

## ENERGY &amp; ENVIRONMENT

# BEYOND THE LOW-HANGING FRUIT

*How should policymakers judge environmental regulations when marginal costs are rising and marginal benefits are falling?*

BY CRAIG LOEHLE AND ERIK B. SCHILLING

**H**ow clean should our air and water be? One would think that the federal Clean Air Act and Clean Water Act would answer that question. But they do not. Instead they instruct the administrator of the U.S. Environmental Protection Agency to issue ambient air and water quality standards for substances that would reasonably be expected to endanger public health or welfare. The standards are to be set to protect the public health with an adequate margin of safety, and so the EPA reviews the scientific literature for any evidence of harms to any subgroup of the population and then establishes standards at lower levels. Over time, the results of those requirements have been increasingly stringent standards.

Early pollution control efforts were often able to take advantage of simple, relatively inexpensive technologies and focused mostly on obvious problems (e.g., undrinkable river water). Those efforts usually resulted in obvious benefits at modest cost. That “low-hanging fruit” was often followed by further regulations requiring more sophisticated technologies or systems that improved environmental quality further, but at higher cost. The results of those efforts were the nation’s air and water becoming markedly cleaner than they were 100 years ago.

But the tightening of regulations has continued. Recent updates of pollution standards have often been very costly (and in some cases impossible) to achieve, and the incremental improvements in health have often been vanishingly small if not zero.

We believe that environmental laws should be amended to eliminate low-benefit, high-cost policies. In plain language, we believe that

environmental regulation should be subject to a budget constraint. We do not spend unlimited amounts of money to reduce auto fatalities, nor should we do so to improve environmental quality.

## BENEFITS AND COSTS

The rationale for ambient air and water quality standards is reduced morbidity and mortality. The evidence for the ill effects of exposure to pollutants comes from epidemiological studies or experiments. Because current levels of pollutants are low relative to the past and relative to background levels that occur from natural sources or pollution from outside the United States, studies that can reliably distinguish small health effects from no effects would require very large sample sizes that are impossibly expensive to administer. So the evidence used to set standards comes from exposure evidence at much higher doses, which is then extrapolated statistically to predict what occurs at the lower exposures that are actually experienced by people in the environment.

Many argue that such low-dose extrapolations mischaracterize the current level of harm from the low levels of radiation, mercury, airborne particulates, or ozone experienced in the United States. As a result, these extrapolations overestimate the health benefits of more stringent regulation. In our view the EPA has made health benefit claims that seem overly generous. How can large reductions in mortality be attributed to new rules on ozone and fine particulate matter when direct links of these pollutants to health (e.g., asthma) are tenuous at best? (See “The EPA’s Implausible Return on its Fine Particulate Standard,” Spring 2013, and “OMB’s Reported Benefits of Regulation: Too Good to Be True?” Summer 2013).

**Costs** / In order to maximize the net benefits of environmental regulation, one must know not only the benefits but also the costs. To economists the most dubious provisions in environ-

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mental law are those that prohibit the consideration of costs. The standards set for particulates (soot), sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone, and lead under the National Ambient Air Quality Standards section of the Clean Air Act cannot take cost into account, by law.

Other sections of the Clean Air Act regulating other pollutants do not explicitly prohibit the consideration of costs. However, the EPA often resists taking costs into consideration when regulating those emissions, and the courts have historically given deference to the EPA. But in June 2015, the U.S. Supreme Court ruled that

products, probably because of the “pollution haven” effect—the expansion of producers in places that have less stringent environmental regulation. Judith Dean et al., in a 2009 *Journal of Development Economics* paper, documented the pollution haven effect for companies within certain industry segments opening facilities in China. Anthony Barbera and Virginia McConnell, in a 1986 *Journal of Industrial Economics* article, found both capital and labor productivity growth over the period 1960–1980 to be negatively affected by pollution control expenditures in the paper, chemical, and primary metal industries. In a 1995 *Academy of Man-*



the EPA is required to consider costs when deciding whether it is “appropriate and necessary” to regulate the emission of mercury and other air toxics from power plants.

Even though the EPA can’t consider the costs of environmental regulatory compliance for many pollutants, those costs have been calculated by economists. In their well-known 1996 *Science* article, Kenneth Arrow et al. estimated that total environmental compliance costs in the United States were at least \$200 billion at that time and are certainly higher today. From 1977 to 1986, industries whose pollution abatement costs increased the most experienced the largest relative gain in imports of that industry’s

products, probably because of the “pollution haven” effect—the expansion of producers in places that have less stringent environmental regulation. Judith Dean et al., in a 2009 *Journal of Development Economics* paper, documented the pollution haven effect for companies within certain industry segments opening facilities in China. Anthony Barbera and Virginia McConnell, in a 1986 *Journal of Industrial Economics* article, found both capital and labor productivity growth over the period 1960–1980 to be negatively affected by pollution control expenditures in the paper, chemical, and primary metal industries. In a 1995 *Academy of Man-*

agement *Journal* paper, Thomas Dean and Robert Brown found that environmental standards can act as a barrier to entry for new firms. Water quality protection practices during timber harvest operations in the Midwest were shown to reduce net revenue by 1%–50%, depending on what types of controls were required in a particular case. Industry modernization may be postponed if new facilities are required to meet more stringent standards, a “grandfather clause” effect that often factors prominently in new power plant construction decisions. (See “What’s Old Is New: The Problem with New Source Review,” Spring 2006.)

From these studies one can conclude that even when environ-



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mental regulation attacked obvious, lower-remedial-cost pollution problems during the first 30 years of the EPA's existence, industrial profitability and competitiveness were negatively affected. More recent efforts to attack more esoteric problems have even higher costs.

To illustrate how costs can accelerate rapidly as zero residual pollution is approached, consider municipal wastewater treatment. Most municipalities have supplemented simple and cheap primary treatment with secondary and often tertiary treatment, including features such as aeration and ultraviolet light treatment that have higher costs.

Technologies that can deliver even cleaner water exist, but the costs are so high that they are found only in demonstration plants. For example, one could distill water: boil it and then collect the water so as to leave pollutants behind. In Naperville, IL (home of one of the authors), wastewater treatment costs about \$10 per person per month (based on monthly residential bills). With a typical per-person usage of 200 gallons a day, the per-gallon treatment cost is 0.1644¢ per gallon. The retail price of distilled water (not laboratory grade) is conservatively \$1.20 per gallon and home distillation can cost about 30¢ per gallon in energy costs. However, let us assume a process cost of 10¢ per gallon. At this price distilled water treatment would be 61 times more expensive than current treatment costs (and many costs of existing treatment will remain because the resulting waste must still be transported and solids removed). This means that *monthly* sewage treatment costs using distillation would be \$2,400 for a family of four. These are, of course, very approximate numbers, but they illustrate the exponentially rising nature of costs to achieve greater degrees of pollution control.

#### AMBIGUOUS STANDARDS

Current environmental standards are costly not only because of the use of increasingly esoteric technologies, but also because the goals are not always clear, not always differentiated from natural variation, and sometimes are outright unattainable. We suggest that standards have unambiguous regulatory endpoints and procedures to verify attainment that are easily differentiated from background exposure.

**Regulatory endpoints** / When a standard is designed to avoid an adverse effect on biota, it is important for "adverse effect" to be defined. While it might be obvious that an algae-covered pond is adversely affected, many other cases are not so obvious. For example, stream and pond biota are naturally variable in space and time and even a healthy pond might have small algal blooms at times. Thus, defining "adverse effect" as differences in biological communities upstream and downstream from a facility or activity may not be appropriate because biota can

vary for many reasons, and differences may not indicate that a biological community has been affected by an activity or that a stream is impaired. Ecosystem or water body "health" is likewise a vague concept that must be made explicit in terms of either aquatic community structure or designated uses. "Impairment" is a binary classification, but effects are multifaceted, continuous, and vary in space and time.

To be relevant, endpoints should consider the process of interest. For example, some equipment types such as diesel generators or trucks have elevated emissions on startup or when they malfunction. If short-term emission limits are imposed during startup, such devices can never be used because the startup emission burst cannot be prevented. Recent proposed standards

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eliminated exemptions associated with startups and shutdowns. Standards that are ambiguous with respect to whether means (arithmetic or geometric), totals, or instantaneous values are to be regulated create uncertainty and raise costs. They can also complicate enforcement.

**Natural and other sources** / Some pollutants arise from natural as well as industrial sources or from industrial sources outside the United States. Cost-effective standards must take into account all causes of impairment. Let us consider an example: the Chlorophyll-a standard for a water body. When the standard is exceeded, point source nutrient concentrations are reduced in an attempt to produce compliance. If, however, non-point nutrient sources or natural ecosystem processes contribute most to elevated concentrations, then exclusively reducing point source loadings will not lead to improvement in the biotic response.

In other cases, pollutants are ubiquitous and detections may be incorrectly attributed to local manufacturing facilities or land use operations. Mercury and other pollutants can be generated elsewhere (e.g., China, volcanoes), deposited from the air onto a watershed, and enter water bodies used for industrial processes. Dioxins and fine particulate matter are created by wildfires. Thus, local or point sources may not be responsible for exceedances. Such a case was documented in the Willamette River Basin in Oregon, in which polychlorinated phenyl (PBC) levels resulted almost entirely from legacy sources and transport rather than from local sources.

Other natural "pollutants" include plant volatile organic

compounds (VOCs) that create haze and photochemical smog, dust (particularly in dry parts of the country), pollen, organics in streams that stain the water, natural arsenic in groundwater, and radon release by rocks. Determining “baseline” or “background” conditions when natural and/or non-U.S. industrial sources exist may not be straightforward. For example, near-surface ozone is produced as a result of reactions of sunlight with VOCs emitted by plants, and natural levels vary temporally and spatially.

**Attainability** / The extent to which a standard is attainable also should be given serious weight in standard setting. This issue has become more critical as measurement technologies have improved such that parts-per-billion levels of many toxics can be found virtually everywhere. There is a divergence between the detectability of pollutants and the ability and need to address them. A standard may not be attainable for a municipal or industrial point source because of a lack of available treatment technology, excessive cost to implement the technology, inherent process fluctuations, or other reasons. For example, different types of water filters will each only capture certain compounds and none of them will remove substances such as tritiated water, a radioactive form of water in which the oxygen atom is replaced with tritium. In industrial processes, production of certain compounds is always accompanied by production of trace amounts of impurities such as PCBs, which can be created when, for example, printing inks are manufactured. In such cases, reducing a pollutant to parts-per-billion levels may be an unattainable goal.

Attainability can be looked at another way. We can ask whether the proposed standard is really necessary to achieve the environmental or health goal society desires. If, for example, there is a point below which a pollutant is low enough that its effect is indistinguishable from “noise” in terms of testable mortality rates (or it is ranked far down the list of causes of illness), then it might be judged that we have already attained our health goal. If removing a pollutant will not improve prospects for aquatic fauna or water quality, then that pollutant is not limiting ecosystem function.

Initial water quality standards for dissolved oxygen (DO) in Florida provide a perfect example of unattainable water quality standards and their unintended consequences. The development in 1979 of DO criteria for Florida waterbodies was intended to ensure that there is enough oxygen in waterways to allow for the growth and reproduction of aquatic species. Unfortunately, these initial standards were based on very limited scientific information, specifically inadequate data on the response of freshwater organisms to low DO concentrations. Because of natural phenomena, Florida’s DO concentrations did not correlate with the state’s 1979 DO criteria for many fresh and marine water systems that were deemed to be high-quality waters with diverse aquatic biota. Even more problematic was the fact that the 1979 DO criteria did not explicitly include language regarding an acceptable departure from natural conditions as it did for other natural stressors (e.g., conductivity, pH, and temperature). The implications of this over-

sight did not become readily apparent until the implementation of the Total Maximum Daily Load program where the lack of a specific natural background clause for DO resulted in numerous natural waters being identified as impaired for DO. This meant that the law indicated that the cleanest natural waters needed to be “cleaned up,” but no technology exists to do so (and, of course, many of those water bodies are healthy). To address this issue, the Florida Department of Environmental Protection collected extensive data to provide the scientific foundation for the state to propose revised and more accurate (i.e., biologically relevant) DO criteria for the state’s freshwaters and marine waters. This resulted in the Florida Environmental Regulation Commission approving the revised DO criteria in May 2013, and the EPA, in turn, approving them later that year.

## CONCLUSION

There is broad societal consensus that measures should be taken to protect the environment. As a result, over the last 50 years there clearly has been progress in reducing water and air pollution. However, regulatory clarity, economic costs, the feasibility and efficacy of available technologies, detectability issues, and natural variability should be considered, particularly when attempting to establish numeric environmental standards. Expensive solutions for trivial gains in environmental quality can divert limited resources from more important issues for both agencies and the regulated community and can erode support for the overall environmental protection enterprise and adversely affect important industries.

Many environmental regulations were promulgated before it was possible to detect trace levels of pollutants and before it was understood that many pollutants are naturally occurring and ubiquitous. Current environmental laws stating that costs and attainability cannot be considered conflict with the reality that many standards are reaching the point at which further improvements may not be possible. We suggest that when developing environmental standards, legislators and regulators consider potential unintended negative consequences and natural variation that may render standards unattainable or assessment of compliance impossible. R

## READINGS

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