

POPULATION AND THE AMERICAN FUTURE

Prepared by: Commission on Population
Growth & the American Future
March 1972

Population And The American Future

**The Report of
The Commission on
Population Growth and
the American Future**



Commission on Population Growth
and the American Future
726 Jackson Place, N. W.
Washington, D. C. 20506

March 27, 1972

To the President and Congress of the United States:

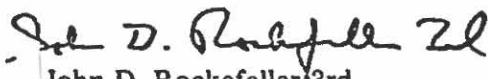
I have the honor to transmit for your consideration the Final Report, containing the findings and recommendations, of the Commission on Population Growth and the American Future, pursuant to Sec. 8, PL 91-213.

After two years of concentrated effort, we have concluded that, in the long run, no substantial benefits will result from further growth of the Nation's population, rather that the gradual stabilization of our population through voluntary means would contribute significantly to the Nation's ability to solve its problems. We have looked for, and have not found, any convincing economic argument for continued population growth. The health of our country does not depend on it, nor does the vitality of business nor the welfare of the average person.

The recommendations offered by this Commission are directed towards increasing public knowledge of the causes and consequences of population change, facilitating and guiding the processes of population movement, maximizing information about human reproduction and its consequences for the family, and enabling individuals to avoid unwanted fertility.

To these ends we offer this report in the hope that our findings and recommendations will stimulate serious consideration of an issue that is of great consequence to present and future generations.

Respectfully submitted for the Commission,


John D. Rockefeller 3rd
✓ Chairman

The President
The President of the Senate
The Speaker of the House of Representatives

effects of enormous increases in world use of pesticides and chemical fertilizers, the environmental impact of multi-national corporations, and many more.

The Commission has been deeply impressed by the unprecedented size and significance of the looming problems of resources and environment on a world scale. We see the need for much greater efforts than are underway now to analyze and understand these problems, and to develop international policies and programs to deal with them. We foresee potentially grave issues of clashing interests among nations and world regions, which could have very serious effects on the United States.

Therefore, we believe strongly that, in its own interest, the United States should work positively and constructively with other countries and international organizations in analyzing and solving problems related to natural resources and the environment in the world. We have made no special study of the detailed policies and programs which the United States should pursue for these purposes. We do now emphatically urge, however, that the nation join vigorously and cooperatively in solving problems of international trade, assistance to less-developed countries, and other pressing issues which will affect so sharply not only the future well-being of others in the world but the direct prospects for a sensible and respectable future for ourselves. We should not approach such problems in a spirit of charity or largesse. Our own future depends heavily on the evolution of a sensible international economic order, capable of dealing with natural resources and environmental conditions on a world scale.

Long-Term Strategic Planning

Our consideration of the problems and prospects involved in this country's long-term future convinces us that an important dimension of policy formation is being overlooked. This dimension involves the identification, study, and initiation of actions with respect to future problems that may require lead times of decades rather than years to resolve. There is a need for continuous monitoring and evaluation of the long-term implications of demographic changes, of future resource demands and supplies, of possible pollution overload situations, and of the underlying trends in technology and patterns of social behavior that influence these factors.

Once future problems are identified, there is a need to undertake the necessary research and development and to formulate the policies to resolve them. We need

to study our social, political, and economic institutions with a view towards recommending modifications that will reduce the discrepancy between the private and the public interest. Practical procedures for utilizing the effluent charge approach to environmental quality management and for initiating a rational system of land-use planning are important cases in point. We need to develop technologies that conserve particularly scarce physical and environmental resources. While appropriate effluent charges will encourage private business to move in this direction, government sponsorship of "yardstick" research on industrial technologies is necessary, particularly when our concern is with the problems farther in the future than private business can afford to look.

While parts of these tasks are being performed by isolated agencies, coordination and analytical assessment on a broad level are lacking. Private business firms and most government agencies are of necessity too present oriented or mission-oriented to serve these functions adequately; nor can they be left to *ad hoc* commission such as this one. On the other hand, we do feel that some group should be assigned central responsibility for such functions. Such a body would serve as a "lobby for the future" to identify potential population, resource and environmental problems well in advance of their occurrence; to establish priorities and sponsor technical and social research directed towards their resolution and where necessary to formulate and recommend policies to that end.

BUREAU OF PLANNING
GOVERNMENT OF GUAM
P.O. BOX 2950
AGANA, GUAM 96910

What are the likely future impacts of population growth on the demand for resources and on the environment in the United States? Here again, we have examined the consequences of the population growing according to the 2-child projection and the 3-child projection, and compared the results. For problems such as air pollution, where local concentrations are important, we have examined the implications of population growth in local areas as well as in the nation as a whole.¹

For several resource and environmental topics, we have extended the analysis beyond the year 2000 to the year 2020; in so doing, we have identified some important effects that do not become particularly noticeable in the shorter period. Beyond the next 50 years, we do not know enough to make quantitative projections. Nonetheless, it is obvious that there are ultimate limits to growth. We live in a finite world. While its limits are unknown because technology keeps changing them, it is clear that the growth of population and the escalation of consumption must ultimately stop. The only questions are when, how, and at what level. The answers to these questions will largely be determined by the course of world population growth, including that of the United States.

Several general conclusions* emerge from our research:

1. Population growth is one of the major factors affecting the demand for resources and the deterioration of the environment in the United States. The further we look into the future, the more important population becomes.

2. From an environmental and resource point of view, there are no advantages from further growth of population beyond the level to which our past rapid growth has already committed us. Indeed, we would be considerably better off over the next 30 to 50 years if there were a prompt reduction in our population growth rate. This is especially true with regard to problems of water, agricultural land, and outdoor recreation.

3. While the nation can, if it has to, find ways to solve the problems growth creates, we will not like some of the solutions we will have to adopt. With continued growth, we commit ourselves to a particular set of problems: more rapid depletion of domestic and international resources, greater pressures on the environment, greater dependence on continued rapid technological development to solve these problems, and a more contrived and regulated society. So long as population

growth continues, these problems will grow and will slowly, but irreversibly, force changes in our way of life. And there are further risks: Increasing numbers press us to adopt new technologies before we know what we are doing. The more of us there are, the greater is the temptation to introduce solutions before their side effects are known. With slower population growth leading to a stabilized population, we gain time to devise solutions, resources to implement them, and greater freedom of choice in deciding how we want to live in the future.

4. The American future cannot be isolated from what is happening in the rest of the world. There are serious problems right now in the distribution of resources, income, and wealth, among countries. World population growth is going to make these problems worse before they get better. The United States needs to undertake much greater efforts to understand these problems and develop international policies to deal with them.

How Population Affects Resources and the Environment

The pressure that this nation puts on resources and the environment during the next 30 to 50 years will depend on the size of the national population, the size of population in local areas, the amounts and types of goods and services the population consumes, and the ways in which these goods and services are produced, used, and disposed of. All these factors are important. Right now, because of our large population size and high economic productivity, the United States puts more pressure on resources and the environment than any other nation in the world.

We have attempted to separate these factors and estimate the impact of population on resources and the environment using a quantitative model which shows the demand for resources and the pollution levels associated with different rates of economic and population growth. The seriousness of the population-induced effects has then been assessed by evaluating the adequacy of resources to meet these requirements and the environmental impacts of pollution.

In discussing the economy, we indicated that under any set of economic projections, the total volume of goods and services produced in the United States—the gross national product—will be far larger than it is today. It is expected to be at least twice its present size by the year 2000, and in 50 years, with rapid population and economic growth, it could be seven times as large as it is now. Regardless of future population growth, the prospect is that increases in

*A separate statement by Commissioner Alan Cranston appears on page 150.

output will cause tremendous increases in demand for resources and impact on the environment.

What happens to population growth will nevertheless make a big difference in the future size of the economy. In the year 2000, the difference in GNP resulting from the different population assumptions would amount to one-fourth of today's GNP. By the year 2020, this difference amounts to more than the total size of today's GNP.

In short, total GNP, which is the principal source of the demand for resources and the production of pollutants, will become much larger than it is now. But if population should grow at the 3-child rate, GNP will grow far more than it will at the 2-child rate.

Minerals

In our research, we examined the demand for 19 major nonfuel minerals: chromium, iron, nickel, potassium, cobalt, vanadium, magnesium, phosphorous, nitrogen, manganese, molybdenum, tungsten, aluminum, copper, lead, zinc, tin, titanium, and sulfur.

Resource consumption will rise more slowly if population grows more slowly. Our estimates indicate that the amount of minerals consumed in the year 2000 would average nine percent lower under the 2-child than under the 3-child population projection. The difference in annual consumption would be 17 percent in the year 2020, and would grow rapidly thereafter.

Population growth exerts an important effect on resource consumption compared with the effect of economic growth. Our research shows that in the year 2000, if GNP per capita were one percent less than projected, the consumption of most minerals would be 0.7 to 1.0 percent less; the consumption of four minerals—cobalt, magnesium, titanium, and sulfur—would be reduced relatively more. In the year 2000, if population were one percent less than projected, minerals consumption would be 0.5 to 0.7 percent less. The population effect, while substantial, is smaller because of an important offsetting effect. As we saw earlier, slower population growth induces higher output per person because of the favorable ratio of labor force to total population. This offsets somewhat the effect that smaller numbers have on the conservation of resources.

While there are clear resource savings from slower population growth, our research supports, with certain qualifications, the view that the United States would have no serious difficulty acquiring the supplies it needs for the next 50 years, even if the population were to grow at the 3-child rate. This is the prospect, even

assuming, as we have done, that the resource demands of the rest of the world grow more rapidly than those of the United States, as has been the case in recent years. Although growing demand may pose some problems of adjustment, adequate supplies of all the minerals we studied can be achieved through tolerable price increases. Price increases will equalize supply and demand by stimulating exploration or imports (increased supply) and by stimulating recycling and the use of more plentiful substitutes (reduced demand). The earth's crust still contains immense quantities of lower grade minerals which can be called into production at levels of costs which we could afford to pay, even if the demands of the rest of the world should rise as projected and our population were to grow at the 3-child rate.

This expectation could be altered by several developments. First, prices could fail to anticipate impending shortages; that is, they might not rise long enough in advance to stimulate the changes necessary to avert shortages. Second, mining operations are heavy polluters, and mineral needs could conflict with environmental policy. Finally, and most serious, there are worldwide imbalances in access to resources. While the United States will remain among the "haves," relatively speaking, disparities between world regions may affect international power balances in ways that would involve us.

Energy

Energy makes the difference between poverty and affluence. The reason per capita income in the United States is so high is that the average American worker has at his command more energy, chiefly in the form of electricity, than any other worker in the world. With energy we refine aluminum, make rubber, shape steel, form new synthetic chemical compounds, propel automobiles, and heat our homes.

How much energy we have available depends on the availability of the necessary fuels and on our ability to convert the fuels to energy—the greatest advance in this regard was the development of inexpensive methods of electricity production. The technology of fuels acquisition and the technology of energy conversion are both critical. So is purchasing power—the ability to pay for domestic development of fuels or to import them. The original inhabitants of North America occupied a continent rich in energy fuels. But they neither knew how to get the fuels out of the ground nor how to convert them to energy. Some modern countries with advanced means of energy conversion lack their own

fuel supplies; they buy them from other countries.

The ability of the United States to meet its future energy needs will be determined chiefly by developments in technology—the technology of conversion and the technology of fuels acquisition. A major question will be whether we can find methods that are environmentally safe. Virtually every stage of energy use—fuel production, delivery, conversion, and consumption—has a significant environmental impact. For example, one-third of all coal is produced by strip mining, and the consequence is a scarred landscape and severe runoff into streams and rivers. Oil spills which contaminate the oceans and beaches may result from offshore drilling. Much airborne pollution comes from the use of such relatively dirty fuels as coal and oil. Some scientists are beginning to raise the possibility of thermal pollution resulting from concentrated use of energy in local areas. Nuclear power generation requires the disposal of radioactive atomic wastes. Because of these problems, the development of energy-production capacity could be impaired.

The increase in our energy needs will be immense under any projection, although not as large under the 2-child population projection as under the 3-child projection. The relative difference in energy demands under the different population projections is about the same as for minerals, and it becomes very large after the population with the lower rate of growth stabilizes. Whether population growth will strain fuel supplies, or cause serious environmental damage in the process of acquiring and using the necessary fuels, depends on future developments in technology.

With no major changes in technology, oil and gas supplies could become a problem for the United States by the year 2000—we would be importing more and paying higher prices; and supplies would certainly be a problem for some world regions. These problems could be averted if we found inexpensive means of using such potential sources as oil shale and tar sands, but using these sources is likely to have environmental consequences as serious as those from the strip-mining of coal. If we unlock the secrets of atomic fusion, we could have an environmentally clean way of generating electricity, with no fuel supply problem. The energy from converting the deuterium contained in 30 cubic kilometers of seawater would equal that of the earth's original supply of coal and petroleum.

Our review of the energy situation indicates that high priority ought to be given to research and development in clean sources of energy production. The faster population grows, the more urgent such break-

throughs become. We turn now to several areas where population growth dominates other considerations—where we cannot be hopeful about the ability of purchasing power and technical development to avert population problems.

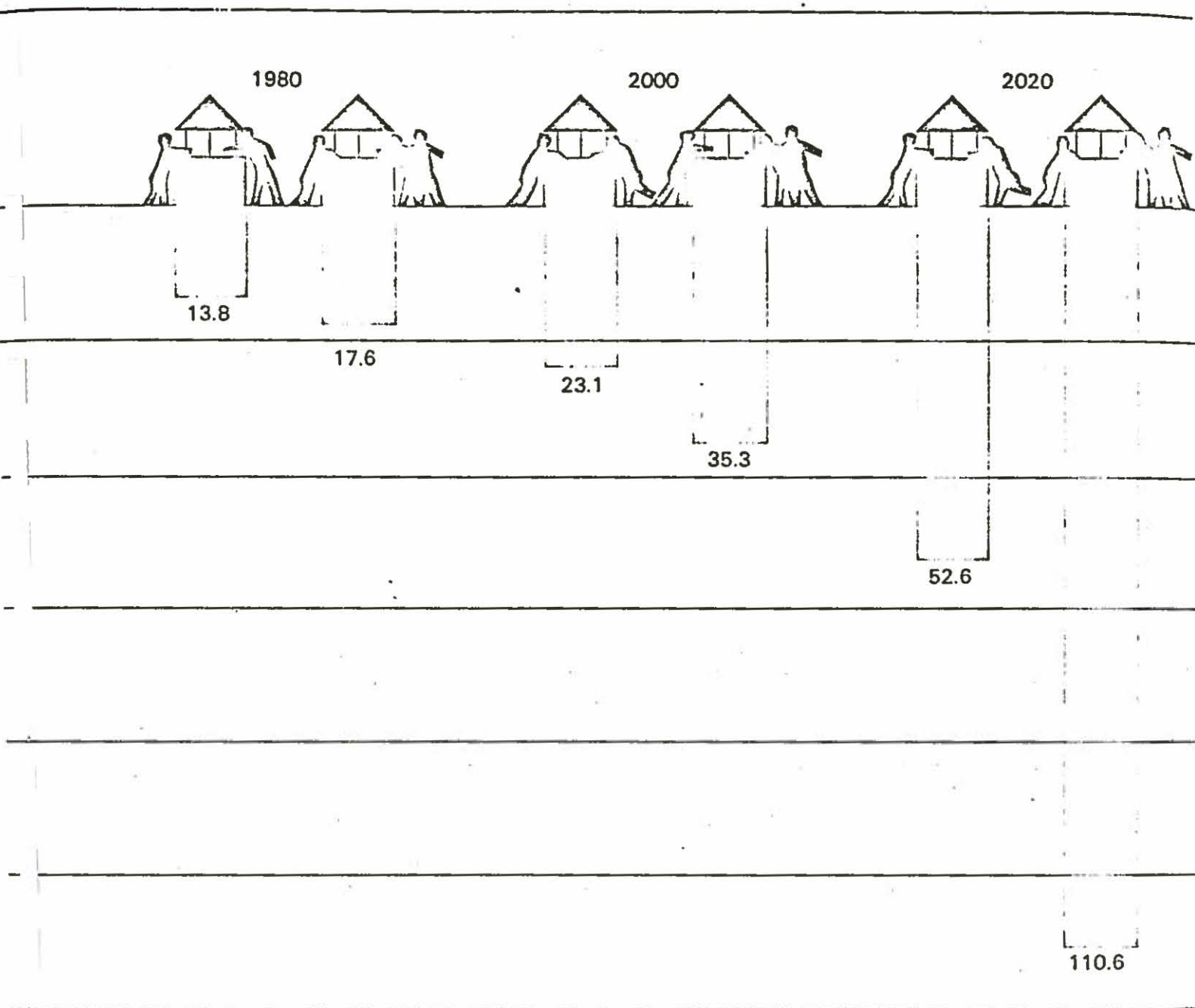
Water

Water requirements already exceed available flow in the southwestern United States. Our research shows that growing population and economic activity will cause the area of water shortage to spread eastward and northward across the country in the decades ahead. Such deficits will spread faster if population growth follows the 3-child projection than if it follows the 2-child projection. This will occur despite large expenditures on water treatment, dams, and reservoirs during the next 50 years. Population growth will be more important than economic growth in causing these growing problems.

Our national abundance of water does not change this picture significantly. If water could be shipped across the country like oil, coal, or manufactured goods, there would be no problems of water shortage. But distances are so long and the amounts of water used so huge, that it would be prohibitively expensive to solve these regional problems by transfers of water from surplus to deficit areas. Nor is there scope for sufficiently large relocation of water users—people and industries—to regions where water is plentiful. An inexpensive method of taking the salt out of seawater could solve the problem, but such technology is not now available. Similarly, artificial control of rain is not advanced enough to be used to any significant extent. While little is known about the extent of groundwater reserves, most experts do not consider the mining of such reserves an adequate alternative.

On the other hand, there is wide scope for reducing use through rationing and the adoption of water-conserving technology. Even today, most water is used virtually free of cost or is distributed on a fee basis that provides no incentives for conservation; and free use of water bodies as waste dumping grounds is more the rule than the exception. If the cost of utilizing water for these purposes were raised to more appropriate levels, factories and power plants would install techniques of production that save water instead of wasting it; farmers would modify their irrigation practices or otherwise adjust by changing location or shifting to crops using less water; and households would eventually adjust by reducing lawns and shrubbery.

Figure 5.1 Regional Water Deficits: Billions of Gallons Per Day

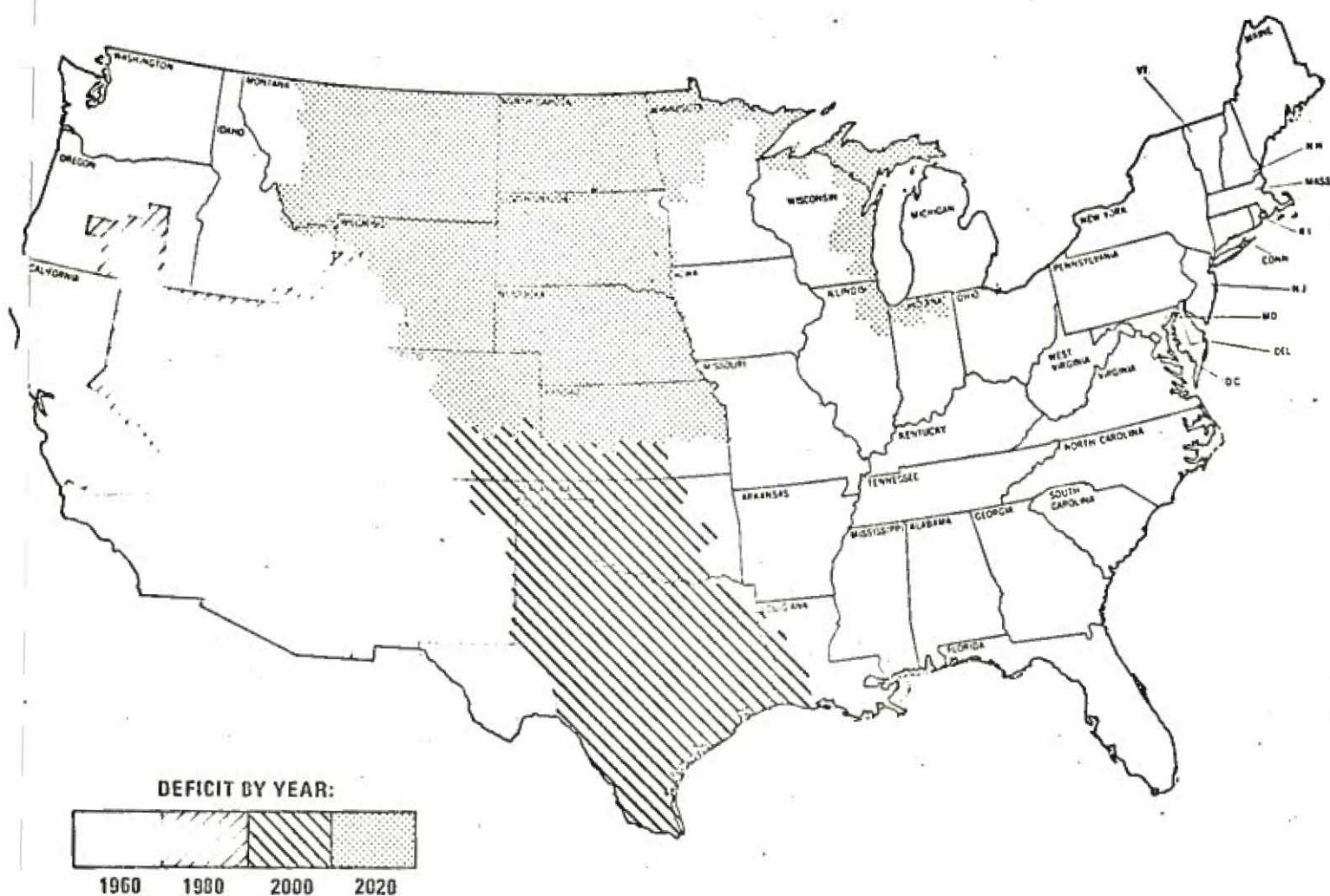


Despite an abundance of water nationally, rapid population growth will cause the extent and severity of regional water deficits to spread more rapidly than they would with slower population growth. This is the case even assuming maximum development of water storage facilities and tertiary treatment of waste water. Chart shows projected effects of growth at 2-child and 3-child rates.

Estimates assume rapid economic growth.

Source: Derived from Ronald G. Ridker, "Future Water Needs and Supplies, with a Note on Land Use" (prepared for the Commission, 1972).

Figure 5.2 Water Deficit Regions: 3-Child Family



Estimates assume rapid economic growth, maximum development of water storage facilities, and tertiary treatment.

Alaska and Hawaii not shown: Commission's data did not include these states.

Source: Ronald G. Ridker, "Future Water Needs and Supplies, with a Note on Land Use" (prepared for the Commission, 1972).

Sooner or later we will have to deal with water as a scarce resource. The sooner this is done, the fewer water crises will emerge in the years ahead. However, doing this will not be easy technically or politically—most water supplies are run by local governments. And few will like the austerity created by the need to conserve on something as fundamental as water. The rate of national population growth will largely determine how rapidly we must accomplish these changes.

Outdoor Recreation

On a recent holiday weekend, Yosemite National Park had a population of 50,000 people, according to a park source. Since then, the number of campsites has been reduced and traffic has been restricted in order to reduce noise and pollution. Still, visitors are put on notice that the water in the river is undrinkable. Yellowstone, too, has far more applications than can be accommodated in the available campsites. Even so, population densities in the non-wilderness areas of the park sometimes exceed densities in the suburbs of Dallas.

More and more Americans have the time, the money, and the inclination to enjoy the outdoors. Production of truck campers and camping trailers shot up from 62 thousand in 1961 to over one-half million in 1971. With better roads and easier travel, national parks have in effect become city parks for the residents of nearby metropolitan areas. In the past 10 years, visitors to all national park facilities more than doubled, while the area of the parks increased by only one-fifth. There are many areas to enjoy and more to be developed, but the enjoyment will depend largely on how fast the population grows.

By the year 2000, incomes will nearly double and hours of leisure will rise. More and more people will be inclined to get away and will be able to do so. However, our research on some 24 outdoor recreation activities and the facilities for these activities indicates that a population growing at the 3-child rate will exert great pressure on outdoor recreation resources—so great that, rather than “getting away” to the outdoors, people will be applying for admission to it.

In the face of rising congestion, many people will substitute organized sports, sightseeing, foreign travel, and artistic and cultural activities, if they so desire. Rising incomes and the increase in man-made facilities will make these alternatives possible. For many, these will be adequate alternatives, but for others they will not.

The prospects for recreation with the 2-child projection are much different for two reasons. First, the population will not be as large as that resulting from the 3-child rate. More important, the percentage of people in the young ages that make especially heavy use of outdoor recreation facilities will be smaller. As a consequence, we estimate that, in the year 2000, the demand for recreational facilities could be as much as 30 percent less under the 2-child than under the 3-child rate of growth.

Either way, recreation will differ from what it is now. The style of life may change with the lower rate of growth as well, shifting from more active to more sedentary pursuits. But in this case it would be voluntary, determined by the individual needs and preferences of an older population, not imposed by the desire to avoid overcrowding.

Agricultural Land and Food Prices

At a time when the federal government pays farmers to hold land out of production, it seems absurd to be looking forward to a scarcity of good agricultural land and rising food prices. Yet these are the prospects indicated by our analysis of what rapid United States population growth implies.

This picture emerges when we combine the requirements for feeding a rapidly growing population with a sound environmental policy which restricts the use of pesticides and chemical fertilizers. There are a number of reasons for believing that the nation will wish to limit application of these chemicals. But to do so will retard improvements in per acre productivity. This means that, to produce a given quantity of food, more acres must be brought into production. It is likely that, with such restrictions, all the high quality land will have been returned to production by the year 2000. Consequently, the task of feeding the more rapidly growing population would force us to bring an additional 50 million acres of relatively low-quality land into production.

This is an expensive undertaking requiring heavy investment in equipment, fertilizer, and manpower, for which farmers must be compensated. The result is that 50 years from now the population resulting from the 3-child average could find itself having to pay farm food prices some 40 to 50 percent higher than they would be otherwise. The needs of the population at the lower growth rate could be met with practically no price increase.

The larger population could avoid the price rise by shifting away from consumption of animal livestock

towards vegetables and synthetic meats. Perhaps it would shift to a closed system of agriculture—food from factories. One way or another, a solution can be found. The problem for a growing population is to survey the possible solutions and select the ones it dislikes least.

Pollution

As the gross national product goes up, so does the production of pollutants. An irony of economic measurement is that the value of goods and services represented by GNP includes the cost of producing the pollutants as well as expenditures for cleaning up afterward. We may fill our tank with gasoline, but due to engine inefficiency, some portion of that ends up in the atmosphere as air pollution. Such pollutants are not free—we had to pay good money to put them in the air. Yet the cost of putting them there is included in our principal measure of national economic well-being.

If we clean up the pollutants, the cost of the cleanup effort is also added to GNP. But many of the costs, such as poorer health and deteriorated surroundings, are never counted at all. It is an indictment of our ignorance and indifference toward what we do to the environment, that in our national economic accounts we count so few of the "bads," and that even when we do count them, we count them as "goods."

To understand the contribution of population to pollution, we have to distinguish two broad classes of pollutants. The first class includes the major products of combustion—carbon monoxide, carbon dioxide, oxides of nitrogen, oxides of sulfur, hydrocarbons, and particulates—and several measures of water pollution, including biochemical demand for oxygen and suspended and dissolved solids. The pollutants in this group, once produced, endure in the environment for a relatively short time—short enough so that long-term accumulations are not a problem. This group contains the more massive and commonly discussed pollutants, and enough information exists about them so that we can link them to economic activity and population.

The second class of pollutants includes those which endure longer—radiation and pesticides, plus a wide variety of ever-changing chemicals emitted by our high technology industries. Most such chemicals are emitted in small, often highly poisonous amounts. For many of these pollutants, future developments depend more heavily on changes in technology than on changes in population and economic growth. In any case, they are very difficult to link to population and economic growth in a simple and quantitative fashion. For this

reason, the results we present here are for the first class of pollutants, although this does not minimize the environmental damage done by the others.

In the next 30 years, most of these pollutants can be eliminated by enforcing treatment standards for pollution emissions. Slower population and economic growth would help; but over this period, by far the biggest reduction in pollution can be achieved by a head-on attack. This is illustrated in Figure 5.3 for hydrocarbons—a major component of auto exhaust and other combustion. In this example, the treatment standard is the Environmental Protection Agency's 1975 standard for emissions into the air. Even if this standard were not met on schedule, it certainly will be met by the year 2000; indeed, by that time, we are likely to have much tighter standards.

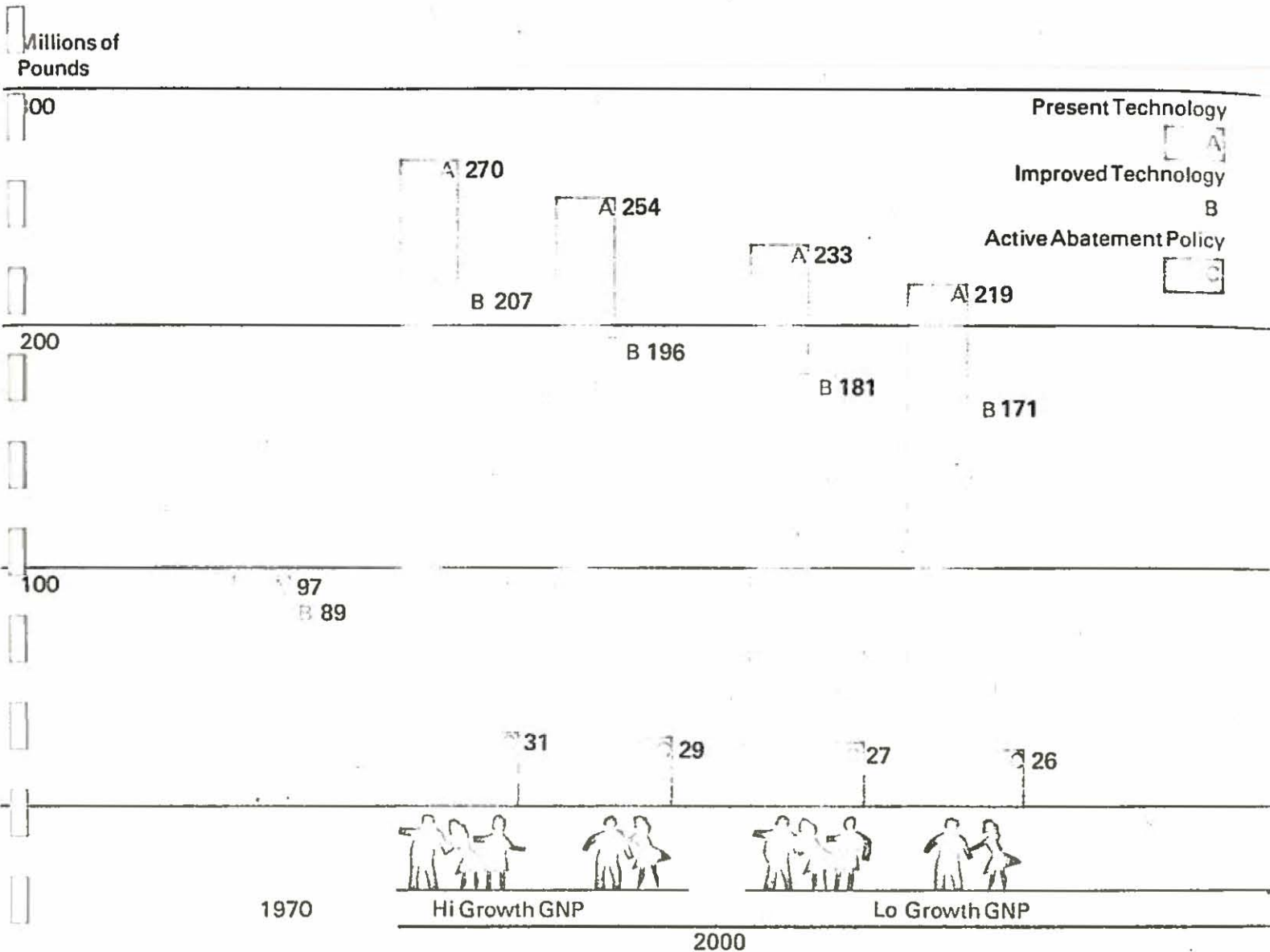
The relationships shown in Figure 5.3 hold generally for the other pollutants we examined. The reason for the spectacular results from enforcing standards is that we have imposed so little control in the past. The results do not assume any big new technological breakthroughs. It is just that we have only now begun to fight. Many of the required changes could be implemented today. Soap could be used instead of detergent; natural-colored paper could replace heavily bleached paper in many uses; returnable bottles could be used; the horsepower of auto engines could be reduced. It is not difficult to find answers when one begins to look.

Whatever we assume about future treatment policy, pollution emissions in the year 2000 would be less with the 2-child than with the 3-child rate of population growth—from five to 12 percent less, depending on the pollutant. If population were one percent less than projected in the year 2000, pollution emissions would be 0.3 to 0.6 percent less. If GNP per capita were one percent less than projected, emissions would be 0.2 to 0.9 percent less.

Once we achieve control over the emissions from each source, pollution will once again rise in response to economic and population growth. We can already see this process at work in rapidly growing parts of the country. At our Los Angeles public hearing, meteorologist James D. Edinger described the successful efforts in Los Angeles to control air pollution from stationary sources—power plants, heavy industry, home heating—and the beginnings of the program to control pollution from motor vehicles. But, he said, in recent years:

... a close race has been run between increasing numbers of sources and decreasing emissions per source. But as emission levels per

Figure 5.3 Hydrocarbon Emissions



The generation and emission of hydrocarbon pollutants is shown under different assumptions about future population growth, economic growth, changes in technology, and pollution abatement policy.

The bars labeled A, shown for background purposes only, indicate the levels of hydrocarbon wastes that would be generated under present technology. These waste levels would be generated if there were no changes in technology between the 1967-1970 base period and the year 2000.

The bars labeled B show actual emissions of hydrocarbon pollutants in 1970 and expected emissions in the year 2000, assuming no change in pollution abatement policy. The difference between A and B shows the extent to which the introduction of more efficient, less wasteful technology between now and the year 2000 is expected to reduce the generation and emission of pollutants below the levels generated if technology remained unchanged. Such changes in technology are likely to come anyway; they do not depend on public pressure to reduce harmful residuals.

The B bars show that, even with improved technology, pollution levels would be much higher in the year 2000 than they are now. These levels would, however, be somewhat lower if population grew at the 2-child rate rather than the 3-child rate, and if the economy grew at a slower rate rather than a more rapid rate (lo-growth GNP vs. hi-growth GNP).

The bars labeled C show hydrocarbon emissions in the year 2000 assuming an active pollution-abatement policy. The assumed policy is the Environmental Protection Agency's 1975 standard for emissions into the air. The changes in production and waste treatment processes induced by this policy would have a greater effect than would any of the other changes shown—in technology, population growth, or economic growth.

Source: Ronald G. Ridker, "The Economy, Resource Requirements, and Pollution Levels" (prepared for the Commission, 1972).

source are trimmed lower and lower the effort required to achieve each new increment of improvement gets more and more difficult. The increase in the number of sources, on the other hand, is projected to rise steadily. If the race for acceptable air quality is to be won, the heroic emission control programs, present and anticipated in Los Angeles, must soon be joined by a leveling off, if not a reduction, in the number of sources.²

Our own research on air pollution indicates that such worries are well founded. The standard for concentrations of nitrogen oxides used by the Environmental Protection Agency is 100 micrograms per cubic meter. In 1970, the air in 36 urban areas had concentrations above this level. An active abatement policy would eliminate the problem in most areas. But if our projections of economic and population growth come anywhere close to the truth, Los Angeles and San Diego in the year 2000 will still have a problem. In Los Angeles, we estimate that even with an active abatement policy, concentrations of nitrogen oxides will still be at least 50 percent above standard, and probably well above that. In this region of the country, clearly something must give: the rate of population growth, the use of the internal combustion engine—especially for personal transport—or the standard itself.

As the case of air quality in Los Angeles illustrates, problems of environmental quality are often worse in metropolitan areas that are larger and in regions that are more densely populated. This is clearly true for air pollution (and associated respiratory disease), noise, traffic congestion, and time spent getting to work. Other factors are less clear. Our research shows that sewage and water treatment costs per person decline as city size increases to about 100,000; above that, engineering data suggest that costs should be the same for conventional facilities, but the actual observed costs appear to rise. If large cities have to change their sewage facilities, costs per person will be much higher. Similarly, solid waste disposal costs either follow a U-shaped curve or increase with city size and density. There is also evidence that large cities change local climate—wind, cloudiness, temperature, and precipitation; we really do not know whether or not such changes are bad. The inner city has all these environmental problems but to a heightened degree.

Yet the underlying cause of poor environmental quality in the larger urban centers may often not be size. Most of our largest centers are the old cities of the

north; their problems may arise more from urban forms and transportation systems appropriate to an earlier era, old and uncoordinated facilities, multiple governmental jurisdictions, and the injustices that lead to inadequate financing and high proportions of minority groups and poor in central cities. In new cities as well as old, environmental quality suffers from inadequate pricing of public facilities and common property resources like space and waste disposal media, such as rivers and air. The historical evidence relating environmental quality to metropolitan size may not be applicable to the building of new cities and the refitting of older cities; indeed, many such problems would remain wherever people live.

The total volume of pollutants in the United States responds, as we have seen, to the size of the national economy, which in turn depends heavily on the size of the national population. People consume resources wherever they live. Whether in New York City or a small town in the midwest, people still drive an automobile made of steel using coal mined in West Virginia. In the process, the air in cities is fouled by smoke and the scenery and the streams of West Virginia are spoiled by strip mining. Wherever Americans live, they make huge demands on the nation's and the world's resources and environment.

Risks and Choices

As a nation, we have always faced choices and always will. What matters is the range of choice we have and the urgency with which the need to choose is thrust upon us. The evidence indicates that continued population growth narrows our choices and forces us to choose in haste.

From the standpoint of resources and the environment, the United States can cope with rapid population growth for the next 30 to 50 years. But doing so will become an increasingly unpleasant and risky business—unpleasant because “coping” with growth means adopting solutions we don't like; risky because it means adopting solutions before we understand them. Within the United States, the risks are ecological and social. And, there are risks which involve our relationship with the rest of the world.

We in this country are tampering with the ecosystem in many ways, the consequences of which we do not begin to understand. The crude methods used to estimate the effect of emissions on air quality and the damages and costs of urban pollution illustrate our ignorance all too well. Worse yet is our understanding of the second class of pollutants, bypassed in our analysis

precisely because we know so little about them. Because such pollutants endure longer, because they are highly poisonous in small doses, because new pollutants are continually being introduced, and because there are long time lags between emissions and the appearance of damages, we shall not quickly improve our knowledge in this area.

Radioactive wastes are an example. There will be more nuclear power plants if rapid population and economic growth occurs, but nuclear management and technology are changing so fast that there is no stable benchmark from which to estimate the amount of radioactive wastes likely to escape into the environment. We know that, once in the environment, such wastes can travel long distances through space and food chains, and we know the kinds of damage they can cause. But we do not know where they will come to rest, the extent of the damage, or when it will occur. Clearly, we need to know far more about how natural systems function when forced to absorb greater quantities of pollutants.

Beyond pollution, there are profound ecological impacts:³ the simplification and destabilization of ecosystems associated with modern one-crop agriculture; the reduction in the variety of gene pools in our most important plants; the threat to the productivity of the sea through the filling-in of salt marshes; the unknown consequences of climate changes caused by man's activities; and many more.

Population growth is clearly not the sole culprit in ecological damage. To believe that it is, is to confuse how things are done with how many people are doing them. Much of the damage we do results from efforts to satisfy fairly trivial preferences—for unblemished fruit, detergents, rapidly accelerating cars, and bright colored paper products. We can and should cut back on frivolous and extravagant consumption that pollutes. The way things are done can, to a significant degree, be changed regardless of how many people are doing them. But the overall effect is a product of numbers times styles of life taken together. One multiplies the other to produce the total impact.

The real risk lies in the fact that increasing numbers press us to adopt new technologies before we know what we are doing. The more of us there are the greater is the temptation to introduce solutions before their side effects are known. It might be far better environmentally to postpone the introduction of nuclear power plants until the inherently cleaner fusion reactors are developed. When one pesticide or food additive is found to be dangerous to man, it is replaced with another about which we know less. We undertake

the expenditure of billions on water treatment, without knowing whether the benefits outweigh the costs of other opportunities foregone. Slower population growth will not eliminate this situation, but it will reduce the urgency, the "crash program" character of much that we do. It will buy time for the development of sensible solutions.

We can cope with population growth for another half century if we have to; the question is whether we want to. We can cope with resource shortages—if we cannot mine a resource, we can import, design around it, find a substitute, or reduce consumption. Where water deficits threaten, we can choose between charging more for its use, transferring people and industry to other parts of the country, and constructing longer and larger canals. If pollution emissions cannot be tolerated, we can change production processes, improve treatment, separate polluters from their victims, treat the symptoms, or simply produce less of the commodity causing the pollution. Congestion during commuter hours can be handled by restricting the use of private cars, developing mass transit, and staggering work hours. Congestion at recreation sites can be handled by building additional facilities, improving management, encouraging substitutes such as foreign travel, and if necessary, by staggering vacations. Even land shortages for agriculture can be handled, given sufficient lead time, through farming the sea, changing our diet, developing synthetic foods, and so forth.

Such changes pose physical, technical, and managerial challenges that we can probably meet if we must. But in so doing, we shall pay a cost reckoned not in dollars but in our way of life.

Population growth forces upon us slow but irreversible changes in life style. Imbedded in our traditions as to what constitutes the American way of life is freedom from public regulation—virtually free use of water; access to uncongested, unregulated roadways; freedom to do as we please with what we own; freedom from permits, licenses, fees, red tape, and bureaucrats; and freedom to fish, swim, and camp where and when we will. Clearly, we do not live this way now. Maybe we never did. But everything is relative. The population of 2020 may look back with envy on what, from their vantage point, appears to be our relatively unfettered way of life.

Conservation of water resources, restrictions on pollution emissions, limitations on fertilizer and pesticides, preservation of wilderness areas, and protection of animal life threatened by man—all require public regulation. Rules must be set and enforced, complaints

heard and adjudicated. Granted, the more we can find means of relying on the price system, the easier will be the bureaucratic task. Indeed, we ought to be experimenting right now with ways of making price incentives induce appropriate use of the environment and resources. At present, most monetary incentives work the wrong way, inducing waste and pollution rather than the opposite.

But even if effluent charges and user fees became universal, they will have to be set administratively; emissions and use will have to be metered, and fees collected. It appears inevitable that a larger portion of our lives will be devoted to filling out forms, arguing with the computer or its representatives, appealing decisions, waiting for our case to be handled, finding ways to evade or to move ahead in line. In many small ways, everyday life will become more contrived.

Many such changes will have to occur no matter which population projection occurs. But the difference, small at first, would grow with time until, a half century from now, the two societies may appear qualitatively different.

Another price we pay for having to cope with continued population growth is the pressure to keep on postponing the solution of social problems. While growth continues, top priority will be given to finding the necessary resources, controlling pollutants, correcting the damages they have done, and building ever larger water canals, highways, and mass transit systems. A large and perhaps growing fraction of our physical and intellectual capital is directly or indirectly devoted to these tasks—to finding ways to cope with the problems that continued growth generates. From past experience, we can predict with a fair degree of confidence that such priorities will continue to subordinate efforts devoted to resolving fundamental social problems. When something must give because the system is becoming overloaded, it is unlikely to be the building of another dam.

The point is that continued population growth limits our options. In the case of the larger population, with less land per person and more people to accommodate, there are fewer alternatives, less room for diversity, less room for error. To cope with continued growth, technology *must* advance; lifestyles *must* change. Slower population growth offers us the difference between choice and necessity, between prudence and living dangerously.

The United States and the World

The research done for the Commission showed that

the United States will greatly enlarge its demands on world resources, especially minerals and petroleum, over the decades ahead. We will be requiring substantially larger imports of many minerals, such as chromium, vanadium, cobalt, and nickel, for which domestic supplies are not available or are available only at substantially higher costs.

The demand of other countries for minerals, petroleum, and other resources will certainly also rise sharply over the coming decades. This will result from rapid increases in output per person in other industrialized countries and from the rapid modernization of agriculture and industry in developing countries. The rates of increase in production in other parts of the world are likely to be higher than those of the United States. Their rates of increase in demand for mineral supplies are likely to rise even more sharply, because they are at an earlier stage of the industrialization process and because the composition of their GNP includes proportionately more goods and fewer services than does that of the United States.

Taking into account the huge increases in population which are in prospect, it seems clear that demands for natural resources in other parts of the world will rise more rapidly than demands in the United States; thus, the share of the United States in the use of world resources will steadily decline. For example, projections made for the Commission indicate that over the next 50 years the share of the United States in the world's use of aluminum may decline from 37 percent in 1968 to as low as nine percent by the year 2020. In the same time period, the share of the United States of total world copper requirements may drop from 22 percent to five percent.

While all such figures necessarily reflect uncertain assumptions about production, income, and technology, nevertheless they indicate the extremely important extent to which the United States is inextricably involved in the development and use of resources on a worldwide scale.

Our research also demonstrates that environmental issues will have to be faced increasingly on an international basis over the years ahead. There are already conspicuous cases of environmental damage and risk which cannot be solved on a national basis. The continuing problem of petroleum pollution in the oceans is such a case. Neither the oceans nor the atmosphere can be successfully dealt with if one looks only at the territory within a nation's boundary. And many additional issues of international ecological significance will be increasingly important—such as the