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Energy, Environment, Economics, and Forest Resource Management

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"Upon the education of the people of this country the fate of this country depends."
—Benjamin Disraeli
"Education is a good thing generally, but most folks educate their prejudices."
—Josh Billings
"Give a man a fish and you feed him for a day. Teach a man to fish and you feed him for a lifetime."—Chinese proverb

INTRODUCTION

An education opens windows and provokes one to open more. An education also provides standards and criteria for evaluating the unending and, too often, undeciphered deluge of information confronting us in our daily lives. Even well-educated citizens can have difficulty in separating truth from fiction, or at least distortion, when confronted with the details of complex problems facing society today.

I want to discuss the current timber demand and supply situation and some problems confronting the forest products industry. I will also describe how the forest products industry's ability to satisfy consumer needs is being affected by restrictions on harvesting of private as well as public forest land. However, I want to do this within the context of three criteria or standards that I use to evaluate forestry issues, namely,

- The entropy law
- The fallacy of composition
- The concept of sustainable development.

ENTROPY AND ENERGY CONSERVATION

The first law of thermodynamics postulates that energy can neither be created nor destroyed. That is, the energy of the universe remains constant. It is the second law pertaining to entropy, however, that is particularly relevant to forestry and forest management.

Energy has two qualities: (1) free or available, and (2) bound or unavailable. Entropy is a measure of the amount of energy unavailable for work. This second law of thermodynamics — often referred to as the Entropy Law— stipulates that the entropy of the universe at all times moves toward a maximum with the final outcome being a state where all energy is latent, or unavailable. In other words, according to the Entropy Law, within the universe there is a continuous and irrevocable qualitative degradation of free energy, available to do work, into bound energy, energy which is unavailable for work. A fundamental challenge to the human race, therefore, is conserving the earth's finite, non-renewable energy supply— that is, the energy stored in oil, gas, coal, and uranium. While this may seem to be a trivial concern as individuals go about their daily lives, this and other physical laws need to be considered when we discuss global concepts.

THE FALLACY OF COMPOSITION

Professor Paul Samuelson, a Nobel laureate in economics, referred to the fallacy of composition in his writings on the principles of economics. Samuelson frequently reminded his students that economics can be very confusing for anyone who assumes that what holds for the individual also holds for whole, such as the entire economy. The actions and personal economic decisions central to our individual lives cannot simply be summed ten thousand-fold to gain an accurate perspective on community or regional economic activities. He used various examples to illustrate this principle, including,

- Attempts of individuals to save more during a depression may lessen the total of the community's savings.
- Higher prices for one industry may benefit its members, but if the prices of everything bought and sold increased in the same proportion, no one would be any better off.
- If all farmers work hard and nature cooperates in producing a bumper crop, total farm income may fall, and probably will (Samuelson, 1955).

SUSTAINABLE DEVELOPMENT

The need to achieve sustainable development was one impetus for last year's United Nation's Conference on Environment and Development ("Earth Summit") in Rio de Janeiro. Simply stated, to achieve sustainable development, we must adopt conservation policies which will assure that future generations will be no worse off than the present. In particular, this means that today's forest resource policies should provide for the needs of the present without compromising the needs of future generations.

I want to use each of these criteria to evaluate some current forestry issues, but first let me provide a brief overview of the timber demand and supply situation.

DEMAND FOR FOREST PRODUCTS TO INCREASE

Consumers worldwide demand an extraordinary amount of wood products. For instance, on the basis of green weight, we use as much wood as food (Sutton, 1992). Furthermore, demand is expected to increase. According to the Food and Agriculture Organization (FAO) of the United Nations, consumption of wood for industrial uses and fuelwood will increase 48 percent between 1989 and 2010 (UNFAO, 1991). Such growth is phenomenal. As Dr. Wink Sutton (1991) points out,

"To achieve this increased production the world has, each year, to harvest the equivalent of another British Columbia or six current New Zealand harvests."

The increase in demand for forest products in the U.S. is equally impressive. According to the most recent assessment conducted by the U.S. Forest Service, demand for all species is expected to increase by 48 percent by 2040 (Haynes, 1990).

Are the forecasts of increased demand for forest products realistic? A short overview of the state of America's forests will provide some clues.

THE STATE OF AMERICA'S FORESTS

Most of the nation's timberland —nearly 73 percent— is located east of the Great Plains and most is privately owned (Haynes, 1990). Furthermore, private forests account for nearly 82 percent of the harvest volume from timberlands.

Federal agencies manage approximately one-third of the nation's forest land. On the average, however, site quality is lower than for privately owned forests. For example, federal forests contain only 20 percent of the nation's forest lands capable of producing wood for industrial purposes; i.e, timberland (Haynes, 1990). Nevertheless, federal lands must play a strategic role in meeting the nation's future forest products requirements. National forests, for instance, account for 47 percent of the nation's softwood sawtimber inventory and provide a significant share of the high quality timber used for producing softwood framing lumber and plywood panels.

In a recent publication, "American Forests: A History of Resiliency and Recovery," Douglas MacCleery (1992) provided a very timely and lucid description of how the nation's forests have recovered from over-exploitation during the 18th and 19th centuries.

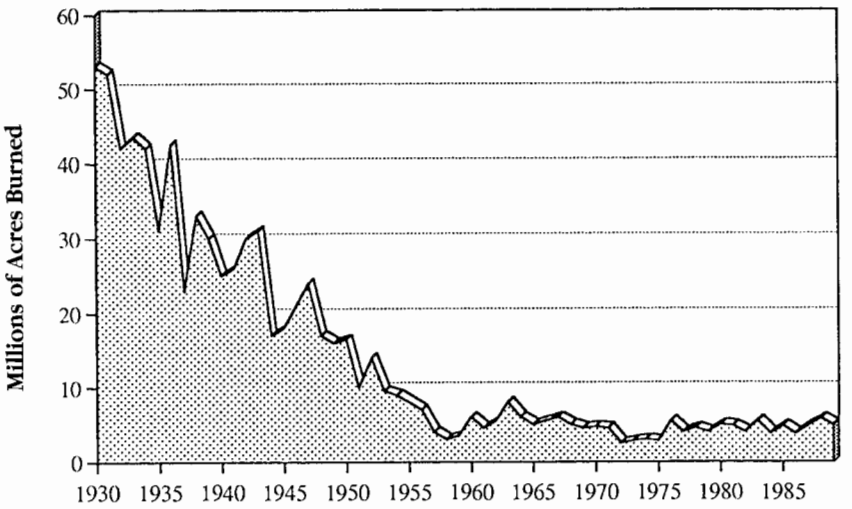
- In 1600, forests covered 1.1 billion acres (49%) of the nation's 2.3 billion acre land mass, before settlers began clearing forests for agriculture.
- After the Civil War, a mobile forest products industry, driven by the nation's growing demand for building materials liquidated the virgin forests in the Northeast, Lake States and the South. At one time, nearly 60 percent of the forests east of the Mississippi had been cleared for agriculture or were in need of reforestation after timber harvesting.
- Each year, fires once burned an area equivalent to the state of Kansas.

Matters began to change for the better during the early decades of the 20th century. Effective fire control coupled with less land clearing for agriculture set the stage for science-based forest management. Particularly in the South, regeneration of old fields served to revive the forest industry. Before extensive fire control was in place (Figure 1), it did not make sense to plant trees in the South or elsewhere.

The area of forest land in the U.S. has remained fairly constant since the 1920's when land clearing for agriculture tapered off with gains in agricultural productivity. Forests now cover nearly one-third of the nation's total land area and represent about two-thirds of the original forest base (MacCleery, 1992). Of the 737 million acres of forest land, two-thirds is classified as "timberland" capable of producing wood for industrial purposes. Since 1952, the acreage of timberland has decreased slightly, from 508 million acres to 489 million. Expansion of the nation's Wilderness Preserve System, carved almost entirely from the National Forest System, accounts for nearly all of this change.

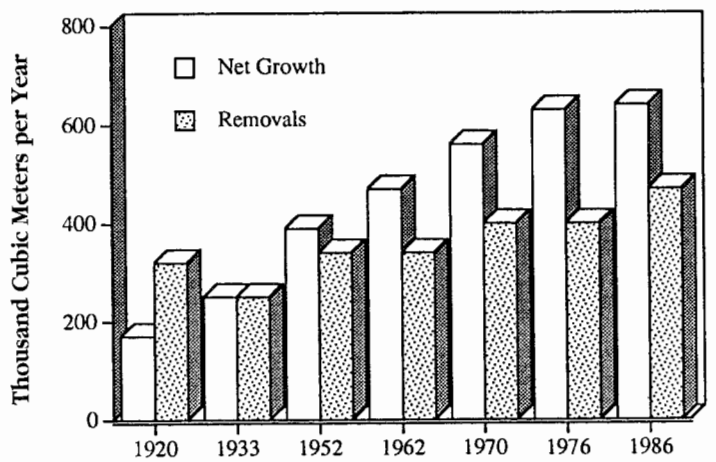
During the past 70 years, the condition of the nation's forests has improved dramatically. In 1920, for example, the U.S. was harvesting twice as much timber as it was growing. Since then, harvest levels have increased significantly, and growth now exceeds harvests by nearly one-third. As a consequence, timber inventories have greatly increased. In fact, between 1952 and 1991, the U.S. inventory of hardwood and softwood timber increased nearly 28 percent (Figure 2).

Figure 1: U.S. Wildfire Trends, 1930–89



Source: Wildife Statistics, USDA-FS

Figure 2: U.S. Timber Growth and Removals, 1920–86

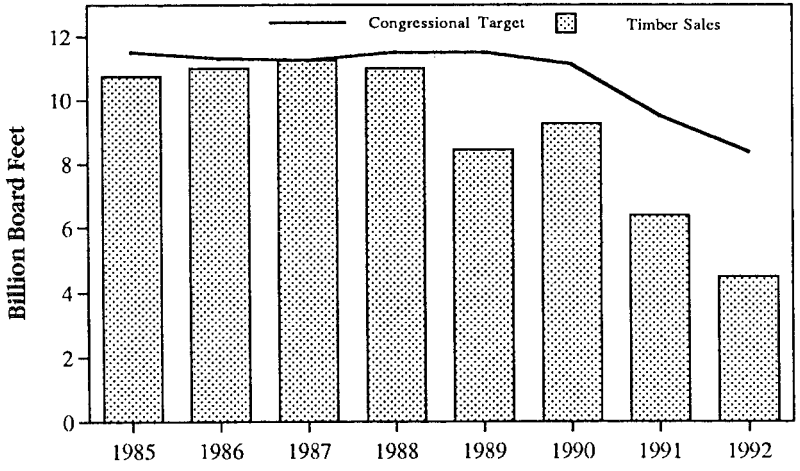


Source: Haynes (1990)

AVAILABLE TIMBER SUPPLY IN JEOPARDY

Despite an abundant supply of timber, the U.S. faces the near-term prospect of having to satisfy diverse consumer needs from a diminishing timber base. The number of environmental issues facing forest managers is increasing at a rapid pace. Already, timber harvesting on private and public land is being restrained significantly. For example, because of a variety of environmental issues, timber harvesting on the national forests has been reduced by more than 50 percent (Figure 3). Resolution of public land management and endangered species controversies in the Pacific Northwest alone could conceivably tie up the equivalent of nearly 25 percent of annual U.S. softwood lumber production in the West —even more if the impact on private forests is included. Other issues such as wetlands delineation, below-cost timber sales, more stringent controls on silvicultural practices, and riparian zone protection will undoubtedly lead to significant reductions in timber.

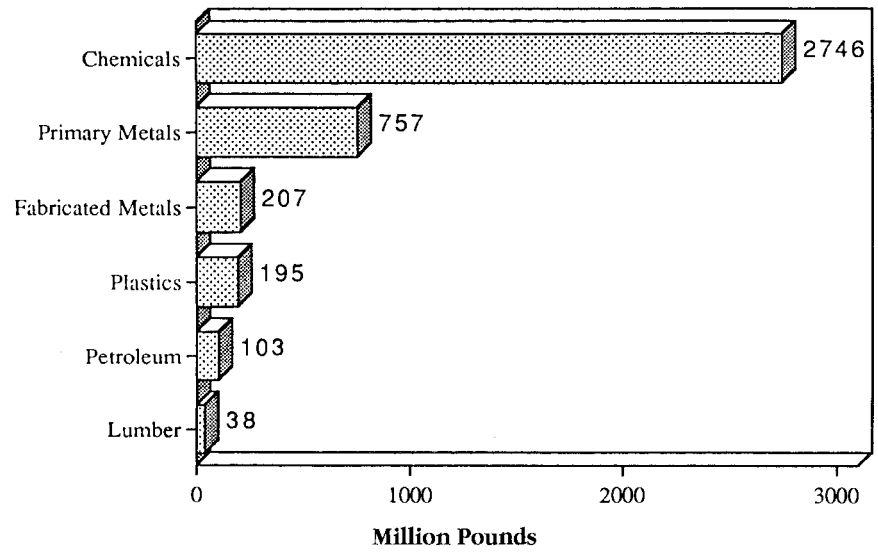
Figure 3: Congressional Timber Sale Targets vs Actual F.S. Timber Sales



Source: F.S. Budget Explanatory Notes, U.S. Forest Service

In addition to a potential domestic shortage, the U.S. consumer faces the prospects of a diminishing supply of forest products from Canada. British Columbia has already indicated that timber supplies from provincial lands —most forest land in Canada is publicly owned— will be decreased by 25 percent during the near term, and other provinces are planning similar cutbacks. The reduction in Canada, like that in the Pacific Northwest, reflects recent decisions by provincial officials to set aside extensive tracts of forest land to protect non-timber values. These plans are particularly important because Canada accounts for about 30 percent of the U.S. softwood lumber consumption.

Figure 4: Toxic Substance Releases and Transfers by Industry



Source: U.S. Environmental Protection Agency (1991)

So, what is the bottom line? Demand for forest products will increase, and consumers undoubtedly will have to pay more for forest products. But why be concerned about higher costs? Eventually, consumers can avoid paying more by selecting substitute materials such as steel, aluminum, concrete and plastics. Ironically, however, the choice of wood substitutes has significant negative environmental and economic consequences (Figure 4). To see why, let's evaluate the timber supply and demand situation using the three evaluation criteria — entropy, environmental quality and sustainable development.

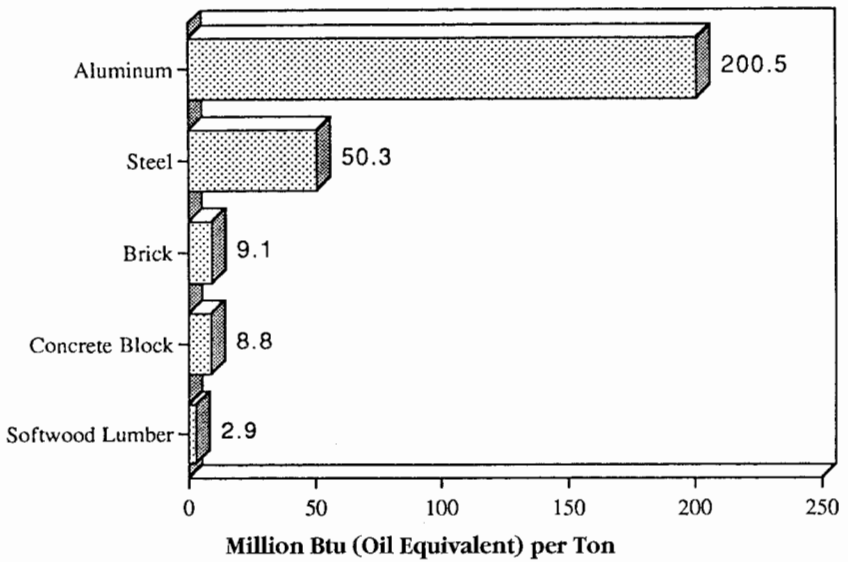
Substitutes Are Energy Demanding

Without exception, wood substitutes require more energy to extract, process, and transport (Figure 5). According to a report prepared by the Committee on Renewable Resources for Industrial Materials (CORRIM), a ton of softwood lumber requires 2.9 million btu's, a ton of steel studs requires 50.1 million btu's, and aluminum siding 200.5 million btu's (Bowyer, 1993; Boyd et al, 1976). A recent analysis by Dr. Peter Koch (U.S. Forest Service) provides an excellent example of why forest resource policies can significantly influence energy conservation.

Koch (1991) analyzed alternative scenarios for managing old growth forests in the Pacific Northwest region. In the extreme case —one involving both public and private forests— the annual harvest from forests in the region would be reduced by 8.2 billion board feet. This shortfall is equivalent to nearly one-third of the U.S. consumption of softwood lumber for residential home construction.

Koch found that if more substitutes were used, "there will be significant

Figure 5: Energy Requirements for Primary Commodities (Extraction, Manufacture and Transport)



Source: National Reserach Council-Committee on Renewable Resources for Industrial Materials (1976)

increases in . . . world consumption of . . oil annually . . . equal to 177 cargoes of tankers the size of the Exxon Valdez—enough to annually operate a fleet of 11 million automobiles." Furthermore, Koch estimated that an additional 62 million tons of carbon dioxide would be released into the atmosphere. Of course, with more super tankers plying the sea, the risk of oil spills and degradation of marine ecosystems will increase.

The entropy law implies that there is no way to reverse the process of energy conversion. Ultimately, all energy will be unavailable and what physicists refer to as "heat death" will befall the planet. However, human habits can influence the rate at which the economically available supply of non-renewable energy is exhausted. Use of more solar energy as well as energy conservation are obvious examples. Meeting such a challenge is a "natural" as far as wood products are concerned. Trees rely on solar radiation for energy, are a renewable resource, and yield wood products that demand less energy to extract, process and transport.

Despite the obvious environmental implications, to date, the energy merits of using wood have not greatly influenced decisions regarding the use of forest resources. Unfortunately, I think it will take a return of the long lines at gas pumps and higher fuel costs before consumers acknowledge the importance of energy conservation. Only then will policy makers consider the unique role forest products can play in extending the confines of non-renewable sources of energy.

Hidden Complexities of Forest Management

Forest managers must constantly reevaluate and, where appropriate, modify silvicultural practices to accommodate ever changing economic and social values.

Significant modifications will, of course, affect future timber supplies. The current debate over biological diversity and silvicultural methods is a case in point.

Dr. Karl Wenger, formerly head of silvicultural research for the U.S. Forest Service, builds a case for even-aged management (Wenger, 1991). His belief is premised on the notion that this practice is an important tool, in association with all-aged management, for enhancing biodiversity. His example demonstrates the fallacy of composition. Wenger points out that,

"The even-aged forest has all age classes, each occupying several parcels of appreciable acreage, intermingled over the entire forest. Thus, all habitats needed by native plants and animals are always present, from freshly exposed mineral soil to mature forest . . . In the selection system, however, the vegetation on every acre is essentially the same, so biological diversity is minimized. With basically uniform forest conditions over extensive areas, habitats for many plants and animals are missing or are too small and wildlife food is comparatively sparse."

A research project conducted on the Nicolet National Forest in Wisconsin adds credence to Wenger's observations. The results of a 40-year study of harvesting methods conducted in the northern hardwood type on the Argonne Experimental Forest reveals that, "The shelterwood system provides the best tradeoff between tree diversity and profits . . . [C]learcutting was similar to the shelterwood system . . . but was far less profitable (Anon., 1992)." Selection harvesting favored the shade tolerant species — mainly sugar maple— and has resulted in significantly less species diversity.

Professor John Perez-Garcia of the Center for International Trade in Forest Products (CINTRAFOR) at the University of Washington provides another illustration of the fallacy of composition. He analyzed the consequences of reduced timber supplies in North America and the tropics on international forest products production (Perez-Garcia, 1993). The reduction in North America included the effects of implementing the current Administration's plan for protecting the northern spotted owl in the Pacific Northwest (PNW) and a comparable reduction in timber production in Canada. Perez-Garcia's analysis reveals a major shift in the nation's timber supply and demand situation. Not only will U. S. consumers have to pay more for wood products, but foreign sources other than Canada will provide a substantial portion of U.S. requirements. Much of the wood supplied by foreign countries might come from Siberia, although current concern for importation of forest pests on shipments of logs makes this solution fraught with problems.

Increasing the nation's dependency on foreign countries for wood products would have serious environmental ramifications. As Bruce Lippke (1991) points out,

"For every economic loss in a preserving region, there are partially off-setting gains in other regions. For every environmental gain in the preserving region, there may be more than of-setting losses in other regions."

The forest resource situation in Siberia illustrates the phenomena of offsetting environmental changes. The productivity of Siberian forests is significantly lower than in the Pacific Northwest (PNW). For example, 15 acres would have to be harvested in Siberia to produce the same volume of wood produced on a single acre in the PNW. Consequently, the environmental trade-offs could be detrimental. As Lippke (1991) further notes,

"There will be habitat losses on the 1.53 million harvested acres [in Siberia], likely involving endangered species, potentially more than offsetting any habitat gains

on the 100,000 acre reduced harvest in the PNW. The increased waste of mill residues and the increased hauling distance for Soviet Far East delivery to markets consumes additional fossil fuel energy and increases the CO_2 emitted without producing products or energy value."

Perhaps the most apparent example of the fallacy of composition is the current plan for managing the salmon fishery in the Pacific Northwest. President Clinton's plan calls for preserving key watersheds to protect critical habitat for spawning salmon. This plan is predicated on the assumption that the salmon fishery can be rehabilitated by restoring the riparian forests to presettlement conditions. According to Van Hyning (1968), this assumption is wrong; the overriding problem is excessive harvesting by commercial and sports fishing. For example, the commercial harvest of Chinook salmon in the Columbia River commercial fishery peaked in 1882, long before large hydroelectric dams were constructed. Timber harvesting in the Pacific Northwest was in its infancy and concentrated in the Puget Sound area. Protection and restoration of riparian zones has been underway for some time, but such endeavors will be not succeed unless overexploitation of the resource in the Pacific is stopped.

Sustainable Development and Forest Products

The concept of sustainable development was first articulated in 1987 in the United Nation's World Commission on Environment and Development, the so-called 'Brundtland Report' (World Comm., 1987). This report focused international attention on the idea that environmental problems cannot be resolved without considering related energy, social and economic problems. The Commission noted that,

"Until recently, the planet was a large world in which human activities and their effects were neatly compartmentalized . . . These compartments have begun to dissolve. This applies in particular to the various global 'crises' that have seized public concern, particularly over the past decade. [T]hese are not separate crises: an environmental crisis, a development crisis, an energy crisis. They are all one."

The authors of *Our Common Future* maintain that a singular focus on the environment, for example, effectively precludes the resolution of energy and economic development problems. This challenge is particularly relevant to the management of forest resources. For example, many developing countries cannot afford kerosene for heating and cooking, and, as a consequence, forests are being depleted for fuelwood. While we in the U. S. obtain less than 10% of our heating needs from wood, the majority of the world's population relies upon wood as the primary source of energy for heating and cooking. Furthermore, deforestation throughout much of the world continues unchecked because forests are still viewed as impediments to agricultural development, as sources of "free capital" for economic development, and as depositories for urban poor in various resettlement schemes. For better or worse, forests are intertwined with human development, and will continue to be so.

Obviously, there is a limit to how much domestic forest resource policies can influence sustainable development. However, because the U.S. is a major producer and consumer of forest products, and because the management of forest resources has received considerable international attention, our domestic policies will most certainly influence other governments. For example, some European countries —particularly Germany and Great Britain— appear willing to boycott any product, including forest products, believed to be produced or harvested in an "environmentally destructive"

way. Likewise, developing countries cannot be expected to promote sustainable forestry unless we set a proper example. In this regard, exporting our environmental problems by encouraging overexploitation of tropical resources while prohibiting development of renewable resources here would not send the correct message.

SUMMARY AND CONCLUSIONS

According to the FAO, worldwide demand for forest products will continue to increase. The U.S. Forest Service has forecast increased domestic consumption of forest products well into the next century. Because of many environmental issues, however, U.S. consumers may have to rely more on foreign sources of supply. In fact, consumers are increasingly faced with the choice between less wood and more substitute materials. Collectively, these choices have significant economic and environmental implications.

Perhaps the most profound deficiency of many proposals for resolving contemporary forest resource issues is the singular focus on the economy and environment of localized areas. What might be a feasible solution to a regional environmental problem could result in serious downstream effects. What might appear to be a feasible solution to a local economic problem could result in irrevocable environmental as well as social and economic problems elsewhere. We cannot expect to understand fully, let alone resolve, most forestry issues without a rigorous, holistic evaluation. On this note I would like to end with the following quote from a Forintek Canada publication (1991),

". . . . undesirable consequences in one area of endeavor may be a small price to . . . [pay for avoiding] . . . much more serious consequences in another area. Not that environmental impacts shouldn't be minimized wherever possible. But there are limits to what can be achieved at any time and we have to be careful to cast our net wide enough to take account of balancing positive and negative effects."

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