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LETTERS

The Cost of Energy Efficiency

Paul L. Joskow and Donald B. Marron, in their Policy Forum "What does utility-subsidized energy efficiency really cost?" (16 Apr., p. 281) (*1*), have mischaracterized our findings, others' (*2*, *3*), and their own. The curve of potential electric savings calculated by Rocky Mountain Institute (RMI) rests not on "assumptions" or "estimates," but on 2235 dense pages of empirical cost and performance data documented in 4755 notes (*4*). Our analyses are used by more than 100 utility companies and 150 other organizations in 35 countries and are consistent with extensive utility field experience.

Contrary to statements made by Joskow and Marron, RMI's curve does include efficiency gains that customers might make unaided. In calculating the curve, we did not apply improvements to the entire equipment stock, but only in appropriate cases ("technical eligibility"). We did not "ignore" administrative costs, but counted them separately, not as part of technical potential supply curves. Such costs depend on program design and are small in good programs (*5*). The other "hidden" costs Joskow and Marron have supposedly discovered are well known and unimportant (*6*).

Joskow and Marron used highly aggregated data from a small group of utilities with wildly divergent programs, installing efficiency improvements often inferior in design or execution to modern standards (*7*). (Anyone who saves electricity at a cost of $1.81 per kilowatt-hour should be fired, and probably was.) Most of the costs from this small sample are at or near the high end (*8*). Nor do Joskow and Marron present data in a way that others can readily scrutinize or reproduce. But even if their data were valid and scrutable, they would be comparable with RMI's and others' supply curves only if they used the same accounting conventions and the same packages of technologies. They do not (*9*), so the comparison is meaningless.

Others who have examined utilities' field results (many are now rigorously evaluated) have found a large range of costs for saving electricity. Joskow and Marron conclude from the high end of available data that "negawatts" (saved electricity) must be costly; but even one cheap program disproves that (just as the bankruptcy of one company does not prove that all must fail). The quality of utility efficiency programs varies widely; dozens deliver extremely cheap "negawatts," and the rest should emulate them. This is actually happening. Vigilant regulators and intervenors ensure that utilities do not waste customers' money for long, if at all. In the best jurisdictions, utilities' profits depend directly on how much, and at what cost, they save energy. Programs that are not demonstrated to be cost-effective get stopped or changed. The rest rightly continue.

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References and Notes

1. Their term "utility-subsidized" is misleading. Utilities' costs of cost-effective efficiency programs are no more a "subsidy" than are their traditional investments in power plants. In either case, the utility is simply acquiring its cheapest marginal resource—the one that will enable its system to deliver desired energy services at least societal cost.
2. For example, they say their reference 7 [S. M. Nadel and K. M. Keating, in *Proceedings of the 1991 International Energy Program Evaluation Conference*, Chicago, 21 to 23 August 1991 (Evanston, IL, 1991), pp. 24–33] shows that "careful ex post evaluations often find actual energy savings to be far below original projections. Realized savings rates of 50 to 60% of engineering estimates are quite common. . . ." In fact, that reference draws the opposite conclusions. It says that (i) 17 of the 42 surveyed programs saved less than 60% of predicted energy (while 12 saved more than 100%); (ii) this shortfall was common only in specific kinds of programs (residential retrofits, small-customer lighting, and showerheads) and not consistently; (iii) shortfalls, where present, had "common explanations" such as poor base-case characterization or modeling, interactions between building systems not accounted for, credit taken for measures recommended but not installed, secondary fuels like firewood omitted, and poor installation quality control; (iv) predictions properly performed to avoid these obvious pitfalls matched measured savings in all kinds of programs; and (v) in any event, most of the cited shortfalls resulted from the analytic method used: comparisons were not made of the same building or equipment before and after, but between participants and a nonparticipating control group that meanwhile often saved energy unaided, reducing the *net* savings ascribed to the program—but only by moving the goalposts.
3. Joskow and Marron have also mischaracterized the Electric Power Research Institute's (EPRI's) supply curve as revealed in their reference 5: EPRI's excludes a 9 to 15% saving expected to be achieved spontaneously, is limited to potential savings by 2000 (rather than RMI's long-run asymptote), excludes saved maintenance costs, and is near the low end of a large uncertainty range. These methodological differences account for most of the gap between the EPRI and RMI findings. The EPRI curve also assumes electric-motor-system savings about three times smaller and five times costlier than EPRI and RMI agree are available (Joskow and Marron's reference 3).
4. A. B. Lovins *et al., The State of the Art: Lighting* (1988); *The State of the Art: Drivepower* (1989); *The State of the Art: Appliances* (1990); *The State of the Art: Water Heating* (1991); *The State of the Art: Space Cooling and Air Handling* (1992), all from E SOURCE, Boulder, CO.

5. Southern California Edison in 1984, for example, reported them to total 0.065 cents per kilowatt-hour in residential and 0.031 cents per kilowatt-hour in other sectors—less than 1% of electricity tariffs.
6. For example, "free riders" (who receive an incentive, but would have saved without it) are virtually impossible to measure, and may well be offset by equally unmeasurable "free drivers" (who save as an indirect result of a utility program, but without taking its incentives) [E. Hirst and J. Reed, Eds., *Handbook of Evaluation of Utility DSM Programs* (ORNL/CON-336, Oak Ridge National Laboratory, Oak Ridge, TN, 1991)].
7. A. B. Lovins, letter to P. L. Joskow, 12 January 1992 (Publication U93-2, Rocky Mountain Institute, Snowmass, CO, 1992).
8. Their mean commercial and industrial savings, for example, cost four to six times the typical medians reported in a review of more than 200 programs by 58 utilities through 1988 [S. M. Nadel, *Lessons Learned: A Review of Utility Experience with Conservation and Load Management Programs for Commercial and Industrial Customers* (Report 90-8, New York State Energy Research and Development Authority with New York State Energy Office and Niagara Mohawk Power Corporation, Albany, NY, April 1990)]. Many costs have fallen since then.
9. Our data and supply curves show the net internal social cost of buying, installing, *and maintaining optimized packages* of *modern* electricity-saving technologies in *all* uses and sectors. In contrast, Joskow and Marron's field data purport to show the gross internal cost to utility companies of designing, administering, and providing incentives for buying (but not of buying or maintaining) suboptimal, obsolete, and fragmented single measures in only some uses and sectors. Joskow and Marron assert that this comparison shows RMI gravely understated costs, but in fact no conclusions whatever can be drawn from such a botched juxtaposition. See further my response in *The Electricity Journal* (in press).

Joskow and Marron compare engineering estimates of the costs of energy conservation programs with "the costs of real programs administered by real utilities for the benefit of real consumers." Their analysis of the historical data reveals that the cost of saving energy to a utility company is about 3.4 cents per kilowatt-hour. This figure compares favorably with their estimate of the current average retail price of electricity, 7 cents per kilowatt-hour. In spite of this finding, Joskow and Marron conclude that the current emphasis on conservation programs is "misplaced" because utilities might be understating the costs of such programs. We think it likely that such costs are overstated as a result of the treatment of data from low-income programs and the lack of data on the potential benefits of "market transformation."

Programs to assist low-income households with "weatherization" are among the oldest and best established of utility conservation efforts. They are not, however, among the most cost-effective because of the need to undertake minor home repairs (for example, to fix water leaks) before energy-efficient equipment can be installed (*1*). There is also evidence that low-income programs have a higher than average "take-back" effect (the participants take back some of the energy saved by increasing indoor temperatures or by taking other actions to increase their comfort) (*2*). Both minor home repair and increased comfort need to be reckoned as benefits of low-income programs, but these benefits are hard to quantify. A further complication is that regulators often favor such programs on grounds of equity; that is, in situations where the only politically feasible alternative would be to give families direct subsidies for fuel purchases. In view of these difficulties, most cost-benefit analyses should exclude low-income programs from consideration.

An important benefit of utility conservation programs is that they can transform markets in ways that increase the availability of, and consumer interest in, energy-efficient goods and services (*3*). If this occurs, then even consumers who do not participate in utility programs are more likely to adopt energy-efficient technologies and practices than they would have been in the absence of such programs. This is the opposite of the "free rider" problem identified by Joskow and Marron. However, as they note, the additional benefits that free riders receive are essentially transfer payments from utility rate payers as a group, so the social costs are relatively small. On the other hand, the social benefits from market transformation can be quite large.

It is possible that Joskow and Marron are right and that utility conservation programs should be deemphasized. But the available data suggest that many of these programs are very cost-effective, and arguments that the data are wrong cut both ways. A situation like this calls for better data, not for jumping to conclusions.

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References

1. M. A. Brown *et al.*, *National Impacts of the Weatherization Assistance Program in Single Family and Small Multifamily Dwellings* (ORNL/CON-326, Oak Ridge National Laboratory, Oak Ridge, TN, 1993).
2. T. Dinan, *An Analysis of the Impact of Residential Retrofits on Indoor Temperature Choice* (ORNL/CON-236, Oak Ridge National Laboratory, Oak Ridge, TN, 1987).
3. T. Eckman, N. Benner, F. Gordon, in *Proceedings of the 1992 Summer Study on Energy Efficiency in Buildings* (American Council for an Energy-Efficient Economy, Washington, DC, 1992), pp. 5.1–5.17.

A central thesis of the Policy Forum by Joskow and Marron is that studies of the technical potential (TP) of efficiency improvements exaggerate the potential benefits of efficiency measures. Unfortunately, Joskow and Marron compare apples and oranges. The TP studies they refer to evaluate the cost and performance of a large number of efficiency technologies based on national average conditions (*1*). In contrast, the survey by Joskow and Marron provides estimates of the cost and performance of a limited set of technologies installed through a small sample of utility programs in particular climate zones (*2*). It would be pure coincidence if these two sets of data produced similar results. The finding that they differ tells us nothing about the relative accuracy of either the technical potential studies or the estimates of program results reported by Joskow and Marron. The appropriate comparison is between the measured cost and performance of specific technologies once installed, and the predicted cost and performance of those technologies in the same region, corrected for differences in performance resulting from behavioral and climatic variations. Several such comparisons have been completed recently by California utilities. In general, they have found that the initial technical potential estimates are inaccurate to some degree, but that the degree of inaccuracy is fairly small, and there is no pattern of systematic bias toward either underestimation or overestimation (*3*).

Despite their apparent validity, statistical models used to estimate impacts of efficiency investments can also misrepresent reality as a result of improper assumptions, measurement error, and other well-documented pitfalls (*4*). The difficulty of accounting for "free riders" is one such problem that Joskow and Marron highlight. Other problems include accounting for changes to equipment markets and consumer behavior that extend beyond a program's immediate participants (for example, "free driver" behavior) and sorting out the effects of these changes over the study period.

Joskow and Marron pursue a valuable objective in trying to refine and update our understanding of the cost and potential of developing energy efficiency resources. However, the Database on Energy Efficiency Programs (DEEP) project under way at Lawrence Berkeley Laboratory (*5*) promises to provide a much more representative and comprehensive survey of the costs and benefits of the $1.8 billion annual utility investment in energy efficiency resources (*6*).

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References and Notes

1. TP studies in some cases include estimates of administration costs, although these too will vary substantially, depending on the type of program. The survey by Joskow and Marron included only utility programs and is not comparable to a technical potential study that considered building and appliance standards as well as utility programs.
2. P. L. Joskow and D. B. Marron, *Energy J.* **13** (No. 4), 41 (1992).

3. "Final report on the evaluation of DSM (Demand Side Management) shareholder incentive mechanisms" (Wisconsin Energy Conservation Corporation, Madison, WI, 1992).
4. E. Hirst and J. Reed, Eds., *Handbook of Evaluation of Utility DSM Programs* (Oak Ridge National Laboratory, Oak Ridge, TN, 1991).
5. E. L. Vine, C. T. Payne, R. A. Weiner, paper presented at the Integrated Resource Planning Conference, Denver, CO, 19 March 1993.
6. E. Hirst, "Electric utility DSM-program costs and effects: 1991 to 2001" (ORNL-CON-364, Oak Ridge National Laboratory, for the Department of Energy, Oak Ridge, TN, 1993).

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Vive Lyons!

Patrick Oswald's statement quoted in the article "French government tries decentralizing excellence" by Michael Balter (Science in Europe, 18 June, p. 1749) that Lyons is "a bit of a scientific desert in physics" cannot pass without comment. Perhaps the areas of research that interest Oswald do not include nuclear physics, particle physics, atomic physics, laser research, fiber optics, luminescent materials, or any of the many other subjects investigated here.

It is true, and well expressed in the article, that Paris is the capital of France in every possible way and the capital of French science through the richness and diversity of its laboratories. It is also true that Lyons has less opportunity for the exploration of every promising field. However, it is in deserts that one can find certain rare species that do not flourish elsewhere. The Nuclear Physics Institute in Lyons is at present developing the mirrors for use in the Franco-Italian VIRGO project for detecting gravitational waves, and many other projects are under way. Lyons has played a crucial role in the development of BGO crystals for the L3 detector at CERN (the European Organization for Nuclear Research) and has made important contributions to the understanding of quark-gluon plasmas. Lyons is also a center of excellence for complex systems of measurement and has no equal in Paris or, indeed, elsewhere. Other areas of special technical expertise include laser spectroscopy, luminescent solutions and gases, dilute media, and the physics of aggregates.

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Corrections and Clarifications

In the Meeting Brief "EUVE [Extreme Ultraviolet Explorer] takes the long view" by Faye Flam (Research News, 25 June, p. 1879), the EUVE principal investigator was incorrectly identified. He is Stuart Bowyer of the University of California, Berkeley.