. Shops, apartments, and offices are clustered around train stations that give people access to jobs on the periphery and in the center. The plan has also allowed city officials to restrict driving and parking downtown, and to make the center more amenable to walking and cycling. Paris has followed similar development policies.[45]

Zoning changes could help offset the common problem of imbalance between jobs and housing, a major contributor to automobile dependence. Since developers often prefer more profitable office and retail projects over housing, and since cities and suburbs want to expand their tax base by attracting corporate investments, housing gets shunted elsewhere, creating long commutes, or gets neglected entirely. Without development controls, affordable housing is not likely to be interspersed with job centers because it is less profitable to developers.[46]

Such controls include strong pro-residential policies in the city center, for example, tying office space development to a required minimum amount of space for homes. An alternative is to levy fees on developers whose projects will worsen the imbalance, and use the revenues to create employment in job-poor areas and homes in housing-poor areas. The Southern California Association of Governments' Regional Mobility Plan, a 20-year undertaking launched in 1990 to address the region's transport problems, is considering using this strategy to improve its balance of jobs and housing.[47]

It is not too late for well-established cities to change their auto-oriented land use patterns, as some Canadian cities have shown. Toronto, for example, has combined public transport expansion with zoning and incentives for developers to create higher densities and shorter travel distances. Half of all apartments built since 1954 are within walking distance of rapid-rail transport, and 90 percent of all new offices are adjacent to stations downtown and at three other locations. Toronto's overall density is now comparable to several major West European cities, and, despite increasing auto ownership, public transport ridership has increased 80 percent in a little more than 20 years. Toronto has grown so quickly (the population doubled during the period of subway construction) that in the eighties local residents began to protest further growth. The city's recent land use plans limit development in the center and use newer rail lines to help divert development out to subcenters.[48]

The rapid-rail system seems to have shaped metropolitan Toronto: viewed from an airplane, the rail stations are clearly marked by the dense clusters of

development around them. But more precisely, the successes of both the transport system and the related land developments have been mutually reinforcing. Rail can be an important force in urban development, but in the absence of specific land use policies, a new rail line by itself will not induce high density. In Paris, Stockholm, Hamburg, and many other cities, rail systems and deliberate land use controls have created compact, efficient developments.[49]

Even cities in Australia and the United States are beginning to rethink their inefficient use of land. Portland, Oregon, took some federal funds it received for road building and constructed a light-rail system instead, while working out plans to intensify development along the rail corridor. The city intends to use revenues from joint development projects (such as leasing air rights over stations to private developers) to make the light-rail line self-sufficient. Portland is encouraging multifamily housing in low-density areas, and emphasizing housing in the city center. City officials also are restricting downtown parking and giving traffic priority to both the light rail and some bus routes.[50]

The time may be ripe for more careful development in other parts of the United States. In a public opinion poll of New Jersey residents, 25 percent of the respondents said development controls should be "very strict" and 50 percent said "extremely strict." However, many popular no-growth initiatives actually undermine the goals of mixing land use and concentrating higher densities near public transport by trying to stop growth altogether. This just diverts inevitable development to areas where the controls are looser, leading to further sprawl. The issue is not whether to reject or accept growth, but rather how best to use it to reduce dependence on cars and make communities more livable.[51]

Housing and taxation policies can either support or undermine land use controls and transportation improvements. For example, suburbanization in the United States has been fueled largely by the subsidy of single-family homes through property tax and mortgage interest deductions from federal taxes. Canadians and Western Europeans, who generally do not receive such benefits, tend to live in denser multifamily housing. Tax codes that favor new construction over improvements to existing buildings also encourage sprawl.[52]

Land use controls have had relatively little success in developing countries because of rapid growth, lax enforcement, and inability to meet regulations, among other obstacles. Particularly in Asian cities, high densities already overwhelm the public transport systems. Yet since so few people have cars, it is important for urban distances to be on a walking or cycling scale. Hong Kong, Seoul, and Singapore have helped manage travel demand by drawing development into designated subcenters outside their cores. Singapore's plan used an extensive low-income housing program to place jobs and homes close to each other, partially relieving downtown congestion without expanding the transport system.[53]

In Pakistan, Karachi's "Metroville" program for urban development operates on a similar principle. The plan enables people to build their own homes within walking distance of jobs, and eliminates some commutes by promoting home-based workshops for producing textiles, furniture, and other goods. In Africa and Latin America, similar schemes that plan urban development to bring together jobs, services, and affordable housing hold great potential for solving city-wide transport problems and giving people access to vital amenities.[54]

A Policy Overhaul

Automobile dependence plagues the world's major cities with problems that further tinkering with car technology will never solve. To fully confront congestion, pollution, oil dependence, and increasingly unlivable cities, governments will need to end the reign of the car. The surest way to lessen overdependence on cars is through a wholesale reordering of transportation priorities.

The first step is to bring to light the hidden costs of driving, such as air pollution, municipal services, and road construction and repair. Perhaps least-recognized of these expenses are items such as police, fire, and ambulance services. According to an analysis of the salaries and personnel time of the Pasadena Police Department in California, 40 percent of department costs are auto-related—primarily accidents, thefts, and traffic control. Extending this finding to the entire United States suggests that driving costs local governments alone at least $60 billion each year. Only when such hidden costs are acknowledged will governments recognize that transportation alternatives are economical.[55]

Employer-provided parking represents an even more direct subsidy of driving. In the United States, where fewer than 10 percent of employees pay for parking, employers can deduct the expense of providing parking from their taxes. But deductions for public transport fare reimbursements are strictly limited. Employees receive parking as a tax-free fringe benefit, worth an estimated $12-50 billion a year nationwide.[56]

Tax benefits for company cars are another common subsidy. Light taxation of company cars in the United Kingdom, for example, diverts some $5 billion annually from the public treasury, and encourages more driving and purchase of larger, less fuel-efficient cars. Company cars on average log nearly twice as many miles per week as household cars, mostly for private purposes. In response to growing public ire over this subsidy, taxes on U.K. company cars have been hiked each year since 1988—provoking vehement protests from the auto industry. The subsidy is still sizable, however, and needs further reduction.[57]

So long as automobile owners are showered with these inducements, they will stay in their cars and leave trains, buses, and bike paths empty. This creates a vicious cycle, since transport planners are unlikely to invest in improved alternative transport when existing systems are underused. Given the gross imbalance in many cities' transport systems, it makes sense to levy auto-related fees and taxes, and spend some of the revenues to develop pedestrian and cycling facilities and public transportation.

Removing parking subsidies, for example, discourages the one-person-per-auto commute. In April 1975, when Canada began charging federal employees 70 percent of the commercial rate for parking, the number driving alone to work dropped 21 percent and commuting by public transport increased 16 percent. In a study of workers commuting to Los Angeles' Civic Center, employees who paid for their parking were 44 percent less likely to commute alone and 175 percent more likely to use public transport than their colleagues who parked for free.[58]

A reasonably high gasoline tax, such as the $1–2 per gallon now common in Europe, would discourage driving, encourage people to use public transport where it is available, and raise revenues to expand transit service. It would also serve as a steadying influence on widely varying petroleum prices. Particularly in the United States and Canada, where the price of gas is comparatively low, steady increases in these taxes are needed during the next decade.[59]

It makes sense to levy a sizable tax on new cars as well and to raise annual registration fees. Such charges encourage people to consider the full costs of driving when they purchase a car, and serve as a disincentive for households to buy a second or third auto. One approach is the new German policy of tying these fees to a car's emissions of pollutants. Another is to base the tax on the car's fuel economy.[60]

The Philippines has achieved remarkable results since 1975 with a transport program that raised fuel prices nearly 100 percent, introduced car sales and registration fees based on engine size, and put a light-rail line in Manila. Between 1976 and 1985, the country's total gasoline consumption dropped by 43 percent, despite expanding population and rising per capita income. In the vicinity of the rail system, travel time on roads has decreased by about a third.[61]

Creating a sustainable transportation system hinges largely on making the alternatives attractive. Surveys show that even Americans choose to drive not out of blind love for cars but rather from consideration of the time and money required for a trip. Because people base their transportation choices on the cost, convenience, time, and dependability of their options, making the alternatives convenient helps cities achieve a better transport balance.[62]

Transit service should be reliable for off-peak as well as commuting trips. Drivers will only use public transport regularly if the standard of service is high and the systems are convenient; aiming to attract these riders creates a more effective system than one that only serves carless citizens. Paris, Hamburg, Copenhagen, Tokyo, Toronto, and other cities have shown that such a strategy can boost ridership markedly.[63]

Municipalities can share the cost of expanding transport services by striking deals with private land developers who benefit from enhanced access to their projects. Joint development schemes can be planned at new metro stations, helping to defray costs. The Metropolitan Area Transit Authority of Washington, D.C., has estimated that the long-term benefits of joint development projects at just two metro stations will exceed public costs by more than $200 million.[64]

Eastern Europe and the Soviet Union are uniquely positioned to avoid the excesses of auto dependence.

A mix of public and private participation in bus and train services can increase efficiency and take financial pressure off city governments—so long as the public sector remains a principal provider, and also plays a strong regulatory role. Throughout Asia, Latin America, and Africa, privately run minibuses and minivans help fill the public transport gap where government services alone cannot meet demand. But such arrangements require careful regulation to ensure that both profitable and unprofitable routes are covered, fares are reasonable, and safety standards enforced.

Eastern Europe and the Soviet Union are uniquely positioned, with extensive public transport systems, to avoid the excesses of auto dependence—even though the near future will bring a flood of opportunities to repeat industrial countries' mistakes. There is ample argument for these governments to focus future transport investments on improving the often-inadequate quality of transit service, and to structure auto costs to reflect accurately their environmental and social impacts.

In developing countries, the deterio-

ration of public transport systems and the neglect of nonmotorized transport are largely the result of lending biases among international development banks, which favor road building. Although the rationale for emphasizing motorization has been to transport goods and thus boost economic development, this strategy has created unbalanced systems that leave those who cannot afford cars with severely inadequate transportation.

With the right incentives, employers may prove the best promoters of public transport.

The extent of developing countries' unmet transport needs and their overwhelming financial debt make it clear that an auto-dominated future is not viable for the Third World. This argues strongly for an international effort to help developing countries finance public transport projects—particularly rail expansion, where appropriate—through increased taxes on fuel, car manufacture, or related items. Such a move would only partially compensate for the industrial countries' disproportionate share of world oil consumption, as well as their responsibility for global warming and other environmental problems.[65]

In cities that are building public transport systems from scratch, dedicated lanes for buses would speed service, helping to attract more passengers where demand is low and greatly improving efficiency where demand is high. Another intermediate step toward public transport is to encourage car pools and van pools by reserving some lanes solely for vehicles with three or more occupants.

Charging drivers for the right to use congested roads is a further incentive for ride sharing. Since 1975, Singapore has successfully used an Area Licensing Scheme, levying a fee on vehicles entering the city center—except for buses, commercial trucks, and cars carrying four or more people. The scheme is part of a package of traffic measures, including expanded bus service, heavy parking charges, and high car taxes, that have reduced congestion and traffic accidents, and have helped avoid further road building.[66]

With the right incentives, employers may prove the best promoters of public transport. Local governments can require large employers to provide bus and train route information and offer financial bonuses to employees to promote ride sharing, use of public transport, and cycling and walking. In Southern California, for example, the South Coast Air Quality Management Plan requires businesses employing more than 100 people to submit plans for reducing one-person-per-car commuting; stiff fines face those who do not.[67]

Effective land use planning is another key to a viable new transportation system. Several studies suggest that there is a threshold level of urban density—30-40 people per hectare—below which reliance on the automobile soars. This is about the density level found in Copenhagen, Toronto, and Hamburg. Comparing Copenhagen (30 people per hectare) with Denver (12 people per hectare), it appears that a 60-percent decrease in density corresponds with a 285-percent increase in gasoline use per person. This dramatizes the difference that relatively moderate land use changes can make, and provides a practical minimum density that planners can use as a guide.[68]

It is important for local land use policies to fit into more comprehensive regional plans. Otherwise, communities may solve their own transport problems—particularly congestion—at the

expense of neighboring areas. The experience of fragmented local planning boards in the United States has also shown that without broader coordination, private developers can play one body off another and so escape controls.[69]

Particularly in the developing world, allotting street space logically and efficiently would mean setting aside exclusive space for buses and giving pedestrians and cyclists priority over cars. In all cities, local authorities can improve people's transport options with ordinances that require buildings to provide secure bicycle parking and convenient access to main entrances for people who arrive on foot, by bicycle, or by public transport.

Peter Newman and Jeffrey Kenworthy have noted that parking is almost a "litmus test" of a city's car orientation. Their 32-city study found that generally there were 150-200 parking spaces per 1,000 jobs in the central business district. But in the most auto-dependent cities there were more than 500 parking spaces per 1,000 jobs. They suggested that these cities should limit their central business districts to no more than 200 parking spaces per 1,000 jobs.[70]

What would the future look like if cities were not dominated by cars? The very heart of a city would be reserved for people on foot and passengers arriving by metro or trolley. Proceeding outward from the center, streets would become the shared domain of pedestrians, cyclists, trolleys, and buses. Slow automobile traffic would be allowed beyond the city's densest core, but convenient bus and rail services—running between stops placed within walking or cycling distance of most points—would offer a faster way to get around. Express public transport routes would link outlying areas to each other and to the downtown. Car parking would be progressively less restricted as you moved away from the city center.

People would make most short trips by foot or on a bicycle, and longer ones by walking or biking to transport stops, then continuing by bus, metro, or trolley. Many long drives between cities would be replaced by train trips. Cars would be used mainly for trips for which these other modes are inconvenient, such as the transport of loads of things or groups of people, travel at odd hours when public transport is running infrequently, and some recreational outings.

The challenge of creating an alternative transport future is ultimately a political one. As elected officials in most societies are well aware, many people continue to support the policies that have nurtured overreliance on cars—from driving subsidies, to tax benefits, to expansion of parking lots and roads. Even more resistance to change lies in the colossal power of the automobile and road lobby.

But as the enormous problems caused by excessive dependence on the automobile continue to plague cities, a political transformation may occur. Indeed, people around the world are beginning to see that the costs of depending on cars are already outweighing the benefits. If cities are to achieve the dream of clean, efficient, reliable transportation once promised by the automobile, they will have to steer toward sustainable alternatives.