(depending on the technology replaced and the type of lamp used). The current state-of-the-art electronic ballast technology was developed by the DOE, in the late 1970s.

Through 1996, over 140 million electronic ballasts have been sold. In 1996, this industry's sales totaled $260 million (over and above the market value of an identical number of magnetic ballasts), accounting for 31 percent of total ballast sales. Electronic ballasts are expected to replace magnetic ballasts in 75 percent of applications by 2015.

The electronic ballast not only improves the lighting quality of fluorescent lamps, but has saved consumers $1.5 billion in energy costs through 1996. For comparison, DOE's investment in the electronic ballast research program totaled only $3 *million*. (1975 dollars) It is this type of payback that justifies our research investment, and contributes to our nation's energy security.

Advanced Energy-Efficient Windows

A DOE research and development partnership between industry and a DOE National Laboratory culminated in the development of an advanced energy-efficient window technology that uses low-emissivity coatings to block heat loss, achieving a 35% energy savings, compared to standard double-pane windows. Prior to the Department's R&D investment, no U.S. manufacturer had invested in this technology. Today, every major glass and window manufacturer offers low-emissivity products.

Approximately 2.4 billion square feet of low-emissivity windows have been sold through 1996. This new industry's marginal sales totaled $625 million in 1996 (compared to ordinary window sales), accounting for 35% of total residential window sales and 18% of nonresidential sales. Low-emissivity windows are expected to replace ordinary windows in 80% of applications by 2015.

Cumulative consumer energy savings through 1996 attributable to using low-emissivity windows are $2.5 billion. Although DOE was only a partner in sponsoring the research, the cited energy cost savings were leveraged and catalyzed by a DOE investment of just $3 *million* through the early 1980s.

The advances made in the low-emissivity window provide the foundation upon which further improvements can be built. DOE is actively involved in cost-shared R&D with industry to develop the so-called "smart window", a window whose properties can be adjusted electronically to respond selectively to changing environmental conditions. Smart windows will save energy and lower operating costs, will allow smaller cooling systems to be installed, and will improve comfort in buildings.

Computerized Analytical Tool for Energy Efficient Building Design

Energy efficiency measures can be designed into the construction of new buildings, and into the renovation of existing structures. DOE research has resulted in the development of a powerful analytical software tool, DOE-2, which can be used to reduce energy use in buildings. DOE-2 calculates hourly building energy use and cost from information on the building's construction, climate, operation, heating, ventilating and air conditioning (HVAC) systems, and utility rate schedule. Architects and engineers using such a tool are able to implement energy-efficieny measures with far greater ease and precision.

Over 8 billion square feet of building floor area has been evaluated using DOE-2 through 1996. The value of DOE-2 design services delivered by U.S. private firms totaled $115 million in 1996. Today, approximately 15% of new commercial building floor area is designed with DOE-2, and the use of DOE-2 is expected to reach half of all buildings by 2015.

DOE-2 users surveyed report achieving an additional 22% energy savings, on average, thanks to the tool. This translates into about $0.33/ft^2 of building floor area. The use of the tool has saved building owners and tenants an estimated $12.5 billion in energy costs through