

## CHAPTER 5

# Microeconomic Initiatives to Promote Efficiency and Productivity

AS WORKERS AND CONSUMERS, we conduct our economic affairs through markets. These markets provide us with a vast array of products and services to purchase, and a host of different ways to earn our livelihoods.

Yet markets are not flawless. They may, for example, become controlled by monopolies, generate excessive pollution, or lead to insufficient investment in research and development. Through collective action, we can sometimes correct such “market failures,” and thereby improve the ability of private markets to serve social goals. When targeted microeconomic policies are successful, they reduce the costs of production and distribution, place goods and services in the hands of those who value them most, and maximize the increase in social well-being that derives from trade in the private marketplace. For these reasons, well-chosen government initiatives are as important for microeconomic policy as they are for macroeconomic policy.

The United States has a long history of employing targeted microeconomic policies to improve the performance of private enterprise in significant industries. Roughly three-fourths of the Nation’s investment in canal construction before the Civil War was publicly financed. Land grants and other subsidies encouraged the development of intercontinental railroads during the second half of the 19th century. Since 1914, the Extension Service of the Department of Agriculture, a cooperative venture of Federal, State, and local governments, has vastly improved the Nation’s agricultural productivity by spreading information about modern farming techniques. Our massive national commitment to create high-technology industries critical to our defense, such as computers and jet aircraft, dates from the Second World War. Targeted microeconomic policies such as these have been employed throughout the history of the Republic, regardless of the political party in power.

The Administration’s initiatives described in this chapter are aimed at both correcting failures of private markets and improving the functioning of the Federal Government. The initiatives are organized around three themes: promoting efficiency in the public

and private sectors, addressing environmental externalities, and promoting technology.

## **PROMOTING EFFICIENCY IN THE PUBLIC AND PRIVATE SECTORS**

In all modern industrialized nations, some goods and services are provided directly by the government, others almost entirely through unregulated private markets, and still others by the private sector through regulated markets. Because none of these methods of conducting our economic affairs is flawless, it is important to develop ways of improving the performance of each. For this reason, the Administration has developed initiatives to promote a more effective government, more competitive markets, and more efficient regulation.

### **CREATING A MORE EFFECTIVE GOVERNMENT**

Governmental activities, however well-intended, are not always performed as efficiently as possible. There are two important sources of what might be termed “government failure.”

First, as recognized by both the framers of the Constitution and modern scholars of public choice, all political systems provide interest groups with an incentive for “rent seeking,” that is, manipulation of collective action for private benefit. Rent-seeking behavior can bias public actions away from maximizing aggregate social welfare. It can, for example, lead government agencies to make decisions that benefit a particular interest group even though they are costly to society as a whole.

Second, the government—in providing services to citizens, in hiring and managing personnel, in procuring supplies, and in making investments—generally does not face the same competitive pressures as private industry to serve customers well and minimize costs. Competition among the political parties; oversight by the Office of Management and Budget (OMB), by the Congress, and by heads of agencies; and public scrutiny through the media provide a partial but incomplete substitute for market competition. Frequently, internal governmental regulations, such as personnel and procurement rules or reporting requirements, are introduced to address these problems. But these are blunt instruments that may create significant managerial inefficiencies of their own.

The Administration has placed a high priority on governmental reform—or “reinventing government.” A major objective is to improve the performance of government by introducing market-like mechanisms and benefit-cost tests wherever possible. Such mechanisms are designed to reduce rent seeking and the governmental inefficiencies resulting from the lack of competitive pressures.

## *The National Performance Review*

The National Performance Review (NPR), directed by the Vice President, took a fresh look at the way the Federal Government performs its tasks, with less emphasis on the related issue, routinely considered in the budgetary process, of whether those functions should be performed at all.

The NPR identified 384 ways that the Federal Government could save money without reducing the level of service and, indeed, often while improving governmental performance. Its report concluded that, by shifting to a market-like focus on customer service, by introducing competition where possible, and by streamlining internal government processes to facilitate better management, we could have a government that “works better and costs less.”

The Administration has moved rapidly to introduce the NPR reforms. One important element is a set of recommendations to improve the procurement process. These include changing laws and regulations to make it easier for the government to buy commercially produced goods and services, to raise the threshold for the use of simplified acquisition procedures, and to amend contract protest rules to streamline contracting and discourage frivolous protests. These reforms can be accomplished while preserving oversight by the Congress and OMB, which is necessary to protect against fraud and abuse. Other NPR recommendations identify ways to streamline management control; improve customer services; shift to mission-driven, results-oriented budgeting; improve financial and human resource management; integrate information technology into the business of government; and improve the functioning of every executive branch department (Box 5-1). In a similar effort, the Defense Department has conducted a “bottom-up” review of its activities.

## *A New Framework for Regulatory Review*

The President’s Executive Order 12866 on Regulatory Planning and Review provides a framework for developing regulations that serve the best interests of the American people without imposing unreasonable burdens on business. The order directs agencies to promulgate only those regulations made necessary by law or compelling public need, such as correcting market failures. The regulatory philosophy that underlies the order calls on agencies to assess all the costs and benefits of the available alternatives when deciding whether and how to regulate, including the alternative of not regulating. Further, the order requires that, to the extent permitted by statute, agencies select a regulatory approach that maximizes the net benefits to the public (benefits less costs). Applying this test to public regulation will lead affected firms in the private

**Box 5-1.—Selected National Performance Review  
Recommendations**

- Allow agencies to create innovation capital funds from retained savings to invest in innovations that can improve service and provide a return on investment.
- Provide line managers with greater budget flexibility to achieve results by expediting the reprogramming of funds within agencies.
- Use electronic funds transfer to pay and reimburse expenses for all Federal employees, to make payments to other agencies, and to pay for purchases from the private sector.
- Create competitive enterprises within the government to manage real property on a fee basis, and give Federal managers the authority to choose their source of property management services.
- Establish a corporation to provide air traffic control services.

sector to roughly mimic what a properly functioning market would do absent the market failure that necessitates regulation.

In conducting benefit-cost analyses of regulatory alternatives, the order directs agencies to consider *all* the benefits and costs—those that are easily measured as well as those that are not. This approach addresses one major criticism of centralized regulatory review in previous Administrations: that the use of a benefit-cost test was subject to bias against appropriate regulations whenever the costs of regulation were more readily quantified than the benefits—which happens frequently.

In addition, the order encourages agencies to act to limit any economic distortions their regulations cause. Agencies must, for example, design regulations to achieve their objectives in the most cost-effective manner. To the extent feasible, agencies must specify performance standards rather than specify a behavior or manner of compliance. Agencies must also consider alternatives to direct regulation that provide economic incentives to encourage the desired behavior.

This framework does not apply solely to new regulatory initiatives. The Executive order also sets forth a procedure for review of existing regulations to ensure that they too maximize the net benefits to society. This wide-ranging review of old and new regulations alike promises to improve the performance of the public sector by making regulation more effective.

## PROMOTING COMPETITION

Competition among the providers of goods and services is the most effective method ever devised for organizing most economic activity. Competition simultaneously leads to low production costs, innovation in product design and production techniques, low prices for consumers, and the allocation of goods and services to those who value them most. For these reasons, our economy must rely upon competition to the maximum extent possible, and the government should act to promote and strengthen competition throughout the private sector. When market failures necessitate public regulation or public provision of services, the resulting public policies should rely on market-like mechanisms to the extent feasible, in order to realize the benefits of competition.

### *Antitrust Enforcement*

For more than a century, the antitrust laws have been, in the words of the Supreme Court, "a comprehensive charter of economic liberty aimed at preserving free and unfettered competition as the rule of trade." The antitrust laws address market failures arising from the exercise of market power (Box 5-2). These laws are enforced directly by the Department of Justice, the Federal Trade Commission, the States, and private plaintiffs.

Over the past dozen years, Federal antitrust enforcement has emphasized challenges to mergers among competitors in concentrated industries and the prosecution of bid-rigging schemes by government contractors. Frequently, the defendants were small firms. Federal antitrust enforcement efforts are now being refocused to encompass harmful conduct by large firms, affecting broad sectors of the economy, through means in addition to merger or bid rigging.

For example, the Justice Department is vigorously pursuing a court case charging the major domestic airlines with widespread price fixing from 1988 to 1992. The conspiracies were allegedly accomplished in a novel way: through the computerized exchange of prospective fare information. In terms of the magnitude of the violation and the size of the firms involved, this alleged price-fixing scheme recalls the electrical equipment conspiracy of the 1950s.

The government's actions to promote and protect competition go beyond filing lawsuits. When appropriate, government agencies issue guidelines that will encourage procompetitive behavior and minimize the private costs of understanding and complying with the law. Merger guidelines are the best examples, but the two Federal antitrust agencies have also recently promulgated enforcement guidelines to promote competitive behavior among health care providers.

### **Box 5-2.—Market Power**

Firms are said to exercise market power when they reduce output below what a competitive industry would sell, in order to raise prices above competitive levels. Firms may achieve market power collectively—for example, through an agreement among competitors to raise prices—or unilaterally, as by engaging in practices that inhibit the ability of current or potential rivals to compete. Firms may also obtain market power through government action, as when imports are blocked by tariffs or quotas.

The exercise of market power is harmful for several reasons. First, an industry in which market power is exercised produces less and employs fewer workers than would a competitive industry. Second, sellers who exercise market power in effect tax buyers unfairly, forcing them to pay more for their products than they would have paid under competition. Finally, firms exercising market power may tend to innovate less than competitors, because they recognize that a successful new product could cannibalize their existing market share and decrease the value of their capital. (In some industries, however, large firms exercising market power may be more likely than small or competitive firms to take the risk of investing in large-scale innovations.)

Although market power is costly to society, these problems are of limited concern in markets in which new competition can quickly and easily appear. Then the exercise of market power is likely to be nonexistent or temporary, and new entrants attracted by the opportunity to share monopoly profits will tend to shift resources into their most socially valuable uses. In some circumstances, moreover, society accepts some exercise of market power in order to achieve another economic benefit otherwise unavailable. For example, since the founding of the United States, the award of a patent monopoly as a prize for a successful invention has been the cornerstone of government policy to encourage research and promote innovation.

The antitrust guidelines for health care respond to the concern that health providers may have delayed cooperative cost-cutting arrangements because of uncertainty about antitrust restrictions. To give providers some security, the guidelines establish a number of “antitrust safety zones,” which describe circumstances under which the government will not normally challenge cooperative ventures. One example is a safety zone for hospital mergers if either of the

merging hospitals averages fewer than 100 beds and less than 40 patients per day over a 3-year period. Another is a safety zone for physician networks (such as preferred provider organizations, or PPOs) that comprise no more than 20 percent of the doctors in each specialty in the relevant geographic market, so long as the network members share substantial financial risk. Mergers or joint ventures by physicians that fall outside the safety zones are not necessarily antitrust violations but will be evaluated individually to determine their legality. The two Federal antitrust agencies have also committed to reduce uncertainty by providing advice to health care providers on an expedited basis.

Other government agencies have also taken steps to limit the exercise of market power. For example, a widely reported investigation by the Department of Transportation helped ensure that an established air carrier would not use anticompetitive practices to exclude a new entrant.

Government can go beyond simply preventing anticompetitive practices; it can act to stimulate competition directly. Thus, the Department of Transportation has provided new airlines with assistance in complying with its regulations. Partly as a result of the department's actions to promote competition, 18 new cargo, charter, and scheduled passenger carriers began service during 1993, and 20 more new carriers are awaiting certification to begin passenger jet service.

### *Spectrum Auctions*

As the Transportation Department's efforts to foster new air carriers suggest, competition can be promoted by encouraging entry. The Federal Communications Commission (FCC) will soon seek to promote competition in this way by allocating portions of the electromagnetic spectrum for telecommunications services. Legislation enacted in August 1993 authorizes the FCC to auction most of the new licenses to use spectrum, and requires the FCC to begin issuing licenses for personal communications services (PCS) by May 1994. The allocation of spectrum to PCS will encourage competition between new firms offering PCS and existing cellular providers. The auction mechanism will ensure that the spectrum goes to those private parties who place the highest value on it. The auction will also raise billions of dollars for the government, by selling the right to the use of a scarce public resource instead of giving it away.

## **MORE EFFICIENT REGULATION OF NATURAL MONOPOLIES**

Economists have long recognized that competition will perform poorly in certain industries that are "natural monopolies" (Box 5-3). In Europe, natural monopolies have often been turned into government enterprises. The traditional U.S. response is to impose

rate regulation. For example, State public utility commissions typically regulate the local distribution of electricity, water, natural gas, and telephone service, and Federal agencies regulate interstate pipelines and long-distance telephone service.

**Box 5-3.—Natural Monopoly**

An industry is a natural monopoly if a single firm can serve the market at lower total cost than two or more firms. A natural monopoly may result when an industry's production technology is characterized by economies of scale, that is, when average production costs decline as output rises. A natural monopoly may also have economies of scope, in which two or more related products can be produced more cheaply by a single firm than by separate firms. The size of the market interacts with the production technology in determining whether an industry is a natural monopoly. For example, if most of the cost reductions from producing at scale are achieved at low levels of output relative to market demand, the market is not likely to be a natural monopoly.

In an unregulated market, some natural monopoly industries would be served by a single firm that exercises market power. Entry would be deterred even though the incumbent firm charges a price in excess of its long-run average cost. Potential entrants, tempted by the opportunity to undercut the incumbent's price, would refrain from doing so because they would recognize that the incumbent would lower its price in response and could sustain that lower price profitably while the entrant could not. One way to avoid the exercise of market power in such a case is to regulate the natural monopolist's prices.

*Oil Pipeline Rate Regulation*

For nearly 90 years the Federal Energy Regulatory Commission (FERC) and its predecessors have regulated rates charged by interstate oil pipelines. Over this period, many if not most pipelines have likely been natural monopolies. Pipeline rates were set through a cost-of-service methodology, similar to the approach that State public utility commissions typically employ to determine rates for electricity, gas, water, and telephone service.

Under the cost-of-service approach, the regulated firm is allowed to earn enough revenues to cover its expected costs of operations plus a fair return on capital to its investors. The regulator sets prices on the regulated firm's individual services in such a way that the firm's expected revenues (based on forecasts of buyer demand) will reach the permitted level. Although this method is generally successful at preventing regulated firms from charging mo-

nopoly prices, it has been criticized on several grounds. Cost-of-service rate setting can be expensive to administer, as the regulatory commission typically engages in a trial-type hearing before determining rates. In addition, if the regulator adjusts rates rapidly when operating costs change, the regulated firm may lack a strong incentive to keep costs low, reduce costs further, or innovate.

Incentive methodologies for setting rates promise to reduce inefficiencies created by the cost-of-service methodology. One form of incentive regulation is a "price cap." The regulator sets a maximum price (or a price path, often set to decline over time) for a collection of regulated services, and permits the firm to set whatever rates it chooses for individual services so long as the price cap is not exceeded. If the regulator and the firm are willing to live by a price cap for a long time, the administrative costs of regulation are greatly reduced. In addition, the regulated firm is given a strong incentive to reduce costs and to innovate: As long as the price cap is not revised downward, the firm gets to keep any additional profits that result from cost savings. Finally, if the price cap applies to the average rate for a broad collection of services, this form of incentive regulation permits the regulated firm to exercise significant discretion in rate design. The resulting rates may distort consumer choice less than those set by regulators. For such reasons, in 1989 the FCC adopted price cap regulation for the long-distance telephone rates charged by American Telephone and Telegraph Co. (AT&T).

In 1993, FERC replaced cost-of-service rate setting for oil pipelines with an incentive methodology. The new approach generally starts with cost-of-service-based rates and caps rate increases for pipeline services at 1 percent below the increase in the producer price index for finished goods. Moreover, wherever the scope of the natural monopoly has narrowed, permitting the pipeline to demonstrate that it lacks significant market power, the regulatory constraint may be removed in favor of relying on competition to determine prices and output.

### *Telecommunications Regulation*

The rapid pace of innovation in telecommunications is creating new industries, transforming old ones, and promising to change the way we live and work. In the coming years, American households and businesses will have access to a National Information Infrastructure (NII)—an interconnected web of networks linking computers, databases, consumer electronics, and communications devices that will put vast amounts of information at every user's fingertips. The technologies to create, manage, manipulate, and use information will fuel economic growth, promote the international

competitiveness of U.S. industry, and create challenging, high-paying jobs.

Many of the innovations that are creating the new information infrastructure are also shrinking the scope of natural monopoly in the provision of telecommunications services. Microwave technology made competition in long-distance telephone service possible. The development of low-cost private branch exchange (PBX) technology has carved out a competitive market for carrying telephone calls within office buildings. For many business customers the local telephone monopoly now ends at the street rather than continuing into the building. Competitive access providers now sell alternative high-capacity services that allow some business customers to complete calls while bypassing some or all of the local telephone company's network. It is now feasible and increasingly practical for telephone lines to carry video programming, for cable lines to carry telephone calls, and for wireless providers to carry both. If and when these developments end the natural monopoly in local telephone and video service altogether, competition can replace regulation as the best economic mechanism for setting prices and providing telecommunications services to buyers.

The information highways that will be central to the emerging information infrastructure will be built in part with fiber optic lines, coaxial cable, and copper wire, and in part through wireless technologies such as cellular telephone, PCS, and direct broadcast satellites. The private sector will make the necessary investments, and the government will promote those investments by encouraging competition. In consequence, the market will determine, to the extent possible, which technologies provide the most value relative to cost and, accordingly, how the information highways will be built.

The Administration's regulatory policies will promote competition among the firms that build and operate the information highways, and among the firms that sell their services and programming through the network. Under the Administration's legislative proposals, for example, local telephone monopolies will be required to unbundle the services they offer and to interconnect with new entrants on a nondiscriminatory basis. This will facilitate new competition in local telephone service by allowing new providers to combine, for example, switching provided by the telephone company with their own transmission facilities. The legislative proposals will also set forth a process by which local telephone companies will be permitted to provide new competition in the interstate long-distance telephone market. The Administration's proposals will identify safeguards that will protect against regulatory evasion through transfer pricing (strategic pricing of goods and services sold to affiliates) and the abuse of monopoly power until the time

that competition in local telephone service makes rate regulation unnecessary.

Rapid developments in technology and the marketplace will create new challenges for telecommunications regulation. Old regulatory structures based on the natural monopoly paradigm are not appropriate for a market now characterized by mixed elements of competition and monopoly. Accordingly, the Administration will propose adding a new title to the Communications Act of 1934, specifying a flexible regulatory framework for this new environment. The new framework can adapt to technological and marketplace developments, to protect consumers from monopolies without discouraging investment, innovation, or the growth of competition. In addition, the Administration's legislative initiative will give the FCC broad power to forbear from regulating when markets become effectively competitive, and the power to preempt State and local regulation made unnecessary by the emergence of competition.

The Administration's policies will also promote universal service, to avoid creating a permanent class of information "have-nots," and open access to the network, to allow all service and information providers to reach potential customers. The government will also encourage research and development designed to create new technologies and new applications, as discussed below along with other technology initiatives.

## **ADDRESSING ENVIRONMENTAL EXTERNALITIES**

The notion of tradeoffs is among the most fundamental in economics: nothing is free; everything has an opportunity cost. In private markets, tradeoffs are handled automatically, as consumers choose among alternative goods and services and producers choose among alternative inputs. Prices guide these decisions. Tradeoffs involving the environment cannot be made so easily, however, because use of the environment is generally unpriced. As a result, firms and individuals, in their marketplace decisions, do not always make the best tradeoffs from the standpoint of society as a whole. The effects of failing to price environmental goods and services are examples of externalities (Box 5-4). When externalities are significant, the government can often design policies that improve the functioning of markets and thereby increase aggregate social welfare.

The Administration has sought to encourage the development of environmental technologies to mitigate tradeoffs and foster economic growth. Improvements in the technologies for preventing and treating pollution, and efforts to spread knowledge about technologies already available, can free resources for other socially ben-

#### **Box 5-4.—Externalities**

An externality, or spillover, is a type of market failure that arises when the private costs or benefits of production differ from the social costs or benefits. For example, if a factory pollutes, and neither the firm nor its customers pay for the harm that pollution causes, the pollution is an externality. In the presence of this negative (harmful) externality, market forces will generate too much of the activity causing the externality, here the factory's production, and too much of the externality itself, here the pollution. In the case of beneficial externalities, firms will generate too little of the activity causing the externality, and too little of the externality itself, because they are not compensated for the benefits they offer. For example, the development of laser technology has had beneficial effects far beyond whatever gains its developers captured, improving products in industries as diverse as medicine and telecommunications. Too little research and development and other activities generating positive externalities will take place in the absence of some governmental intervention.

To remedy market failures and induce the market to provide the efficient level of the externality-causing activity, the private parties involved in the activity must face the full social costs and benefits of their actions. Policymakers may employ a variety of tools to accomplish this result, such as taxes, user fees, subsidies, or the establishment or clarification of property rights.

eficial purposes or permit the attainment of higher environmental goals without increasing the burden on the economy. Given the worldwide explosion in environmental regulatory activity—in the Far East, in eastern Europe, in Mexico, and elsewhere—the development of more-effective and lower cost pollution control technology can also increase our export competitiveness. In fact, we already enjoy considerable success in this area. The United States is now the world leader in exports of environmental equipment. In a global market for environmental technologies of \$295 billion in 1992, the \$134 billion U.S. share is the largest by far. Our trade surplus in pollution control equipment has been increasing and was \$1.1 billion in 1991.

The Administration has also sought to improve the “technology” of regulating the use of natural and environmental resources. This effort involves seeking a better balance among conflicting interests in the use of natural resources, and developing approaches to regulate pollution that rely more on economic incentives and eliminate the economic distortions of some current regulations. Examples of

improving the technology for regulating the environment are found in the Administration's plan for managing the old growth forests of the Pacific Northwest, in its approach to grazing on Federal lands, in the Climate Change Action Plan, and in the Administration's position favoring the reauthorization of the Comprehensive Environmental Response, Compensation, and Liability Act, better known as "Superfund." To better assess where interventions to improve the environment will benefit the economy, the Administration is also engaged in efforts to define sustainable development and develop "green" GDP accounts.

## MANAGING RESOURCES ON FEDERAL LANDS

The Federal Government owns vast tracts of land, primarily in the West. These lands contain natural resources of economic importance to both local communities and the Nation, including timber and other forest products, forage for grazing livestock, and mineral deposits. They are also sources of extremely valuable environmental amenities, such as open space for recreational uses like wildlife viewing, scenery, camping, hiking, and hunting; fish and wildlife (including endangered species) habitat; watershed protection; and many others.

Improving the "technology" of regulating the use of these Federal lands is a centerpiece of Administration policy. Two principles guide that policy: (1) reducing inefficiencies caused by improper pricing and regulatory restrictions, and (2) ensuring that both pricing and regulation will achieve a better balance among competing uses of these resources, particularly between extractive (timber, grazing, mining) and environmental uses. These principles can be seen at work in the Administration's plans for managing old growth forests in the Pacific Northwest and for rangeland reform.

### *Old Growth Forests, Spotted Owls, and Timber*

The controversy over logging in the old growth forests and spotted owl habitat of the Northwest provides a case study in reconciling environmental and economic objectives and illustrates how a careful balancing of competing interests can result in progress on all fronts.

The forest products industry is a major industry in the Pacific Northwest, where it is heavily dependent on timber from Federal lands. Much of the Federal land on which this logging has taken place consists of mature forest stands. Referred to as "old growth," this mature forest is the habitat of the northern spotted owl, a threatened species, and many other plants and animals.

For several years Federal forest policy in the Northwest failed to take appropriate account of impacts on environmental quality and biodiversity. In particular, timber harvests on Federal lands were accelerated substantially in the mid- and late 1980s: Such harvests

in the habitat of the spotted owl rose from 2.4 billion board feet (bbf) in 1982 to 6.7 bbf in 1988. According to experts, these levels were too high to be sustained indefinitely. Legal challenges to Federal timber policy resulted in injunctions blocking the sale of timber on Federal forest lands in the spotted owl region, in part because agencies within the Federal Government had failed to work cooperatively to comply with environmental and forest management laws. The injunctions had a severe impact on the timber industry, albeit in large part because harvest levels had been extraordinarily and unsustainably large.

The Administration put a high priority on resolving the problems associated with forest management policy in the Pacific Northwest. Accordingly, in July 1993 the Administration announced a "Forest Plan for a Sustainable Economy and a Sustainable Environment." The plan attempts to end the uncertainty caused by legal wrangling and confusion and ameliorate the impact of economic dislocation, while achieving full compliance with existing laws. It also seeks to maintain and improve the ecosystem as a whole, balance the interests of competing uses of the ecosystem for environmental and economic purposes, and create a political consensus to avoid economic instability.

The plan provides for the maximum legally defensible harvest from Federal forests in the spotted owl region (about 1.2 bbf annually). The process of adjustment to the new, lower harvest levels will be smoothed by an economic adjustment plan that is expected to create more than 8,000 new jobs and 5,400 retraining opportunities in the region in 1994. Many of the new jobs will be in enterprises that improve water quality, expand the prospects for commercial fishing, and improve forest management in the region.

The plan focuses on maintaining and improving the environmental quality of watersheds in the region, recognizing how the complex interactions of flora, fauna, and human activities affect that ecosystem. It establishes old growth reserves and protects over 6.5 million acres of old growth forest (about 80 percent of existing old growth). It also establishes 10 "adaptive management areas" for experimentation into better ways of integrating ecological and economic objectives.

### *Rangeland Reform*

The Federal Government owns extensive rangelands throughout the West. While these lands are used primarily for grazing cattle and sheep, increased demand for environmental uses has fueled controversy over Federal management. The controversy over rangeland reform shows the importance of integrating pricing with regulation to use the Nation's resources more efficiently and strike a better balance between economic and environmental objectives.

A central point of contention involves the fees that the Federal Government charges ranchers to graze animals on Federal land. These fees should reflect both the value of the forage used by an additional animal and the external environmental costs of grazing an additional animal (such as the value of reductions in recreation or water quality). Charging ranchers the marginal value of forage, the first component, encourages efficient use of the range. By preventing overgrazing, it protects the condition of the range for future grazing uses. It also promotes long-run efficiency in the livestock industry: Prices for forage that are too low encourage excessive investment in the industry. Forage value varies from tract to tract because of differences in forage productivity, location, proximity to roads and other transportation, rainfall, and access to water. But it can still be measured easily and reliably using the value of private rangelands in nearby locations. The second component, the external costs of grazing, cannot be determined from private market transactions. But economists have developed ways of inferring the value of open space or other environmental amenities from the costs people willingly incur to use them or from sophisticated survey methods.

Current Federal management policies are relics of an earlier era when the Federal Government used resource subsidies to encourage settlement of the West. One result is that grazing fees on Federal lands average only 17 to 37 percent of the value of grazing on comparable private lands. Moreover, the formula used to calculate Federal grazing fees has kept those fees from increasing along with private grazing lease rates. Promoting efficiency thus means both increasing grazing fees and ensuring that Federal grazing fees change from year to year in accordance with changes in rent on private grazing land. The Administration's plans for rangeland reform do both. The current proposal calls for phasing in a new fee structure that more than doubles current fees, and for using an updating formula that will adjust Federal fees at the same rate that private fees change.

Pricing reform must be accompanied by changes in regulation. For example, Federal grazing permits have "use-it-or-lose-it" provisions, under which decreases in the number of animals grazed may result in the loss of a grazing permit or a reduction in the number of animals that the permit holder may graze in the future. This policy prevents ranchers from temporarily reducing the number of animals grazed to improve range condition. The Administration's plan allows the terms of grazing permits to be rewritten to allow ranchers to vary the number of animals they graze in response to changes in weather or economic conditions. The plan also includes provisions to strengthen environmental management.

## CLIMATE CHANGE ACTION PLAN

Certain gases emitted into the atmosphere by industrial, automotive, and other combustion have been implicated as a threat to the global climate: By preventing reflected solar radiation from escaping into space, these “greenhouse gases” may be causing a generalized warming of the planet. For this reason, an international agreement to reduce greenhouse gas emissions, the Framework Convention on Climate Change, was signed in 1992. The previous Administration had adopted what was called a “no regrets” policy; it was willing to take steps to reduce emissions only if those actions would be beneficial for other reasons—that is, even if greenhouse gas emissions were ultimately found unrelated to changes in the global climate. In contrast, this Administration sees cost-effective policies to reduce greenhouse gas emissions as appropriate “insurance” against the threat of climate change. Accordingly, the President, in his Earth Day speech on April 21, 1993, issued a “clarion call” for the creation of a cost-effective plan to reduce U.S. greenhouse gas emissions to 1990 levels by the year 2000.

The President’s call resulted 6 months later in the Climate Change Action Plan, containing nearly 50 initiatives that cover reductions in all significant greenhouse gases and will affect most sectors of the economy. The plan was based on the understanding that the climate change threat results from *all* greenhouse gases, that it depends on *net* emissions (after accounting for greenhouse gas “sinks” such as forests and oceans), and that the problem is *global*. The strategies adopted to address the externalities associated with greenhouse gas emissions were chosen on the basis of a qualitative assessment of the cost-effectiveness of the alternatives, in part by selecting policies that make markets work better.

Some of the strategies expand upon initiatives of this and previous Administrations to promote energy-saving technology. For example, the Green Lights program improves the diffusion of technology by providing consumers and firms with information about environmentally friendly products such as energy-saving lights that promise to reduce electricity generation and the resulting emissions. Other strategies reduce emissions by making government more efficient. Two examples are (1) reform of regulations that block the seasonal use of natural gas (a low-polluting alternative to coal) by electric utilities, and (2) removal of regulatory impediments to private investments in upgrading Federal hydroelectric facilities.

### *Parking Cashout*

Greenhouse gas emissions will also be reduced by improving the pricing of activities that generate externalities. The parking cashout policy attempts to correct a distortion in private incentives resulting from the tax treatment of employer-provided parking.

Currently, the Internal Revenue Code allows employers to deduct any costs for employer-provided parking as a business expense, and lets workers exclude the benefits from their taxable income (up to \$155 a month). As a result, 95 percent of automobile commuters receive free or subsidized parking, more than half of them in central business districts. All told, U.S. companies claim \$52 billion per year in parking-related deductions from this free or subsidized service.

The Climate Change Action Plan proposes that Federal tax laws be modified to require that firms offer employees the option of taking the cash value of their employer-provided parking benefit as taxable income rather than accepting their free parking space. The program would apply initially only to those firms with more than 25 employees that make monthly cash payments for their employees to park in lots owned by third parties. Thus, only about 15 percent of employer-provided parking would be covered at first, although the program would expand later as new parking leases are negotiated.

This policy change should reduce the overuse of automobiles for commuting resulting from the current parking subsidy, by making commuters face more of the social costs of driving. As consumers shift to carpools and public transportation, greenhouse gas emissions, other pollutants, and traffic congestion should all be reduced. Other distortions of the choice between commuting by car and by public transit will remain uncorrected, however, to the extent that current regulation of automobile emissions does not fully capture their environmental, congestion, and health costs.

### *International Strategies for Greenhouse Gas Reductions*

One hundred and sixty-one countries signed the Framework Convention on Climate Change in 1992, agreeing that it is necessary to stabilize greenhouse gas concentrations at a level that will prevent "dangerous anthropogenic interference with the climate system." Because this is a global problem, the Climate Change Action Plan addressed what is termed "joint implementation"—the cooperative effort between countries or entities within them to reduce greenhouse gas emissions. The plan recognizes that there may be enormous cost savings to meeting global goals for greenhouse gas reductions if acceptable international strategies can be developed to reduce emissions where it is cheapest to do so, rather than have each country pursue its emissions reduction goals on its own. Some important questions need resolution, however, such as how reductions are to be identified, monitored, and enforced. To begin testing the joint implementation concept, the plan creates a pilot program that evaluates investments by U.S. firms and government assistance to foreign countries for new greenhouse gas emission reductions; measures, tracks, and scores these reductions; and, in gen-

eral, lays a foundation for broader, more formal policy initiatives in the future.

## **SUPERFUND REAUTHORIZATION: THE ADMINISTRATION POSITION**

The Comprehensive Environmental Response, Compensation, and Liability Act, better known as Superfund, was enacted in 1980 and amended in 1986 in response to widespread concerns that improperly disposed-of wastes threatened human health and valuable natural resources, such as groundwater aquifers. The act has been unsatisfactory in addressing this problem. Fewer than 20 percent of the 1,300 disposal sites on the priority list drawn up by the Environmental Protection Agency (EPA) have been fully "cleaned up," although 3,500 separate actions have been taken to remove wastes posing an immediate threat to health.

At the same time, the costs of the program have been substantial, running almost \$7 billion per year. This figure includes direct draws on the Superfund trust fund collected from the oil and chemical industries to pay for EPA expenses (including \$1.6 billion in spending on cleanups where no private parties can be assigned responsibility), \$3.2 billion in spending by Federal agencies that own or contributed to hazardous waste sites, and \$2 billion in spending by private parties, much of which goes to lawyers' fees and other transactions costs in an effort to escape or reduce liability. Some estimates put the total cost of cleaning up the 3,000 sites projected to be on the EPA's National Priority List (NPL) over the next 30 to 40 years at \$130 billion to \$150 billion, with \$200 billion to \$300 billion more needed for Federal facility cleanups.

In response to the poor cost-effectiveness and slow pace of this program, the Administration has proposed several significant reforms. The two most important involve the standards and processes governing the cleanup strategy chosen at a site, and the process for assigning and financing liability.

### *Remedy Selection*

Under the current law, remedial measures at Superfund sites are chosen with a preference for treatment and permanent cleanup of soil and water. They are also selected to meet high standards of cleanliness: land generally must become suitable for residential use, and water often must achieve drinking quality. Costs have little weight in remedy selection; they come into play only to identify the cheapest of the set of remedies meeting other criteria.

The Administration's position establishes more-reasonable goals and processes for cleanup decisions. It sets uniform national goals for health and environmental protection to guide remedy selection. It substitutes a concern for long-term reliability as a factor to consider in remedy selection, in place of the preference for treatment

and permanence (except for treatment of "hot spots"). It explicitly recognizes containment as a legitimate cleanup strategy. It limits the use of State and Federal standards designed for other pollution contexts. Finally, it introduces greater flexibility and community input into the determination of appropriate land use for the site, permitting some sites to be designated for industrial use, with appropriately lower levels of cleanup required.

The Administration's proposal also offers a streamlined approach to remedy selection at individual sites. With EPA approval, parties will be able to avail themselves of a set of cost-effective "generic" remedies established by the EPA that apply to certain frequently encountered types of waste disposal problems. Alternatively, they can formulate designs that meet national cleanup levels that are based on realistic assumptions and practices concerning risks. If the party liable for cleanup believes it can devise an even cheaper remedy that can meet the national health standards, it can perform a site-specific risk analysis to make its case to EPA. This option allows parties to propose remedies based on the ultimate goal of protecting health and the environment, rather than on the "intermediate" targets of reductions in soil or water concentrations, and helps tailor remedies chosen for a site to its particular features.

Most important, a factor in the remedy selection process at individual sites will be a comparison of the reasonableness of costs against several measures of effectiveness. This approach introduces discipline, transparency, and recognition of tradeoffs into the remedy selection process, while retaining consideration of other factors such as community acceptance and meeting the primary criterion of protecting health and the environment. Cost will also be considered in decisions on whether to defer final cleanups for cases where a new technology is on the horizon to replace a current one that has disproportionately high costs.

### *The Liability System*

The transactions costs associated with cleanups, especially litigation expenses, have been massive under current law. One study found that these costs account for 19 to 27 percent of all Superfund costs. Transaction costs are substantial in part because liability under current law is strict, joint and several, and retroactive: A party that contributed waste to a site used by others can be held liable for the entire cost of cleanup, and a party is liable for the results of its dumping even if its action was legal at the time. As a result, potentially responsible parties (PRPs) have strong incentives to contest their liability (resulting in high enforcement costs to the EPA), to sue other PRPs to recover costs, and to sue their insurance companies when the latter refuse to pay related claims.

The Administration's proposal seeks to limit these transactions costs by streamlining the liability allocation process and making it more fair. The new allocation process is based upon nonbinding arbitration, in which PRPs are assigned a share of liability based on factors such as the volume and toxicity of their wastes. PRPs who settle for their assigned shares would surrender their rights to pursue other PRPs for contribution, be protected from suits by other PRPs, and be offered, for a fee, protection from future liability arising from remedy failure or undiscovered harms. As an added incentive to settle, the EPA would pay settling parties for their share of the "orphan shares"—the share of liability attributed to an identified but insolvent party—but nonsettling parties could still be held liable for all or part of the "orphan share."

The Administration proposal also addresses the growing problem of Superfund-related insurance litigation. The problem arises because insurance contracts written before Superfund was enacted did not expressly allocate Superfund liabilities. Subsequently, courts in some States have interpreted those contracts to require insurance companies to assume most Superfund liabilities, but courts in some other States have held the opposite. The scope of insurers' liability in most States is undecided. Building on a proposal originally suggested by the insurance industry, the Administration proposal calls for creation of an Environmental Insurance Resolution Fund financed through fees and assessments on property and casualty insurers. If the PRPs can show sufficient insurance coverage before 1986, the fund would be used to settle their insurance claims for cleanup and restoration costs at pre-1986 NPL sites, as well as some costs at non-NPL sites, at rates determined simultaneously for all of a PRP's sites. The combination of the allocation process and the insurance settlement process should substantially reduce transactions costs and increase fairness.

## SUSTAINABLE DEVELOPMENT AND GREEN ACCOUNTING

According to the 1987 report of the World Commission on Environment and Development, sustainable development is that which "meets the needs of the present without compromising the ability of future generations to meet their own needs." In short, future generations must be able to attain a quality of life, in both economic and environmental terms, equal to ours if they desire. To make this possible, the present generation must leave the future with the wherewithal—the "social capital," consisting of human, natural, and physical (manmade) capital—to create our kind of life or a life of at least equal quality to ours. Although this definition is widely accepted, its interpretation remains subject to debate. One controversy concerns the extent to which the three types of

capital can substitute for one another, given the underlying scientific principles and economic behavior, while keeping the resulting development sustainable.

However this controversy is resolved, it will be necessary to measure social capital and the value its use brings in order to understand whether a growth path for the economy is sustainable. This is the province of "green accounting," an idea first raised in 1969. Much of the recent research effort to augment the national income and product accounts to incorporate previously unmeasured aspects of social welfare focuses on identifying the net change in the stock of social capital resulting from environmental externalities. This research effort seeks to identify the loss (depreciation) of social capital caused by pollution, the value of the reduction of finite resources (such as fossil fuels and minerals), the loss from overharvesting of renewable resources (such as forests and fisheries), and the value of the environmental services (e.g., clean air) derived from investments in pollution control equipment.

The President has made it a priority of his Administration to augment the national accounts to incorporate these aspects of social capital. In his 1993 Earth Day speech the President directed that "green" gross domestic product (GDP) measures be developed to improve existing national income and wealth accounts that ignore the cost of pollution or the loss of natural resources. In the first phase of fulfilling this mandate, the Commerce Department's Bureau of Economic Analysis will publish modified GDP accounts in 1994 to reflect the depletion of selected natural resources and will continue to explore measures that incorporate additional environmental values. This effort will be aided by the Department of Interior's forthcoming National Biological Survey, an effort to inventory the biological and ecological resources of the Nation.

## **PROMOTING TECHNOLOGY**

Technological progress fuels economic growth. It creates new industries and reinvigorates old ones. It can enable small businesses to do high-quality design and manufacturing work that previously required the resources of big business. It can help big businesses achieve the speed, flexibility, and closeness to customers that once were a defining characteristic of small business. Technology helps to make our work force more productive and, in doing so, improves the Nation's standard of living. Every recent generation has seen its dreams turn into technological marvels, new products from new industries that have transformed the way we live and work: from the telephone, radio, airplanes, and x-rays, to television, xerography, computers, and magnetic resonance imaging equipment. Ad-

vances in technical know-how have accounted for at least one-quarter of our Nation's economic growth over the past half-century.

During the past two decades, powerful trends have altered the environment for American technology development. Commercial technology has become increasingly science-based and interdisciplinary. International competition has intensified as other nations have advanced in wealth and technological sophistication. The Nation's defense capability has become increasingly dependent on technologies developed and applied first in commercial markets. A microelectronics-based revolution in production has transformed the organization of office and factory work, increasing the need for a well-trained and flexible work force.

By the end of the 1980s, many analysts believed that these trends required a reexamination of the existing approaches of government and industry for supporting technology development and diffusion. Accordingly, in its first year the Administration has supported tax incentives for investments in research and development (R&D) and new businesses, liberalized export controls, shifted Federal resources toward basic research and civilian technology, invested in worker skills, and promoted defense conversion. In addition, the Administration's technology initiatives, such as the promotion of the National Information Infrastructure discussed above, the Partnership for a New Generation of Vehicles, and the creation of a Manufacturing Extension Partnership, rely on an alliance of government and industry. They also require rigorous attention to the economic rationales for cooperative efforts and then to the details of project design and assessment, to ensure that market failures are corrected, not made worse, by government action.

## PRINCIPLES OF TECHNOLOGY POLICY

The Administration's technology initiatives aim to promote the domestic development and diffusion of growth- and productivity-enhancing technologies. They seek to correct market failures that would otherwise generate too little investment in R&D, with programs that avoid "government failure."

### *The Economics of Appropriability*

New technologies often fail to attract sufficient private sector investment because their technical risk is high or because of limited appropriability—that is, the new technologies create economic and social benefits beyond what the investing firms can capture for themselves. Indeed, despite intellectual property protection, the social returns to innovation have been estimated to exceed the private returns by between 35 and 60 percent.

The most important innovations generate spillover benefits for interconnected sectors, creating economic gains well beyond any that eventually accrue to their inventors. These innovations include

risky “pathbreaking” technologies that pay off in the creation of new industries (or the transformation of existing industries), and lower risk “infratechnologies” that can enhance the productive performance of a broad spectrum of firms and industries but that receive low levels of investment because of barriers to appropriability and implementation. For example, the development of refrigerated steamships at the end of the nineteenth century increased the availability of perishable agricultural products throughout the world. Most of this benefit ultimately accrued to farmers and consumers rather than to the inventors of refrigerated steamships. Similarly, the principle of interchangeable parts in manufacturing, originally developed for the production of firearms, soon was adopted for use in the fabrication of clocks, hardware, sewing machines, and other manufactured products.

The appropriability problem is not limited to basic research, but frequently extends to so-called precommercial technology development and eventual commercial applications. Indeed, technological progress is full of feedbacks where developments downstream alter the course of behavior upstream, as well as the degree of ultimate market success. A sharp distinction between basic research and precommercial development activities is difficult to draw. Investments that are necessary to the utilization and adoption of research results—investments in information gathering, work force training, or the integration of new production equipment into automated systems—can also create spillover benefits that the investing firm cannot perfectly appropriate. In addition, new manufacturing processes that lower cost or improve quality may not be patentable, and new ideas embodied in computer software can often be imitated rapidly without violating the originator’s intellectual property rights. In all of these cases, public actions can offset the effects of underinvestment by the private sector that is caused by limitations on appropriability.

### *Avoiding “Government Failure”*

The goal of technology policy is not to substitute the government’s judgment for that of private industry in deciding which potential “winners” to back. Rather, the point is to correct a genuine and significant market failure—underinvestment in basic research and in precommercial R&D resulting from the divergence between private and social returns to those activities. A complementary goal is to design the technology investments that the government itself makes in public goods—national security, public health, education, a clean environment, an efficient transportation system—in ways that maximize the potential external benefits for the Nation’s commercial technology base. In both cases, technology policy enhances the Nation’s economic and social welfare.

Investments in R&D are risky. Like all risky investments, public or private, government-supported explorations sometimes drill dry holes—such as the efforts during the 1960s and 1970s to develop synthetic fuels, a supersonic transport, and a fast breeder reactor. Yet even research that never delivers an enormous economic payoff for itself often contributes useful technical knowledge and lessons for the future. And when the drilling strikes oil, as with government support of R&D for computers and integrated circuits, jet engines and airframes, and biotechnology and medical equipment, the initial gusher can generate an entire field of newly productive, wealth-enhancing, job-creating economic activity. For this reason, the success of government R&D policy must be measured by the rate of return on the entire portfolio of R&D investments supported by the public.

We can learn from both the gushers and the dry holes about how to design programs to promote investments in basic and precommercial R&D to maximize their prospects for success. Federal R&D investment programs leading to successful commercial products tend to share certain design features: They are insulated from the demands of distributional politics; they subject potential projects to rigorous technical and economic evaluation; and they recognize that product specifications must be developed with an eye toward manufacturability and a balance between product performance and cost that will be acceptable to commercial customers. Accordingly, the Administration's efforts to promote innovative technology contain design features that are meant to limit the possibility of "government failure" in the implementation of technology policy:

- To ensure that R&D funded by the government in cooperative ventures with the private sector has direct market applications, participating firms must bear a significant share of program costs. In most cases, the Administration's technology partnerships require that private firms cover at least 50 percent of the costs.
- To ensure that both the timing and the content of government investments in technology-based infrastructure impart maximum leverage on industry's competitive efforts, research frameworks for collaborative R&D should be initiated and designed by private industry and should be closely coordinated with industry investment patterns.
- To insulate publicly supported R&D efforts from political pressures exerted on behalf of special interests, evaluations of competing R&D proposals should be conducted by independent experts in the relevant scientific, technological, and economic fields. Political considerations should not be allowed to influ-

- ence a project's technical objectives, the location of R&D facilities, or the way that management of the project is structured.
- Investments in a broad array of technical fields, including materials sciences, manufacturing product and process technologies, biotechnology and biomedical sciences, and telecommunications and computer-related technologies, should compete for a finite flow of funds. This competition will help to ensure that expanded Federal support for precommercial R&D does not get captured by the champions of any particular technology or by any particular set of firms.
  - Government investments in basic and precommercial R&D should be reviewed while in progress to determine whether funding should continue. Such reviews are difficult because the success of an R&D project is often not apparent for many years, but rigorous assessments can nevertheless be made by independent expert panels at regular intervals.

### *A New Approach*

An enduring American approach to promoting technology development and diffusion evolved just after the Second World War. The United States channeled public investment into basic research at universities and government laboratories, then supported the initial application of the results in products and production processes procured by public agencies. New technologies first developed for (and procured by) the Department of Defense, the Department of Energy, or the National Aeronautics and Space Administration (NASA), or supported by the National Science Foundation or the National Institutes of Health (NIH), would then diffuse, or "spin off," into commercial use. In this manner, the Federal Government supported the development and diffusion of jet aircraft and engines, semiconductor microelectronics, computers and computer-controlled machine tools, pharmaceuticals and biotechnology, advanced energy and environmental technologies, advanced materials, and a whole host of other commercially successful technologies.

This system worked well as long as military systems represented the leading-edge applications of new industrial technologies and as long as foreign competitors, with direct support from their own governments, did not pose a significant competitive challenge. In many areas of basic research supported outside the defense establishment, including biomedical research and the development of pharmaceuticals, biotechnology, and medical diagnostic devices, the system continues to work well. But the circumstances that allowed the United States to rely primarily on a defense-led model have changed. With the end of the cold war, demand for new defense systems is now less than it was. Commercial product spinoffs from military research have also diminished from their heyday of the

1950s and 1960s, and American companies face intense international competition from increasingly capable foreign firms. On the other hand, these changes also create exciting new opportunities: Innovative defense technologies are now more likely to emerge first in commercial products and production techniques, and American companies are taking advantage of expanded opportunities in foreign markets. Accordingly, the Administration's technology initiatives are shifting the composition of Federal R&D from military to civilian concerns, and the composition of military R&D toward the development of so-called dual-use technologies—those with applications to both military and commercial products.

## THE ADMINISTRATION'S TECHNOLOGY INITIATIVES

The Administration's investments in growth- and productivity-enhancing technologies encompass a wide range of physical and human resource priorities. They finance basic research and leverage private funds for technology development and commercialization. They promote the diffusion and adoption of advanced manufacturing technologies by U.S. industry. They facilitate defense conversion by easing defense suppliers into civilian markets, focusing military R&D on dual-use technologies, and freeing the Pentagon to purchase commercial products and processes. They seek to promote the development of a national telecommunications infrastructure for the information age. Finally, they create partnerships with industry and academia to ensure that the government's investments to solve pressing problems in energy, transportation, and the environment simultaneously work to promote the Nation's economy and overall standard of living.

### *Basic Research*

The Administration worked with the Congress to increase budget authority for basic research in all categories to \$13.8 billion in fiscal year 1994. This includes a 7.2-percent increase in the National Science Foundation's budget to a total of \$1.9 billion. The National Science Foundation will continue to provide strong support for fundamental research critical to manufacturing, advanced materials, environmental technologies, and biotechnology. It has also doubled its support for modernizing academic research facilities and instrumentation. In addition, basic space science research is continuing at NASA, representing an investment of \$1.9 billion in fiscal 1994. The Department of Defense has been appropriated \$1.2 billion for basic research in fiscal 1994; the Department of Energy will support an additional \$1.7 billion in basic research, in areas including materials science, chemical science, engineering and geoscience, high-energy nuclear physics, and nuclear fusion. Finally, the Administration continues to support basic research conducted through the National Institutes of Health, which account for over 40 per-

cent of federally sponsored basic research. NIH is projected to spend nearly \$6 billion for basic research in fiscal 1994, exceeding last year's level by almost \$300 million (or 5 percent).

### *Technology Development and Commercialization*

Through the Commerce Department's Advanced Technology Program and through the hundreds of cooperative research and development agreements that have been signed between private firms and researchers at many of America's 726 Federal laboratories, the government is investing in industrial projects to develop and to promote commercialization of technologies with high payoff potential. The Nation's antitrust laws have also been clarified to avoid discouraging beneficial private research collaborations.

*The Advanced Technology Program (ATP).* The ATP is administered by the Commerce Department's National Institute of Standards and Technology (NIST). In four competitions completed over the past 4 years, the ATP has made 89 awards to 66 companies and 23 joint ventures. The projects receiving awards have included ventures to develop a way to control personal computer programs through "natural language" instructions; a pen-based character-recognition system for the Chinese language, with the goal of enhancing software exports to Chinese-speaking companies; and a technology for preserving patients' bone marrow during chemotherapy.

The ATP is designed to avoid government failure. Government acts as the catalyst, but the ATP relies on industry to define and carry out its R&D projects. Independent expert panels select projects through rigorous competitions based on both technical and business merit. The ATP provides technology development funds under cooperative research agreements. It requires single-company applicants to pay their own indirect costs, and joint ventures to provide matching funds. In general, award recipients may patent inventions or copyright software developed under an ATP award, but the government retains a nonexclusive license.

The total of ATP awards plus private sector funds over the life of the first 89 awards amounts to over \$500 million. The Administration has proposed to increase the ATP budget from \$68 million in 1993 to \$750 million in 1997, and \$200 million has been appropriated for the program in 1994. In addition to announcing about 100 new awards to industry in fiscal 1994, the ATP will embark on a set of "strategic" program competitions. These competitions will focus on particular technology areas recommended by industry as having especially significant potential to generate large economic and social payoffs.

*Cooperative Research at Government Laboratories.* The Nation's 726 Federal laboratories, especially the three large, multiprogram nuclear weapons laboratories (Los Alamos and Sandia in New Mex-

ico and Lawrence Livermore in California), offer a repository of vast technical expertise that can be leveraged to enhance the competitive performance of American industry. As part of its plan to alter the balance between military and civilian objectives in the Federal R&D budget, the Administration has authorized the weapons labs to redirect at least 10 to 20 percent of their defense program budgets to commercial technology-transfer activities with industry. The Department of Energy's 31 laboratories, which employ over 23,000 scientists and engineers and perform \$6 billion in civilian and military research annually, already have in place over 650 cooperative research and development agreements (CRADAs) with private firms, totaling \$1.4 billion in combined public and private funds. CRADAs are also used to structure public-private partnerships involving laboratories at NIST and the Department of Defense. A similar program is in place at NASA.

Using CRADAs, Federal laboratories have already begun or strengthened jointly financed collaborations with companies and industry consortia in a number of research and production prototyping projects. These have covered semiconductor production equipment, flat panel display technology, new technologies for textile manufacturing, the investigation of new polymer blends, biosensors, new aerospace alloys, and microscopic-sized machines known as microelectromechanical systems. These partnerships may begin a longer term process of redirecting the defense-oriented labs' missions toward civilian needs—ranging from the development of energy-efficient and environmentally sustainable industries to the invention of new medical, manufacturing, and transportation technologies—while utilizing the labs' expertise in such fields as high-performance computing, communications, and new materials.

*Collaboration in Research and Development.* Competition promotes R&D, but collaboration can also promote both research and the effective commercialization of research results. When firms have complementary skills or information, an R&D joint venture among them may speed the development and commercial adoption of a new technology. And when firms have similar skills or information, an R&D joint venture may avoid costly duplication of effort. Yet allowing collaboration in R&D risks facilitating undesirable cooperation in the firms' other activities. For example, it may make it easier to engage in price fixing or other anticompetitive practices in the sale of the products manufactured by the firms collaborating on research. This risk is small if collaboration is limited to early-phase R&D, however.

The Congress balanced these concerns in 1984 when it passed legislation guaranteeing that collaborative research would violate the antitrust laws only if the collaboration were found unreasonable. That legislation also provided that research joint ventures

could register with the government and thereby limit their anti-trust exposure to actual damages, rather than face the usual treble damage penalty for antitrust violations. Legislation enacted in 1993 extends these protections to production joint ventures, thereby removing a barrier to collaborative efforts to implement new manufacturing techniques and production processes. Because these aspects of the production process can be understood as research into product commercialization, this extension serves a purpose similar to that of the 1984 legislation.

### *Development and Diffusion of Advanced Manufacturing Technology*

Anecdotal examples abound of technologies developed in the United States, such as numerically controlled machine tools, that were commercially exploited first or more successfully abroad. These anecdotes point to market failures other than imperfect appropriability that also contribute to insufficient adoption and utilization of research results. For example, firms may face unnecessarily high transactions costs for obtaining information, and firms with good ideas but limited sources of collateral or internal finance may find themselves unable to raise funds in the capital markets.

The effort to commercialize a new technology often presents firms with an array of organizational challenges: New manufacturing processes and distribution channels must be developed, workers must be retrained, and new suppliers and perhaps even new customers must be identified. In meeting these challenges, firms develop a great deal of valuable information—from manufacturing know-how to marketing insights—some of which cannot be protected as intellectual property or trade secrets.

On the other hand, firms sometimes have difficulty gaining access to other types of technological know-how developed inside other companies and the ways different firms have met implementation challenges. Adoption of advanced manufacturing technology is typically a “systems” problem. Suppliers must be able to sell components that fit into complex automated production systems. Buyers must be assured of compatibility among machines, robots, transfer lines, and the like, or they will not adopt the technology.

To help remedy these market failures, and so promote more rapid and extensive commercialization and diffusion of important new technologies, the Administration is expanding NIST's Manufacturing Extension Partnership (MEP) program. Manufacturing Technology Centers (MTCs) form the backbone of the program. MTCs offer impartial advice to small and medium-sized manufacturers from people with extensive industrial experience. This advice is backed by hands-on technical assistance. MTCs will be linked among themselves to a set of smaller Manufacturing Outreach Centers (MOCs), geared to areas with smaller concentrations

of industry. MOCs will be affiliated with technical colleges, vocational schools, and State technical assistance centers. Together MTCs and MOCs will help firms to identify, evaluate, install, adapt, and then commercially exploit appropriate advanced technology in their manufacturing and business operations. The Administration anticipates that 100 centers will be established nationwide by 1997, up from 7 at the outset of this Administration.

Linkages have also been formed between the MEP and other Federal agencies with roles to play in the delivery of technical assistance, work force training, and small business support services. These agencies include the Department of Energy, NASA, the Small Business Administration, and the Department of Labor. In addition, the Department of Energy dedicated over \$400 million to advanced manufacturing-related technologies in fiscal 1993 and has under way or in negotiation more than 115 advanced manufacturing cooperative projects involving over 60 companies. One of these is the AMTEX Partnership, a model collaboration between the Department of Energy's national laboratories and the American textile industry. Finally, the deployment portion of the Administration's defense conversion Technology Reinvestment Project (discussed below) includes an additional \$87 million for manufacturing extension programs.

### *Telecommunications Infrastructure for the Information Age*

All Americans have a stake in the construction of the advanced National Information Infrastructure described earlier in this chapter. Private industry is already developing and deploying the NII, and, as explained above, it is the private sector that should build and own the NII of the future. There nevertheless remain essential roles for the government to play in ensuring the growth of an affordable and universally accessible telecommunications infrastructure. Many of the key breakthroughs in telecommunications and computing stemmed from research funded by the Federal Government. For example, the Internet and laser technology both grew out of government-sponsored research.

The Administration will continue the High-Performance Computing and Communications program, which funds R&D into more-powerful computers, faster computer networks, and more-sophisticated software. A key objective of this program is the application of computers to economically important problems. The Department of Energy has funded several collaborations among national laboratories, universities, and industry, applying these computing technologies to materials, chemistry, energy, and environmental problems. Beyond that, the Administration has created a new component of the program, emphasizing information infrastructure technologies and applications. This program will develop and apply high-performance computing and high-speed networking tech-

nologies for use in the fields of health care, education, libraries, manufacturing, and provision of government information. Additional research on information technologies and applications will be conducted by the Department of Energy's national laboratories.

Finally, the government is supporting an array of NII pilot and demonstration projects. Federal matching grants will be awarded on a competitive basis to school districts, libraries, State and local governments, health care providers, universities, and other non-profit entities to connect institutions to existing networks, to enhance those networks, and to permit users to interconnect among different networks. The program is presently funded at \$28 million per year and is planned to grow in coming years to \$100 million annually. Its goal is to ensure that every school and library in the country is connected. In addition, NASA has launched the Advanced Communications Technology Satellite, an experiment to test pioneering concepts and technologies that promise to advance on-demand, flexible communications services.

### *Transportation, Energy, and the Environment: New Technologies for Growth*

Environmental improvements have traditionally been viewed as something we trade off for increased economic performance. Yet, as noted earlier in this chapter, a strong environmental policy framework can encourage innovation, strengthen key competitive industries, and improve our environment simultaneously. Environmental policy can create new demand for the goods and services of the environmental protection industries, which then increase employment and production to meet this demand. Policies that call for leading-edge environmental solutions can induce U.S. industry to respond with novel, world-class technologies. This response positions U.S. industry to meet the rapidly growing world demand for advanced "green" technologies, providing additional economic and environmental benefits for U.S. consumers and producers.

Accordingly, this Administration is developing an environmental policy framework whose objective is to maintain and strengthen environmental protection while also promoting economic and technological development. The Administration is working with the U.S. business and research communities to promote the development and deployment of new technologies that simultaneously prevent pollution, increase energy efficiency and the efficiency of the Nation's transportation infrastructure, and promote economic growth. Clean technologies—such as energy-efficient light bulbs and motors, alternative fuel vehicles, computerized traffic management systems, and advanced steelmaking—reduce many kinds of pollutants. Such technologies can also reduce the energy needs of U.S. companies, trimming costs and improving international competi-

tiveness. Again, the hoped-for result is both enhanced environmental quality and greater long-term economic growth.

*Partnership for a New Generation of Vehicles.* This initiative, begun in September 1993, is a joint effort of the Federal Government and the three leading domestic automobile manufacturers. The initiative aims to develop the technologies necessary to create a new type of automobile, one that is both safer and up to three times more fuel efficient than today's cars. In both its goals and its implementation, the program is characteristic of this Administration's technology policy. It focuses on developing technologies that may generate technological progress in two important areas: in making U.S. automobile producers more technologically competitive in the international marketplace and in reducing air pollution. The initiative is structured as a set of public-private partnerships in R&D. One such partnership seeks to develop a "hybrid" vehicle that combines electric propulsion with conventional heat engine systems to increase efficiency and meet tight emission standards.

*The Environmental Technologies Initiative.* The EPA has launched the Environmental Technologies Initiative to stimulate technological innovation to meet the Nation's environmental objectives. The initiative aims to create a more productive environmental technology marketplace and works toward incorporating environmental considerations into the design of new technologies and into upgrades of existing technologies. This program is also designed to aid the Administration's defense conversion effort by facilitating the use of military bases for demonstrations of environmental remediation or "cleanup" technologies. In addition, the EPA and the Commerce Department are jointly developing environmental technology programs at NIST regional technology centers; and the EPA has undertaken a new collaborative venture with the Small Business Administration to help small businesses access information on pollution prevention. These and other domestic initiatives also support the Administration's strategic framework for environmental technologies exports, which engages U.S. environmental businesses in the design and implementation of market-specific export assistance and export financing strategies.

The NICE<sup>3</sup> program (National Industrial Competitiveness through Energy, Environment, and Economics), jointly administered by the EPA and the Department of Energy, aims to promote innovative technologies that simultaneously improve energy efficiency, reduce waste generation, and increase economic competitiveness and productivity. The program also seeks to improve cooperation between State agencies and industry. In addition, the President has directed the Department of Energy and the EPA to accelerate the commercialization of advanced, energy-efficient technologies through the formation of partnerships with key market

players. These partnerships may include contests for new technology introductions; working with government procurement agencies to leverage their purchasing power to acquire qualifying products; and working with utilities to coordinate incentives for markets for new technologies. For instance, the Department of Energy, together with the EPA and utilities, is using such partnerships to create a new market for manufacturers of chlorofluorocarbon-free refrigerators (chlorofluorocarbons have been implicated in degradation of the atmospheric ozone layer).

Finally, the Department of Energy is engaged in developing and deploying innovative environmental remediation and cleanup technologies to deal with the cleanup of military bases slated for closure, as well as of contaminated facilities and sites administered by the Energy Department itself.

*Other Transportation Technology Initiatives.* The Department of Transportation has begun a series of outreach seminars entitled "Promoting Transportation Applications in Defense Conversion and Other Advanced Technologies." In addition, the department has initiated studies aimed at having a prototype demonstration of an automated intelligent vehicle highway system by 1997. The Defense Department's Advanced Research Projects Agency (ARPA) has selected six regional coalitions—in Hawaii, Sacramento, Los Angeles, Indianapolis, Atlanta, and Boston—to work on electric and hybrid electric vehicle technology and infrastructure. A team of officials from the Departments of Defense and Transportation is also investigating how to augment the existing satellite-based global positioning system for use in improving air navigation and collision avoidance. The Department of Energy's Clean Cities program makes use of the Federal Government's purchasing power to accelerate the introduction of alternative fuel vehicles (and an alternative refueling infrastructure) into urban areas in order to reduce emissions. Finally, the Administration is continuing to fund research into an array of next-generation transportation technologies, including high-speed ground transportation, advanced subsonic planes, and supersonic air transports.

### *Facilitating Defense Conversion*

The share of gross domestic product (GDP) devoted to national defense is expected to shrink from 6.5 percent in 1986 to 3.3 percent in 1997. This decline in defense spending, resulting from the end of the cold war, is smaller relative to the size of the economy than the cutbacks that followed World War II and the Korean and Vietnam wars, and much more gradual. Yet the impact on particular regions, such as southern California, is severe, and three additional factors work to make the economic adjustment this time more difficult. First, the economy's recovery from the recession of 1990–91 was weaker than the average postwar recovery, while ef-

forts to cut the massive Federal budget deficit leave little room for fiscal expansion to stimulate economic growth. Second, many defense firms and workers are more isolated from commercial market practice than during earlier build-downs, because the defense procurement system that has evolved over time has erected a wall between commercial sectors and defense. Third, technological innovation and the economic growth it generates may be hard hit by the defense retrenchment, because nearly 60 percent of Federal support for domestic R&D was defense related and because roughly one-fifth of the Nation's engineers work in defense-related areas.

The end of the cold war was an unanticipated event with serious economic consequences for several domestic economic sectors. Our Nation has long accepted a collective responsibility to ease the transition for those most heavily affected by major economic shocks, for example by providing unemployment insurance and disaster relief. This principle readily extends to transitional assistance when the shock results from a large and unanticipated structural economic change, particularly when government is effectively the agent of that change.

For workers, the problem of large, regionally concentrated economic dislocations is made worse by a capital market imperfection. It is often difficult for workers to borrow for retraining and relocation because their human capital cannot serve as collateral. Such capital market transactions are particularly difficult to arrange for people who have just lost a job or who have incurred a capital loss on their home—a frequent consequence of geographically concentrated defense cuts. Moreover, dislocated workers may have a difficult time learning about job opportunities in other regions or occupations.

Defense conversion is also difficult for firms. Although many defense contractors have access to knowledge, production facilities, and skilled workers that could be valuable if channeled to commercial applications, the many years spent designing their organizations to serve the needs of one customer—the Defense Department—often leave them without crucial skills or the right organizational configuration to serve the commercial marketplace. To the extent that these firms lack internal funds to finance new investment, and to the extent they are unable credibly to demonstrate to lenders and other capital providers their potential to serve other lines of business, these resources will not be able to move to their most efficient uses.

The Administration's 5-year, \$22 billion Defense Reinvestment and Conversion Initiative addresses these problems of the post-cold war transition.

*Workers.* The initiative provides \$5 billion over 5 years for worker adjustment, including funding for retraining displaced defense

workers and early retirement benefits for military personnel with at least 15 years of service. In addition, the Administration is sponsoring pilot programs to train defense workers and personnel leaving the military for national service as teachers, health care workers, and law enforcement personnel.

*Communities.* The Administration is also expanding the Defense Department's Office of Economic Adjustment, so that communities affected by scheduled military base closures have the resources and technical assistance necessary to plan a smoother adjustment to new economic activities. More resources are being devoted to the Commerce Department's Economic Development Administration, to target help to communities hardest hit by the defense industry drawdown. Meanwhile the Defense Department is working with the EPA and other public and private bodies to make sure that the process of environmental cleanup and restoration at closed military bases does not hamper local economic recovery.

*Technology: The Technology Reinvestment Project.* The Administration's Technology Reinvestment Project (TRP) is an effort to promote the development of dual-use (commercial and military) technologies and to help small defense firms make the transition to commercial production. The TRP is jointly implemented by a six-agency council representing the Departments of Commerce, Energy, Transportation, and Defense, NASA, and the National Science Foundation, and is chaired by an official from ARPA. One-hundred and sixty-two projects had been selected for TRP support as of early December 1993, totaling nearly \$1 billion in combined public and private funds (the Federal share is about \$415 million).

The TRP funds three types of projects: technology development (46 projects), technology deployment (70), and manufacturing education and training (46). Examples include construction of a highway bridge from composite plastics, development of a new jaws-of-life rescue device powered by pyrotechnic cartridges, and the exploration of medical uses for a noninvasive diagnostic device that measures oxygen levels in the blood. The TRP is also funding the development of a new manufacturing engineering curriculum at a State college, a manufacturing technology center to help defense suppliers adapt to other fields, and a project to retrain laidoff defense engineers in pollution-prevention and remediation.

*MARITECH.* The Defense Department's MARITECH (maritime technology) initiative, a defense conversion program focused on shipbuilding, is structured similarly to the TRP. This 5-year, \$220 million program will supply matching funds to help U.S. shipyards shift production from military to commercial markets.

## TECHNOLOGY POLICY, GROWTH, AND COMPETITIVENESS

Government must work with American industry to provide a sound communications and transportation infrastructure and a solid science and industrial technology base. These are among the prerequisites for economic growth. Yet to be effective in a market economy, technology policy must leverage private investment, not direct it. It must be sensitive to those reasons why markets by themselves may lead to insufficient investment. The Administration's technology initiatives take their inspiration from a long American history of public-private partnerships, from the Agricultural Extension Service to the Arpanet (now the Internet worldwide computer network). These initiatives seize strategic opportunities inherent in the shifting composition of Federal R&D from military to civilian concerns, help remedy the underinvestment in R&D created by the limitations on private appropriability of its economic returns, and focus Federal R&D funds on facilitating the commercialization and commercial diffusion of technology. Together these technology initiatives are essential to promote U.S. economic competitiveness, meaning not only the ability of American firms to sell high-quality goods and services in the international marketplace, but more importantly, the ability to do so while maintaining high and rising wages and living standards for the American people.