The Rebound Effect and Energy Efficiency Programs: An Evaluator's Perspective

Edward Vine
Lawrence Berkeley National Laboratory
June 17, 2010

For the purposes of this paper, "rebound" effects (also called takeback or substitution effects) refer to those effects that can mitigate the reductions in energy consumption associated with EE. David Owen's recent article in *The New Yorker* (2010) on EE and rebound phenomena, followed by the Breakthrough Institute's report (Jenkins et al. 2011) and John Tierney's article in the *New York Times* (2011), have sparked a lively debate about the potential for improvements in EE to more than negate environmental gains. While the scholarly treatment of rebound effects goes back a century and a half to Jevons (1865), Brookes (1990) and Khazzoom (1980, 1987) are generally credited with establishing the modern awareness of rebound phenomena. Since then, the number of researchers devoting attention to this issue is too numerous to mention, but a good place to start is in Saunders (2011).

As noted by Jenkins (2011) and Saunders (2011), rebound comes from several sources, requiring important distinctions. Typically, rebound analysts distinguish *consumer*-side effects from *producer*-side effects. A second distinction is between so-called *direct* and *indirect* rebound. On top of these rebound classifications, some analysts identify a so-called *macroeconomic* effect. For the focus of this paper – the evaluation of EE programs - we limit our discussion to the direct and indirect rebound effects for consumers. The <u>direct rebound effect</u> on the <u>consumer side</u> theoretically arises because an EE gain reduces the effective price of energy, potentially causing consumers to use more of it. An example is the installation of more efficient heaters or air conditioners that causes the household to heat or cool more rooms. The <u>indirect rebound effect</u> on the <u>consumer side</u> theoretically arises from consumers taking the money saved from, say, buying a more efficient refrigerator, and potentially spending it to purchase other goods and services that require energy.

David Owen uses air conditioning as an example of indirect rebound. According to Owen, more efficient air conditioners have led to a decrease in the cost of running an air conditioner, and the decreased costs, therefore, have made air conditioners more affordable to more people. As a result, more people have bought air conditioners, leading to increased electricity usage. Owen's critics, such as Steve Nadel (2011), argue that the causes of rising use of air conditioners were due to rising household incomes and the declining price of air conditioners, not because of greater EE. Similarly, he argues that rising incomes and declining costs are driving growing saturations of microwave ovens, personal computers, and flat screen televisions, and that improved EE has contributed only marginally to the growing use of these services. He concludes that EE has helped to moderate (but not eliminate) the associated increases in energy use as these services grow.

Clearly, it is theoretically possible for some consumers in some situations to act in accord with Owen's theory, but even that is correlation, and causation is still questionable. Unfortunately, the EE evaluation industry is not very well positioned to respond to these arguments, because we have not made any significant effort to study the issue of rebound in the last 18 years. Nadel (1993) serves as the last best review of rebound studies in EE programs: from his review of 42 studies, he concluded that rebound could occur but that it was not a widespread phenomenon. Instead, he noted that rebound was more likely a localized phenomenon, largely limited to specific end uses (e.g., residential lighting (10% increase in operating hours due to the installation of CFLs), and industrial plant production (2% increase due to the installation of EE process measures)). For other end uses, he found no data or inconclusive data supporting the rebound effect.

We do not wish to revisit the methods used to derive the above estimates, or the particulars in the arguments for supporting or criticizing the rebound effect. But we do want to alert evaluators that they should be aware of: (1) these rebound studies and the implications for their work – particularly for those working on potential studies and carbon emission reduction plans and policies; and (2) the methodological issues associated with these studies – in particular, the reliance on a few questions in self-reported surveys and small samples of households or buildings for the micro effects analysis, and the lack of causation in the macroeconomic effects studies. More research is clearly needed, so that advocates and opponents of the rebound issue can have a firm basis to support their positions!

Future Research

Two types of research are needed: Retrospective Evaluation and Prospective Evaluation. In retrospective evaluation, past evaluation studies of energy efficiency programs are examined to see how the rebound effect was calculated and to see if the methodology could have been improved. In prospective evaluation, future evaluation studies incorporate a methodology that includes the analysis of the rebound effect. These new studies will build on the lessons learned from retrospective evaluation. If the analysis of the rebound effect becomes of greater interest, then it may be useful to add this type of analysis to the evaluation guidelines that states use for evaluating energy efficiency programs (e.g., CPUC 2006).

IEPEC Rebound Panel

The evaluation community is starting to pay more attention to the rebound effect. At the next International Energy Program Evaluation Conference in August 2011, there will be a panel on the rebound effect (www.iepec.org). This panel is organized to make evaluators more aware of: (1) rebound studies and the implications for their work; (2) the methodological issues associated with these studies; and (3) additional data or analysis that addresses the issue of second-order effects of efficiency improvements. The panelists are: David Owen, David Goldstein, and Skip Laitner.

References

Brookes, L. 1990. "Energy Efficiency and Economic Fallacies," *Energy Policy* March: 783-785.

California Public Utilities Commission (CPUC). 2006. *California Energy Efficiency Evaluation Protocols: Technical, Methodological and Reporting Requirements for Evaluation Professionals*. San Francisco, CA: California Public Utilities Commission.

Jenkins, J., T. Nordhaus, and M. Shellenberger. 2011. *Energy Emergence: Rebound & Backfire as Emergent Phenomena*. Oakland, CA: Breakthrough Institute.

Jevons, S. 1865. "The coal question—can Britain survive?" First published in 1865, reprinted by Macmillan in 1906. (Relevant extracts appear in *Environment and Change*, 1974; February.)

Khazzoom, J. D. 1980. "Economic Implications of Mandated Efficiency Standards for Household Appliances," *The Energy Journal* 11(2): 21-40.

Khazzoom, J. D. 1987. "Energy Saving Resulting from the Adoption of More Efficient Appliances," *The Energy Journal* 8(4): 85-89.

Nadel, S. 1993. *The Takeback Effect: Fact or Fiction?* Washington, DC. American Council for an Energy-Efficient Economy.

Nadel, S. 2011. "Our Perspective on the 'Rebound Effect' – Is It True That the More Efficient a Product Becomes, the More Its Owner Will Use It?" January 12. Available at: http://www.aceee.org/blog/2011/01/our-perspective-rebound-effect-it-true-more-efficient-pro.

Owen, D. 2010. "The Efficiency Dilemma," *The New Yorker*, Dec. 20.

Saunders, H. 2011. "Six Misconceptions about Rebound and Backfire." Available at http://thebreakthrough.org/blog/2011/01/six_misconceptions_about_rebou.shtml.

Tierney, J. 2011. "When Energy Efficiency Sullies the Environment," *New York Times*, March 7.