Appendix C

Power Generation Markets

C. LEVELIZED COST FOR RANKING ALTERNATIVES AND EXAMPLE CALCULATIONS

Economic choice between electricity generating alternatives is often done on the basis of levelized cost, which is the level revenue requirement that would cover all operating expenses and capital-related costs for the generating facility. Capital-related costs include return on invested debt, return on invested equity, federal and state income taxes associated with the return on equity, book depreciation (for recovery of debt and equity capital), and property taxes and insurance. Operating costs include fuel and non-fuel operation and maintenance costs.

A levelized unit cost is a delivered product unit cost that, if charged for each year's production over the analysis period, would yield the same net present value of revenues as if the actual annual cost for each alternative were collected instead over the period. It is C in the following equation:

$$\sum_{i=1}^{n} \frac{CE_i}{(1+r)^i} = \sum_{i=1}^{n} \frac{c_i E_i}{(1+r)^i}$$

where C is a constant \$/kWh cost to be charged each ith year over the analysis period (n=30 years, for example), E_i is the kWh sold in each such year, and c_i is the actual annual \$/kWh cost for each year, comprised of a current expense for fuel, labor, etc. plus a component for recovery of the investment cost, which may be a level series or may vary through time in some fashion.

The constant C can be brought outside the summation on the left side. Then the expression on the right can be divided by the remaining summation on the left, leaving just C on the left side. Since the product inside the summation on top on the right, $c_i E_i$, is dollars for each year, and the $1/(1+r)^i$ is a discount factor, the top of the right side looks like the present value of revenue requirements. The bottom is denominated in kWh and looks like the present value of energy. This is why one often hears that levelized cost is computed as the present value of costs divided by the present value of energy.

The levelized costs of energy (LCOE) in this study are computed as described above. In our calculations we have assumed that costs which vary over the evaluation period are covered by revenues of equal magnitude (i.e., operating costs are treated as a pass-through). Property taxes and insurance also are handled as pass-throughs.

All other capital-related costs (debt service, return on and of equity, income tax, etc.) are recovered as a uniform charge over the evaluation period.

The financial model which developed the LCOE figures in this report performs the levelized cost calculation two ways: (1) in nominal dollars, where capital and operating costs escalate due to inflation and money rates are nominal values that include an inflation premium and (2) in real terms, where capital and operating costs do not escalate and the cost of debt in the financial calculations has had the inflation premium removed.

Exhibits C-1 shows an example calculation for a CSP alternative in nominal dollar terms, where inflation is included for capital and operating costs and market costs of money are used in the financial calculations. Exhibit C-2 is the same calculation when done in real terms, with no inflation in capital and operating costs and using a deflated cost of debt. The inflation assumption used in these calculations is 2½% per year. In both cases the capacity payment for recovering capital-related charges is set to achieve a 1.35 debt service coverage ratio using the financial leverage from the nominal dollar calculation.