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# The impact of DOE building technology energy efficiency programs on U.S. employment, income, and investment

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**Abstract**

The U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy (EERE) analyzes the macroeconomic impacts of its programs that are designed to increase the energy efficiency of the U.S. residential and commercial building stock. The analysis is conducted using the Impact of Sector Energy Technologies (ImSET) model, a special-purpose 188-sector input–output model of the U.S. economy designed specifically to evaluate the impacts of energy efficiency investments and saving. For the analysis described in the paper, ImSET was amended to provide estimates of sector-by-sector capital requirements and investment. In the scenario of the Fiscal Year (FY) 2005 Building Technologies (BT) program, the technologies and building practices being developed and promoted by the BT program have the potential to save about $2.9 \times 10^{15}$ Btu in buildings by the year 2030, about 27% of the expected growth in building energy consumption by the year 2030. The analysis reported in the paper finds that, by the year 2030, these savings have the potential to increase employment by up to 446,000 jobs, increase wage income by $7.8 billion, reduce needs for capital stock in the energy sector and closely related supporting industries by about $207 billion (and the corresponding annual level of investment by $13 billion), and create net capital savings that are available to grow the nation's future economy.


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## 1. Introduction

As part of measuring the impact of government programs in improving the energy efficiency of the nation's infrastructure, the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy (EERE) is interested in assessing the economic impacts of these programs, specifically on national employment, wage income, and (most recently) investment. As a consequence, EERE funded Pacific Northwest National Laboratory (PNNL) to develop a simple-to-use method for in-house estimation of economic impacts of individual programs. This work grew out of a continuing debate over the macroeconomic benefits of energy efficiency programs, which are known to reduce the Nation's energy bill but have uncertain distributional effects among sectors of the economy: that is, the energy savings reduce the sales of electric utilities, gas companies, and heating fuel companies at the same time as they save energy, giving an uncertain net effect on the economy. Moreover, the investments required to bring about the energy savings also divert investment from other productive investments. The distribution of economic impacts and benefits across the economy is potentially a question of some importance.

The 188-sector Impact of Sector Energy Technologies (ImSET) model used in this paper (Roop et al., 2005) is based on the U.S. Bureau of Economic Analysis (BEA) 528-industry 1997 national input–output table (Lawson et al., 2002), and was derived from a predecessor model ImBuild II (Scott et al., 2002), a 98-sector input–output model of the national economy based on the 1992 U.S. input–output table. While the models are quite similar, there are differences in sectors covered, sector aggregation, and changes between the national input–output tables for 1997 and 1992.

A significant effort was made in the ImBuild II users' guide to identify and characterize differences between ImBuild II and other then-extant models, emphasizing a comparison with a model used in an American Council for an Energy Efficient Economy (ACEEE) macroeconomic impact analysis of energy efficiency in the U.S. economy (Alliance to Save Energy et al., 1991; Geller et al., 1992). ImBuild II also was compared with models used in other applied studies (Buchsbaum et al., 1979; Jaccard and Sims, 1991; Laitner, 1992). The differences between ImBuild II and the ACEEE model analyses could be explained by differences in the sectoring plan and the fact that the ACEEE report was based on the 1987 Benchmark Input Output (I–O) table while ImBuild II was based on the 1992 Benchmark I–O table. Perhaps a more significant source of differences in results arose from the way that programs were implemented in the two analyses. For example, the source of funding for incremental investment in a technology in the ACEEE report might have been a reduction in demand for the sector using the technology (i.e., a change in demand) rather than a change that reflected supply-side impacts.[1]

In addition to the extended discussion about the ACEEE study, the ImBuild II users' guide also examined several other reports, but none of these could be easily compared with the methodology used by ImBuild II (see, for example, Laitner et al., 1998). In summary, the report concluded that ImBuild II's results were roughly comparable to those of other recent models.

As a framework for differentiating between different approaches, Berck and Hoffmann (2002) provide taxonomy of five approaches. In order of complexity, the approaches are 1) supply and demand analysis of the affected industry, 2) partial equilibrium analysis of multiple markets, 3) fixed-price general equilibrium simulations, 4) non-linear general equilibrium simulations (CGE models), and 5) econometric estimation of the adjustment process. Included in the third approach are both I–O and social accounting matrix (SAM) models, in which ImSET fits. Berck and

[1] See text on pages 4–1, 4–5, and 4–6 in Scott et al. (2002) for a more detailed discussion.