Strategies for Reducing Congestion and Four Basic Principles of Traffic

Proposed remedies for reducing traffic congestion cannot be properly evaluated without some understanding of possible strategies useful for that purpose and of four basic principles of vehicle traffic that are all too often overlooked.

Fundamental Strategies

Congestion can be tackled by supply-side or demand-side tactics. Supply-side tactics are designed to expand the means that travelers can use for commuting and other trips. An example is building more roads to increase carrying capacity. Demand-side tactics are designed to reduce the number of persons or vehicles traveling during peak periods. An example is charging high taxes on gasoline that make driving more costly. (Subsequent chapters separately analyze both types of tactics in detail.)

Another way to look at anticongestion tactics is to consider whether they are primarily market oriented or primarily regulatory. Market-oriented tactics use pricing mechanisms of some type to influence how people behave but leave choosing among the alternative courses of action up to each individual to make voluntarily. Regulatory tactics require people to behave according to certain compulsory rules that apply to everyone in the same manner.

The anticongestion tactics discussed in this book can be classified in accordance with both these schemes simultaneously, as shown in figure 6-1. The two horizontal rows divide these tactics into primarily regulatory ones or market oriented. The two vertical columns divide the same tactics into primarily supply-side or demand-side groups. Some tactics have both supply-side and demand-side elements at the same time; they are shown in boldface type. An example is making some existing expressway lanes into high-occupancy vehicle (HOV) lanes. That tactic is designed to attract more people into sharing vehicles, thereby reducing the number of vehicles traveling during peak hours. But the same tactic also alters the supply of road space available to single-occupancy vehicles.

This figure shows that most anticongestion tactics are primarily regulatory, and that there are many regulatory tactics of both supply-side and demand-side types. In contrast, fewer tactics are market oriented, and all but one of those are primarily demand side in nature. However, it is not entirely unambiguous just how every one of these tactics should be classified. The groupings shown represent my view; readers may wish to classify certain tactics differently.

The Market-Based Approach

Market-based tactics assign monetary value to different types of travel behavior and then rely on travelers to choose among them. Their goal is to achieve more efficient use of scarce resources, usually by making the prices of different travel options more nearly equal to their social costs so that marginal benefits will equal or exceed marginal costs. These tactics raise the price of the behaviors they seek to discourage in relation to the prices of those they seek to encourage.

Charging fees for using heavily congested roadway during peak hours is such a tactic. It leaves the choice of routes and travel times to individual drivers. Another example would be to have employers pay each worker a travel allowance of $75 per month but also charge $75 per month for providing each parking space formerly furnished free. Employees who wished to share rides or use public transit could profit by spending less than their travel allowances on commuting. Those who still wanted to drive alone could do so by paying the parking charge.

The underlying principle of the market-based approach is that users of specific facilities should directly pay at least some of the costs they
FIGURE 6-1. Classifying Tactics to Combat Peak-Hour Congestion

<table>
<thead>
<tr>
<th>Supply side</th>
<th>Demand side</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primarily regulatory</td>
<td>Prohibiting certain license numbers from driving on specific days</td>
</tr>
<tr>
<td>Building more roads or expanding existing ones</td>
<td>Changing federal work laws that discourage people from working at home</td>
</tr>
<tr>
<td>Building more transit facilities and increasing service and amenities in existing transit systems</td>
<td>Ramp metering on expressways</td>
</tr>
<tr>
<td>Improving highway maintenance</td>
<td>Encouraging transportation management associations</td>
</tr>
<tr>
<td>Adding roving response teams to remove accidents</td>
<td>Encouraging more people to work at home</td>
</tr>
<tr>
<td>Traffic management centers</td>
<td>Keeping minimum residential densities higher</td>
</tr>
<tr>
<td>ITS mechanisms for speeding traffic flows</td>
<td>Clustering high-density housing around transit stops</td>
</tr>
<tr>
<td>Deregulating public transit activities</td>
<td>Limiting growth and development in local communities</td>
</tr>
<tr>
<td>Upgrading existing city streets</td>
<td>Improving the jobs/housing balance</td>
</tr>
<tr>
<td>Staggering work hours for more workers</td>
<td>Using traffic-calming devices to slow flows</td>
</tr>
<tr>
<td>Developing means of transit feasible in low-density areas</td>
<td>Concentrating jobs in a few suburban clusters</td>
</tr>
<tr>
<td>Building special roads for trucks only</td>
<td>Making some lanes HOT lanes</td>
</tr>
<tr>
<td>Primarily market-oriented</td>
<td>Road pricing with tolls set to raise peak-hour flows</td>
</tr>
<tr>
<td>Converting free HOV lanes to HOT lanes</td>
<td>Commuting allowance for employees</td>
</tr>
<tr>
<td>Increasing high taxes on gasoline</td>
<td>Charging high taxes during peak hours</td>
</tr>
<tr>
<td>Increasing high taxes on parking during peak hours</td>
<td>Eliminating tax deductibility for employers for providing free parking</td>
</tr>
<tr>
<td>Increasing automobile license fees</td>
<td>Increasing automobile license fees</td>
</tr>
<tr>
<td>&quot;Cashing out&quot; free parking provided by employers</td>
<td>&quot;Cashing out&quot; free parking provided by employers</td>
</tr>
</tbody>
</table>

Source: Author's calculations.

The Regulatory Approach

Regulation mandates certain behaviors or prohibits others. It does not attach varying prices to different behaviors, nor does it leave the choice up to individual travelers. Instead it prohibits or limits by government fiat the behaviors it wants to discourage and permits or requires those it wants to encourage. For example, prohibiting automobiles with license plates ending in the digit 5 from driving on Fridays, and those ending in other digits from driving on other specific days, is a regulatory tactic.

Advantages and Disadvantages of the Market-Based Approach

As an economist, I generally favor the market-based approach. Its advantages seem to far outweigh its disadvantages. Admittedly, nearly all its tactics contain some regulatory elements (for example, the choice of where and when to use road pricing is inherently a regulatory one that must by imposed by fiat). The most effective overall strategy for reducing traffic congestion should probably consist of both market-based and regulatory elements.

The principal advantage of the market-based approach is that it leaves more choice to individual travelers. Therefore it is more flexible than regulations and requires far less enforcement effort. It is also economically more efficient because it seeks to equate the marginal prices of different behaviors with their marginal social costs. Although neither approach can achieve a perfectly efficient allocation of transportation resources, the results of the market-based approach are usually closer to that ideal.

Since the tactics in this category charge for the behavior they seek to discourage, peak-hour road pricing might raise huge amounts of money
that could be used to improve regional transportation facilities. Another advantage is that all drivers have the same set of choices, and groups are not treated differently, in contrast to regulations—such as the once-proposed California rule that firms with one hundred or more employees allow no more than 55 percent of their workers to commute alone in their cars. The assumption seemed to be that large firms are better able to persuade their workers to act in this manner than small firms. And it is easier for regulators to administer a rule that applies only to large firms. Tactics that treat all drivers the same way apply not just to commuters but to all vehicles traveling during peak hours. In contrast, many regulations designed to reduce congestion apply only to persons making journeys to and from work and would not deter others from traveling during the most congested period.

The market-based approach would also be easier to enforce, because it would require a smaller bureaucracy to administer, and its instruments would be more difficult to evade than most congestion-reducing regulations. It would be far easier to identify cars that fail to pay the peak-hour road price on a congested highway than to ensure that 45 percent of the workers in every large firm did not drive to work alone (as discussed in chapter 4).

The principal complaint against market-based strategies is that they put undue stress on low-income households and hence are economically regressive and inequitable. Such households are less able to pay the prices imposed than are higher-income households. Some arguments have been put forth to counter this charge, but they are not very persuasive.

One is that the many low-income workers who already commute by bus would not have to pay congestion prices but would benefit from the results. The question is, how many do use the bus? In 1995, the fraction of workers commuting by private vehicles was 84 percent among those from low-income households, versus 90 percent among those from non-low-income households. Only 5 percent of low-income commuters used public transportation, versus 2 percent of all other commuters. These outcomes were true even though the share of households with no private vehicle available was 26 percent among low-income households but only 4 percent among other households. Even the suggestion that the money raised by road pricing could be used to improve transportation facilities used by low-income workers is questionable. A high percentage of all those adults who commute by public transit come from households with incomes of $20,000 or more—the figure in 1983 was 56.1 percent.

Unless the funds from peak-hour tolls can be used to compensate low-income drivers directly, road pricing may have regressive effects.3

Advantages and Disadvantages of the Regulatory Approach

The regulatory approach to coping with traffic congestion has several advantages over the market approach. Regulations can specify exactly what type of behavior is to be encouraged or discouraged in order to reduce congestion. For example, expressway lanes can be set aside for exclusive peak-hour use by high-occupancy vehicles (HOVs), and “high occupancy” can be defined as buses or vehicles with two persons or more than three persons or more. Regulations also normally apply exactly the same way to all persons in similar circumstances, whereas the market approach usually permits similar individuals to choose among alternative courses of action. Thus a stop sign requires—at least in theory—every vehicle to stop before proceeding. Because of these two traits, regulations—when carried out as specified—create more predictable and uniform patterns of behavior than market-based approaches. And behavior patterns governed by regulations are easier to alter to fit changing circumstances. The agency issuing the regulations can modify them for a whole region simultaneously and expect fairly rapid public conformity to the changes.

But regulations also have disadvantages compared with market-based tactics. Several of these drawbacks are the obverse of regulatory advantages. Because regulations apply in exactly the same manner to all, they do not permit different individuals to choose varied actions best suited to their own preferences or immediate needs. For example, so-called high-occupancy toll (HOT) lanes are extra lanes added onto an existing expressway on which sufficiently high tolls are charged during peak hours to keep traffic volumes low enough to permit continuous high-speed movement. But the initial expressway lanes are left free from toll, so they tend to become congested during peak hours. This arrangement offers a choice to motorists between fast movement for which they must pay a significant toll or slow movement which requires no toll. Such a choice allows people in a big hurry on a particular day to move fast by paying, and those not in such a hurry to save money by moving more slowly. This permits individuals with different needs or preferences to more closely adapt their behavior to their current needs, rather than forcing all of them to do the same thing. Providing choices increases the overall welfare of all those involved.
Another drawback of the regulatory approach is that it requires stronger and costlier enforcement activities than most market-based tactics. Speed limits are a universally employed form of traffic regulation, but they are probably the most frequently violated ordinances in the nation. Getting a high percentage of drivers to conform to speed limits takes major and sustained efforts by police, courts, and administrative officials to apprehend and punish at least some of the people who do not conform. In contrast, tolls are expensive to collect but are inherently self-enforcing and also provide the revenues necessary to administer themselves.

The regulatory approach often leads to a larger bureaucracy than the market-based approach and does not automatically produce the revenues needed to support that bureaucracy, as do many market-based tactics that involve collecting fees.

**Four Key Principles of Traffic Flows**

A vital point to recognize in evaluating remedies to congestion—whether they follow the market-based or regulatory approaches—is that traffic flows are influenced by four principles that are usually ignored. They are the principles of triple convergence, dual swamping by growth, the imperviousness of growth to local public policies, and one hundred small cuts. Many other principles of traffic movement are also important, but they are normally taken into account by persons weighing possible congestion remedies. These four principles are discussed in detail because they have vital impacts on the potential effectiveness of specific tactics.

**Triple Convergence**

Most vehicle drivers search for the quickest route, one that is shorter or less encumbered by obstacles (such as traffic signals or cross streets) than most other routes. These direct routes are usually limited-access roads (freeways, expressways, or beltways) that are faster than local streets if they are not congested. Since most drivers know this, they converge on the “best” routes from many points of origin.4

During peak travel hours on weekdays, so many drivers converge on these best routes that they become congested, particularly in large metropolitan areas. Traffic on them eventually slows to the point where they have no advantage over the alternative routes. That is, a rough equilibrium is reached, which means that many drivers can get to their destinations just as fast on other roads. At times, the direct road may become even slower than alternative streets, and some drivers eager to save time will switch to them. Soon rough equality of travel times on both types of routes is restored at the margin. The opposite happens if travel becomes slower on alternative streets than on the expressway.

Several observations can be made about this equilibrium situation: it tends to recur, because most drivers develop habitual travel patterns; during equilibrium each limited-access road is carrying more vehicles per hour than each normal city street or arterial route because it has more lanes, more direct routing, and fewer obstacles; many drivers time their journeys to miss these periods because they do not like to waste time in heavy traffic; and at the peak of equilibrium, traffic on most expressways is crawling along at a pace far below the optimal speed for those roads.

Now suppose that the limited-access route undergoes a vast improvement—for example, its four lanes are expanded to eight. Once its carrying capacity is thus increased, the drivers using it move much faster than those using alternative routes. But this disequilibrium does not last long because word soon gets around that conditions on the expressway are superior.

In response, three types of convergence occur on the improved expressway: many drivers who formerly used alternative routes during peak hours switch to the improved expressway (spatial convergence); many drivers who formerly traveled just before or after the peak hours start traveling during those hours (time convergence); and some commuters who used to take public transportation during peak hours now switch to driving, since it has become faster (modal convergence).5

This triple convergence causes more and more drivers to use the improved expressway during peak hours. Therefore its traffic volumes keep rising until vehicles are once again moving at a crawl during the peak period. This outcome is almost inescapable if peak-hour traffic was already slow before the highway was improved. If traffic is going faster than a crawl on this direct route at the peak hours, its users will still get to their destinations faster than users of city streets, which are less direct and more encumbered by signals and cross streets. Total travel times on these two types of paths will only become equalized if the limited-access roads are so overloaded that vehicles on them are moving at slower speeds than those on normal streets. Triple convergence creates just such an effect during peak hours.
Even so, highway improvements that expand hourly road capacity clearly produce social benefits. The total number of vehicles moving toward their destinations during each peak hour will be greater than before. Therefore, more commuters will be able to move at their most preferred times. If there has been no growth in the total number of persons traveling each day, periods of peak traffic congestion will become shorter because the system can carry more vehicles per hour. Traffic will now move faster just before and after the peak periods. As the proportion of all commuters traveling during peak periods increases, commuter welfare will improve, because more people will be traveling during the most convenient times. And peak-hour congestion on alternative routes and on public transit will decline because more commuters have shifted to the expressway. This might even cause the public transit system to reduce the frequency of its service if its total revenues fall. Except for this possible decline in public transit service, the region's traffic situation will be better.

These effects of trip convergence are short-run impacts because they involve persons who were already traveling each day during, or shortly before or after, peak hours. But there can also be long-run impacts of increasing the capacity of a major roadway. For example, widening an expressway may encourage more intensive property development in the primary destination it serves—often a region's central business district. More commuters will arrive at that destination during each hour while encountering the same degree of traffic congestion as before. Hence the road improvement may stimulate more real estate development instead of less congestion, or some combination of reduced congestion and intensified development. This impact clearly takes a considerable time to occur. Another more important long-run impact is that improving a roadway may cause more residents and businesses to locate along it in order to enjoy its upgraded access. These newcomers will then also use the expanded roadway, thereby adding to total traffic on it. This added traffic will offset some of the benefits that the original users of the road hoped to gain from expanding it in the first place. This type of long-run growth in demand caused by improving a roadway is called induced demand, since it was called forth by the roadway improvement (see chapter 8). But regardless of whether upgrading a road evokes induced demand in the long run, any upgrading is certain to evoke convergent increases in demand in the short run, as just explained. Such short-run increases in demand caused by convergence are sometimes referred to as induced traffic.

Thus, because of trip convergence, expanding a roadway's capacity does not fully eliminate peak-hour traffic congestion, or even reduce the intensity of traffic jams during the most crowded periods—although those periods will be shorter. In fact, it is almost impossible to eradicate peak-hour traffic congestion on limited-access roads once it has appeared within a nonshrinking community. In theory, such congestion could be eliminated only if the capacity of those roads were increased enough so they could carry every single commuter simultaneously at the peak minute, at, say, 35 miles per hour or faster. In nearly all metropolitan areas, that is impossible. Therefore, expansions of road capacity—no matter how large, within the limits of feasibility—cannot fully eliminate periods of crawling along on expressways at frustratingly low speeds.

With one notable exception discussed later, any initial improvement in peak-hour travel conditions on high-capacity roadways will immediately elicit a trip convergence response. This is a crucial aspect of traffic flows that enormously affects how well various proposals to reduce peak-hour congestion will work in practice. Convergence will soon restore heavy congestion during peak periods, although those periods may now be shorter. Such improvements need not be made to the highway itself. For example, if a new fixed-rail public transit system is opened, it will attract some peak-hour commuters out of automobiles. That should initially reduce daily-period traffic congestion on expressways and normal streets. But as soon as drivers realize that expressways now permit faster travel, many will convert from normal streets and nonpeak periods onto those expressways during peak periods. That, in turn, will quickly overload those expressways during such periods, forcing traffic back to a crawl. Peak periods will not even be much shorter unless a new public transit system has drawn a great many commuters out of automobiles. There is no evidence that new fixed-rail public transit systems in the Washington and San Francisco Bay areas have diminished peak-period congestion on any expressways there. True, those transit systems carry a lot of passengers during peak hours. By removing those people from the roads, the transit systems may have shortened the periods of greatest congestion intensity on each region's expressways. But intensely congested periods still arise daily there, and the roads are just as jammed then as they were before the transit systems were built. Other factors were also at play there, however, as I discuss later.

Similarly, if many people decide to "telecommute" by working at home one or more days a week, that would initially reduce peak-period traffic on roadways. But trip convergence would soon wipe out at least
part of any resulting improvements in congestion on those roads during peak periods. All the same, many remedies to intensive traffic congestion are unquestionably worth pursuing. The point is that initial gains must not be considered permanent inroads on congestion—at least during peak periods. Furthermore, any realistic analysis of exactly what effects will emerge from proposed remedies must take the principle of triple convergence into account.

**The Converse of Triple Convergence: Triple Divergence**

The principle of triple convergence also operates in reverse. Any factors that increase peak-hour congestion on limited-access roads tend to cause more auto-driving commuters to shift away from those roads in peak periods to the same roads in nonpeak periods, alternative routes during peak periods, and public transit during peak periods. Such triple divergence has important policy implications.

Residents in fast-growing metropolitan areas are especially eager to limit traffic congestion because they want to prevent further expressway traffic from spilling over onto adjacent local streets. To many residents, such spillover is just as great a concern as the time lost in commuting during peak hours.

It is widely assumed that high levels of peak-hour highway congestion will stimulate public transit patronage. That is why many metropolitan areas have expanded, or are considering expanding, their public transit systems to relieve highway congestion. Yet those communities that have built new public transit systems have not experienced much—if any—reduction in peak-hour automotive congestion.

Triple divergence is really an inadvertent form of demand management inherent in all intense congestion. Whenever peak-hour congestion on a roadway gets worse, the resulting decline in the desirability of using the roadway during those hours motivates some drivers to shift to other routes, other times, or other modes. This reduces the demand for that road during peak hours, thereby partially offsetting the worsened congestion until a new equilibrium is reached. Hence congestion is partially self-correcting through such triple divergence. This illustrates the basic nature of congestion as a balancing mechanism between supply and demand.

**One Remedy That Avoids Triple Convergence: Road Pricing**

One proposed remedy, apart from moving residences or jobs, that does not suffer from the offsetting impacts of triple convergence is road pricing. If drivers had to pay relatively high tolls for using expressways during peak periods, congestion on those roads would initially fall. Moreover, the tolls would discourage commuters now using other routes, other time periods, and other modes from converging onto those expressways during peak periods. Hence peak-hour congestion on those toll roads would remain lower, although some drivers would be diverted by triple divergence: many commuters formerly driving to work during peak hours would be induced to shift to other times, to nontolled routes, and public transit.

**Dual Swamp by Growth**

As already mentioned, traffic congestion is most severe in areas experiencing absolutely rapid growth in their total populations of people and vehicles in use. In fact, rapid population growth tends to offset the beneficial impacts of any particular remedies adopted to reduce traffic congestion. A remedy that successfully cuts peak-hour travel in year 1 by 5 percent will probably have no visible effects by year 3 if the number of vehicles in use is growing 2.5 percent per year. The added vehicles traveling each day will return traffic conditions to what they were before that remedy was adopted—even if the remedy is still in effect. Of course, conditions would have been worse in year 3 if the remedy had not been adopted and the growth nevertheless occurred. So that remedy would not be used entirely in vain.

Nevertheless, local residents will become increasingly frustrated if all the policies they support to reduce congestion—such as building costly new roads—fail to produce any perceptible improvements. Yet that is just what has happened in fast-growing areas such as southern California because rapid growth swamps most such remedies. In many cases, it is part of a vicious circle: authorities improve highways to fight congestion but then those improvements create incentives to increase automotive vehicle ownership and use and change the location and form of residential and nonresidential growth. Over the long run, these actions tend to intensify traffic congestion. Such increases in congestion result from induced demand caused by improving the roads. But once more population arrives, its presence may motivate authorities to build even more roads—an outcome sometimes referred to as induced growth or induced development.

For example, construction of the interstate highway system and many other expressways in U.S. metropolitan areas was a prime factor causing more citizens to buy and use automotive vehicles instead of commuting.
by public transit. Moreover, these roadway improvements motivated many businesses to choose highly dispersed locations along expressways. As a result, such workplaces were difficult to reach by public transit and railroads. So more shippers began to use trucks and more workers began to commute in private cars. As worker ownership of cars became more widespread, housing spread further into low-density suburbs, where public transit was even less feasible to use.

Road improvements were certainly not the only causes of increased vehicle ownership and use. Massive advertising by auto manufacturers, the federal provision of mortgage insurance for single-family homes, federal tax benefits for homeownership, and rising real incomes also played major roles. Moreover, it would be inaccurate to attribute all the population and job growth along new highways to their construction. Growth in any metropolitan area is mainly the result of whatever forces are expanding employment there over the long run, not of specific new highways. The latter determine where growth will occur within the area, rather than its total amount. True, a metropolitan area well supplied with road capacity is a more attractive location for added jobs than one without such capacity. But that is only one factor governing the area's total growth. Nevertheless, past road expansions have surely contributed to the severe traffic congestion now plaguing many U.S. metropolitan areas.

Where growth is located also influences what mode of travel people use. If it is located along highways rather than in older, closer-in neighborhoods well served with public transit, it will generate more automotive traffic.

Traffic congestion resulting from rapid growth is extremely difficult to relieve if the growth has been caused by factors other than good transportation facilities. The rapid recent growth of southern California's population has resulted from such factors as good weather, proximity to Mexico and to Pacific Rim countries supplying immigrants, the presence of a large low-wage labor pool and many highly educated workers, and the huge size of the local market. The attraction of these factors remains strong even though rising congestion has made local travel increasingly frustrating and inefficient. Hence these increases in congestion have not created any self-correcting processes. They are apparently not yet bad enough to discourage further growth by other factors.

Rapid growth can also aggravate spillover effects related to traffic congestion. Since 1970, public policies have tremendously reduced the amount of air pollutants discharged into the atmosphere in the greater Los Angeles area by each automotive vehicle, factory, and other stationary source. As a result, the total air pollution there has fallen in the past three decades, despite a big increase in vehicle population. But these gains could be wiped out by the massive population and vehicle increases projected to occur through 2020. Authorities dealing with air pollution there already feel they are swimming against the tide of additional growth. Peak-period traffic congestion would also be affected.

The Imperviousness of Growth to Local Policies

The preceding analysis suggests that one way to prevent the quality of life from deteriorating in a fast-growing area would be to slow its growth rate. That is the approach of "no-growth" or "antigrowth" advocates. Halting the area's growth altogether would indeed reduce some of the above problems, but such a policy would be highly impractical.

To begin with, no suburban community can hope to stop the growth of its metropolitan area as a whole if conditions favor the expansion of jobs there. A given community could ban all expansion of housing and workplaces within its boundaries, but that would not prevent nearby communities from absorbing more jobs and residents. Almost every U.S. metropolitan area has at least some communities encouraging further growth. Even if none did, newcomers would continue to arrive anyway if they believed good economic opportunities were available there, as history has repeatedly proved. Such immigrants would live on the outskirts of the metropolitan area in unincorporated places with no antigrowth policies, or they would illegally double and triple up in dwelling units in communities that had formally banned further growth.

These observations indicate that regional growth is impervious to local public policy. That is to say, no one suburb can substantially affect the future growth rate of its overall metropolitan area through its own policies. Therefore, attempts by any one suburb to halt growth within its own boundaries simply divert potential growth, along with its problems, to nearby communities. Even then, the problems will not be confined to the places that generate them. They will inevitably spill over into surrounding communities, as is clear from the problems associated with air pollution and vehicle traffic.

Antigrowth tactics are especially difficult to sustain because growth generates economic benefits. As incomes rise, purchasing power increases and more money is spent in local stores and businesses. With
more new commercial development, local tax revenues increase and reduce the property tax burdens on existing residents. Furthermore, added jobs provide income to many existing residents. Although growth also has its drawbacks—greater traffic congestion and air pollution are but two—completely banning further growth in a community imposes sizable penalties on many of its businesses.

One Hundred Small Cuts

No one policy can fully remedy metropolitan traffic congestion. Indeed, most individual policies cannot even make a dent in such problems—especially in rapidly growing areas. That means various remedies must be combined to effect anything like a cure. Those who are striving to do so are like the woodsman who must cut down a huge tree with only one small axe. He cannot fell the tree or even make much of a cut in it with one swing of the axe. But he can eventually cut it down, with one hundred or more small cuts. A multifaceted approach offers the only hope of reducing traffic congestion significantly or at least slowing down its future growth.

However, even ten thousand small cuts will not completely eliminate peak-period congestion because of triple convergence. Hence congestion remedies should not be expected to eliminate the problem altogether. Rather, they should aim to reduce the duration of maximum congestion appreciably, reduce the average length of time required for commuting, increase the average commuting speed, increase the proportion of all commuters traveling during periods of maximum convenience, reduce the intensity of commuter frustration, and offer commuters more choices about how and when to travel to and from work.\textsuperscript{12} Rapidly growing areas may find it impossible to achieve any of these goals. Even so, they may be better off than they were before adopting their congestion remedies.

Incidents—including accidents—are responsible for a large share of all traffic congestion. Therefore, reducing the number of incidents and better controlling the impacts of those that occur could decrease congestion significantly.

Coping with Incident-Caused Traffic Congestion

Many strategies and tactics have been suggested for coping with incident-caused traffic congestion. Analyzing all of them in detail is not within the scope of this book. However, the most significant are listed in the following paragraphs to illustrate the variety of possible approaches.

Improving the Physical Design of Existing Roadways

This strategy includes the following tactics to reduce the probability of accidents:

\begin{itemize}
\item Redesigning entrance and exit ramps to reduce the severity of their curves (which often cause trucks exiting too fast to overturn);
\item Building barriers separating flows of traffic moving in opposite directions adjacent to each other;
\item Creating more gradual curves on existing roadways;
\end{itemize}