EPA Compromises Consistency in Its Coastal Oil and Gas Industry Cost-Effectiveness Analysis

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Introduction

The U.S. Environmental Protection Agency (EPA) conducts a cost-effectiveness (CE) analysis to estimate the cost of complying with each newly proposed set of industrial effluent limitation guidelines (ELGs). CE is defined as the incremental annualized cost of a pollution control option in an industry per incremental pound equivalent (PE) of pollutant removed annually by that control option. When calculating annual pollutant removal, the relative effects of the different pollutants must be considered. One way of scaling different pollutants is to assign a weighting factor to each pollutant based on its toxicity. EPA's methodology calculates weighting factors using EPA's ambient water quality criteria for chronic aquatic life protection (fresh or salt water) and for human health protection from exposure through fish consumption. For carcinogenic pollutants, the risk factor is taken as 10^{-5}. All pollutants are normalized to a standard of 5.6 ppb, the aquatic life protection criterion for copper at the time the methodology was developed. Equation 1 shows the formula used.

$$\text{weighting factor} = 5.6/AL + 5.6/HH, \text{ where} \qquad (1)$$

AL = aquatic life protection criterion and
HH = human health protection criterion.

A more toxic pollutant has lower criteria resulting in a higher weighting factor.

The next step in the procedure is multiplication of the anticipated pounds removed through the proposed treatment requirements by the weighting factors to obtain PE removed. Since CE is calculated on an incremental basis, the PE must be calculated separately for each pollution control option. The incremental PE is the PE for the option under consideration minus that for the next less stringent option. Costs must also be calculated on an incremental basis. The CE (expressed as $/PE) is then calculated by dividing the incremental annualized cost by the incremental PE.

There are two possible purposes for conducting the CE analysis: a) calculation of the absolute $/PE removed, or b) comparison of the $/PE for the industry in question to the other industries for which EPA has conducted a CE analysis. EPA favors the second purpose in the way it structures the CE analysis requirements and the way in which it portrays the results.

EPA's guidelines for conducting the CE analysis require that all costs be expressed in 1981 dollars so that comparison to other industries can be done on a consistent basis. In the results of its CE analyses, EPA presents information showing $/PE values for all the industries for which it has done the CE analysis. These examples indicate that EPA is interested in maintaining consistency and comparability. EPA is not legally bound by the results of a CE analysis; however, if the $/PE for a proposed ELG is calculated to be significantly higher than the $/PEs for other comparable ELGs, EPA might reconsider its proposal.

In March 1993, EPA issued final ELGs for the offshore oil and gas industry (operations located seaward of the coastline) and published an offshore CE analysis. In February 1995, EPA published proposed ELGs for the coastal oil and gas industry (operations located inland from the coastline, but located over water) and prepared a coastal CE analysis. The chemical characteristics of produced water from the offshore region are essentially the same as those of produced water from the coastal region. It was surprising, therefore, that EPA chose a much longer list of pollutants and generally stricter weighting factors for the coastal CE analysis.

Selection of Pollutants

To characterize coastal produced water effluent quality, EPA collected samples at ten Gulf of Mexico coastal facilities. Produced water is the underground brine that is associated with oil and gas formations and is the largest volume waste stream for the oil and gas industry. Based on the ten-facility study, EPA reported data for 75 pollutants. These data were used in the coastal CE analysis. In contrast, the offshore CE analysis, completed just two years earlier, considered only 32 pollutants. This should not suggest that the produced water in the offshore subcategory is significantly different and cleaner than produced water from the coastal subcategory. Instead, the sampling program used to characterize the coastal industry was much more detailed and intensive than the sampling program used for the offshore industry. Several other reasons for the larger number of pollutants in the coastal CE analysis are discussed below.

Some of the substances included in the coastal list, such as chlorides, calcium, and magnesium, should not be included on a list of pollutants since they are common components of natural saline waters. Many other pollutants were detected in only a low percentage of the effluent samples analyzed.

The coastal CE analysis, in addition to quantifying the individual pollutants, included several groups of pollutants (i.e., n-alkanes, steranes, triterpanes, and total xylenes). There is overlap and double counting by including both these groups and their individual constituent pollutants. For example, the n-alkanes analysis will include the same chemical substances as the sum of the 11 individual n-alkanes (n-decane through n-triacontane). Likewise, the total xylenes analysis will include the same substances as the sum of m-xylene and o- and p-xylene.

Calculation of Weighting Factors

Toxicity data are updated periodically in the literature. EPA's guidance on CE analysis methodology encourages the authors of CE analyses to look for the most current toxicological information when formally adopted EPA criteria are not available. This can lead to important differences in weighting factors that are, in turn, responsible for significant increases in PEs removed. For example, the weighting factors for two pollutants increased significantly in just two years. The two largest contributors to PEs removed in the coastal CE analysis are radium 228 and benzo(a)pyrene. The weighting factor for radium 228 increased from 1.3×10^6 to 3.5×10^8, a factor of 269. The weighting factor for benzo(a)pyrene increased from 18.56 to 4,200, a factor of 226. These pollutants did not become more toxic in a two-year period, but the analysts who calculated the weighting factors relied on new data or revised approaches. In a related study, Veil (1995) demonstrated that some of the revised weighting factors used in the coastal CE analysis were based on inappropriate data, assumptions, or analysis. For example, Veil (1995) recalculates the radium weighting factor using a separate set of assumptions. These radium weighting factors range from 91,000 to 350,000, which are lower than, not higher than, the offshore weighting factors.

Results and Conclusions

EPA's coastal CE analysis calculates about 6.1 million PEs removed and a cost-effectiveness of $4/PE. EPA concludes that its calculated $/PE is "well within the range of cost-effectiveness values seen for other rules." This conclusion provides a measure of justification that the selected option is reasonable and cost-effective.

EPA considers both consistency and comparability as important goals of the CE analysis. With this in mind, perhaps the most appropriate approach for the coastal CE analysis is to use the same list of 32 pollutants and weighting factors as was used in the 1993 offshore CE analysis. The revised CE, recalculated using this approach, is $52/PE, which is much higher than the $4/PE calculated by EPA, and is higher than the $/PE for most of the other industries listed in the coastal CE analysis.

EPA's approach of using an expanded pollutant list and revised weighting factors probably generates a more accurate estimate of the PEs removed for the coastal oil and gas industry, but in doing so, EPA loses the ability to equitably compare this CE analysis to the CE analyses that have been done for other industries. This shortcoming is particularly obvious since the offshore CE analysis, evaluating a nearly identical waste stream, was completed just two years earlier. Given EPA's concern over consistency and comparability to other industries, it may be appropriate to modify this approach for the coastal CE analysis. Another alternative that would allow EPA to reflect the newest toxicological information and still preserve consistency and comparability would be to recalculate all earlier CE analyses whenever new weighting factors are developed. Given current budgetary restraints, this alternative is not realistic.

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Reference

Veil, J.A., 1995, *Analysis of EPA's Cost-Effectiveness Study for the Coastal Oil and Gas Effluent Limitations Guidelines*, prepared for DOE Office of Policy and Office of Fossil Energy, May.

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