Long-Term Cost Estimation in the Department of Energy
State And Tribal Government Working Group
Stewardship Committee
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Background
Current cost estimating techniques fail to provide a basis for the comparison of near-term costs with very long-term costs. Even the NDAA Report to Congress truncated costs at 70 years in the future, clearly demonstrating the need for new methodology to properly account for costs lasting hundreds of years or more. This resulting bias provides a quantitative basis for selecting remedies that defer clean up in favor of remedies that utilize often unproven, long-term institutional controls.

The STGWG Stewardship Committee researched the economics and cost estimating literature and interviewed experts in these fields to identify potential alternate methodology. These efforts are ongoing; however, this paper documents our current understanding of the issues.

State of the Art
Federal agencies are required to account for their expenditures using standard accounting practices. Each agency has specific accounting rules to be used by that agency and by contractors providing services to them. It is fundamental to these systems that the government get the best price for services and that expenditures secure the best value for the funds used.

In estimating the costs of major projects, such as environmental remediation, agencies must evaluate various alternative projects and select the one providing the best overall result. Factors other than cost play a major part in the selection, and specific agencies or specific types of projects have codified criteria to weigh in making the selection.

Under CERCLA, remedy alternatives must be evaluated against nine criteria of differing importance. Cost evaluation is in the second tier of importance with four other factors, and must include the complete costs of each alternative, specifically O&M costs. The standard method for evaluating alternatives is to reduce each alternative's criteria to a comparable basis. For costs, the method of choice is the present worth value.

Present worth is the value that a future cost would represent today, at a given discount rate and time period. This technique can be applied to either lump sum costs (say, for a complete remedy replacement) or annual costs (such as O&M). The difficulty in accurately predicting the present worth is the uncertainty in the key elements of the equation:

- the discount rate in the future
- the time period of the project, and
- the accuracy of the cost estimate.

Nonetheless, present worth comparisons are the staple for virtually all cost comparisons. Using this method and standard federal discount rates, the present worth of future costs become negligible after approximately thirty years.

The DOE uses this tool to compare remedy costs for clean up of their sites. For most contamination problems, remedy alternatives will include some combination of the following options:

- "complete" removal, with high initial costs and no long-term costs
- partial removal, with moderate initial costs and low to moderate long-term costs
- containment, with low initial costs and moderate to high long-term costs

If the remedy addresses a long-lived contaminant, such as metals or radioactive materials, the long-term portion of the remedy will likely be significantly in excess of thirty years. If so, the present worth cost comparison does not accurately reflect the anticipated costs.

Alternative evaluation is supposed to address both quantifiable factors such as costs, and non-quantifiable factors, such as permanence. In addition, the evaluation is supposed to address uncertainty in all factors. It is anticipated that the uncertainty of non-quantifiable factors is perceived as being higher than the uncertainty of quantifiable factors. The Fallacy of Quantitation holds that if something is measurable (like capital cost), it tends to receive more weight in decision making than a qualitative factor (like environmental degradation). Thus, remedies with a high initial cost that is relatively certain, appear less desirable than remedies dependent on highly uncertain future costs.

Uncertainties play a major role in alternative comparison, but also contribute to the lack of quantitation for long-term remedies. As noted above, each major component of the present worth calculation is uncertain. Estimating the discount rate in the future is generally based on recent historical trends over periods equal to the life of the project. A thirty-year project would look at historic thirty-year trends and determine the appropriate value. Fifty-year trends or one hundred-year trends become more speculative, but still reflect modern times and economies. Two hundred years takes us back to the age of imperialism and the founding of our country. Five hundred years puts us in the European Middle Ages; a thousand, the European Dark Ages. When we address contaminants requiring essentially perpetual care, what trending period should we choose?

This quandary highlights the uncertainty associated with the time period of the project. At Rocky Flats for example, it is expected that some long-term protections will be required for low levels of plutonium contamination. Plutonium has a half-life of approximately 24,000 years. Is the project life one hundred years or one half-life? The recent NDAA cost estimates specified that long-term costs be projected through 2070, a mere seventy years into the future. New long-term stewardship cost estimation guidance may require identification of life-cycle costs, but how long does a remedy last? When does a cap need replacement or major overhaul? These estimates suffer from the same degree of uncertainty as other long-term features.

Technology changes can also undermine the accuracy of our understanding of long-term remedies. It is possible to estimate current costs for existing, proven technologies with relative accuracy. However, knowing how groundwater monitoring is performed today may have little applicability in a specified future time. Thus, the accuracy of the cost estimates for these future activities is extremely uncertain.

In summary, when we evaluate long-term remedies we enter an area of extreme uncertainty. However, the pressure to protect current funds and the tools we now have at our disposal allow us to discard more expensive, but greater, certainty in favor of our hope that the future will solve our existing problems better than we can. Finding different tools to explain actual costs may help us face this problem with more assurance.

Discounting and Intergenerational Equity

In a present worth analysis, selection of a discount rate implies value judgments regarding how future generations value their money and the decisions made in the past. This concept is captured in the term "intergenerational equity", explained as

> "Future generations should not have to pay for benefits received by current generations. If the current generation pays for all the benefits it receives and does not pass those on to future generations then there is generational equity." (Sacco, 2001)

Intergenerational equity has been the focus of major discussions in the past regarding clean air, global climate change, nuclear waste disposal, preserving biodiversity, and other issues. Intergenerational equity is addressed by manipulation of the discount rate. Volumes of material have been produced justifying various approaches to selecting the appropriate rate. The attached bibliography lists a representative selection of those documents.

The selected discount rate determines the present value of a future cost. The higher the discount rate, the lower the present worth of a future cost, and vice versa. Major discussion has focused on whether discount rates should be fixed or variable over time. A fixed rate assumes that each succeeding generation places the same value on future money as the current generation. Numerous models have been proposed that reflect a variable discount rate, usually with the discount rate declining over time.

Much of the literature also considers the social context of discounting. The selected rate reflects where we want to direct spending and how we value various social issues. Discussions include whether the value of moral satisfaction and moral harm should be included in the analysis.

An oversimplification of the discounting issue presents the following conclusions:

1. Standard discount rates devalue future costs appropriately, since future generations can make their own decisions about how to commit their resources.
2. Very low discount rates or a zero rate are appropriate so that the current generation does not put off their tough decisions onto future generations.
3. A negative discount rate is appropriate to cause the current generation to invest in future generations.
4. Discount rates (or compensatory values) should be determined from some kind of public polling or scientific surveys.

There appears to be widespread acceptance of the use of present worth analysis and discounting in benefit-cost analysis. The majority of economists support the use of a positive discount rate, but the problems arising from discounting in the "deep future" continue to cause concern.

Discussions with Experts

Various members of the Stewardship Committee contacted experts in the fields of economic analysis to identify resources and determine whether alternative analysis techniques exist. Universities and similar organizations throughout the country were contacted, and follow up conversations held with specific individuals. The conversations with Dr. Michael Greenberg of Rutgers and Dr. Richard Zerbe at the University of Washington were the most productive and are summarized below.

Dr. Greenberg and his associate Hank Meyer have researched the discount rate question and are interested in applying different rates to DOE projects to demonstrate their impact on the analysis. They are part of the CRESP project and, as a result of our conversation and a problem statement developed by Max Power (Wa), they anticipate incorporating this analysis in their FY02 grant request. The available approaches are:

1. Standard government approach using OMB guidelines.
2. Zero discount rate reflecting equal value for current and future generations. (same as using total cost)
3. Variable discount rate reflecting project risk implications. (social time preference rate)

They will consider using these approaches on a major DOE project with long-term implications, such as the Hanford tanks, to perform this sensitivity analysis.

Dr. Richard Zerbe has significant expertise in benefit-cost analysis and has considered options to the standard discounting approach. He believes that a failure of imagination has resulted in the failure of the present worth approach. Present worth analyses will be improved not so much by discount rate manipulation as by incorporating values into the analysis. Our values are reflected in our willingness-to-pay (WTP) to avoid moral harm to future generations. This WTP can identify compensation that can be factored in to the analysis. The WTP is most likely to be quantified through surveys.

He has had some association with CRESP through the university and they have also done some work directly with Hanford. He may be able to use one of these mechanisms to complete such a survey, possibly in conjunction with the sensitivity analysis discussed by Greenberg through CRESP.

Conclusions

Based on both the research and conversations with experts in the field, present worth analysis will remain the cost comparison tool of choice for DOE remedies. However, it appears that enough concern exists about the method's applicability to "deep future" costs that there is value in continuing to evaluate optional methods and optional applications of the present worth analysis.

The STGWG Stewardship Committee recommends the following approach:

1. Continue to investigate alternate methodology through research of the literature and conversations with experts in the field.
2. Support a sensitivity analysis of various discounting techniques on a major DOE project to determine the impacts of differing discount rates. This may be the project to be proposed by CRESP in their FY02 Grant request.
3. Support a survey of a given project's stakeholders to determine willingness-to-pay to avoid moral harm to future generations. This project may be conducted in coordination with the project identified in Item 2 to broaden the overall results.
4. Continue to require DOE to estimate life-cycle costs for all proposed remedial alternatives and stewardship activities. Request the elimination of arbitrary time horizons in the cost estimates. These requirements will be addressed in comments to the LTS planning guidance documents.

The Stewardship Committee will work with DOE and other entities to establish funding and support for the projects proposed in these recommendations.

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