WASTE-TO-ENERGY FACILITY CAPITAL COSTS

H. GREGOR RIGO AND A. DALE CONLEY
Rigo & Rigo Associates, Inc.
Berea, Ohio

Discussion by

Theodore R. Siegler
Ascutney, Vermont

Rigo and Conley have developed a useful method for developing preliminary cost estimates for waste-to-energy facilities. A review of their analysis raises the following points.

First, the authors state that the data used to develop the estimating equation were derived primarily from Official Statements. Cost data in an Official Statement reflect costs as of the date of financing. Given the average two-year construction period and the rapidly changing regulatory climate and potentially adverse political climate surrounding many waste-to-energy facilities, costs developed during financing may not adequately reflect final construction costs. Further, experience has shown that at least some cost estimates in Official Statements are overly optimistic.

Second, the authors correctly emphasize that such costs as land purchase and infrastructure improvement, development costs, financing costs, and the impact on costs associated with corporate risk posture and varying business deals, are not included in the analysis and may impact costs by as much as 50%. Because many of the development and financing costs are relatively independent of facility size, failure to account for these costs is especially significant when estimating costs for small facilities.

Finally, it would be helpful if the authors addressed in more detail some of the statistical problems which can affect the accuracy of the equation developed using multiple regression techniques. For example: How have they accounted for the potential problem of high correlation between explanatory variables, and the implicit assumption that other variables are constant during interpretation of the coefficients (Pindyck and Rubinfeld, 1976)? In addition, given the number of important variables not accounted for in the equation, have the authors adequately tested for "goodness of fit" (Gilbert, 1987; Pindyck and Rubinfeld, 1976)?

In conclusion, users will benefit from the estimating technique developed by the authors, provided they recognize that a number of important cost factors are not described by the equation, and that estimated costs reflect costs as of financing and not actual costs as of completion.

REFERENCES

Gilbert, Richard O. *Statistical Methods for Environmental Pollution Monitoring*. New York: Van Nostrand Reinhold Company, 1987.

Pindyck, R. S., and Rubenfeld D. *Econometric Models and Economic Forecasts*. New York: McGraw-Hill, Inc., 1976.

Discussion by

Kenneth L. Woodruff
Resource Recovery Consultant
Morrisville, Pennsylvania

The authors have presented a timely evaluation of facility capital costs. As indicated, it must be stressed that the costs do not indicate anything other than the actual facility installed cost. Total project capital requirements may be 50% more.

It was interesting to note that the authors indicate the cost of refuse-derived fuel facilities to be virtually the same as mass burn waterwall installations. Other studies have also shown this to be the case up until relatively recently. You may wish to look more closely at this cost comparison, because it appears to me that RDF facility costs are now somewhat less than mass burn. Regardless of this, the authors comment that the "final decision can probably be made on the basis of noncost considerations" is appropriate.

I was pleased to note that the default reference plant includes a dry scrubber and baghouse or dry scrubber-ESP.

Perhaps the draft text of the paper which was provided to me had typographical errors, but it does not appear that the text agrees with the cost curves presented in Fig. 2. The text indicated 500–1500 TPD facilities having $85,000–$112,000 per TPD capacity capital costs, while 2000–3000 per TPD facilities cost $112,000–$129,000 per TPD. This indicates no economy of scale and, in fact, a unit cost increase with capacity. Figure 2 is not consistent with this. I believe experience indicates little if any economy of scale. Please clarify this discrepancy.

AUTHORS' REPLY

The authors want to thank Messrs. Siegler and Woodruff for the effort they put into reviewing our paper. Their questions provide an opportunity to discuss important aspects of our work.

We fully concur with the reiterated caution that Official Statements are written before construction so that final costs are not represented. Unfortunately, this is the best available data (acronym: BAD!). In an attempt to deal with the problem, we have assumed that all inflation and construction reserve funds are expended. Only time will tell how successful we were.

In developing the equation, we began with many more variables and their cross products (interactions) than we retained. We only retained variables that had statistically significant coefficients. No cross products were significant. With the retained variables, we found no co-linearity. The beta weights were significant and vector co-linearities were also small for the final equation. The overall "F" and "R^2" we reported are highly significant. We used full residual plots, pivot point identification and similar advanced tests to establish "goodness-of-fit". We understand these are more powerful than the tests enumerated in the references cited by Mr. Siegler. In fact, the tests in Gilbert appear to apply to the shape of the underlying distribution for repeated measures and not a curve fit so we don't know how to apply them to this analysis. We would encourage any user, however, to convince themselves of the correctness of our results using whatever means they have available.

We agree that financed cost will exceed capital cost. The multipliers we have seen range between 1.36 and 1.64.

We also agree that reported RDF costs are numerically smaller than MBWW costs. Given the variability of the data, however, we cannot agree that they are different. Perhaps in the future we can reach that conclusion.

The range data we reported is from the low end of lower confidence limit to the high end of the upper confidence interval for a given type of facility; not the ends of the plotted line. As a result, the reported ranges are correct as stated. While we have been struggling for many years with how to present the confidence interval concept, it is clear that we have not yet succeeded in making it easily understandable.

ERRATUM

We want to bring to the reader's attention that in the confidence limit equation, exponents were inadvertently dropped. The correct equation is as follows:

$$CL = \pm \text{(Std. Error)}\ (t, \alpha) \left[1 + \frac{1}{N} + \frac{1}{N-1} \sum \left(\frac{\text{PARM-MEAN}}{\text{SDEV}_{\text{parm}}}\right)^2\right]^{1/2}$$