represents. However, a number of energy subsidies to the LWR were not included in the evaluation, and there are several misleading, if not erroneous, calculations given. The implication that these calculations represent a total energy investment is inaccurate.

The energy investments calculated by Rombough and Koen include only the construction energy for the LWR and the fossil fuel energy used for mining, milling, enrichment, fuel fabrication, and reprocessing. Conspicuous omissions include construction energy for the milling, enrichment, fabrication, and reprocessing facilities prorated for one 1000-MW(e) reactor over 30 yr; the energy value of the chemicals and other materials used in operating these same facilities; energy utilization in transporting the various forms of uranium from facility to facility; and the energy requirements of radioactive waste disposal which include the required system infrastructure and security. These are no more difficult to calculate than the energy costs included by Rombough and Koen and, in fact, some of them have already been calculated. More difficult to evaluate but important in a total energy investment analysis are the environmental costs (in energy units) resulting from each step in the fuel cycle, the energy value of the federal research and development support included so that the comparison could be made on the same basis. In addition, the above work demonstrates that all of these indirect costs account for only ~20% of the total energy investment, and therefore the implication that the value reported is only a "small part" of the total is incorrect.

Generally, there are three ways to interpret the energy investment when dealing with different forms of energy. Consider for example, that an energy investment were 50 Btu's of electricity and 50 Btu's of thermal energy for an output of 1000 Btu's of electricity. The first method assumes that we are interested in how much energy in the electrical form is required. This method assumes that the 50 Btu's of thermal energy could have been used to generate 50/3 = 17 Btu's of electricity so that the total input is 67 Btu's of electricity. The ratio is then 67/1000 = 6.7%. This is the method favored by Gilliland and Freim. The second method assumes that we are interested in how much thermal energy is required. In this case, the input electricity is converted to 50 \times 3 = 150 Btu's of thermal energy for a total input of 200 Btu's of thermal energy. The ratio is then 200/1000 = 20%. Note that there is a factor of 3 difference between these two methods. The third alternative assumes that any input energy would eventually be made up from the plant itself. That is, electricity is substituted directly for input energy regardless of form. In this case, the investment is 100/1000 = 10%. Since the third alternative lies between the other two alternatives and appears to be more fundamental, this is the one that we chose in performing the analysis. The final alternative is conservative in that electricity is used more efficiently than fossil fuels, though not with a ratio of 3 to 1. For example, a natural gas water heater may be 62% efficient compared to a 95% efficient electric water heater (a ratio of 1.5). The error then introduced by assuming that electricity is substituted directly for thermal energy would be a factor of 1.25 for the above example (since 50% of the input is thermal).

We regret that the word "electrical" was inadver-
tently omitted from our manuscript. The figure, 98%, however was not used anywhere in the calculation.

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