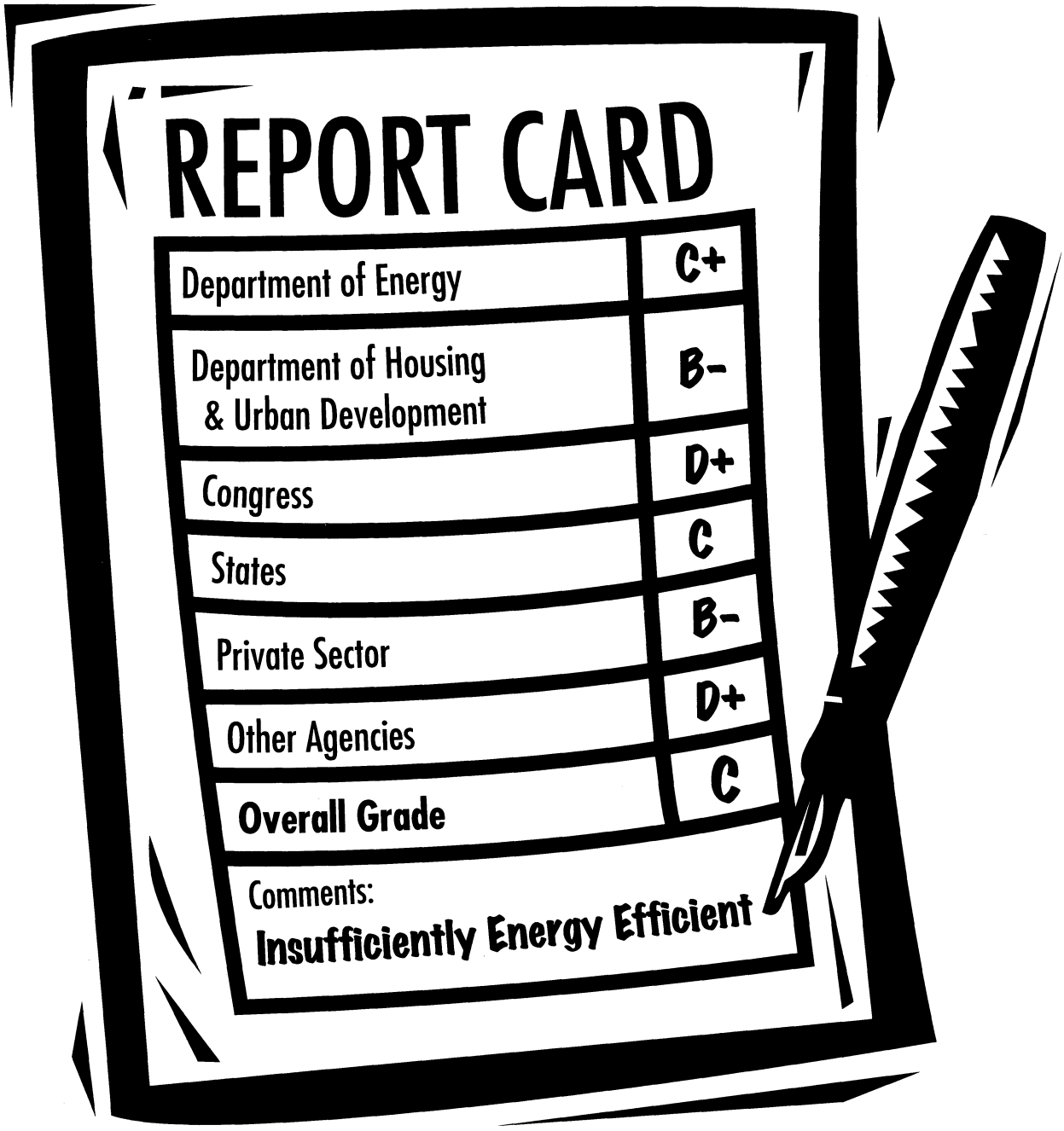
Missing the Mark

Five-Year Report Card on the Energy Efficiency Provisions of the Energy Policy Act



American Council for an Energy-Efficient Economy and Alliance to Save Energy

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American Council for an Energy-Efficient Economy
Alliance to Save Energy

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The following Alliance and ACEEE staff members took responsibility for developing specific sections of the report: David Nemtzow (History), Bill Prindle (Buildings), Steve Nadel (Utilities and Appliance and Equipment Standards), Ted Jones (Industrial), Malcolm Verdict (State and Local Assistance and Miscellaneous), Mark Hopkins (Federal Agency Energy Management), Joe Loper (Renewable Energy), and Howard Geller (Energy Trends; Research, Development, and Demonstration). We also want to acknowledge Genevieve Cullen, David Hamilton, and Katie Miller for their research and written contributions to the report. Special thanks to Renee Nida for editorial support and to our production team, including Rozanne Weissman, Kara Saul, and Robert Gluck.

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Executive Summary

On October 24, 1992, President George Bush signed the Energy Policy Act of 1992 (known as EPAct) into law. The law devoted considerable attention to energy conservation and included a wide range of provisions aimed at increasing energy efficiency in buildings, appliances, industries, and transport. Expectations were high that significant energy savings would result.

Today, five years later, as the United States and other countries are negotiating an international treaty to limit greenhouse gas emissions, the Alliance to Save Energy and the American Council for an Energy-Efficient Economy are taking a hard look at how effectively the energy efficiency provisions in EPAct were implemented. For each major energy efficiency provision, we reviewed the requirements, the actions taken to meet these requirements, and the overall degree of success. In addition, we assigned letter grades to implementation of each major title (or subtitle) as well as to each major actor involved in implementation of EPAct efficiency provisions.

Implementation by Title

In summary, we give a grade of "C" for overall EPAct implementation. There have been significant successes but on balance, implementation falls significantly short of the legal mandate, let alone short of the overall intent. Table ES-1 summarizes our review of the implementation of and overall grades for the major energy efficiency provisions in EPAct.

This summary masks considerable variation within and between programs. Among the successes are the following:

- Fourteen states upgraded their building codes; in addition, technical assistance by DOE has helped many states with code adoption and implementation;
- Smooth implementation of commercial heating and cooling equipment and plumbing product standards and reasonable implementation of lamp and motor standards (i.e., with some problems that have been worked out for the most part);
- Department of Housing and Urban Development's (HUD) adoption of updated standards for manufactured housing;
- HUD and Agriculture departments adopted the 1992 Model Energy Code as a condition for receiving federally backed mortgages;
- The National Fenestration Rating Council established a well-designed labeling program to promote energy-efficient windows; labeling programs for lamps and lighting fixtures also were initiated;
- Facilitation of energy savings within the federal government by establishing financial incentives for facility

TABLE ES-1
SUMMARY OF EPACT INTENT AND IMPLEMENTATION BY TITLE

IA Buildings B-

Intent—Requires states to adopt up-to-date commercial energy codes and to consider new residential energy codes; encourages HUD to adopt new manufactured housing standards; establishes regional building energy efficiency centers; promotes energy-efficient mortgages.

Implementation—30 states have updated their residential codes (up from 16 before EPAct) but only 28 states have implemented the commercial code requirement; HUD issued new energy standards for manufactured housing; Congress never funded the 10 regional centers for building energy efficiency; no home energy rating guidelines have been issued; however, an energy-efficient mortgage pilot program was launched.

IB Utilities B-

Intent—Encourages states, TVA, and WAPA to implement integrated resource planning and other policies to promote energy efficiency investments by utilities.

Implementation—A few states adopted new policies; TVA and WAPA customers prepared plans; but due to "tidal wave" of utility industry restructuring, these sections received limited attention and had limited impact.

IC Appliances C+

Intent—Adopts minimum efficiency standards for electric motors and lamps, commercial heating and cooling equipment and plumbing fixtures; requires DOE to consider standards for other products and develop labeling programs for additional products.

Implementation—Standards written into the law are now in place and generally functioning well although implementation delayed in some cases; consideration of new standards way behind schedule; labeling programs in place.

ID Industry C

Intent—Promotes energy efficiency in industrial facilities, particularly process-oriented industries, on a voluntary basis; establishes voluntary audit and insulation guidelines.

Implementation—Grants to smaller industrial associations were issued just last year; grants were also issued to states to promote process-oriented energy efficiency; voluntary audit and insulation guidelines were well conceived and implemented but with limited dissemination.

IE State/Local D

Intent—Establishes revolving loan fund for retrofitting state and local government buildings; requires training of building designers and contractors; promotes left-turn on red.

Implementation—DOE never requested funding for the loan fund; training for building designers and contractors did take place but very slowly; and left-

turn-on red requirements were added to the state energy conservation plan but neither DOE or NHTSA ever conducted the specified study.

IF Federal Facilities C+

Intent—Sets goals and calls for a wide range of activities aimed at increasing energy efficiency in federal facilities.

Implementation—While many good demonstration and incentive programs have resulted from EPAct, loopholes, limited financing, poor data collection practices, and lack of accountability have limited actual energy savings in federal facilities.

IG Misc. B

Intent—Collects additional energy efficiency information and study district heating and cooling opportunities.

Implementation—EIA has collected information and published annual reports on utility DSM efforts as well as renewable energy production; DOE completed a report on district heating and cooling saving opportunities but did not make this report available to the public.

XII Renewable Energy C

(energy efficiency provisions)

Intent—Improves federal actions and programs that promote export of energy-efficient products and services; further demonstrate commercially available energy efficiency technologies.

Implementation—DOE has done a relatively good job in implementing export promotion through COEECT, however, lack of funding hindered implementation; joint ventures program and analysis of energy technology requirements were never implemented.

XX–XXII Energy/Environment RD&D B

Intent—Authorizes continued RD&D on energy-efficient technologies that serve the buildings, industry, and transportation sectors.

Implementation—RD&D on-going; several new technologies have been commercialized and many others were advanced and appear promising.

managers, a limited federal energy efficiency fund, demonstration projects, widespread training of federal energy managers, and the recent region-wide, multi-project energy-savings performance contracts; and

- Increased federal research and development on a wide range of promising technologies, resulting in significant progress on many fronts and commercialization of several products, including alternative refrigerants, a flame quality indicator for oil burners, new housing designs, new ceramic and metal allow materials, and industrial process improvements for manufacturing chemicals, glass, and steel.

On the other hand, many EPAct energy efficiency provisions have not been successful. The less effective provisions include:

- Residential energy efficiency ratings where battles between electric and gas interests, battles between different program purveyors, and DOE reluctance to take a stand have paralyzed issuance of uniform national guidelines;
- Energy-efficient lighting and building centers, grants to states for utility integrated resource planning (IRP) activities, and the revolving loan fund for retrofit of state and local government buildings that were never funded;
- Provisions to encourage states, TVA, and WAPA customers to pursue least-cost planning, which were largely ignored once utility industry restructuring became the primary focus of utilities and utility regulators;
- Efforts to set transformer efficiency standards, which are now many years behind schedule despite a commitment in the Climate Change Action Plan to accelerate the process; and
- Federal energy agency management, which has suffered due to limited funding and attention to the issue outside of DOE, data reporting problems, and problems related to procurement of energy-efficient products and equipment.

For many other programs, activities are now proceeding and success cannot yet be evaluated.

Implementation by Actor

As noted previously, we give a grade of "C" for overall EPAct implementation. Our grades for each of the major players are shown in Table ES-2.

DOE has made a good faith effort to implement most of the EPAct provisions, with a few notable exceptions such as the Home Energy Rating Systems (HERS) guidelines, the revolving loan fund for state and local building retrofits, and the transformer efficiency standards. Also, DOE's efforts have been flawed in a number of important areas (e.g., implementation of the commercial building code requirements, motor and lighting standards, and federal energy management provisions). In

some cases, DOE was delayed or limited by lack of funding or other restrictions imposed by the Congress. For these reasons, we give DOE an overall grade of "C+."

HUD successfully implemented a number of provisions such as adopting efficiency standards for manufactured housing and for homes receiving federally backed mortgages as well as the energy-efficient mortgage pilot program. But HUD ignored the Section 105 mortgage provision, which called for a study and determination. For these reasons, we give HUD an overall grade of "B-."

Other federal agencies have generally paid limited attention to EPAct. Examples include the poor efforts by TVA and WAPA to implement utility integrated resource planning, as well as the limited cooperation of key agencies such as GSA and the Defense Department in federal energy management. Therefore, we give "other agencies" an overall grade of "D+."

Congress consistently provided less funding than was requested by DOE for EPAct implementation as well as for other important energy efficiency programs in the FY94-98 time period. Furthermore, the deep funding cut and legislative riders in the FY96 Appropriations bill particularly hampered DOE's efforts. However, Congress did provide some additional funding for implementing most EPAct energy efficiency provisions during the early years of this time period. For these reasons, we give Congress an overall grade of "D+."

Some states complied with EPAct's building code and utility policy review requirements, but many did not (especially in the area of commercial building codes). Also, states did not support implementation of the Section 141 revolving loan fund. For these reasons, we give states an overall grade of "C."

Regarding the private sector, many companies have co-funded and participated in RD&D projects with DOE. Private companies have actively supported other initiatives such as the use of performance contracting for federal buildings retrofits. Also, most equipment manufacturers affected by the EPAct efficiency standards supported timely and meaningful implementation of these provisions. However, a few companies attempted to create and exploit loopholes in the lamp standards as well as frustrate effective implementation of the office equipment labeling provisions. For these reasons, we give the private sector an overall grade of "B-."

Our overall grade of "C" is based on combining the grades for each of the

TABLE ES-2
GRADES FOR KEY ACTORS

Organization	Overall Grade
Department of Energy	C+
Dept. of Housing & Urban Development	B-
Other Agencies	D+
Congress	D+
States	C
Private Sector	B-
OVERALL	**C**

key actors, with weightings based on our perception of the relative importance of each. Specifically, we used the following weightings: DOE—35%, HUD—5%, other agencies—5%, Congress—30%, states—10%, and the private sector—15%.

Energy Savings Impact

Unfortunately, EPAct's energy efficiency provisions have not fully achieved their original objectives. Energy use increased approximately 10% from 1992-1996, an average of 2.4% annually, up from the 1.8% average annual increase in the prior decade. While the relative increase in energy use in recent years is partly explained by high economic growth, the underlying pattern is that efficiency improvements have slowed. During 1992-1996, the energy intensity (primary energy use per unit of gross domestic product) fell only 0.8%, an average of 0.2% per year. During the prior decade, energy intensity declined an average of 1.1% annually.

Still, without EPAct, these trends would have been worse. Based on detailed energy saving estimates made when EPAct was passed, and adjusting for actions and changes over the past five years, we estimate that EPAct will reduce U.S. energy use in 2000 by approximately 1.0 quadrillion Btu, a savings of 1% relative to projected energy use that year. These savings will increase after 2000 as more efficient equipment and buildings fostered by EPAct make up an increasing share of the overall equipment and building stock.

Our current estimate of energy savings due to the EPAct energy efficiency provisions is approximately 50% lower than the energy savings expected when EPAct was adopted. This shortfall is due to: (1) underfunding of EPAct programs; (2) lack of follow-through on the part of implementing agencies in some cases; (3) the voluntary nature of many EPAct provisions that turned out to be of limited practical value; and (4) changing external conditions such as utility industry restructuring.

Lessons Learned

In many ways, the energy efficiency provisions of EPAct were a "laundry list" of good intentions. However, Congress did not provide adequate funding to implement many of the provisions. And other provisions were ultimately voluntary in that they only required consideration of specific actions or, even where actions were required, federal agencies and states could ignore them without fear of penalty. As a result, many of the provisions had very limited impact. In retrospect, EPAct probably had too many weak provisions that diluted implementation efforts. It probably would have been better to concentrate on a limited number of substantial and workable provisions.

By our estimation, only five provisions are likely to have cumulative energy savings of 0.2 quad or more by 2000—equipment efficiency standards (which alone account for half of the total savings achieved), commercial building codes, window testing and labeling,

office equipment ratings, and energy efficiency RD&D. These are probably the areas that should be emphasized during the next few years of EPAct implementation.

Finally, our review clearly indicates that adopting legislation does not guarantee results. The legislation provides the blueprint, but without good program design and implementation, not to mention funding, the vision contained in the blueprint will not be realized. In particular, the Administration needs to request and Congress needs to provide adequate funding to implement the new legislation. Likewise, agencies should not ignore legislated time schedules for developing new programs and implementing regulations, and Congress should exert adequate oversight to help keep agencies on track.

Next Steps

EPAct has achieved some significant energy efficiency gains, particularly in improving the efficiency of new commercial buildings and new energy-consuming equipment such as lamps, electric motors, commercial heating and cooling equipment, plumbing equipment, windows, and office equipment. But much remains to be done.

First, there are a number of EPAct provisions that we recommend be given high priority as implementation continues. Focusing on the following areas could increase significantly the overall energy savings ultimately provided by EPAct.

- Issue and enforce equipment efficiency standards, particularly completion of the distribution transformer rulemaking which is many years behind schedule;
- Work on upgrading building energy standards in the roughly 20 states that now have out-dated standards, perhaps with DOE withholding building code-related grants from states who are not moving toward compliance with this portion of the law;
- Develop new, state-of-the-art model building standards, particularly new commercial building standards as the current model standards are nearly a decade old;
- Strengthen efforts to work with the private sector in the development and implementation of RD&D initiatives for key energy end-use areas, particularly in the buildings sector;
- Cut federal energy waste, including wide use of ESPCs, a line item for energy efficiency projects in Agency budgets, re-establishing the energy efficiency fund, increasing procurement of efficient products, and improving tracking and reporting.

Second, EPAct devoted relatively little emphasis to one of the largest areas of energy use—the transportation sector. Dramatic improvements in the efficiency of cars, trucks, and planes were achieved in the 1970s and early 1980s but in recent years efficiency has largely stagnated (airplanes being an exception). While the Partnership for a

New Generation of Vehicles (PNGV) holds some promise, complementary efforts are needed to promote efficiency improvements in the nearer term and to develop programs and policies that will encourage consumers to purchase PNGV cars in the long-term. Likewise, stronger efforts are needed to improve energy efficiency and reduce oil use in light trucks and freight transport, as well as to moderate growth in driving (i.e., reduce vehicle-miles of travel).

Third, energy issues are again coming onto the Congressional agenda, including utility industry restructuring legislation and the possibility of a new climate change treaty that in turn is leading to new policy initiatives to reduce U.S. greenhouse gas emissions. As we move into these debates, it is useful to keep EPAct's lessons in mind. In particular, policy makers should concentrate on a limited number of substantial and workable provisions rather than a "laundry list" of limited and/or difficult to implement provisions.

With respect to utility restructuring legislation, bills introduced by Senator Jeffords and Representative DeFazio contain provisions that would continue utility ratepayer funding for energy efficiency and other public benefit programs. These policies could achieve substantial energy savings. Other proposals floated, such as new requirements for states to consider specific policies, are reminiscent of some of the weaker EPAct provisions and are likely to have limited impact.

With respect to climate change mitigation, development and widespread implementation of energy saving technologies is essential for achieving long-term reductions in greenhouse gas emissions (particularly carbon dioxide). Such technologies can be advanced through increased RD&D, targeted tax credits, and other policies that address barriers inhibiting widespread adoption in the marketplace. In addition, broad policies aimed at reducing greenhouse gas emissions, such as a revenue-neutral carbon tax plus offsetting investment tax credits and/or payroll tax reductions or carbon emissions caps along with tradable carbon emissions allowances, would indirectly boost energy efficiency efforts.

Recent studies by DOE (Scenarios of U.S. Carbon Reductions) and by the Alliance, ACEEE, and other groups (Energy Innovations) conclude that U.S. energy and carbon dioxide emissions can be cost-effectively reduced by 20-25% in 2010 relative to a "business-as-usual" scenario. These studies also conclude that achieving such savings can result in significant economic as well as environmental benefits. However, achieving such savings will require substantial action and strong policies, given recent trends of growing energy use and stagnating national energy intensity. EPAct provides the basis for some of these efforts but much more needs to be done. Now is the time to build upon EPAct and enact additional policies that will advance cost-effective, pollution-cutting, and job-creating energy efficiency measures.

Introduction

On October 24, 1992, President George Bush signed the Energy Policy Act of 1992 (known as EPAct) into law. Expectations were high that significant energy savings would result. If strictly followed, EPAct promised to save not only energy, but significant amounts of money and pollution; all by helping consumers to use energy more efficiently and productively. Many organizations worked long and hard to help members of Congress target the most promising opportunities to save energy. Two nonprofit organizations, the Alliance to Save Energy (the Alliance) and the American Council for an Energy-Efficient Economy (ACEEE), were among those providing testimony, data, analysis, and other key inputs that went into the development of EPAct.

Today, five years later, as the United States and other countries are negotiating an international treaty to limit greenhouse gas emissions, the Alliance and ACEEE are taking a hard look at how effectively the energy efficiency provisions in EPAct were implemented. This joint study first provides a background section that describes the historical context in which EPAct was enacted. Next, we look at macro trends in the U.S., including federal budget and energy use trends, and explore the impacts of EPAct in these broad contexts. We then proceed to examine the major energy efficiency provisions in EPAct by subtitle and section (i.e., FEMP, Buildings, Equipment Standards, RD&D, etc.). For each of these sections the report summarizes the particular requirements, the actions taken to meet these requirements, and the degree of success. The report concludes by reviewing key findings from each of the sections in order to evaluate the overall impact of EPAct, lessons learned, and next steps.

Analysis and Grading

For each EPAct section, an Alliance or ACEEE staffperson was assigned to be lead author. Each lead author conducted personal interviews with energy experts, reviewing official reports to Congress as well as other documents, and contacting federal agencies and contractors. For each source of information the lead authors asked three questions: (1) what the current status of the EPAct requirement was, (2) whether the requirement was successfully implemented or not, and (3) if the actions taken to implement the requirement where faithful to the original intent of the legislation. In addition, lead authors also asked each contact to rate the performance of the assigned implementers, i.e., Congress, DOE, or other federal agency. Each lead author was then asked to summarize these findings and give an overall letter grade based on performance.

Letter grades were given to the assigned implementers of each major title (or subtitle) of EPAct, based on how

well (or poorly) the letter and intent of the legislation was fulfilled. In this report, eleven major sections affecting energy efficiency are analyzed. The analyzed sections are listed in Table 1.

Although the U.S. Department of Energy plays a critical role in implementing most of these requirements, it was understood that the cooperation and active support of many are needed to make these EPAct's provisions successful. Therefore, the role of Congress, the states, other agencies, and the private sector are also considered within this report.

The grades reflect the relative performance of each party in carrying out the intent of EPAct. The "guidelines" to establish the grades listed for each section are summarized in Table 2.

TABLE 1
MAJOR EPACT SECTIONS ON ENERGY EFFICIENCY

I. Energy Efficiency
- A. Buildings
- B. Utilities
- C. Appliance and Equipment Energy Efficiency Standards
- D. Industrial
- E. State and Local Assistance
- F. Federal Agency Energy Management
- G. Miscellaneous

XII. Renewable Energy (energy efficiency sections)

XX. General Provisions; Reduction of Oil Vulnerability

XXI. Energy and Environment

XXII. Energy and Economic Growth

This grading scheme is generous, in that completing assigned work earns a grade of "B" and going beyond the letter of the law in order to fulfill the intent earns an "A". Unfortunately, as is discussed below, even with such "grading on a curve," implementation of many EPAct sections fall below the "B" level.

History of EPAct

On October 24, 1992, at an oil rig in Louisiana, President George Bush signed into law Public Law 102-486, the Energy Policy Act of 1992, a few days after Congress approved this "historic" act.

Culminating four years of effort and two years of formal legislative debate and action, the 1,500 page Energy Policy Act entered into the pantheon of major energy laws. It shared many traits with its predecessors: broad in scope and grand in intentions—with provisions affecting not just energy efficiency, but electricity, natural gas, nuclear power, alternative motor fuels and renewables; its fault lines were as geographic as they were partisan; its impact on the economy long-lasting and measured in ten, if not hundreds, of billions of dollars.

Unlike its predecessors, EPAct was drafted, debated, amended and adopted during a period of relatively stable energy prices and supplies—and public inattention to energy matters. Not surprisingly, the three provisions aimed at decreasing U.S. vulnerability to imports of foreign oil—strengthening automotive fuel economy standards (CAFE),

drilling in the Arctic National Wildlife Refuge (ANWR), and creating a mandatory fee for financing the Strategic Petroleum Reserve—did not find their way to final passage.

In fact, CAFE and ANWR drilling were the only two elements of debate over the bill that received widespread attention from the public, media and members of Congress not on the various committees of jurisdiction. But with the passage of an Energy Policy Act that lacked these provisions, it became clear that two areas of the bill stood out in their importance: Title VII's opening up of electricity generation and transmission to greater competition and Title I's authorization of an array of energy efficiency programs and regulations. In short, despite the Energy Policy Act's holes and shortcomings, it was difficult to disagree with Senator Richard Bryan's (D-Nev.) observation that "even in reduced form, the legislation would affect the way almost all Americans consume energy" (Krauss 1997).

EPAct's origins were threefold. One, Congress had not passed important energy legislation for a number of years and pressure to do so was steadily building up. Two, shortly after taking office, President Bush's Energy Secretary, Admiral James Watkins, began a series of meetings around the country to help develop a new national energy strategy. Three, in August 1990 Saddam Hussein invaded Kuwait, initiating the series of events that put a half million American soldiers in harm's way and leaving no doubt about the importance of our heavy dependence on foreign oil.

On February 20, 1991 the Administration released their proposed "National Energy Strategy." Leading Congressmen and Senators introduced, or re-introduced their energy bills and the legislative debate started in earnest.

The most important and controversial energy efficiency proposal were efforts to strengthen CAFE standards. Prior CAFE standards are credited with saving the U.S. 2.5 million barrels per day of oil and tens of billions of dollars

TABLE 2
GUIDELINES FOR GRADING EPACT ENERGY EFFICIENCY PROVISIONS

Grade	Meaning
A	Implementers have done a very good job implementing the EPAct provisions, going beyond the narrow letter of the law in order to fulfill the overall intent of the provision.
B	Implementers have done an acceptable job implementing the EPAct provisions, meaning they have fulfilled the legal requirements but not gone beyond these.
C	Implementers have not fully implemented the EPAct requirements. Substantial work has taken place, but some of the legal requirements have not been met.
D	Significant legal requirements have not been met but some work has taken place.
F	Implementers have largely ignored EPAct provisions and/or implementation falls short of the legal requirements in fundamental ways.

annually. Increasing CAFE standards had been debated for a decade, but the leading proponent of higher standards, Senator Bryan, was not able to get them in the Senate bill. Representative John Dingell's (D-Mich.) forceful chairmanship of the Energy and Commerce Committee made their adoption by the House a virtual impossibility from the start.

With CAFE standards off the table, proponents of energy efficiency turned their attention to developing a variety of other proposals. These proposals had various origins and were circulated on and off Capitol Hill by a variety of means, including the introduction of key bills. Various efficiency proposals were included in Senator Timothy Wirth's (D-Colo.) bill S.324 (the "Renewable Energy and Energy Efficiency Technology Competitiveness Act of 1989"). Senator Wirth summed his bill up in a 1989 hearing, "Energy efficiency is good for the economy. Energy efficiency is good for our trade situation. Energy efficiency is good for our situation around the world." (U.S. Congress 1989).

Another key bill, which would later be incorporated into EPAct, was H.R. 2451 "The Energy Efficiency Standards Act " introduced on a bipartisan basis on May 23, 1991 by Representatives Ed Markey (D-Mass.), Michael Bilirakis (R-Fla.), and others. In large part designed by efficiency advocates, H.R. 2451 "borrowed" minimum efficiency standards from other sources. The electric motor and the HVAC standards proposed in the bill were closely based on industry's own voluntary set of standards that were already commonly in use by manufacturers. The lighting standards were modeled after Massachusetts' standards; the showerheads after California's.

The chairman of the House Energy and Commerce Committee's subcommittee on Energy and Power, Rep. Phil Sharp (D-Ind.) commenced marking up his proposed National Energy Policy Act on October 24, 1992, by considering Title I, the energy efficiency provisions. Marking up energy efficiency on the first day had two important effects. One, it sent Chairman Sharp's intended message that energy efficiency must be the cornerstone of the nation's energy policies. Two, it caught many participants off-guard, including opponents of some of the new equipment regulations and opponents of the new building codes. After a relatively short debate, the efficiency title handily passed the subcommittee by a near-unanimous vote, setting it on a relatively "safe passage" through the full Energy and Commerce Committee and the full House, with most of the key efficiency provisions which would eventually be signed into law. (In total, the Energy Policy Act was formally considered by nine separate House committees and at least 6 separate Senate committees.)

In addition to Chairman Sharp's prodding, several factors led to the relative ease by which the energy efficiency provisions were accepted by the House, and eventually the Senate and President Bush.

1) Efficiency advocates—Members and outside organizations alike had done their homework. As described earlier many of the efficiency provisions—such as new building codes, appliance standards, and federal energy management efforts—had been well-researched and "vetted."

2) Republicans, led by Representative Carlos Moorhead (R-Calif.), the senior member of the Energy Subcommittee, and producing-state Democrats decided early in the process that they would support non-CAFE efficiency provisions, or at least not actively oppose them. Most observers concluded at the time that this strategy was a combination of substantive views—especially in areas such as FEMP—and a desire to demonstrate an even-handedness between promoting supplies and efficiency. Additionally, the Bush Administration's Department of Energy was ineffective in its attempts to block various efficiency provisions. Reaching negotiated agreements with equipment manufacturers also helped diffuse a traditional source of opposition to efficiency standards.

3) Chairman Dingell appeared to desire strong *non-automotive* efficiency provisions in the bill.

4) With CAFE no longer under active consideration, the efficiency title was relatively uncontroversial—especially compared with EPAct's electricity, gas and nuclear sections. Furthermore, work on the efficiency title was conducted in large part by staff members who, as one Committee staffer described it, "had very good chemistry."

Although there were a few difficulties—such as maze of the multiple committees that had jurisdiction over the FEMP provisions—the energy efficiency provisions of EPAct made it through both the Senate and the House quite unscathed, becoming part of the new law.

Macro Trends

Before beginning to evaluate the effectiveness of EPAct and its specific requirements, it is helpful to understand how this piece of legislation fits within the context of major budget and energy consumption trends. In order to have an impact at all, EPAct required support from both Congress and the President through the budget process. Furthermore, EPAct was drafted in response to troubling energy consumption trends and was intended to have a major impact on those trends in the future. Both energy and budget trends are described below from a macro-perspective. Following this, we estimate how well EPAct faired in realizing the actual energy savings it was intended to achieve.

Federal Funding for EPAct and Other Energy Efficiency Programs

Funding for programs contained in EPAct has been erratic. While fiscal years 1992-95 saw a steady increase for EPAct and energy efficiency programs generally, relative to prior years, steep cuts were levied on them in FY 1996 (see Table 3).

Federal Funding Trends. The initial build-up in federal funding for energy efficiency was a result of increased attention given energy efficiency during the Bush Administration, departing from low funding precedents set by the Reagan Administration. The onset of EPAct influenced the FY 1993 and 1994 budgets in a positive direction. On November 1, 1991, Senators sympathetic to environmental and clean energy concerns were able to defeat Senate Energy Committee Chairman J. Bennett Johnston's first attempt at a national energy bill which included little additional efficiency effort and would have opened the Arctic National Wildlife Refuge to oil drilling. Following the defeat of this initial version, it became clear that EPAct would include more energy efficiency and renewable energy provisions, leading the Appropriations Committee to provide more funds for FY 1993 than were requested by President Bush.

The FY94-95 budgets represented what has been a more sympathetic

TABLE 3
FEDERAL FUNDING FOR ENERGY EFFICIENCY PROGRAMS (MILLIONS $)

Fiscal Year	Requested	Appropriated (nominal $)	Appropriated (constant 1992 $)
FY91	213	493	507
FY92	289	536	536
FY93	521	576	561
FY94	778	690	658
FY95	978	794	738
FY96	937	549	500
FY97	715	570	510
FY98	688	612 (est.)	537 (est.)

treatment generally given to energy efficiency by Democrats, as they controlled both the White House and Congress for the first time in years. However, despite the development of the Climate Change Action Plan by the Clinton Administration, even the Democratic 103rd Congress refused to fund energy efficiency programs near the levels requested by the President (see appendix for details).

Energy efficiency funding took a dramatic turn for the worse in FY 1996 as the Congress shifted from Democratic to Republican control. The programs were targeted by conservative interest groups as part of a broader effort to reduce federal spending. The House Science Committee passed a bill demanding a 60% cut in energy efficiency programs in FY 1996. More supportive Appropriations Committees in both the House and Senate limited those cuts to 31% (in nominal dollars) but severe damage was done to EPAct implementation. In addition, in 1996, the Congress passed a one year moratorium on the issuance of lighting and appliance standards by DOE.

Fiscal years 1997 and 1998 have seen energy efficiency funding start to rebound, with a 3% increase in FY 1997 and a 7% increase in FY 1998 (in nominal dollars). These increases are the result of a combination of intensive education and advocacy efforts on the part of businesses, energy efficiency groups, state officials, and other advocates, and a rising recognition that energy efficiency will have to play a leading role in any effort the U.S. makes to reduce emissions contributing to global climate change. Whatever actions the world community takes toward climate change, calls for increased research, development, and deployment of energy-efficient technology are getting louder. This may result in increased funding for programs through DOE, EPA, HUD, and other agencies in the coming years.

Evaluation of Federal Energy Efficiency Funding. While EPAct laid out ambitious goals, erratic and insufficient funding of the programs has slowed progress and destabilized many efforts. It's hard for a program manager to work effectively toward a goal when he or she does not know until a month into the current fiscal year at what level—or even whether—their efforts will be funded.

The fault for this can be spread widely. With primary responsibility for funding, Congress receives the lion's share of the blame. Without a war in the Mideast or lines at gas pumps in their districts, members of Congress have paid little attention to energy since passage of EPAct, despite a greater than 50% dependence on foreign oil, and accumulating evidence of climate change caused primarily by burning fossil fuels. Energy efficiency has been largely an afterthought in the Interior Appropriations bill, and—even worse—many incoming conservative members in 1995 believed that federally funded energy efficiency research and development programs were expendable altogether. Though funding levels have begun to rise again, the overall commitment to energy efficiency does not reflect the

level of priority required to make these programs as effective as Congress intended them to be in 1992.

While the Congress has not appropriated the funds needed for EPAct to live up to its promise, it is not the only actor responsible. After losing the battle over its proposed energy tax in 1993, the Clinton Administration largely steered clear of the entire subject of energy until the President became interested in global climate change in 1997. And there has been little focus on energy in negotiations which have taken place between the White House and Congress on the Interior Appropriations bill in recent years.

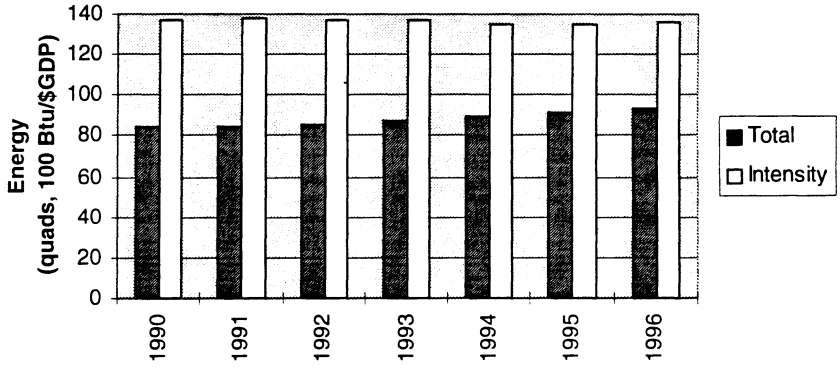
Finally, the Department of Energy has not been able to clearly and effectively articulate the purpose and importance of EPAct programs to members of Congress. In addition, energy efficiency has sometimes been a victim of the intense internal lobbying which goes on between energy programs at DOE. In summary, the Clinton Administration also shares in the blame for inadequate funding for EPAct efficiency provisions.

U.S. Energy Trends, 1990-96

Although 1990 is prior to the passage of EPAct, it is commonly used to as a baseline year for examining energy use and carbon dioxide emissions. Trends during the six-year period, 1990-1996, are consistent with the trends subsequent to the passage of EPAct in October 1992.

Overall Energy Use. In spite of policies such as EPAct and the Climate Change Action Plan, overall U.S. energy intensity is no longer significantly falling. Total U.S. energy use grew from 84.1 quadrillion Btus (quads) in 1990 to 93.8 quads by 1996, an increase of 11.6% (see Figure 1) (EIA 1997a). During this same period, GDP increased from $6.14 trillion to $6.91 trillion (1992 dollars), a 12.5% increase. Thus, the energy intensity of the U.S. economy (primary energy use per unit of GDP) fell only 0.9% over this six-year period, 0.15% per year on average (EIA 1997a). In contrast, the energy intensity of the U.S. economy declined 28% during 1973-90 (nearly 2% per year on average). Of course, the situation during 1990-96 might have been worse (i.e., increasing energy intensity) in the absence of EPAct and other policies promoting greater energy efficiency.

FIGURE 1
U.S. Energy Consumption and Intensity 1990-1996



Note: Primary energy consumption is defined in quadrillion (10^{15}) Btu. Energy intensity is defined as 100 Btu of energy consumption per dollar of GDP (in 1992 dollars).

Source: DOE-EIA, *Annual Energy Review, 1996*.

Relatively low energy prices contributed to the lack of progress on energy efficiency during 1990-96. Corrected for inflation, the average price of both gasoline and electricity fell about 10% over this period (EIA 1997a). The average price of natural gas also fell slightly during this period.

Given these energy use and price trends, it is not surprising that U.S. carbon emissions rose 8.9% between 1990 and 1996. Part of this rise was due to abnormal weather and the fact that 1996 was a leap year, but about 80% of the increase was due to other factors (Geller and Thorne 1997). The United States is clearly not on track for returning its greenhouse gas emissions to their 1990 levels by 2000. In fact, if current trends continue, carbon emissions in 2000 could exceed 1990 emissions by 15% or more.

U.S. energy use is growing most rapidly in buildings, but industrial and transport energy use is also on the rise (see Table 4). The sectoral trends are briefly reviewed below.

Residential Energy Use. Including energy losses in power generation and supply, residential energy use rose from 16.6 quads in 1990 to about 19.4 quads in 1996, nearly a 17% increase. Part of this increase is due to growth in the number of households, but energy use per household also rose by 9.5% during this period. Continuing electrification is one factor causing the rapid growth in residential energy use so far this decade. Residential electricity use increased about 18% during 1990-96, compared to about a 14% increase in use of other fuels. Growth in electricity use is caused by the proliferation of home electronic equipment, high-power halogen lamps, and continued growth in the fraction of households using appliances such as central air conditioners, clothes washers, and electric clothes dryers (Appliance 1997).

Increasing housing size is another factor driving up residential energy use. The average size of housing units increased from 1,673 square feet per household in 1984 to 1,800 square feet in 1990 and 1,875 square feet in 1993 (EIA 1995a; EIA 1995b). Furthermore, new housing units built in the early 1990s had over 2,200 square feet on average.

Increasing appliance efficiency is helping to prevent even higher growth in residential energy use. For example, due to new standards which took effect in 1993, the typical refrigerator sold in 1996 consumed about 660 kWh/yr.

TABLE 4
PRIMARY ENERGY USE TRENDS, 1990-96 (QUADS)

Sector	1990	1992	1994	1996 (est.)
Residential	16.6	17.1	18.0	19.4
Commercial	12.9	13.2	13.8	15.0
Industrial	31.9	32.7	33.4	34.6
Transport	22.5	22.4	23.6	24.4
Total	84.1	85.5	89.2	93.8

Notes: Totals may not equal sum of sectors due to rounding errors and use of different data sources. Sector amounts include energy losses in electricity production and supply.

Sources: EIA 1994; EIA 1996; EIA 1997a.

compared to 915 kWh/yr. for the typical 1990 vintage model (AHAM 1997). The typical central air conditioner sold in 1996 had a SEER rating of 10.6, compared to 9.3 in 1990 (ARI 1997). As for gas furnaces, 58% of new furnaces sold in 1990 had an AFUE efficiency rating less than 80% and only about 17% had a rating above 88%. By 1996, only 15% of new furnaces were rated below 0.80 and 23.5% were rated above 88% (GAMA 1997). The big improvement for both furnaces and air conditioners came in 1992 when the NAECA standards took effect.

Building envelope improvements such as better insulation and windows are also helping to restrain growth in residential energy demand. The fraction of all housing units with wall insulation, for example, rose from 66% in 1990 to 70% in 1993, and over 90% of new housing units built during the early 1990s included wall insulation (EIA 1995b). Regarding windows, while only about 4% of the housing stock had low-E windows as of 1993 (EIA 1995b), over 30% of new residential windows sold in recent years are low-E. Likewise, around 23% of housing units built in the early 1990s contained a setback thermostat, double the penetration of this efficiency measure in the entire housing stock (EIA 1995b).

Commercial Energy Use. Commercial buildings energy use (including energy losses in power generation and supply) rose from 12.9 quads in 1990 to about 15.05 quads in 1996, nearly a 17% increase. Much of this increase is due to growth in the building stock, but energy use per square foot of floor area also rose by about 4.8% during this period. Increasing electrification was one factor causing the growth in commercial energy use so far this decade. Growth in electricity use is due in part to increasing penetration of personal computers, printers, and other types of office equipment (so-called plug loads).

As is the case in the residential sector, the diffusion of a number of efficiency measures is preventing commercial energy use from growing even more rapidly. Lighting is one area where there have been widespread efficiency improvements. For example, electronic ballasts represented over 30% of new fluorescent ballasts produced in the United States in 1995-96, compared to just 4% of production in 1990 (DOC 1997). Approximately 136 million electronic ballasts were produced in the United States during 1990-96 (most are being used here, but some were exported).

Surveys of commercial buildings also indicate growing adoption of certain energy efficiency measures. For example, it is reported that the presence of lighting control systems (daylighting or occupancy sensor and controls) increased from about 9% of commercial floor space in 1992 to about 21% in 1995 (EIA 1997c). Likewise, use of compact fluorescent lamps increased from 14% of floorspace in 1992 to 27% of floorspace in 1995 (EIA 1997c). And use of insulation in commercial buildings also increased between 1989 and 1995 (EIA 1997c).

Industrial Energy Use. Energy use in industries (including energy losses in power generation and supply) rose from

31.9 quads in 1990 to 34.4 quads in 1996, about an 8.5% increase. Thus, industrial energy use per unit of GDP as well as industrial energy use per unit of industrial output fell slightly during this period. This is due to a combination of structural shifts and technical changes, which vary from subsector to subsector. Overall manufacturing energy intensity (primary energy use per dollar of shipments) fell about 6.6% between 1991 and 1994 according to EIA survey data, but more detailed analysis of sectoral trends and the causes of this decline is not yet available.

Transport Energy Use. Transport energy use rose from 22.5 quads in 1990 to 24.4 quads in 1996, about an 8.6% increase. Approximately 80% of this increase is in light duty vehicles; the remainder is in other modes such as freight transport. Motor vehicle ownership and use continued to rise at a steady pace, with nearly 8% more vehicles in use and average miles driven per vehicle up a similar amount in 1995 compared to 1990 (EIA 1997a).

The increase in transport energy use during the 1990s was restrained somewhat by a small increase in the average fuel efficiency of the light vehicle fleet, which is estimated to have improved from 18.9 MPG in 1990 to 19.7 MPG by 1995 (EIA 1994; EIA 1996). While the average fuel economy of new cars and light trucks did not improve during the 1990s, there was still some improvement in the fleet average due to factors such as retirement of older, inefficient vehicles. However, this trend appears to have essentially ended, with the fleet average fuel economy no longer rising (EIA 1996). The growing popularity of light trucks (vans, pick-ups, and sport utility vehicles) is contributing to the lack of improvement in overall vehicle fuel efficiency today.

Utility Sector Trends. Electric utilities and to a lesser extent gas utilities have been an important stimulus for energy efficiency improvements during the early 1990s. Spending on demand-side management (DSM) programs by electric utilities increased from about $1.2 billion per year in 1990 to $2.7 billion per year as of 1993-94 (EIA 1997b; Hadley and Hirst 1995). However, with major restructuring of the utility industry underway, utilities collectively reduced DSM spending to $2.4 million in 1995 and projected further reductions in 1996 (EIA 1997b). Nonetheless, utilities estimate that their cumulative DSM efforts saved about 57 TWh in 1995 or 1.8% of national electricity use that year. This compares to savings of just 22 TWh as of 1990. As of 1995, utilities report about 45% of the total electricity savings in the commercial sector, 35% in the residential sector, and 17% in the industrial sector (EIA 1997b).

With the emergence of restructuring and increasing competition, the nature of DSM programs is changing. Utilities are cutting or eliminating incentive (rebate) payments and are increasing their emphasis on financing, information, load management, and market transformation activities (Nadel 1996). Anecdotal evidence suggests that the loss of utility incentive payments may be adversely af-

fecting the market penetration of efficiency measures in some situations (Prahl and Pigg 1997), although in other cases the market for efficiency measures did not significantly erode after utility incentives were withdrawn (Peach et al. 1996; Meberg et al. 1997). It remains to be seen if the new generation of utility energy service activities will have a significant impact with respect to improving efficiency and reducing overall energy use.

On the electricity supply side, new technologies such as gas-fired combined cycle power plants offer the potential for higher power generation efficiency. However, relatively little progress was made in increasing the efficiency of power generation as a whole during the early 1990s. The average heat rate of fossil fuel-based power plants declined by 0.9% between 1990 and 1996, meaning there was a very slight overall efficiency gain (EIA 1997a).

EPAct's Energy Savings

In 1992, ACEEE and the Alliance released a report estimating the energy savings from each of the energy efficiency provisions in EPAct (Geller et al. 1992). The energy savings estimates were adjusted to exclude savings from efficiency improvements that were expected to occur without EPAct. At that time ACEEE and the Alliance estimated that EPAct's energy efficiency provisions would save about 2.0 quads per year of primary energy by 2000, representing about 2.1% of projected energy use. Total cumulative energy savings from the law were estimated to be about 6.8 quads through 2000.

Using these savings estimates as a baseline, lead authors of each section of this report reviewed progress made in implementing each section of EPAct to estimate the proportion of the original (1992) savings estimate that were likely to be achieved by 2010. The 1992 savings estimates were then multiplied by this "savings achieved proportion" to arrive at a current (1997) savings estimate for each section. In considering these "savings achieved proportions" please bear in mind that these relate to the original savings estimate. Thus, a savings achieved proportion of 100% for window labeling does not mean all windows are labeled, but instead means that we are on target to label 25% of windows by 2000, where 25% was a key assumption used to estimate energy savings in our 1992 analysis.

Based on this analysis, the Alliance and ACEEE estimate that almost half of the initially projected savings will be realized by 2000, or 3.14 quads, through EPAct. A breakdown of savings estimates for each EPAct section is provided in Table 5. Both the ACEEE estimates and the estimates of the actual savings achieved should be viewed as rough approximations due to the tremendous uncertainty regarding the response to some of the provisions. However, there is more certainty now than in 1992 as to whether or not DOE, Congress and other implementers of EPAct are making progress toward the targeted energy savings. For many of the provisions, programmatic trends have been set in the last five years that will be difficult to alter in the remaining three years.

TABLE 5
ESTIMATED PRIMARY ENERGY SAVINGS FROM THE ENERGY EFFICIENCY PROVISIONS IN THE ENERGY POLICY ACT OF 1992

EPAct Proposal (Quads)	Cumulative Savings 1993-2000[1] (Quads)	Estimate of Actual Savings Achieved Through EPAct	Revised Savings 1993-2000
Building Standards			
• Residential	0.06	60%	0.036
• Commercial	0.51	57%	0.29
HERS	0.13	10%	0.01
Electric Utility Reg. Reform			
• Demand Side	0.30	10%	0.003
• Supply Side	1.10	10%	0.110
Least Cost Planning TVA	0.29	0%	0
Least Cost Planning WAPA	0.11	10%	0.011
Gas Utility Reg. Reform	0.20	0%	0
Window Testing and Labeling	0.23	100%	0.23
Equipment Efficiency Stds.	1.98	80%	1.58
Luminaire and Office Equipment Testing and Ratings	0.39	75%	0.293
Energy Efficiency in Industrial Facilities	0.27	10%	0.027
Process-Oriented Industrial Efficiency Programs	0.16	50%	0.080
Industrial Insulation and Audit Guidelines	0.22	60%	0.132
SECP Amendments			
• State Buildings Funds	0.02	0%	0
• Building Retrofit Stds	0.02	0%	0
Federal Energy Management	0.33	10%	0.033
Taxation of Transport Benefits	0.03	100%	0.030
Taxation of Utility Rebates	0.09	50%	0.045
Energy Efficiency RD&D	0.31	75%	0.232
Total	**6.75**	**47%**	**3.142**

[1]Estimates made by ASE & ACEEE in 1992.

Analysis of Table 5 reveals an uneven performance among EPAct's requirements. By our estimation, only five provisions are likely to have cumulative energy savings of 0.2 quad or more by 2000—equipment efficiency standards (which alone accounts for half of the total savings achieved), commercial building codes, window testing and labeling, luminaire and office equipment ratings, and energy efficiency RD&D.

Other EPAct provisions have been more disappointing when it comes to providing energy savings. Home Energy Rating Systems (HERS), least cost planning initiatives for TVA and WAPA, gas utility regulatory reform, the state energy conservation program (SECP) provisions, and the federal energy management provisions in EPAct have been disappointing when it comes to realizing energy savings. The reasons why these provisions have not been successful are discussed in the reviews below.

Energy Policy Act of 1992

Analysis By Title

Buildings Title I, Subtitle A

Overview of Provisions

Title I of EPAct addresses energy efficiency in a variety of contexts, starting with buildings. The buildings subtitle requires states to adopt the ASHRAE standard 90.1-1989 for commercial buildings, and to consider adopting the residential Model Energy Code (MEC-1992). It also requires the establishment of regional building energy efficiency centers, provides advice to HUD on manufactured housing energy standards, and establishes pilot programs and other provisions regarding energy-efficient mortgages.

Section 101. Building Energy Efficiency Standards

This section requires states to consider upgrading their residential building energy codes to meet or exceed MEC-1992, and to adopt a commercial building energy code that meets or exceeds ASHRAE 90.1-1989. In addition to providing technical and financial support to states in this effort, DOE was to develop new building standards for federally owned buildings, and to support development of improved private-sector building energy codes. A review of key activities and their status is summarized below.

State review and consideration of MEC-1992. States were required to review and consider adoption of the 1992 version of the Model Energy Code (1992 MEC), and to report to DOE on whether and why they did or did not adopt the code. At this point, almost all of the states have reported. Thirty states have either adopted the 1992 MEC or a more recent version, or have residential building energy codes deemed to be more energy efficient (BCAP 1997). These states account for about 60% of total U.S. housing starts (Johnson 1997). Prior to EPAct, only about 16 states had residential codes at least as stringent as the 1989 MEC, which is less stringent than the 1992 version (Howard and Prindle 1991). It is apparent that EPAct caused several states to review and adopt one MEC version or another; DOE technical assistance and grants may also have helped some states do the analysis needed to support these changes.

Among the states in which DOE assistance—in the form of DOE grants, or technical assistance from the DOE-supported Building Codes Assistance Project (BCAP) or Pacific Northwest National Laboratory (PNNL)—was particularly critical in achieving adoption of the MEC are Massachusetts, South Carolina, Vermont, Kansas, Iowa, Ohio

and Delaware. BCAP also assisted Virginia, Maryland, Rhode Island, and Oklahoma in their decisions to adopt the 1996 BOCA code, in which the 1995 MEC is included (McQueen 1997).

PNNL has provided assistance in various ways, such as conducting cost-effectiveness analysis for states, developing compliance support information, conducting training for code officials, designers and builders, and creating the MECcheck software. MECcheck has been a valuable tool in overcoming the resistance to MEC adoption based on the perceived complexity of the code. MECcheck allows designers, builders, and code officials to determine whether any given design complies with the MEC, and also provides sample compliant practice packages. Dissemination and training on MECcheck have helped several states overcome builders' and code officials' reluctance to use the MEC (Johnson 1997).

The energy, economic, and environmental benefits of state adoption of the MEC are substantial. We estimate that, while many states have adopted the 1992 MEC, the savings potential from the 1993 version of the MEC remains large. By adopting the 1993 MEC or a more stringent equivalent in the 31 states that have not yet done so, 8 trillion Btus in energy use, $92 million in consumer energy bills, and 247,000 tons of air pollution could be saved annually (Norland 1997).

State adoption of ASHRAE 90.1 Standards. While EPAct required states only to review and consider adoption of the 1992 MEC, they were required to *implement* commercial building energy codes at least as stringent as ASHRAE Standard 90.1-1989. Progress on this front is less encouraging; despite the legal requirement. Only 28 states are in compliance with the Act five years after its passage (BCAP 1997). These states, however, account for 64% of the commercial new construction activity in the U.S. (Johnson 1997).

DOE, while it has provided technical assistance to states, has not been aggressive in enforcing this requirement. Some states have reportedly received and spent DOE technical assistance funds without complying with the EPAct commercial building code mandate.

There are examples where DOE-funded assistance helped states to meet this requirement. First, BCAP provided technical assistance to the state of Louisiana in its decision to adopt 90.1-1989. Second, PNNL has been working with the Multi-State Working Group, which includes MA, RI, VT, NC, FL, IN, CA, OR, and MN, to develop a simplified version of 90.1-1989 that is easier to administer than the existing standard. PNNL developed the COMcheck-EZ software that enables individual states to determine compliance with ASHRAE 90.1-1989 in a simplified fashion. It has also helped the states develop a simplified code-language version of 90.1-1989 for smaller/simpler commercial buildings. This simplified code-language version was accepted for inclusion in the 1998 Model Energy Code (Johnson 1997).

DOE review and determination of MEC upgrades. EPAct required DOE to review subsequent versions of the MEC and other national model codes, and to make determinations whether they are significantly more energy-efficient. If such a determination were to be made, DOE is required to ask states to review and report on the adoption of the new version of the code. DOE did make such a determination regarding the 1995 MEC in December 1996. Pursuant to the Act, states have until December 1998 to report (Turchen 1997). At present, it is estimated that 15 states have codes at least as stringent as the 1995 MEC (BCAP 1997).

Assistance from DOE, through PNNL and BCAP, has been instrumental in adoption of the 1995 MEC in states such as Massachusetts, South Carolina, and Vermont.

DOE review and determination of ASHRAE 90.1 upgrades. As with residential codes, DOE is required under EPAct to review subsequent versions of ASHRAE 90.1 and make determinations whether they are more stringent than the 1989 version. If DOE makes such a determination, it must require states to implement the updated version. ASHRAE Standard 90.1-R is still under development. Currently in its second public review draft, it is not likely to be issued soon. Thus DOE has not had occasion to perform a review and certification under this provision.

Provide technical assistance and grants to states. EPAct required DOE to provide technical assistance, both in kind and as grants, to states and others considering adoption of the MEC. Since passage of the Act, DOE and states have sought and obtained appropriations for these services. Approximately $12 million has been spent on grants to states, with the great majority of states receiving at least one grant (Appel 1997). DOE continues to issue grant solicitations under the program. In addition, PNNL has conducted training and technical assistance in 46 states and four territories (Johnson 1997).

Review and upgrade energy codes for federal buildings. DOE has been charged with upgrading its residential and commercial building energy standards that apply to federally-owned buildings. DOE has issued draft standards for comment; comments were received in fall 1996 for commercial buildings and summer 1997 for residential buildings. No final standards have been issued to date. Some commenters have been disappointed in the length of time it has taken DOE to develop the drafts, and in the aggressiveness of various efficiency criteria in the drafts. For example, the residential draft did not include certain window standards that have been included in the 1995 MEC. There was no apparent reason why DOE failed to keep pace with the MEC on this issue. On the other hand, the commercial draft did include lighting power levels that are stronger than the levels in ASHRAE 90.1-1989.

Support upgrades in "voluntary" building energy codes. DOE was mandated in EPAct to participate in voluntary code development processes, such as

those run by the MEC secretariat and ASHRAE. DOE and its contractors (such as PNNL) are active in the MEC and ASHRAE development processes, and regularly submit proposals and provide testimony and analysis. For example, in the 1997 MEC code change hearings, DOE submitted six proposals and PNNL submitted eight (BOCA 1997). PNNL's simplified version of Standard 90.1 for smaller, simpler commercial buildings was accepted and will be included in the 1998 MEC as an alternative to using 90.1 for qualifying buildings. DOE and PNNL staff also serve on numerous ASHRAE and other committees. In fact, ASHRAE's two code development committees are currently chaired by PNNL staff.

Upgrade codes related to FHA and RECD mortgage programs to MEC-1992. The Act required the HUD and Agriculture Departments to upgrade building standards used in the FHA and RECD mortgage programs. These programs provide low-cost mortgages to qualifying lower income purchasers of homes in urban and rural areas. In addition, both agencies have upgraded their standards to comply with the 1992 MEC requirement; HUD has completed a study of the 1995 MEC, but has not yet changed its standards to comply with it (HUD 1997).

Section 102. Residential Energy Efficiency Ratings

This section requires DOE to promulgate voluntary national guidelines for home energy ratings, and to provide technical assistance for their implementation to state and local organizations. Prior to the Act, DOE had voluntarily conducted a national collaborative with a wide range of stakeholders to seek consensus on HERS guidelines. It was anticipated that this process would extend naturally into the development of the EPAct-mandated guidelines.

DOE extended financial support to the HERS Council, beginning in 1993, and gave it responsibility for developing draft guidelines. The Council board was structured in an attempt to balance the interests of electric and gas utilities, home builders, state energy offices, nonprofit rating organizations, and other stakeholders. This structure proved to be fragile—competing interests between stakeholders developed along several dimensions, and eventually frustrated consensus on the Council.

The Council did perform significant technical work; its Technical Committee addressed the key issues in detail, and resolved the fundamental technical issues. The final draft standards represented painstaking work and consensus on most issues. However, political issues prevented their work from being formally adopted.

DOE's role in this process has gone from one of leadership to one of indecision. In the late 1980s and early 1990s, DOE exhibited leadership in organizing the Council and supporting various kinds of research work on HERS. As the HERS Council developed, however, DOE's leadership of the process faltered. Staff handling of key political issues was viewed as less than effective. And as the last round of political

conflicts threatened to stymie the rulemaking process, DOE declined to take a leadership role in forcing resolution of the main issues. DOE continues to take no action on issuance of the rules mandated under EPAct.

DOE's role in providing technical assistance to states is moot, since the guidelines have not been promulgated. Thus, there is no basis for offering implementation assistance.

Section 103. Energy Efficient Lighting and Building Centers

This section required DOE to establish a grant program to support 10 regional centers for promoting energy efficiency in buildings; $10 million was authorized for the grants. This program was never funded by Congress; therefore the centers were not established.

Section 104. Manufactured Housing Energy Efficiency Standards

This section required HUD to recommend energy efficiency standards to the National Commission on Manufactured Housing. This commission was created in the Cranston-Gonzalez National Affordable Housing Act of 1990 as a compromise over an impasse on energy standards for manufactured housing.

The section also creates a pre-emption exception: if HUD failed to issue standards within a year following the enactment of EPAct, states could create their own standards.

The National Commission never resolved the energy standards issue. However, HUD, possibly because of pressure from states under the pre-emption clause in EPAct, has issued new energy standards for manufactured housing.

Section 105. Energy Efficient Mortgages

This section required the Task Force created under the Cranston-Gonzalez Act to determine whether notification of mortgage applicants would increase demand for energy-efficient mortgages, and if so, to recommend guidelines for affected mortgage institutions.

The initial intent of this provision was to revive a proposed provision in the Cranston-Gonzalez Act that would have required mandatory notification regarding energy-efficient mortgages to borrowers at the time of mortgage application. This provision was not included in the final bill. In its place, a Task Force and study were called for.

The Task Force met officially only once, in 1992 prior to the signing of EPAct, and thus has not taken up this EPAct provision. HUD has shown no intention of carrying out its requirements in this area, either under the Cranston-Gonzalez Act or EPAct.

Section 106. Energy-Efficient Mortgage Pilot Program

HUD was required to set up a pilot program in five states for its FHA

mortgage insurance program, using prescribed program parameters. After the pilots, HUD had to show cause why it should not adopt the new parameters on a national basis.

HUD followed through with this provision. The five states (AK, CA, VA, VT, AR) received HUD grants, and as of 1995 the program has been amended nationwide to reflect the provisions mandated in the pilots. While data is very sketchy, one HUD source indicated that at least 3000 new EEM loans had been issued under the new national guidelines.

Final Grade "B-"

The final grade for EPAct's building requirements reflects the performance of DOE and others with respect to each of its sections. Regarding codes and standards, DOE has followed through in conducting the state certification effort, providing technical assistance and grants, developing new federal standards, and beefing up its presence in code development processes. Some commenters believe that the federal standards could be more aggressive, and that DOE could be more assertive in enforcing the commercial building code requirements and proposing efficiency increases in code development processes.

On HERS, DOE has performed less satisfactorily. Initially, DOE's work and leadership was laudatory, but after the HERS Council process began DOE began to lose control. The Department has shown little initiative in resolving the issues that remain; it is unfortunate that a lot of good technical work is being wasted by this inability to complete the EPAct mandate to issue the guidelines.

It should be noted that the HUD's performance was above average in three areas: manufactured housing standards, EEM pilots, and EEM Task Force. It fulfilled its legal mandate to issue standards, which was no mean feat considering industry opposition. It conducted the EEM pilots, and in fact went beyond the EPAct mandate and made the EEM program a national, permanent provision, though its ongoing management support for the program is minimal. However, HUD failed completely to take action on the Section 105 requirement, although it is not clear if this provision could have had a significant impact.

Utilities
Title I, Subtitle B

Title I, Subtitle B of EPAct deals with utilities. Section 111 urges state regulatory commissions to encourage investments in energy efficiency by electric utilities, Section 112 authorizes grants to states for Section 111 activities, Sections 113 and 114 encourage least-cost planning by the Tennessee Valley Authority and the Western Area Power Administration, and Section 115 is similar to Section 111 except it applies to gas utilities. These provisions are discussed in the paragraphs below.

Sections 111 and 115. Encouragement of Investments in Energy Efficiency by Electric and Gas Utilities

The Public Utility Regulatory Policies Act of 1978 (PURPA) included provisions directing state regulatory bodies to consider adopting specific policies at the state level. Sections 111 and 115 of EPAct expand the list of policies states must consider to include integrated resource planning for electric and gas utilities, and adjusting gas and electric ratemaking to encourage (or at least not discourage) investments in energy efficiency including efficiency investments on both the customer and utility side of the meter. EPAct provided states with a two year period to consider these new policies.

In 1995, DOE completed a report to the President and Congress that reviewed the impacts of these EPAct provisions. It was based on a survey of state utility commissions (DOE 1995). This report concluded that:

- States report being heavily involved with integrated resource planning and demand-side management but little of this activity was said to be the direct result of EPAct.
- States report being less heavily involved in requirements for energy-efficiency investments for power generation and supply than for IRP and DSM but that EPAct appears to be encouraging some states (i.e., 12) to open dockets in this area.
- States also report being less active in gas than electric IRP and DSM but 13 states reported opening a docket in these areas.

A subsequent National Association of Regulatory Utility Commissioners (NARUC) survey published in 1996 reported little additional progress (NARUC 1996).

These results are not surprising. Initially, following EPAct enactment, quite a few states began proceedings to consider the policies encouraged by EPAct, particularly policies on supply-side efficiency and gas IRP and DSM. In fact, some public interest advocates report that the EPAct legislation

was useful to convince some states to open dockets (Wooley 1995). However, in 1994, with the publication of California's "Blue Book" (CPUC 1994), major changes hit the electric utility industry which made integrated resource planning and related policies much less relevant than when EPAct was enacted. In part, encouraged by Title VII of EPAct, many states have given or are considering giving retail customers the ability to choose from many electric suppliers, with the result that the emphasis is shifting from long-term resource planning to much shorter term and more flexible planning processes. Similar changes are taking place in the gas industry.

Likewise, with generators preparing for competition, they have much larger incentives to improve efficiency in the generation and transmission system, thereby cutting costs and freeing up additional kWh to sell. Provisions to encourage distribution utilities to promote energy efficiency investments are generally still relevant, but these have received limited attention as states devote available resources to the question of whether and how to restructure the electric industry within their states. In addition to the tidal wave of utility restructuring, the fact that Section 112 (discussed below) was never funded may have also contributed to limited state activity on Sections 111 and 115.

Overall, Sections 111 and 115 appear to have had some limited impact in the first two years after EPAct enactment. They also aided in increasing regulator, utility, and public interest advocate attention to the role of energy efficiency in the utility industry. But these provisions were designed for the old world of highly integrated utilities. With utility industry restructuring, these provisions are no longer very relevant and hence their long-term impact is limited.

Section 112. Energy Efficiency Grants to State Regulatory Authorities

Section 112 authorized a grant program to help states undertake the policy investigations called for in Sections 111 and 115. However, the Clinton Administration never requested money for this program nor did Congress appropriate money for this program and hence the program was never started. However, while funds for grants to states were never provided, Congress did initiate the DOE Integrated Resource Planning program in the 1993 fiscal year, and the Congress, Bush Administration and Clinton Administration continued to support the program during the 1994 and 1995 fiscal years. Funds from these program supported a wide range of technical assistance to states including services provided by the NARUC, the Regulatory Assistance Project, and others. Unfortunately, Congress zeroed out the budget for this program for fiscal year 1996.

Section 113. TVA Least Cost Planning Program

Section 113 directed the Tennessee Valley Authority (TVA) to undertake a least cost planning process "which evaluates the full range of existing and incre-

mental resources (including new power supplies, energy conservation and efficiency and renewable energy resources) in order to provide adequate and reliable service to [TVA customers] at the lowest system cost." In the late 1980s, TVA had canceled most of its energy efficiency programs; Section 113 was developed in large part to get the agency to reconsider this decision.

TVA did in fact undertake the planning process called for in EPAct. According to one observer, the plan was massive and technically well done (Hirst 1997). However, TVA management is focused on being competitive in the new restructured utility industry, and has little interest in promoting energy efficiency. Given these biases, the TVA plan focused on flexibility and made no significant commitments to energy efficiency. And according to several observers, the limited efficiency steps included in the plan have largely been ignored.

Thus, Section 113 appears to have largely failed in its mission to encourage increased energy efficiency activities by TVA. This is due in part to changes sweeping the entire U.S. electric industry, and in part to TVA management's disinterest in energy efficiency issues.

Section 114. WAPA Least Cost Planning Program

Section 114 amended the Hoover Power Plant Act of 1984 to require Western Area Power Administration (WAPA) customers (primarily public utilities) to prepare integrated resource plans as a condition of receiving electric power from WAPA. WAPA was also directed to review and approve plans and to monitor implementation of the plans. WAPA customers not complying with these provisions are liable for a surcharge of 10% or more on the cost of power they purchase from WAPA.

Based on discussions with WAPA observers, WAPA did implement the IRP requirements and most utilities did file plans. The quality of plans varied widely, from ones that were just "cookie cutter" plans designed to meet the minimal EPAct requirements to those that were carefully prepared and served as an important tool to guide utility decision-making. However, following the filing of plans, WAPA significantly cut back on staff (due to a desire to reduce costs and avert privatization) and monitoring of plan implementation was substantially reduced. Since then, implementation of the plans appears to be spotty, but some utilities have found them to be a useful exercise. Many of these utilities offer DSM programs including some that most likely began as a result of EPAct. Still, due to changes sweeping the electric utility industry, the impact of Section 114 appears to be minimal (Driver 1997).

Final Grade "B-"

The EPAct utility provisions appear to have had minimal impact on the direction of utility energy efficiency activities. In the initial years these provisions were having an impact in some states, but these impacts largely disappeared when the tidal wave of utility restructuring began

to sweep the country. Had restructuring not taken place, the impacts of these provisions would probably have been greater. But even still, the impacts would probably be modest, as these provisions only demanded consideration of DSM and related policies by utilities. TVA, many WAPA customers, and some states did little more than consider these provisions and never really took them seriously. On the other hand, these provisions did increase attention paid to energy efficiency programs by regulators, utilities and public interest advocates; in some cases this attention still continues today. Overall, we give a grade of B- for implementation of these provisions—technically in compliance with the law for the most part but falling well short of the spirit of the law in many cases. But the limited impacts of these provisions are primarily due to the voluntary nature of these provisions (only "consideration" is required) and the changes sweeping the utility industry.

Appliance and Equipment Energy Efficiency Standards Title I, Subtitle C

Among the most important energy efficiency provisions in EPAct are Sections 122 and 123 which set national minimum efficiency standards for lamps, electric motors, commercial heating and cooling equipment, and plumbing products. In addition, Section 124 directs DOE to consider minimum efficiency standards for distribution transformers, high intensity discharge lamps, and small electric motors. And Sections 121, 125, and 126 deal with efficiency labeling of incandescent and compact fluorescent lamps, luminaires (lighting fixtures), windows and office equipment. Each of these provisions is discussed in the paragraphs below.

Section 122. Electric Motor Efficiency Standards

Electric motor minimum efficiency standards are contained in Section 122 of EPAct. The standards apply to 1-200 horsepower motors of the most commonly used types. The EPAct standards were based on a definition of "high efficiency motor" developed by the National Electrical Manufacturers Association (NEMA), a trade group representing most motor manufacturers. The standards go into effect for most motors on the fifth anniversary of EPAct; for motors requiring special UL safety certifications, an additional two years are provided. Much has happened over the past five years as manufacturers and others prepared for the motor standards taking effect. Overall, motor manufacturers have been very cooperative. Manufacturers have worked together through NEMA to provide input to DOE on implementing rules, including providing suggestions on how to close potential loopholes so that all covered products comply with the intent of EPAct.

Unfortunately, DOE has been very slow in developing the implementing rules for the EPAct motor standards. Draft rules were published in November 1996, but the draft rules contained a variety of problematic provisions. NEMA and other interested parties have worked together to develop joint recommendations to DOE on ways to improve the rules, but as of this writing, final rules have not been published.

DOE did issue a letter to manufacturers on September 17, 1997 delineating the specific products that will be covered by the EPAct standards (Romm 1997). This letter was released only a

month before the standards take effect, giving manufacturers very little time between publication of the letter and the effective date of the standard. Means of demonstrating compliance have yet to be finalized by DOE; in the interim DOE is relying on manufacturers to exercise good faith efforts to comply with the terms of EPAct (Ervin 1996).

While the issues addressed by these rules are complex, most of the delay can be attributed to internal problems at DOE. As a result, the testing and certification process to demonstrate compliance with EPAct will not begin until after the standards take effect. Also, DOE has had to delay the effective date for some highly specialized types of motors which have only recently (i.e., in the September 1997 letter) been included as products covered under EPAct. With a speedier rule-setting procedure, these delays and the need for interim letters could have been avoided.

In summary, manufacturers have been very cooperative and proactive in implementing this Section of EPAct. DOE has not kept up its end of the bargain; five years after EPAct adoption DOE has been unable to complete the implementing rules for the motor standards.

Section 122. Commercial Heating and Cooling Equipment Efficiency Standards

Efficiency standards on commercial packaged air conditioners, furnaces, boilers and water heaters are also contained in Section 122 of EPAct. These standards make mandatory the equipment efficiency recommendations developed by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) and published in ASHRAE standard 90.1-1989. Prior to EPAct, the ASHRAE standards applied to new commercial buildings in a handful of states that adopted 90.1-1989 as part of their state building codes. With the passage of EPAct, these standards cover all states and apply to replacement equipment in existing buildings in addition to equipment used in new construction.

The EPAct HVAC standards took effect one year after the passage of EPAct (two years for large packaged air conditioners). Implementation has gone smoothly as the standards apply to all covered equipment (there was no need to consider exemptions). The HVAC industry has established procedures for certifying equipment performance, thereby meaning DOE did not need to spend a lot of time on these issues.

On the other hand, updates to the standards have not proceeded as smoothly. Under EPAct, federal HVAC efficiency standards are to be revised whenever ASHRAE standard 90.1 is to be revised. Under ASHRAE procedures, standards should be revised at least every five years. ASHRAE is working on a revision to standard 90.1, with extensive financial and technical support from DOE (e.g., the Chair of the 90.1 Committee works for PNNL and PNNL staff are doing extensive support work). However, even under the most optimistic sce-

narios, the new standard will not be completed until 1999 at the earliest, at least five years behind schedule.

Furthermore, the ASHRAE HVAC efficiency values were developed based on 1993 data on equipment efficiency and costs. By the time ASHRAE completes standard 90.1, the analysis underlying the HVAC equipment efficiency values will be at least six years old and no longer accurate. Therefore, DOE will probably need to conduct a new analysis to use as the basis for setting federal standards. This new analysis will probably result in additional delays in revising the federal standards, although the end result of this revised analysis may well be a tougher federal standard than the forthcoming ASHRAE standard.

Overall, the HVAC standards are functioning well, although delays in updating the standards, due to delays at ASHRAE, are of concern.

Section 123. Lamp Efficiency Standards

Section 123 of EPAct established minimum efficiency standards for the most common types of fluorescent and incandescent reflector lamps. The intent of the fluorescent lamp standards was to eliminate low-cost, full-wattage lamps from the market (e.g., 40 watt "coolwhite" lamps), making energy-saver lamps (e.g., 34 watt coolwhite lamps) the least expensive products on the market, but also leaving a variety of improved efficiency, high quality lamps on the market as well. In this way buyers who were primarily motivated by first cost would generally wind up with energy-saver lamps, while buyers who were willing to invest in efficiency and quality would have a variety of products to choose from. The intent of the incandescent reflector lamp standards was to eliminate standard reflector incandescent lamps from the market, leaving buyers with a choice of energy-saving products including halogen lamps, ER and BR lamps (special lamp shapes designed to reduce the amount of light trapped in fixtures) and energy-saver lamps (reduced wattage versions of standard lamps).

The EPAct lamp standards went into effect for eight-foot fluorescent tubes in May 1994 (18 months after enactment) and for remaining covered products in November 1995 (three years after enactment). Overall, the standards appear to be moving the market in the desired directions, although implementation has been marred by two significant problems: (1) delays by DOE in completing the implementing rules for the lamp standards; and (2) creation of new products by manufacturers which seek to create or exploit loopholes in the EPAct legislation. EPAct also called for DOE to conduct rulemakings on whether to amend the EPAct lamp standards and whether to set standards on additional incandescent and fluorescent lamps not covered under the original standards. None of these rulemakings have begun.

By and large, the EPAct lamp standards have accomplished what they set out to do. In the case of fluorescent lamps, manufacturers report that they are now shipping mainly the energy saving version of the standard products which

were made illegal. With both four-foot and eight-foot products, consumers have by and large converted to the energy-saving, lower wattage product as opposed to the compliant higher color rendering, higher wattage products, whose sales continue to be moderated by their higher prices. The one exception to this has been on the residential side, where 40 watt "coolwhite" products are often being replaced with 40 watt "coolwhite deluxe" products (exempted from EPAct due to their high color rendering), resulting in little or no energy savings. On the incandescent reflector lamp front, commercial and industrial customers have shifted mainly to lower wattage halogen products. This shift has also occurred with residential customers but at a substantially slower pace.

For EPAct to be properly implemented, DOE needed to complete detailed implementing rules approximately a year before the standards take effect so that manufacturers have a chance to adjust production plans and to test products for compliance prior to the effective date of the standards. Unfortunately, DOE was very slow in developing and finalizing the implementing rules. Interim rules were published in September 1994, five months *after* the first standards took effect but 13 months *before* most of the standards took effect. Final rules were not published until May 1997, 19 months after all of the standards took effect. The delays were due in part to the complex issues involved and also to the fact that, concurrent with the rulemaking process, several manufacturers sought to create and exploit loopholes in the law, loopholes that DOE needed to close. Still, DOE moved more slowly than it should have in completing the implementing rules. These delays in turn caused uncertainty and difficulties for manufacturers and have reduced the amount of energy saved during this transition period, due to limited enforcement and a major loophole (discussed below) that was not closed until the final rule was published.

In the period between enactment of the EPAct lamp standards and their effective date, several manufacturers developed products which sought to comply with the letter but not the spirit of the law. Most notable were a 25 watt energy-saving fluorescent tube which uses 40 watts when driven by most commercial ballasts and the full-wattage BR incandescent reflector lamp (which uses a specialty lamp shape exempted from the EPAct standard to get around the EPAct lamp efficiency standards). The latter loophole was particularly significant, for during the period from October 1995, to October 1997, the vast majority of standard incandescent reflector lamps took advantage of this loophole. In May 1997, DOE largely closed this loophole by limiting the BR exemption to lamps that used less energy than standard lamps. In June 1996, DOE partially closed the 25 watt fluorescent tube loophole by limiting this exemption to products with a short life that is acceptable for most residential applications, but will make these lamps a poor choice for most standard commercial building applications.

Under EPAct, DOE was supposed to complete two other rulemakings

within five years of EPAct enactment. One was a rulemaking to consider whether any of the EPAct lamp standards should be amended; the second to determine whether the EPAct lamp standards should be extended to additional types of fluorescent and incandescent lamps including general service incandescent lamps (the standard pear-shaped light bulb). Under the legislation, both of these rulemakings were to be completed by October 1997. However, neither of these rulemakings has begun. Much of the blame for this lack of activity appears to rest with Congress, as annual appropriations for the DOE standards program have been inadequate to cover all mandated activities. Through a prioritization process that includes public participation, DOE has chosen to concentrate its resources on other products covered by standards.

In summary, the EPAct lamp standards appear to be functioning reasonably well at this point, although delays by DOE in developing implementing rules, attempts by some manufacturers to exploit loopholes in the legislation, and inadequate funding by Congress have all contributed to moderate reductions in the energy savings achieved.

Section 123. Plumbing Product Efficiency Standards

Efficiency standards on showerheads, faucets, faucet aerators, toilets and urinals are included in Section 123 of EPAct. The showerhead and faucet standards reduce hot water use, thereby directly saving energy and water. The toilet and urinal standards save cold water, but also reduce the amount of energy used to pump water and treat water and wastewater. The EPAct standards were based on state and local plumbing product standards that had been adopted in approximately 20 states prior to the passage of EPAct.

The EPAct plumbing standards went into effect for most products January 1, 1994. For toilets designed for commercial use, EPAct specified an effective date of January 1, 1997. Implementation of the EPAct plumbing standards appear to have gone smoothly and complying products now dominate the market. Surveys of consumers indicate that most consumers are satisfied with their new plumbing products (see, for example, Robison 1990; Wirthlin Group 1995). However, despite these positive consumer survey results, a few Congressmen and media personalities have been pushing for repeal of the EPAct plumbing standards, arguing that the new units do not work (Knollenberg 1997). Plumbing product manufacturers, water utilities, and environmental groups have all opposed the repeal effort, arguing that the new plumbing equipment saves energy and water, and performs reasonably well (Adams et al. 1997; American Supply Association et al. 1997).

Most of this discussion has focused on toilets, and whether EPAct-compliant toilets adequately dispose of solid waste, clog more frequently, or need cleaning more frequently. According to a study

by the Los Angeles Department of Water and Power, consumers report that cleaning frequency is about the same overall with EPAct-compliant toilets relative to the old toilets which they replaced. On the other hand, the Los Angeles study reports small increases in double flushing and use of a plunger with the EPAct-compliant toilet compared to conventional toilets (e.g., 39% of households double flush more than once a month with their new toilet, versus 28% who did so with their old toilet). However, even if the toilets are double-flushed 10% more, the reduction in water use per flush is still nearly 50% relative to the old toilets. Furthermore, some models of EPAct-compliant toilets do not suffer from these problems, indicating that these limited problems can probably be solved with improved design by those manufacturers whose toilets are the cause of most of the complaints (Wirthlin Group 1995).

In summary, the plumbing standards appear to be functioning well, and the controversy over toilet flow requirements appears to be based more on rhetoric than facts.

Section 124. Distribution Transformer, HID Lighting and Small Motor Efficiency Standards

Section 124 of EPAct called for DOE to determine whether energy conservation standards for distribution transformers, high-intensity discharge lamps and small electric motors would be technologically feasible, economically justified, and result in significant energy savings. DOE was given 30 months from passage of EPAct to make these determinations and to issue test procedures if these determinations are positive. The situation with distribution transformers is particularly troubling because in October 1993, one year after EPAct, one of the actions in the Climate Change Action Plan was to direct: DOE to promulgate efficiency standards for high-efficiency electricity transformers used to convert high voltage transmission power to lower voltage power for end users. Pending the results of a study which will be completed by March 1994, DOE will implement new cost-effective standards for replacement of utility transformers by 1996 (Clinton and Gore 1993).

Furthermore, in July 1996, DOE issued a technical report that concluded that improved efficiency distribution transformers were already on the market, and that transformer efficiency standards could save 3.6-13.7 quads of energy by 2030 (Barnes et al. 1996). Finally, on October 22, 1997, DOE issued the transformer determination, concluding that transformer standards are technically feasible, economically justified and will save significant energy. This determination lays the groundwork for developing test procedures in 1998, more than three years behind the legislative schedule in EPAct, not to mention the accelerated schedule in the Climate Change Action Plan. Finalization of a DOE standard is not likely until 2001, approximately five years beyond the time schedule in EPAct.

For the other two products covered

by Section 124, DOE has yet to issue a determination as called for in EPAct. DOE did prepare a draft technical report on electric motors and began to prepare a technical report a HID lamps. The motor report concluded that savings opportunities from high-efficiency small motors were moderate (e.g., 0.8-4.5 quads saved by 2030) and cost-effective in about half the cases examined (LBNL 1996). Based on these results, DOE has decided that other equipment efficiency standard rulemakings are a higher priority. Also, while DOE has not completed a draft report on HID lamps, reports from manufacturers indicate that use of inefficient HID lamps has declined since passage of EPAct, and thus minimum efficiency standards will not result in large energy savings.

In summary, DOE inaction has delayed transformer efficiency standards by approximately five years despite a move in the Climate Change Action Plan to accelerate this rulemaking. DOE inaction on small motors and HID lamps is less important since available information indicates that standards for these products will save less energy than other equipment efficiency standard rulemaking proceedings now underway.

Sections 121, 123, 125 and 126. Labeling of Windows, Incandescent and Fluorescent Lamps, Office Equipment and Luminaires

EPAct called for labeling and information programs on windows (Section 121), general service incandescent and fluorescent lamps (Section 123), office equipment (Section 125), and luminaires (Section 126). The purpose of these labeling and information programs is to give consumers information on the relative energy use of different products, thereby encouraging them to consider energy efficiency as part of their purchase decisions. All of these labeling programs are now functioning to at least some extent.

Of these programs, the window program has probably been the most successful thus far. The window labeling program was developed by the National Fenestration Rating Council (NFRC), using funds from DOE, states, and window manufacturers. Prior to NFRC, there were multiple window testing protocols, and some of these protocols were easy to "game," making comparison of products and verification of performance very difficult.

NRFC developed standardized testing and calculation procedures to rate the energy performance of windows, and a certification process to ensure that ratings are accurate. This information is placed on a NFRC label and also frequently appears in product catalogs. As of this writing, approximately half the states in the U.S. make reference to NFRC ratings in their state building codes. In addition, many utilities require use of NFRC ratings in determining products that are eligible for rebates and other promotional programs (Douglas 1997). Thus, the NFRC label is contributing to the accuracy of building code enforcement and utility promotion

programs, resulting in significant energy savings.

The lamp labeling program was developed by the Federal Trade Commission (FTC) as called for in EPAct. The EPAct lamp labeling rules went into effect in the spring of 1995. As a result, general service incandescent and compact fluorescent lamps have a label that prominently indicates the light output (measured in lumens) so that consumers can more easily find energy-saving products that have the same light output as conventional lamps. However, the FTC declined to include comparative information on operating costs on the label, a step called for by energy efficiency advocates. The lamp labeling program is probably achieving some energy savings, but since few consumers know how to convert watts into operating costs, the impacts of the program are likely to be very limited.

The luminaire (lighting fixture) labeling program was developed by the National Electrical Manufacturers Association (NEMA). The program established a new metric (the Luminaire Efficacy Rating—LER) for measuring luminaire efficiency and instituted improved procedures for measuring the efficiency luminaire systems. Participating manufacturers have agreed to list LER ratings in their product catalogs. LER ratings are now appearing in many manufacturers catalogs and other publications (NEMA 1997). However, since these ratings have just begun to appear, it is too early to assess the impact of this program on purchaser behavior.

Work to develop office equipment testing and labeling procedures was begun by the Council on Office Products Energy Efficiency (COPEE), a group created by office equipment manufacturers with public interest representatives in an advisory role. But midway into the process, COPEE stopped work and instead petitioned DOE to accept use of the EPA Energy Star label for office equipment as an acceptable alternative to the program called for in EPAct.

The EPA Energy Star program has been very effective. According to a survey conducted for EPA by Dataquest, 74% of personal computers, 93% of computer monitors, and 97.5% of printers met Energy Star criteria as of 1995 (Dataquest 1996). However, the Energy Star label is based on a maximum energy use of 30 Watts of power in the "sleep" mode (equipment goes to "sleep" after significant periods of inactivity). Further energy use reductions are possible, but without widespread testing of equipment, labeling, and dissemination of testing results, it is not possible for consumers to identify these more efficient products. Furthermore, without this information, it is more difficult for EPA to revise Energy Star levels in the future.

In addition, another issue for the Energy Star program is whether real equipment, as installed and used, actually "sleeps" when it should. EPA has recently revised the Energy Star criteria to require that equipment be shipped with the sleep mode enabled. However, additional steps are probably needed to encourage users to keep the sleep mode enabled and to

improve hardware and software so that the sleep mode is a viable option for networked equipment.

In April 1996, DOE conditionally accepted the COPEE proposal to rely primarily on the Energy Star program, but DOE noted its expectation that shortcomings in the current program would be addressed. These expectations included providing consumers with more information to enable comparison of the potential cost savings of alternative products; educating consumers about the program; and disseminating information on equipment energy use in sleep mode. Since this ruling, some consumer education efforts have taken place, but data on equipment energy use and cost savings are not readily available. To address this latter problem, EPA could expand its listing of qualified products to include test results on actual energy use in sleep and active modes.

In summary, most of the labeling programs are functioning as intended by EPAct. The office equipment program has been substantially changed from what was described in EPAct, and these changes may be reducing the amount of energy savings achieved. However, none of these labeling programs has been evaluated, so the impacts of these labeling programs on purchase decisions and energy savings cannot be determined as yet.

Final Grade "C+"

Implementation of the EPAct equipment efficiency standards and labeling requirements has been a mixed bag. Clearly the lamp, motor, HVAC, and window labeling requirements have improved the efficiency of products being sold, thereby saving significant energy. The lamp and luminaire labeling programs are also up and running, although their impacts cannot be determined at this time. With a few exceptions, equipment manufacturers have followed the intent of EPAct in changing their product lines and implementing labeling requirements. The cooperation of motor, luminaire and window manufacturers has been particularly noteworthy. The FTC also gets high grades for timely implementation of the lamp labeling program (as well as marking requirements for plumbing products). And DOE, in developing implementing regulations for lamp standards, has closed the most significant loophole by limiting the "BR" exemption to energy-saving products.

On the other hand, DOE has been slow to complete many of the rulemakings called for under EPAct. Particularly egregious are the lack of a determination on distribution transformer standards, lack of implementing rules for motor standards, long delays before completing the implementing rules for lamp standards, and issuing regulations that allow one significant loophole in the fluorescent lamp standards (for the 25 Watt lamp). Congress shares some of the blame for these delays as Congress has underfunded the standards program and the 1996 Congressional moratorium on new standards also delayed several rules.

And lamp and office equipment manufacturers have not been fully cooperative, with the former developing products to exploit loopholes in the legislation and the latter abandoning efforts to develop the testing and labeling program called for in the legislation.

Overall, implementation of the EPAct efficiency standards and labeling requirements merits a grade of C+—passing but plagued with a number of problems. This overall grade masks significant variation from product to product. For example, the window industry gets a grade of A for its work on window labeling, while DOE has clearly failed with respect to distribution transformers.

Industrial Title I, Subtitle D

EPAct's Title I, Subtitle D contains three sections that address industrial energy efficiency. Section 131 has three parts; each intended to promote energy efficiency in industrial facilities on a voluntary basis. Section 132 also has three parts; each intended to promote greater energy efficiency in process-oriented industries. Finally, Section 133 calls for the development of voluntary guidelines for energy efficiency audits and insulating industrial plants. This section requires the Energy Secretary to promote the voluntary guidelines through education and technical assistance and to evaluate their effectiveness in the field.

Section 131. Energy Efficiency in Industrial Facilities

Section 131 has three major provisions, including a grant program to industry associations, an award program to recognize highly efficient companies, and a report on voluntary targets.

Grants to Industry Association. Implementation of this portion of Section 131 was greatly delayed. Under the direction of DOE, the American Institute for Pollution Prevention (AIPP) advertised a grant opportunity in *Commerce Business Daily* in 1996. Five cost-shared grants were awarded in 1997 to national industry associations for the establishment (or promotion) of voluntary energy efficiency improvement programs for industrial facilities. Awards were made to:

- *Industrial Gas Technology Commercialization Center*—Development of Voluntary Efficiency Improvement Target Programs for Stoker Boilers
- *Institute for Textile Technology*—Compressed Air System Audit and Optimization Workshop and Handbook for the Textile Industry
- *National Association of Metal Finishers*—Energy and Environmental Benchmarks: A Program for Metal Finishers
- *North American Die Casting Association*—Transfer of Pollution Prevention and Energy Efficiency Technological Information to the Die Casting Industry
- *Steel Recycling Institute*—Contributions to Life-Cycle Energy Efficiency Optimization in Steel Mills and Fabrication Facilities.

According to AIPP, the five associations have received one-half of their awards, and all the programs are in various stages of implementation. Although the programs have not yet had an impact, the peer reviewers for the grants felt that these projects would not likely have

been funded by other means (due to monetary constraints) and would likely have significant positive impacts. It is estimated that the annual energy savings from the grants will someday exceed 1.2 trillion Btus per year, not including savings from reduced water and raw materials usage and reduced emissions to the environment (Fero 1997).

Awards Program. In 1995, DOE sponsored a national award program that satisfies a requirement in Section 131, i.e., the 1995 National Awards for Energy Efficiency and Renewable Energy. However, the awards program was never explicitly linked to EPAct. The award program recognized outstanding contributions in five different categories: buildings technology, energy and environmental sustainability, industrial technology, transportation technology, and utility technology. The nominations received a technical review from an independent panel of energy and environmental experts.

A report describing the awards given in each category was published in October 1995 (DOE 1995). Although many good projects were recognized through the awards program, it is difficult to determine if any lasting benefits resulted from the effort. The fact that DOE has not held another awards program since 1995 indicates that the program was of limited value.

Energy Efficiency Reporting and Voluntary Targets Study. The remaining requirement in this section is for DOE to complete a study of the feasibility and potential benefits of mandatory energy efficiency reporting and voluntary industrial energy savings targets. A thorough study was carried out and published by DOE in February 1994 (DOE 1994). Based on consultation with industry representatives as well as independent analysis, the study concluded that traditional sector-wide reporting and targets would not motivate industries to undertake efficiency investments. However, the study recommended that the government encourage voluntary goal-setting and reporting on a company-wide or industrial facility basis. The Climate Wise program established jointly by DOE and EPA is oriented in this direction.

Overall, implementation of EPAct's Section 131 was late and only partially completed. It was the intent of Congress for DOE to work with major industry associations including the most energy- and waste-intensive industries in the country. While the energy efficiency reporting and savings targets study was completed and appears to be of good quality, relatively little was done with respect to the industry association grants and awards programs. On the other hand, DOE has greatly expanded its cooperative efforts with energy-intensive industries and their associations through the "Industries of the Future" program. While not explicitly called for in EPAct, this major initiative is consistent with the spirit of Subtitle D.

Section 132. Process-Oriented Industrial Energy Efficiency

Section 132 also has three parts, including a grant program to states, a

report discussing the barriers to promoting energy efficiency in industrial processes, and a series of activities listed under "Other Federal Assistance".

Grants to States. EPAct's Section 132(b) authorizes grants to states to promote process-oriented industrial energy efficiency. In FY95, as part of its Industrial Assessment Center (IAC) program activities, OIT provided approximately $300,000 in 10 grants to states to support the promotion and development of industrial assessment programs and to identify energy efficiency and waste reduction opportunities in industry. These grants, which averaged approximately $30,000 each, involved cooperative efforts with a total of 15 states. In FY96 and FY97, OIT participated with the DOE-Office of State and Community Programs to make similar awards to states on a competitive basis. Although the awards were made in an efficient manner, there is little indication of how successful the grant program has been. This program is relatively small and overshadowed by DOE's successful IAC program.

Other Federal Assistance. The "Other Federal Assistance" section contains a laundry list of activities to promote process-oriented industrial energy efficiency. The first and most important task is for DOE to work with a non-profit organization to develop criteria for process-oriented energy efficiency assessments on an industry-by-industry basis. In response to this requirement, a "best practice" manual was developed through the IAC program (Industrial Assessment Opportunity Workbook, V1.0). Although DOE technically did not work with a nonprofit organization, the workbook provides valuable technical information and procedures to allow manufacturers to systematically identify energy efficiency, waste reduction, and productivity opportunities. The manual is technically sound and easily obtained, but more could be done to promote its use.

The workbook has been distributed through the Internet and Rutgers University reports that the workbook is downloaded about 15-20 times a month—mostly by industry. It is used primarily by small companies that don't qualify for the IAC program (e.g., companies that are outside an IAC's service territory). There has been little feedback (although the small amount of feedback has been positive), and there has been no formal assessment of the workbook's impact (Barnish 1997).

Section 132 also requires DOE to complete a number of other activities including:

- *Directory.* Under DOC-NIST sponsorship the Northeast-Midwest Institute completed *Advancing Manufacturing Competitiveness: A Practitioner's Guide to Federal Assistance* in December 1995. A more comprehensive directory of organizations offering industrial energy assessments is currently under development, *A Manufacturers' Guide to Federal and State Resources* (Bartsch 1997; DOE 1997).
- *Award Program.* An annual Award Program was started by DOE in

partnership with the Pennsylvania State Energy Office and NASEO. Awards were presented in October 1995 (Demetrops 1997).

- *Annual Meeting.* The DOE has sponsored several annual meetings that highlight process-oriented efficiency developments. For instance, DOE established the annual OIT-EXPO (1997 was its third annual). OIT also sponsors several other industrial energy meetings, such as the Texas A&M Industrial Energy Technology Conference and ACEEE "Summer Study" on Energy Efficiency in Industry (Demetrops 1997).
- *Annual Reports.* The Northeast-Midwest Institute (NMI), with assistance from DOE-OIT, DOC-NIST, and EPA, completed a report on the challenges of implementing industrial energy efficiency projects, which identified six key barriers including those pertaining to utility-assistance programs (Bartsch 1997). In 1997, DOE completed a report to the President and Congress that reviewed the impacts of EPAct provisions and made a series of recommendations (based in part on the NMI report). The recommendations included the need to match DOE resources with industry needs, the importance of establishing partnerships with industry to target the most promising technologies, the need to develop "visions" and "roadmaps" with industry, the importance of analyzing opportunities for "leapfrog" technologies, conducting cost-shared RD&D, and accelerating the implementation of state-of-the-art energy and waste reduction technologies (DOE 1997).

Section 133. Industrial Insulation and Audit Guidelines

Section 133 calls for the development of industrial insulation and audit guidelines as a means to promote greater industrial energy efficiency on a voluntary basis. It also mandates the creation of a program to promote the use of the voluntary guidelines. Lastly, it calls for a report to review the status of industrial energy efficiency audit procedures and to evaluate the effectiveness of the voluntary guidelines.

DOE issued the insulation guidelines in 1995 (DOE 1995) and they are available through the Energy Efficiency & Renewable Energy Clearinghouse. The guidelines also are available on the Internet which makes them widely available, *if* one has access to the Internet in the first place. For those without Internet access, the University of Massachusetts runs a telephone "help line" to answer insulation-related questions. Additional education and technical assistance services were established at UMASS to promote the use of the insulation guidelines (Wilkes, Demetrops, and Ambs 1997). However, there has been no formal analysis of the effectiveness of the guidelines or how often they are used by industry.

In addition to the DOE insulation guidelines , the North American Insula-

tion Manufacturer's Association is disseminating its 3E+ computer program, which calculates the most economic thickness for pipe insulation and the heat saved/lost due to insulation. This sophisticated tool is also being promoted by DOE, and complements the DOE guidelines. More recently, OIT and the Alliance to Save Energy have started a voluntary program on steam efficiency, which promotes industrial insulation as well as other energy saving technologies related to boilers and steam systems.

Significant activities have taken place regarding both the audit and insulation guidelines. While Section 133 probably has had some impact, it is difficult to estimate how much without a formal evaluation.

Final Grade "C"

Based largely on the activities in response to Sections 132 and 133, we indicate an overall grade of "C" for implementation of this Subtitle of EPAct. Substantial work has taken place, but the relevant parties (Congress, DOE, states, industry associations, and non-profit groups) have not done all they should have to fully implement EPAct's industrial efficiency provisions. DOE, especially, needs to put more effort into outreach and dissemination efforts in order to get the most out these EPAct activities.

To DOE's credit, the Industries of the Future program in large part meets the intent of several provisions in Sections 131, 132, and 133. However, it was difficult to find anyone at DOE who was still tracking these requirements. Indeed, with no funding for some of the requirements, DOE and Congress clearly have established other priorities in the industrial energy efficiency arena.

State and Local Assistance Title I, Subtitle E

Section 141. Amendments to State Energy Conservation Program

A variety of actions were called for in Section 141; each is described below. It should be noted that these provisions are relatively minor and followed in the wake of the State Energy Efficiency Improvement Act of 1990 (P.L. 101-440).

Revolving Loan for State and Local Government Buildings. Section 141 amends the Energy Conservation and Policy Act (EPCA) by creating a revolving loan fund for State and local government buildings. The Secretary of Energy may provide up to $1 million per state beginning in FY94 for financing energy efficiency improvements. However, the Department of Energy never requested funding for this activity and states never urged the Congress or DOE to provide funding as there was concern that this new program might take away from existing State grant programs, given the strong Congressional pressure to reduce overall budget levels (Genzer 1997).

Training Building Designers and Contractors. Another activity under this section creates a new, optional State Energy Conservation Plan (SECP) program for training building designers and contractors on building energy retrofits and the development of building retrofit standards for use by owners at the time of resale. This section also permits states to conduct feasibility studies for the use of renewable energy technologies in federal programs, including the Rural Electrification Administration and the Farmers Home Administration. The State Energy Conservation Grant Program regulations were amended to include the added program elements created under this section for the FY97 grant cycle. However, the DOE rulemaking process was extremely slow, taking over 4 years to complete.

Impact Permitting Right and Left Turns on Red Lights. Under this EPAct section, DOE is to conduct a study regarding the impact of permitting Right and Left Turns on Red Lights. It called for both a DOE study and a report to Congress within 2 years by the National Highway Traffic Safety Administration to determine the impacts of providing for mandatory left turns on a red light at one-way street intersections. While the requirements of this section were added to those for the SECP, neither DOE nor NHTSA ever prepared the report.

Blame here lies partly with Congress as authorizing language was ambiguous when it failed to mention that a left turn on red was to apply to a "one-way street." Twenty-three states have implemented this provision in their state. The National Highway Traffic Safety Administration has never completed the required study because a lack of readily available data and the absence of appropriated funds (Santoaro 1997)

Section 142. Amendments to Low-Income Weatherization Program

Section 142 creates a new financial assistance program for state weatherization programs to: (1) leverage financial assistance from utilities, private sector and other non-federal entities, and (2) authorizes new funding for technical transfer, training and information exchange for state weatherization' providers. This section also adds solar thermal water heaters and wood heating appliances to the list of eligible weatherization measures.

In December 1993, DOE provided $3.0 million (using "reprogrammed" weatherization funding) to all state grantees to implement this section. The award was $58,300 per state. Most states have incorporated these activities within their weatherization programs. DOE changed program guidelines to include solar water heaters in July 1994. DOE program guidelines included wood stoves as a permissible measure prior to EPAct. It should be noted that Congress did not appropriate additional funds to comply with this provision, but instead permitted DOE to reprogram existing unexpended funds.

Section 143. Energy Extension Service Program

Section 143 repeals the Energy Extension Service (Title V of P.L. 95-39 and Section 103 of Energy Reorganization Act of 1974). This section was effective upon enactment of EPAct.

Final Grade "D"

Sections 141, 142 and 143 were largely relatively minor, were ignored by Congress and DOE, and had very little impact on energy savings. The revolving loan program never got started because DOE failed to request funding for this activity. State Energy Conservation Grant Program regulations were amended to include training for builders and designers but the process was extremely slow. While the requirements of the "right and left turns on red" study were added to those for the SECP, neither DOE nor NHTSA ever conducted a report analyzing the energy impacts.

DOE did an admirable job with the new weatherization program requirements in Section 142 by adding $3.0 million to all state grantees to implement this section. Congress did not appropriate additional funds to allow DOE to comply with this provision but instead permitted DOE to reprogram existing unexpended funds. Finally, there is little to say about Section 143; the Energy Extension Service was repealed with the enactment of EPAct.

Federal Agency Energy Management Article I, Subtitle F

Subtitle F addresses the opportunity for the federal government to capture energy savings in its own federal buildings and other facilities. Subtitle F establishes a number of federal agency goals and requirements under seven sections. Each of these sections is analyzed below.

Section 152. Federal Energy Management Amendments

This section amends several sections of the National Energy Conservation Policy Act (NEPCA) to reflect and supplement many of the goals and requirements set forth in Executive Order 12759. The section contains provisions regarding energy management requirements, life-cycle cost methodology, budget treatment for energy conservation measures, incentives for federal agencies, reporting requirements, new technology demonstrations, and agency surveys of energy-saving potential.

Energy Management Requirements for Federal Agencies. EPAct's Section 152 (b) amends Section 544 of NEPCA requiring federal agencies to reduce energy use in their facilities by 20% per square foot by the year 2000 and install all energy and water improvements with less than a 10 year payback by 2005.

At of the close of FY95, the federal government is on target to meeting the 20% reduction by the year 2000 (DOE 1997). Between 1985 and 1995, energy consumption per gross square foot fell

SITE VERSUS SOURCE ENERGY ACCOUNTING

In 1991, President Bush's Executive Order 12759 on FEMP changed the energy accounting system from a source to site accounting method. Source accounting measures the total amount of Btus used to produce energy consumed in a building, including the energy used in producing the electricity (about two-thirds of the energy consumed at the power plant is lost in the conversion and transmission of the electricity). Site accounting measures the Btus that are actually consumed at a building or facility and ignores any "lost" energy.

If source energy accounting was still being used to measure federal energy consumption, agencies would not have met the EPAct goals for 1995. Rather than saving 14.2%, federal agencies would have been only a 1.1% decrease! To be fair, six agencies would have met their target even using source accounting: DOE, GSA, DOJ, TVA, EPA, and DOC (DOE 1997).

To understand the impact of the accounting change, a comparison is illustrative. In 1995 non-electric fuel consumption at federal facilities was 213.8 trillion Btus and site electricity consumption was 150.7 trillion, for a total of 361.5 trillion Btus. Meanwhile, conversion losses for electricity used in federal facilities totaled 361.7 trillion Btus! In other words, electric power conversion losses are now equal to the total site energy used in federal facilities, yet is not counted in the federal energy accounting system.

by 14.2%. However, the federal government would not be on target to meet the reduction goal were it not for President Bush's 1991 Executive Order. This mandate changed the energy accounting system from a source to site accounting method. Site methodology leaves out energy consumed at the power plant and lost in the conversion and transmission of the electricity before it is delivered to the building. If source accounting was still used to measure federal energy consumption, agencies would only have achieved a 1.1% decrease in energy consumption! This problem is discussed in more detail in the side bar. For now, the focus will be on other issues surrounding the 14.2% reduction in energy consumption based on site accounting.

Although all the federal agencies taken together are on track in reducing their energy consumption, there is significant variation in individual agency performance (DOE 1997) (see Table 6). Of the 21 major federal agencies, six have already met or exceeded the Fiscal Year 2000 energy saving requirement, and five appear to be on target for meeting this goal by the year 2000 (assuming they continue to average a 1.3% per year reduction). Six other agencies do not appear to be reducing consumption at a pace that is fast enough to meet this requirement, while five agencies have actually increased their energy consumption. The Department of Defense (DOD) is among the agencies who are on target, but the DOD is also the largest federal agency energy consumer, responsible for over 70% of the federal government's total energy consumption in buildings. For this reason, the energy saving performance of the DOD dominates the direction of the overall government-wide performance.

Also, while EPAct sets a 20% reduction goal by the year 2000, it has been superseded by the President Clinton's Executive Order 12902, issued on March 8, 1994. This Executive Order increased the goal to 30% by the year 2005. Not only do agencies have to continue reducing their consumption over an extended period of time, but they also have to increase the rate at which the reductions are made. This later Executive Order is the goal the federal energy officials use today.

The FEMP does not document whether or which agencies are installing all energy and water improvements with a payback of less than 10 years. The 10 year payback criteria was to encourage comprehensive building upgrades, as opposed to what is called "cream-skimming." For instance, federal energy managers want to maximize the

TABLE 6
WHERE FEDERAL AGENCIES STAND ON EPACT REQUIREMENTS

Already Meeting Goal	On Track to Meeting Goal	Not Reducing Consumption Fast Enough[1]	Have Increased Consumption Since 1985
Energy, Agriculture, Commerce, Justice, Transportation FEMA	Defense, Interior, Veterans Affairs, GSA, NASA	PostalService, Labor, HHS, HUD, EPA, TVA	State, Treasury, FCC, Panama Canal Commission OPM

[1]assumes reduction should be at least 1.3% per year

cost-effectiveness of their investments in energy efficiency and only install measures with the shortest payback periods, typically much less than ten years. Given this desire and the lack of tracking and reporting in addition to budget constraints, it is doubtful that agencies are following the requirement. Perhaps this is less a criticism of the agencies than a reflection of Congress' lack of support on this issue.

Energy-Intensive Operations. Another problem complicating reporting is that the agencies are permitted to exclude "energy-intensive operations" from their energy reduction goals. It is the responsibility of each agency to determine if energy-intensive activities occur in their buildings. While not specifically defined, examples of such activities are industrial processes, research and development, and large computer facilities.

In the reported data, excluded buildings consume approximately one-third of federal building energy. Because it is not clearly defined for reporting, it is possible for agencies to move buildings in and out of the excluded category each year. Since 1985, excluded building energy consumption increased more than 150%, 8% in 1994 alone, the year before the 1995 targets were to be met. The excluded buildings loophole is helping agencies meet the goals of the Executive Order by removing buildings which consume greater amounts of energy and listing them as "energy-intensive" facilities. **In fact, if not for this loophole, the federal government would have only achieved a 5% reduction by 1995 rather than the 14.2% now reported on a site basis.** (Calculation by Alliance based on data provided by Annual Report to Congress, Fiscal Year 1995, pp. 48 and 51, and McNeil Technologies.)

Budget Treatment for Energy Conservation Measures. Section 152 also amends NEPCA Section 545 by requiring federal agencies to record energy information accurately and report it properly. This amendment addresses the concern that agencies did not include energy cost and efficiency investment information in their annual budgets and that energy use and cost reporting after-the-fact might not be as accurate as it should be.

In general, agencies still do not have a separate line item for their energy cost and efficiency investments in their annual budget submissions. Currently, they are grouped in with larger classifications, such as requests for all utility expenses or for all facility improvements. If agencies did submit these separate line items (as virtually any business does), OMB could do an annual "cross cut" to determine whether agencies were requesting less money for energy each year (as they should be based on meeting their energy reduction targets) and whether the amount of investment in energy efficiency was sufficient to meet the federal energy saving targets. This situation may be changing. OMB recently said that starting in the next budget cycle (FY99), agencies will include a supplemental report in their budgets which breaks down energy efficiency spending (Steer 1997).

It is very difficult to determine whether the energy use and savings data reported by agencies are accurate. DOE does run some simple tests to check the numbers. For example, one test is a unit-cost analysis to compare consumption to cost to ensure reported per unit energy prices are reasonable. They also compare this year's to last year's consumption; if the difference is more than 10%, FEMP inquires about the reason (Tremper 1997). But after these checks, FEMP assumes whatever data an agency submits are accurate.

However, a close examination of the data in the FEMP annual reports raises questions about this assumption. For instance, some agency energy consumption fluctuates widely from year to year and many agencies change their square footage frequently so comparisons are difficult. At least one agency hired an outside consultant who determined that instead of increasing their energy consumption, as reported in previous annual reports, in fact the agency was right on target in saving energy. Another agency had to estimate their data for the year because some field offices refused to submit their data.

Private conversations with federal energy managers reveal how difficult it is for agencies to assemble accurate information on energy use. Nevertheless, significant work needs to be done in this area.

Section 155. Energy Saving Performance Contracts

Section 155 amends Section 801 of NEPCA, principally by granting federal agencies the authority to enter into energy saving performance contracts (ESPCs). In preparing EPAct, Congress clearly envisioned that one of the major ways the federal government should reduce their energy waste was through private sector investment. Congress crafted a series of provisions to enable agencies to make use of ESPCs, which is widely used in the private sector and in state and local governments.

While FEMP has worked hard to encourage agencies to adopt ESPCs, it is difficult to determine how widely they are used. Agencies are not required to report on their use of ESPCs, although FEMP has documented 40 ESPCs to show other energy managers how they can be used (DOE, *Awarded Alternative Financing Contracts* 1997). Agencies also submit information about their ESPCs to include in the *Annual Report to Congress on Federal Government Energy Management and Conservation Programs* (DOE 1997). But in general, agencies have been slow in implementing ESPCs. Reasons for this include: barriers related to government contracting and procurement rules, insufficient staff dedicated to ESPCs (most federal energy managers are engineers, not contractual or procurement experts), and many energy efficiency projects are too small in size to justify the time and effort to do an ESPC.

There is, however, a recent and very encouraging development. Last year, FEMP developed a new program called Super ESPC, a region-wide, multi-contractor, indefinite delivery/in-

definite quantity award that may eliminate many barriers and enable agencies to easily access ESPCs. FEMP estimates that when all six regions have Super ESPCs in place, savings will amount to over $1 billion a year (DOE press release 1997). The first Super ESPC was announced on May 21, 1997 for DOE's Western Region (Alaska, Arizona, California, Hawaii, Idaho, Nevada, Oregon, Washington, and the U.S. Trust Pacific Territories). Three delivery orders have already been issued under the Super ESPC. They include lighting retrofits, HVAC and chiller upgrades, boiler plant retrofits and installation of energy management control systems (Department of Energy, *FEMP Focus*, Federal Energy Management Program, August/September 1997). Super ESPCs in other regions are expected to be in place within the next two years.

However, EPAct provisions related to ESPCs are to sunset in 2000. Given reduced appropriations for energy efficiency projects in federal facilities, it is imperative that Congress reauthorize ESPCs and support FEMP's development and training activities.

Federal Energy Efficiency Fund. Because of concerns, even back in 1992, that Congressional appropriations for agency energy saving projects would be insufficient and that agencies would be slow in implementing ESPCs, EPAct also authorized a three year Federal Energy Efficiency Fund to help finance energy efficiency improvements. While higher levels of investment were authorized, in 1994 only $6 million and in 1995 only $8 million was appropriated and provided to agencies. No money has been appropriated by Congress for the Fund since then, in spite of requests for funding by DOE.

The number of proposals to the Federal Energy Efficiency Fund increased substantially by 1995, when only 26 of 72 proposals could be funded. The selection process became highly competitive as more agencies sought financial assistance from this limited fund. Many worthwhile projects did not receive funding because of the limited resources. The total estimated savings for the selected projects was $26 million, whereas for all 72 projects the estimated savings were $95.9 million. By 1995, the Federal Energy Efficiency Fund assisted 37 projects which are saving $54 million in energy and water costs (DOE, *Annual Report to Congress* 1997).

Recently, Senator Kohl has introduced new legislation calling for the formation of a Federal Energy Bank to be funded by taking 5% of each agencies' energy budget over a three year period and placing it in a Treasury account. FEMP would be authorized to make loans to agencies for cost-effective (three year payback or less) energy saving projects and agencies would repay the account with interest. The Congressional Budget Office has recently scored the bill and determined it has a positive financial benefit to the government (Spees 1997). It should be noted that although a Federal Energy Bank would provide more funds for necessary energy efficiency improvements, the fund would limit the scope of many energy savings projects

by only considering projects with a three-year payback or less.

Utility Incentive Programs. When EPAct was written, many electric and gas utilities offered incentives, typically financial rebates, to end-users who installed energy-efficient equipment. EPAct authorized and encouraged federal energy managers to take advantage of these incentives. Since then, the utility industry has moved toward greater competition environment and many state utility commission-mandated incentive programs have disappeared or were scaled back. At the same time, many utilities are extremely interested in retaining federal customers, especially large customers, as their markets open to competition.

Working with the General Services Administration (GSA), the utility industry has put in place 90 area-wide agreements with federal facilities. These agreements allow facilities to contract on a sole-source basis with their local utility for "energy services". However, it appears that the majority of these agreements focus strictly on the supply of electric and gas, rather than energy efficiency activities—only one-third of the utility agreements (28) specifically incorporate demand-side management as part of the agreement.

Financial Incentive Program for Facility Energy Managers. EPAct's Section 152(d) authorized the creation of a three year program to give federal energy managers financial awards for outstanding energy saving work. This allowed for the expansion of FEMP's existing awards program. As a result, in 1994 and 1995, FEMP distributed $250,000 in bonuses each year, the largest being $10,000 (Tibbs 1997). While the authorization for providing financial awards has ended, FEMP has continued with the spirit of the idea, conducting an energy saving awards program every year. Last year, FEMP provided non-financial awards to 62 individuals or groups out of a total of 177 nominations.

Section 156. Intergovernmental Energy Management Planning and Coordination

One barrier facing federal energy saving efforts is the lack of energy efficiency knowledge on the part of facility managers, procurement officials, and others. EPAct legislation authorizes GSA to address this issue, and they hold at least five regional workshops each year (Ziskind 1997). In 1997, these included an ESPC teleconference, an ESPC Workshop for regional energy coordinators, and a Washington regional conference in which energy saving equipment and service providers shared their expertise with federal energy managers from the area. A national conference, The Energy and Environmental Meetings (TEEM), was held in 1994 and 1996 and attended by 600 people. The DOE is co-sponsoring the 1998 conference in Bellevue, Washington, and 1000 are expected to attend.

This year's teleconference was especially helpful because it opened with a message from the GSA Administrator stating the importance of ESPCs as a

funding vehicle for energy saving projects. This kind of high-level involvement is needed to emphasize the importance of the issue to federal facility managers. GSA would like to hold more regional workshops in which equipment and service providers meet with federal energy managers, but there is no budget line item. GSA workshops and funding must come from limited general funds.

Section 157. Federal Agency Energy Management Training

EPAct requires that all facility energy managers are trained in five areas: building energy systems; energy codes and standards; energy accounting and analysis; life-cycle costing; fuel supply and pricing; and energy surveys and audits. Since 1994, FEMP has trained over 8,000 federal technical and procurement employees in these and other areas (Collins 1997).

FEMP revises the training program annually, for example, new courses in utility deregulation impacts and utility financing will be offered in 1998. Through a computerized Training Locator, federal energy managers can find out about 250 courses on energy management that they can attend. And FEMP holds seminars at national conferences that allow representatives from federal agencies, state and local governments, private companies, utilities, and non-profit organizations to share ideas about energy management issues.

Although FEMP trains a large number of federal energy managers each year, there is no information on what the energy managers have done as a result of the training.

Section 161. Procurement and Identification of Energy-Efficient Products

Facility managers do not always, nor even usually, consider energy efficiency in their purchasing decisions. This statement is based on a number of conversations with federal energy managers. Yet, federal purchasing of energy-using equipment is in the tens of billions of dollars annually and offers a huge opportunity for energy savings (*Buying Energy-Efficient Products 1997).* FEMP, through its Procurement Challenge Program, is developing technical resources to encourage energy-efficient purchasing. In 1995, the leaders from 22 federal agencies, representing 95% of federal purchasing power, signed the Procurement Challenge, committing to improving the energy efficiency of the products they purchase.

The Procurement Challenge is doing several things. They publish energy efficiency recommendations for different types of equipment, which set "recommended" levels representing the top 25% of efficiency, and provide life cycle cost and savings information. Twenty-two of the 63 planned product recommendations have been completed as of October 1997 (Coleman 1997). They are also working with GSA and the Defense Logistics Agency (DLA) to label the energy-efficient equipment listed in their catalogs. Also, the Procurement Challenge is being extended to non-federal

government agencies, which greatly increases the potential impact.

While progress is being made, there are several concerns. First, while 22 agencies signed the Challenge, it is unclear how much has been done to implement an energy efficiency purchasing ethic within their agencies. Moreover, there is no system for overseeing whether agencies' equipment purchases comply with the top 25% requirement. Second, some energy efficiency industry companies have complained that important energy saving technologies—for example, building insulation, controls, and energy monitoring equipment—were not included in the recommendations. Curiously, while Executive Order 12902 requires agencies to purchase in the top 25% of efficiency, the GSA and DLA catalogs continue to list less efficient equipment. Lastly, there is concern about label confusion. For instance, why not simply adopt the Energy Star label in federal catalogs? Since the Executive Order requires agencies to purchase equipment in the top 25% of efficiency, why not exclude all equipment that is not in the top 25% of efficiency?

New Technology Demonstration Program. EPAct's Section 152 modifies NEPCA Section 549 in order to demonstrate the effectiveness of new technologies in federal facilities. FEMP has a cost-sharing public/private partnership program in place to demonstrate and alert federal energy managers about the performance of new energy-efficient and renewable energy technologies (Thomas 1997). Several demonstrations have been completed, among them are:

- Natural-gas engine driven chillers at Willow Grove Naval Air Station and at Fort Sam Houston;
- Gas-Fired Products Seahorse system at Fort Stewart; and
- Roofberg ice storage retrofit system for rooftop air conditioning at Oak Ridge National Laboratory.

Others projects include: polarized lighting; insulated liquid coating; desiccant cooling dehumidification; and lighting design controls.

While these projects serve to demonstrate the feasibility of these technologies in federal facilities to procurement officials and others, the program does not yet have information on whether or not other facilities are installing these technologies as a result. Below are three other noteworthy FEMP demonstration projects.

Greening of the White House. In a special demonstration, FEMP assisted the White House (in the Executive Residence, on the White House grounds, and in the Old Executive Office Building) to create a model of sustainability for energy efficiency, pollution prevention, and waste reduction. With the help of the American Institute of Architects and the National Park Service, the White House was expected to cut energy use by $182,000 annually. Improvements included upgraded HVAC systems, more efficient chillers, condensate heat recovery system, high-efficiency lighting, energy-efficient office equipment and appliances (such

as the "Golden Carrot" refrigerator), thermostatic radiators valves, skylights for better daylighting, and better energy maintenance and operation. The project was all accomplished within the confines of the White House's historic, aesthetic, and security constraints.

Forrestal Lighting Project. In order to provide an example of the potential of ESPC to other agencies, DOE entered a 7-year ESPC in 1993 to upgrade lighting (T-8 lamps, electronic ballasts, specular reflectors, and motion sensors) in their headquarters, the Forrestal Building. This project received a $1.2 million rebate from the local electric utility. The upgrade is saving $400,000 a year in lighting costs and the building also uses less cooling energy as a result (DOE, *Technical Assistance: Case Study* 1997).

State Department. A new State Department initiative is now underway to upgrade selected Embassy complexes as part of the department's Environmental Hub Embassy Program. Hub embassies are being set up around the world to better coordinate regional environmental policy. Each of these embassies are to be retrofitted with both energy-efficient and renewable energy technologies under long term ESPCs.

Section 162. Federal Energy Efficiency Funding Study

Several EPAct sections require DOE to analyze the energy saving and investment needs in federal facilities. For instance Section 162 requires the Secretary of Energy to conduct a study to determine the financial investments necessary to comply with EPAct efficiency requirements for federal buildings, to identify unusual or abnormal changes in energy consumption, and to check the accuracy of utility charges for electricity and gas consumption.

In December 1996, FEMP issued a report on the energy (and water) saving and investment needs of the federal government. They estimated that the federal government could cost-effectively save $1 billion annually (similar to estimates by the former Office of Technology Assessment and the Alliance to Save Energy) and that to capture those savings will require the investment of about $5.7 billion in energy saving equipment and services between now and 2005 (DOE 1996). The report estimates that $2.4 billion will come from appropriations, $.9 billion from energy saving performance contracts, and $.4 from utility demand side management, leaving a **$2 billion shortfall in funding resources.**

This $2 billion shortfall estimate may actually be an underestimate. For instance, it assumes that Congress will appropriate $240 million per year for energy saving projects. However, in FY 1996, the same year as the study, Congress appropriated only $150 million. Since 1996, appropriations to agencies for energy efficiency improvements have fallen to even more austere levels. Even at 1996 funding levels, there will be an additional shortfall in energy efficiency funding of $90 million per year, adding $900 million to FEMP's projected $2

billion shortfall by the year 2005. Unless funding is greatly increased, that's a lot of squandered opportunity.

Sections 163, 164, 165, and 166. Federal Energy Management and the U.S. Postal Service

These EPAct sections focus on energy management within the U.S. Postal Service. Under these requirements, the U.S. Postal Service is required to issue regulations to account for energy consumption, conduct a Postal Service energy survey, and submit a report to Congress on the Postal Service's building management program as it relates to energy efficiency.

The Postal Service has not been successful in reaching its energy reduction goals, reducing energy use by just 5.8% since 1985. Unless performance is improved, they will not meet EPAct's 20% energy saving goal. In fairness, part of the reason the Postal Service is failing to meet the target is that, because of efforts to improve overall productivity, the Postal Service is mechanizing and concentrating its operations in smaller buildings. This can have an adverse effect on energy use per unit of floor area due to increased mechanization and consequently less floorspace.

Section 168. Energy Management Requirements for Congressional Buildings

This section of EPAct requires the Architect of the Capital to undertake a program of analysis and, as necessary, retrofit of the Capitol Building, the Senate Office Buildings, the House Office Buildings, and the Capitol Grounds. Due to the unique characteristics of the buildings it is responsible for, the Architect of the Capitol has been slow in upgrading the energy efficiency of the Capitol Complex. It has, however, been able to install a system-wide energy management system (EMS) and variable speed drives on most of its fan motors. It also has installed an energy-efficient condensate recovery system in its heating system, which improves the efficiency of the steam system by 15 to 18%. Recently, the Architect of the Capitol commenced work on upgrading most of the lighting in their buildings. The project involves the installation of energy-efficient lamps, ballasts and lighting controls, and involves over 100,000 fixtures (Hanlon 1997). These upgrades will increase the efficiency of lighting by over 50%. While all the technologies mentioned above have been widely adopted in the private sector for a number of years, they are still relatively new for the federal government.

Final Grade "C+"

Since EPAct was enacted, energy efficiency gets far more attention within the federal government. Energy champions are recognized for their contributions, previously through financial incentives and now through an awards ceremony. ESPCs are now being used by some agencies, and the Super ESPC initiative appears very promising. DOE

and other agencies offer many training programs which educate federal employees on various issues affecting energy consumption.

The Federal Energy Management Program (FEMP) within the DOE houses numerous programs which promote the use of energy-efficient technologies in federal agencies. FEMP has shown itself to be a very capable and innovative leader in the federal energy management arena, most notably with the development of the Super-ESPC. Indeed, if our grade was based only on the training, education and other efforts of FEMP with DOE, the grade given would be higher. But our grade is not based on FEMP alone. The grade is based on the actions of the Congress and other federal agencies as well.

Training programs, technology demonstrations, and streamlining the energy saving performance contracting process give agencies the tools to improve the energy efficiency of their buildings. However, it does not appear that these tools are being used and that overall energy consumption at the agencies has been reduced on a large scale.

The data reported in the *Annual Report to Congress*, the only data available to track agencies' energy use over time, are suspect. Furthermore, progress is being reported in terms of site energy which gives a much more favorable impression than energy savings based on total (source) energy use. And while agencies are required to purchase equipment within the top 25% of efficiencies where practicable and cost-effective, there is no system required or in place for implementing or tracking this requirement. Without a tracking system, it is difficult to monitor whether agencies are considering the life-cycle cost of their purchases as required by EPAct. In general, Congress has provided no meaningful oversight to ensure that agencies comply with the federal energy management provisions contained in EPAct.

Congressional support for financing energy efficiency projects has been unreliable from year to year. Although Congress required agencies to reduce their energy consumption, it has failed to provide the necessary financial assistance for agencies to make the required efficiency improvements (e.g., by denying support for the Federal Energy Efficiency Fund). Some agencies have compounded the problem over the last several years, using money intended for energy efficiency improvements for non-energy related purposes. Furthermore, federal agencies in general still do not include separate line items for energy use and energy efficiency investments in their annual budgets.

In short, agencies are not taking the energy reduction targets and purchasing requirements seriously. Congress and the President are not providing sufficient oversight of agency compliance, nor are they giving federal energy management the necessary financial resources. As a result, the federal government continues to waste millions of dollars on energy.

Miscellaneous Title I, Subtitle G

Section 171. Energy Information

EPAct's Section 171 changes some of the survey requirements of the Energy Information Administration from a triennial basis to "at least once every two years". It requires EIA to collect annually the total domestic electrical energy production from renewable sources (solar thermal, geothermal, biomass, wind, and photovoltaic) and total installed capacity. And it requires a survey annually of electric-utility demand-side management programs and energy savings estimates from these programs.

EIA has implemented most of the provisions of this section. The new information is incorporated in EIA's *Annual Energy Review*, the *Renewable Energy Annual*, and the *U.S. Electric Utility Demand-Side Management* report series. However, due to funding limitations, the EIA has not increased the frequency of its industrial survey as called for in EPAct (O'Brian 1997).

Section 172. District Heating and Cooling

EPAct Section 172 requires DOE to conduct a study of existing district heating systems to (1) determine their cost-effectiveness, (2) estimate the economic value of additional benefits such as reduced emissions, (3) the cost- effectiveness of district heating and cooling using waste heat from electricity generation, and (4) make recommendations for removing institutional barriers inhibiting greater adoption of district heating and cooling. DOE also was required to report the findings of this study to Congress within 2 years of enactment with recommendations for carrying out federal, state, and local programs.

DOE completed a study that was sent to Congress in March 1997. A formal report was prepared for internal review but was never released. However, one may obtain copies by contacting the Utilities Division within the energy efficiency office at DOE (DOE 1997). Downsizing at DOE and reduced funding levels have apparently prevented distribution of this report.

Final Grade "B"

Sections 171 and 172 were completed by DOE, but it is doubtful whether the energy savings resulting from these sections will be great. DOE has fully implemented the provisions of Section 171. Likewise, DOE provided a report to Congress as called for in Section 172. The report was late and Congress has not done anything with the findings, nor has DOE actively distributed the report.

Renewable Energy (Energy Efficiency Provisions) Title XII

Section 1202. Demonstration and Commercial Application Projects for Renewable Energy and Energy Efficiency Technologies

Section 1202 amends the Renewable Energy and Energy Efficiency Technology Competitiveness Act by eliminating the requirement for a Joint Ventures Advisory Committee, authorizes $50 million in appropriations in FY94, and creates a new Advisory Committee on Demonstration and Commercial Application of Renewable Energy and Energy Efficiency Technologies. The purpose of these provisions was to help commercialize additional renewable energy and energy efficiency technologies through demonstration projects co-funded by DOE and the private sector.

Although well intended, a DOE interpretation of this EPAct section prevented the implementation of the Advisory Committee's recommendations. Relatively little funding was obtained for energy efficiency projects, and most of this went towards a competitive solicitation program for joint ventures with states (NASEO 1997).

Section 1207. Duties of Interagency Working Group on Renewable Energy and Energy Efficiency Exports

In recognition of the largely untapped international markets for U.S. energy efficiency products and services and the economic and environmental benefits they represent, Section 1207 of EPAct mandated that DOE establish an interagency working group and subgroups to consult with industry groups and agency heads, establish a program to inform foreign countries of the benefits of policies that increase energy efficiency, and help U.S. energy efficiency companies access foreign markets.

DOE established the Committee on Energy Efficiency Commerce and Trade (COEECT) in 1994. Similar to the Committee on Renewable Energy Commerce and Trade (CORECT), COEECT works to breakdown barriers to commerce by promoting energy market reforms, identifying financing resources, and coordinating the export activities of different federal agencies.

Much of the COEECT program is implemented through the Export Council for Energy Efficiency (ECEE), an as-

sociation of five non-profit organizations that work closely with U.S. energy efficiency industry companies. ECEE helps those companies identify and expand markets for their energy efficiency products and services. Examples of ECEE activities to date include:

- Reports describing markets for energy efficiency products and services in Brazil, Chile, India, Mexico, Philippines, and Poland;
- More than 50 different U.S. energy efficiency companies have participated in ECEE trade missions to China, Portugal, Brazil, Mexico, Chile, India, and the Philippines.
- More than one thousand operators of factories, hotels and hospitals attended workshops to hear about U.S. energy efficiency products and services; and
- Approximately 100 representatives from energy service companies, equipment vendors, commercial banks and multilateral banks participated in a Financing Roundtable in Washington, DC.

In its short life, ECEE activities have proven popular with energy efficiency companies. Perhaps a dozen energy efficiency projects have been implemented as a result of ECEE activities. At least three companies—manufacturers of occupancy sensors, controls, and motors—report substantial increases in sales of their equipment as a result of the ECEE trade missions.

At the same time, ECEE has tapped the expertise of more than fifty companies to provide quality low-cost energy efficiency training to more than one thousand energy end-users overseas. ECEE's $870,000 annual budget is leveraged by the resources of the private sector since they pay their own way to participate in ECEE activities overseas. COEECT is a good example of the federal government working in partnership with the private sector to encourage energy efficiency improvements.

While COEECT has had a positive impact, it could be improved. To increase COEECT's influence, the program needs to expand its presence in targeted international markets and build on the relationships that have been developed with overseas partners. Also, much has been learned over the last three years about how to most effectively promote U.S. energy efficiency equipment and services overseas and the types of assistance that companies need. The activities that do work should be emphasized and given increased funding.

Section 1209. Data System and Energy Technology Evaluation

This section requires the Department of Commerce to determine the energy technology needs of foreign countries and the technical competitiveness of U.S. technologies to meet these needs and establish a data base for use by government and industry. Beginning June 1, 1993, Commerce was to prepare a biennial report to Congress on: (1) the full range of energy and environmental technologies necessary to meet

the energy needs of foreign countries, (2) an inventory of U.S. technologies fulfilling those needs, (3) an update on bilateral programs promoting such technologies, and (4) an evaluation of current U.S. programs that promote the use of these technologies in foreign countries to reduce greenhouse gases.

To the best of our knowledge, no funding was provided to meet the requirements of this section, and neither a database nor a report were prepared by the Commerce Department.

Final Grade "C"

The performance in response to this EPAct Title has been wide-ranging. First, lack of funding and DOE's interpretation of Section 1202 limited the value of this provision. In response to Section 1207, COEECT and ECEE have had some success in providing education, promotion and access for U.S. business to foreign energy efficiency markets. The future success of the program will depend on its getting sufficient funding to expand its presence in key target markets and to build on activities that have proven successful in the past. Finally, it does not appear that the Congress provided funding for nor did the Commerce Department take any actions to fulfill the requirements of Section 1209.

Energy Efficiency Research, Development & Demonstration Titles XX-XXII

Titles XX-XXII of EPAct authorize a wide range of energy efficiency research, development and demonstration (RD&D) programs over the five year period 1993-1997. These titles are organized around broad goals including reducing oil imports (Title XX), improving energy efficiency and the environment (Title XXI), and fostering economic growth (XXII). Many DOE energy efficiency programs are covered in these titles. For the purpose of presenting this review, we cluster programs by sector (buildings, industry, and transportation) since this is how the programs are organized at DOE.

In carrying out this review, we define the EPAct authorizations broadly and include more recent initiatives that fulfill the intent of EPAct in full or part. For example, the PNGV was started after EPAct was adopted, but falls within the scope of Section 2021 which calls for RD&D on more fuel efficient as well as alternative fuel vehicles in order to reduce demand for oil in the transportation sector. Likewise, the Industries of the Future program was started up after EPAct was adopted, but falls within the scope of various sections of Title XX which call for five-year RD&D programs in major energy-intensive industrial sectors.

RD&D Activities for Buildings

Title XXI, Subtitle A, Improved Energy Efficiency, focuses on initiatives to improve energy efficiency in a number of areas. RD&D activities for buildings covered by EPAct include: (1) energy-efficient natural gas and electric heating and cooling technologies (Section 2102) and (2) advanced building designs, materials, evaluation tools, and construction techniques, what EPAct terms "Advanced Buildings for 2005" (Section 2104). No particular authorization levels are provided for these programs. DOE conducted (and the Congress has provided funding for) substantial RD&D programs in both of these areas over the past five years.

Section 2101 of EPAct instructed DOE to prepare a five-year program plan to guide energy efficiency RD&D activities in the buildings and industrial areas covered by EPAct (see below). DOE never prepared this plan. However, a plan was prepared to guide RD&D activities in the transport area.

Heating and Cooling RD&D. DOE's Office of Building Technologies (OBT) conducts a wide-ranging RD&D program on heating and cooling technologies. Funding rose from about $10

million in FY92 to nearly $18 million in FY95. However, funding was reduced to $10 million and $11.6 million in FY96 and FY97, respectively (compared to a request of $18 million for FY96). The main areas of RD&D over the past five years were: (1) alternative refrigerants to replace CFCs and HCFCs without an energy penalty, (2) thermally activated heat pumps, (3) desiccant technologies, (4) low emissions burners for heating systems, and (5) fuel cell-based cogeneration systems. Also, significant funding was provided starting in FY95 to stimulate greater adoption of high efficiency heating and cooling systems in both residential and commercial buildings.

Alternative Refrigerants. OBT has had considerable success in testing and evaluating alternatives to CFCs and HCFCs through work at Oak Ridge National Laboratory and CRADAs with the chemicals, air conditioning and appliance industries. This effort has helped manufacturers of appliances, air conditioners and refrigeration systems replace CFCs without increasing energy use. In addition, ORNL has developed new heat exchangers for use with alternative refrigerants and a very high efficiency prototype refrigerator which uses no CFCs or HCFCs. These projects are influencing manufacturers' product designs (Brown and Vaughn 1995).

Thermally Activated Heat Pumps. OBT has developed prototype gas-fired absorption heat pumps through national laboratory-private sector partnerships. This technology offers a 30-50% fuel savings compared to typical heating systems sold today and cooling efficiencies comparable to electric systems (Brown and Vaughn 1995). However, the goal of commercializing a gas-fired residential heat pump by 1997 was not met due to the industry partner (Carrier Corporation) withdrawing from the project. DOE is now working with a small manufacturer to commercialize the technology (Fiskum 1997).

Absorption Chillers. OBT has made significant strides towards developing high efficiency, "triple effect" absorption chillers for use in larger commercial buildings. DOE has licensed the technology to York International, and a field test is planned for 1998.

Desiccants. A RD&D program was begun in FY95, was not funded in FY96, and was revived in FY97. This discontinuity has delayed prototype development and field testing. However, prototype high efficiency desiccant systems are currently being tested in restaurants.

Heating Systems. OBT has worked with equipment manufacturers to develop, test, and introduce a low emissions, high efficiency, small oil heating burner (the so-called fan-atomized burner). While testing and technology transfer projects are still underway, commercialization of this burner has not occurred yet. However, the development and introduction of a flame quality indicator was completed during the past five years. This technology warns of oil burner efficiency and emissions degradation. As of mid-1997, it was licensed to and produced by three manufacturers.

Fuel Cell Microcogeneration. This program was first proposed by DOE in FY94 but was not funded by the Congress until FY97. DOE is focusing on reforming of natural gas and is working with the private sector to develop proton exchange membrane (PEM) fuel cell systems for building applications. This program will take a number of years to complete.

Advanced Buildings for 2005. OBT started a "Building America" program aimed at developing, demonstrating, and disseminating innovative residential building designs and construction techniques. OBT co-funded four industry consortia involving about 70 companies, with a total program budget of $16 million during the past four years. The four consortia are expected to complete about 200 demonstration homes by the end of 1997. The test homes are providing up to 50% energy savings compared to current "good practice" with little or no increase in first cost. Some participating builders are very pleased with the results and are planning to incorporate the new designs into entire new housing developments. The program is continuing and hopes to directly or indirectly result in 10,000-15,000 innovative new homes by 2000 (Reese 1997).

Industrialized Housing Program. OBT also carried out an industrialized housing program during the past five years. This program helped to develop, demonstrate, monitor, and disseminate information on energy-efficient factory-built housing designs. A number of demonstration homes were built and monitored. As of 1997, a few manufactured home builders were incorporating energy-efficient features into their housing designs (Karney 1997).

Commercial Buildings. OBT has conducted a number of activities relevant to Section 2104 of EPAct. The most noteworthy efforts include: (1) evaluating and promoting building commissioning techniques, (2) developing and demonstrating advanced diagnostic and performance monitoring techniques together with building controls companies, (3) developing state-of-the-art design tools, and (4) analyzing and disseminating information on exemplary buildings.

One achievement has been the preparation and wide dissemination of *Softdesk Energy*, a software tool developed for architects who use computer-aided design (CAD) systems. It enables architects to easily identify and analyze energy savings opportunities during the was the completion of the BACNet standard protocol for building control systems. This standard facilitates the interoperability of different building systems. It is being required for all control systems in GSA buildings, and is expected to be widely adopted in the private sector.

While many activities have been carried out during the past five years, it is difficult to identify significant impacts on commercial building design, construction, or operation so far. However, some activities such as the release of *Softdesk Energy,* completion of the BACNet protocol, and the forthcoming

release of a new version of the popular DOE-2 design tool could have a significant impact on new commercial buildings in the future. The original version of the DOE-2 software is widely used to design new buildings and was estimated to have saved consumers $1.9 billion cumulatively through 1993 (Mills 1995).

RD&D Activities for Industry

EPAct authorizes five-year RD&D and deployment programs in a number of industrial areas. Programs were authorized for the following specific sectors or end use areas: (1) advanced paper and pulp technologies (Section 2103), (2) electric drive systems (Section 2105), and (3) steel, aluminum and metal casting technologies (Section 2106). In addition, EPAct authorizes broad RD&D and commercialization activities for: (1) improving energy efficiency in energy-intensive industries generically (Section 2107), (2) energy efficiency and pollution prevention technologies (Section 2108), (3) advanced materials (Section 2201), and (4) advanced manufacturing technologies (Section 2202). Thus, EPAct encompasses most of the activities carried out by DOE's Office of Industrial Technologies (OIT). Funding for the overall OIT program grew from about $99 million in FY92 to $135 million in FY95. Funding was then cut to $114 million in FY96 and about $118 million in FY97.

Industries of the Future. In the past few years, OIT has reorganized a large portion of its RD&D efforts around seven "Industry of the Future" initiatives. The seven initiatives cover the aluminum, chemicals, pulp and paper, petroleum refining, steel, metal casting, and glass sectors, which account for about 80% of manufacturing energy use. Each sectoral initiative has developed a vision of its desired long-term future, identified technological objectives, and defined a technology roadmap for achieving the objectives. This process resulted in a set of RD&D and information dissemination projects that are carried out collaboratively by industry and the national laboratories. The projects address energy, environmental, productivity, competitiveness and other concerns, not just energy efficiency.

While the Industries of the Future program required a number of years to organize, it has resulted in a well-focused RD&D program that is highly responsive to industry's needs. The initiatives (and the DOE-funded programs preceding them) have produced numerous innovations, some of which have been commercialized and others that are still being tested. Below we briefly review some of the most noteworthy innovations that are within the scope of the sections of EPAct listed above.

Paper and Pulp Industry. OIT has made major strides over the past five years in developing and demonstrating two major innovations—black liquor gasification and impulse drying. These technologies provide multiple benefits including reduced pollutant emissions, cost savings, greater recycled content, and energy savings (OIT 1997). While

not yet commercially available, the technologies are very promising.

Aluminum Industry. DOE has developed, demonstrated, and tested a number of advances during the past five years including stable cathodes, inert cathodes and anodes, spray forming of aluminum, an energy-efficient and advanced sensors and controls. These technologies, in various stages of commercialization, offer the potential for significant energy savings, increased output, reduced pollutant emissions and waste generation, and substantial cost reductions (OIT 1997).

Steel Industry. A major focus in the early 1990s was developing direct reduction of iron oxide ore (i.e., eliminating coke production), which promises significant energy savings as well as environmental and economic advantages. However, the project was terminated due in part to industry's lack of interest in co-funding a demonstration project. One spin-off technology, the post-combustion lance for electric arc furnaces, was successfully commercialized in 1994. It increases furnace productivity and product quality, as well as saving energy (OIT 1996).

OIT subsequently formed an "Industries the steel industry. The program is focusing on technologies that improve production efficiency, facilitate recycling, and reduce waste and emissions (OIT 1997). Promising projects underway include work on removal of zinc from steel scrap and application of advanced process controls.

Chemicals Industry. DOE has helped to develop, commercialize, and disseminate a number of innovative technologies during the past five years. For example, DOE has helped to develop new membranes for recovering solvents from liquid waste streams which cuts down on both atmospheric emissions and hazardous waste, reduces worker exposure, and saves energy (OIT 1996). Also, application of catalytic distillation, which DOE helped to develop in the 1980s, expanded during the past five years especially in the production of MTBE (an oxygenate used in reformulated gasoline). In addition, some of the bioprocessing technologies which produce useful products from agricultural, food and wood wastes have begun to enter the marketplace.

Glass Industry. The so-called "oxy-fuel firing" technology was successfully commercialized and widely adopted during the past five years. It permits use of oxygen instead of ambient air in glass melting furnaces, thereby saving energy, reducing pollutant emissions, and increasing the production rate. As of 1996, more than 15% of the glass melting capacity in the U.S. had adopted or was converting to oxy-fuel firing (OIT 1996).

Electric Drives. DOE began a "Motor Challenge" program in 1994 as part of the Clinton Administration's Climate Change Action Plan. The program, which received about $5 million per year during FY95-FY97, has set a goal of saving 5 TWh/yr of electricity by 2000 (Hirsch 1997). The program is conducting showcase demonstrations, providing information and decision tools to motor users, and supporting

market transformation partnerships such as promotion of premium efficiency motors by a large number of utilities and efficiency improvements in compressed air systems (Hirsch 1997). While nearly 2,000 companies have joined the Motor Challenge program, so far there are no estimates of the energy savings and other impacts.

Energy Efficiency and Pollution Prevention Technologies. OIT has helped to develop and commercialize numerous technologies that both cut emissions and reduce energy use (OIT 1996, OIT 1997). This has occurred through OIT's core RD&D programs as well as through the "NICE3" partnership program. In addition, OIT funds the industrial assessments program which is conducted by 30 university-based centers. In recent years, this program was expanded to cover waste minimization and productivity improvement as well as energy efficiency. This program performs about 750 assessments per year for small and medium-size manufacturers. To date, participants report over $400 million in energy savings, over ten times the cumulative program cost (DOE 1997). DOE attempted to start Environmental Technology Partnerships to fund other activities in this area, but the Congress did not provide funding for this.

Advanced Materials. OIT carried out substantial RD&D on advanced materials during the past five years, as called for by Section 2201 of EPAct. In particular, a variety of ceramics and ceramic composite technologies were developed, tested, and commercialized by small companies working in partnership with the national labs (Brown and Vaughn 1995). New ceramic and ceramic composite materials are starting to be used in cutting tools, heat exchangers, pump seals, burners, and engine components (OIT 1997). In addition, OIT has supported a successful RD&D program on new metal alloys, most notably nickel aluminide. This high-tech material, developed by Oak Ridge National Laboratory and several industrial partners, is being used in a growing number of applications including heat treating operations, forging dies, and glass molding (OIT 1996).

Advanced Manufacturing Technologies. EPAct also authorized a five-year program on advanced manufacturing technologies. While OIT indirectly supports work in this area, no direct funding was provided by the Congress for the purpose of implementing this initiative.

Transportation Sector

EPAct authorized a wide-ranging RD&D program on increasing transport vehicle efficiency and use of alternative fuels in order to reduce oil consumption (Sections 2021-2027). These provisions call for expanded on RD&D on: (1) fuel economy in general, (2) alternative fuel vehicles, (3) biofuels, (4) electric vehicles, fuel cells, and associated equipment, (5) renewable hydrogen, and (6) advanced diesel engines.

DOE's Office of Transportation Technologies (OTT) has funded substantial RD&D programs in these areas over the past five years. Much of this

during the early 1990s reaching about $36 million per year by FY95. However, battery funding was reduced to $18-19 million per year in FY96 and FY97. OTT and its Advanced Battery Consortium partners have developed new higher energy density batteries such as the nickel/metal hydride, lithium ion, and lithium/polymer batteries. But each of these batteries still has one or more major drawbacks—high cost, limited power density, uncertain durability, or safety concerns (OTA 1995). Progress in improving batteries has been slow, but electric and electric-hybrid vehicles are starting to be produced by major car companies. Honda, for example, recently introduced its new "EV PLUS" in California. This four-passenger model contains nickel-metal hydride batteries and other innovative features such as regenerative braking.

Fuel Cells. Fuel cells appear very promising as a longer-term, clean vehicle propulsion technology. Significant technical progress has been made in the past five years with funding from OTT of about $20 million per year on average. OTT has developed and tested PEM fuel cells as well as on-board fuel reformer (which converts gasoline or alternative fuels to hydrogen). While major improvements in performance and reductions in cost were achieved, much remains to be done in reducing fuel cell size and cost, as well as in developing practical fuel storage and fuel reformers (OTA 1995; NRC 1996).

Alternative Fuel Vehicles. OTT has sponsored modifications of conventional vehicles (i.e., a Ford Taurus and Geo Prism) to run on ethanol and natural gas while meeting future emissions standards. Ongoing R&D is focused on improved fuel storage systems, efficiency improvements, and ways to lower the cost of alternative fuel vehicles (AFVs). Along with R&D, OTT is supporting introduction of AFVs in vehicle fleets, assisting with fuel infrastructure development, and collecting field data. The federal government purchased approximately 20,000 AFVs by the end of 1995. In addition, about 55 cities are purchasing AFVs through the DOE-sponsored Clean Cities program.

One unanswered question concerns the actual use of alternative fuels—many AFVs are "flex fuel" vehicles capable of running on both gasoline and other fuels such as ethanol or methanol. These vehicles are now running on gasoline. And vehicle manufacturers receive CAFE credits for producing "flex fuel" vehicles, thereby potentially increasing gasoline use. Only time will tell if competitively priced alternative fuels will become widely available and used in these vehicles.

Final Grade "B"

It is difficult to evaluate the overall success of the five-year energy efficiency RD&D program authorized by EPAct. EPAct itself contains some broad goals in this area—strengthening energy security, stimulating economic growth, reducing environmental impacts, and the like. It seems clear that these RD&D efforts have not had noticeable impacts on this scale so far. But RD&D

funding was devoted to the U.S. Advanced Battery Consortium begun in 1991 and the Partnership for a New Generation of Vehicles (PNGV) launched in 1993. Both are cost-shared government-industry partnerships. With the establishment of these initiatives and the EPAct mandate, total funding for OTT RD&D programs increased from $112 million in FY92 to $192 million in FY95. Funding was then cut to $150 million in FY96 but was given a small increase in FY97.

Partnership for a New Generation of Vehicles. The PNGV is a cooperative program between the federal government and the U.S. auto industry. It has set ambitious goals, namely to develop family-size cars that achieve three times the fuel economy of current vehicles (i.e., 80 MPG). At the same time, the vehicles should maintain performance and safety, meet current and future emissions requirements, and have a lifecycle cost equivalent to current vehicles. Part of the goal is to have "production prototype" vehicles built by 2004. In addition to this longer term goal, PNGV has set a goal of stimulating near-term use of fuel efficiency measures in conventional vehicles.

OTT received about $98 million in FY96 and $104 million in FY97 for PNGV-related projects (excluding battery and electric vehicle research). These levels were considerably below the Administration's request. Nonetheless, the PNGV has made significant progress in a number of technical areas including: (1) improvements in fuel cell performance, (2) development of key components and fabrication of hybrid vehicles for testing and technology validation, (3) development of an improved NOx catalyst for emissions control, (4) successful development and testing of ceramic vanes and blades for gas turbine engines, (5) demonstration of high-volume fabrication processes for new materials, and (6) improvements in various energy storage technologies (DOE 1997; NRC 1996).

The PNGV program suffers from a number of shortcomings, however (Sperling 1996-97). First, the relatively short time horizon for production prototypes has led the automakers to focus on nearer term technologies such as advanced diesel engines (for use in a hybrid configuration) rather than more innovative technologies such as fuel cells. The reliance on diesel engines also raises emissions concerns, especially given the recent decision to tighten emissions standards for NOx and fine particulates. Second, funding for the PNGV on the part of both industry and the federal government has been relatively modest; much of the effort is a repackaging of ongoing R&D. Third, a large portion of federal funding has been channeled through the Big Three automakers, who have vast R&D budgets of their own and are also less likely to bring new technologies to the market than innovative supplier companies. And fourth, efforts to improve vehicle efficiency in the short run have been neglected in the push for 80 MPG prototypes.

Batteries and Electric Vehicles. OTT support for batteries rose steadily

during the early 1990s reaching about $36 million per year by FY95. However, battery funding was reduced to $18-19 million per year in FY96 and FY97. OTT and its Advanced Battery Consortium partners have developed new higher energy density batteries such as the nickel/metal hydride, lithium ion, and lithium/polymer batteries. But each of these batteries still has one or more major drawbacks—high cost, limited power density, uncertain durability, or safety concerns (OTA 1995). Progress in improving batteries has been slow, but electric and electric-hybrid vehicles are starting to be produced by major car companies. Honda, for example, recently introduced its new "EV PLUS" in California. This four-passenger model contains nickel-metal hydride batteries and other innovative features such as regenerative braking.

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is inherently a risky and uncertain undertaking. There are inevitable failures and delays, and moving technologies from concept to prototype to commercial product can take a decade or more. Thus, it is not reasonable to expect that a RD&D program would have a significant national impact after just five years.

This review has identified a number of technologies that DOE helped to develop during this period which have already entered the marketplace. These technologies include alternative refrigerants, a flame quality indicator for oil burners, new housing designs, new ceramic and metal alloy materials, and industrial process improvements for manufacturing chemicals, steel, and glass. Although the energy savings provided by these technologies is not yet large, the benefits will increase tremendously over the next 10-20 years as the new technologies, building designs, and industrial process improvements are widely disseminated. A few might turn out to be "big winners", thereby justifying the entire federal program.

Other technologies, while not yet commercialized, were significantly advanced during this five-year period. These technologies include gas-fired heat pumps and chillers, process improvements for manufacturing paper and aluminum, and automotive fuel cells as well as hybrid vehicles. With continued support, many new energy efficiency technologies could reach the marketplace over the next 5-10 years.

Funding for energy efficiency RD&D was increased during the past five years, thereby helping DOE to accelerate technology development in many areas. However, the funding cuts in FY96 slowed down a number of programs such as the PNGV and RD&D on heating and cooling systems. Likewise, DOE's efforts to reorganize around new initiatives such as the CCAP, PNGV, and Industries of the Future, while useful over the long run, may have delayed implementation of some EPAct provisions.

Given the caveats listed above, implementation of these sections of EPAct deserves a "B" grade. Some significant advances were made, but performance overall was not outstanding. This overall grade is based on the actions of the Congress and partners involved in the programs, not just DOE.

TABLE 7
SUMMARY OF EPACT INTENT AND IMPLEMENTATION BY TITLE

IA Buildings B-

Intent—Requires states to adopt up-to-date commercial energy codes and to consider new residential energy codes; encourages HUD to adopt new manufactured housing standards; establishes regional building energy efficiency centers; promotes energy-efficient mortgages.

Implementation—30 states have updated their residential codes (up from 16 before EPAct) but only 28 states have implemented the commercial code requirement; HUD issued new energy standards for manufactured housing; Congress never funded the 10 regional centers for building energy efficiency; no home energy rating guidelines have been issued; however, an energy-efficient mortgage pilot program was launched.

IB Utilities B-

Intent—Encourages states, TVA, and WAPA to implement integrated resource planning and other policies to promote energy efficiency investments by utilities.

Implementation—A few states adopted new policies; TVA and WAPA customers prepared plans; but due to "tidal wave" of utility industry restructuring, these sections received limited attention and had limited impact.

IC Appliances C+

Intent—Adopts minimum efficiency standards for electric motors and lamps, commercial heating and cooling equipment and plumbing fixtures; requires DOE to consider standards for other products and develop labeling programs for additional products.

Implementation—Standards written into the law are now in place and generally functioning well although implementation delayed in some cases; consideration of new standards way behind schedule; labeling programs in place.

ID Industry C

Intent—Promotes energy efficiency in industrial facilities, particularly process-oriented industries, on a voluntary basis; establishes voluntary audit and insulation guidelines.

Implementation—Grants to smaller industrial associations were issued just last year; grants were also issued to states to promote process-oriented energy efficiency; voluntary audit and insulation guidelines were well conceived and implemented but with limited dissemination.

IE State/Local D

Intent—Establishes revolving loan fund for retrofitting state and local government buildings; requires training of building designers and contractors; promotes left-turn on red.

Implementation—DOE never requested funding for the loan fund; training for building designers and contractors did take place but very slowly; and left-

Conclusions

EPAct is the only comprehensive energy legislation enacted by Congress since the 1970s. Given the infrequency of major energy legislation, making the most of each legislative opportunity is especially important, as it can be a decade or more before a legislative opportunity will come again. Broadly speaking, the energy efficiency sections of EPAct were intended to moderate growth in U.S. energy demand, and to promote steady improvements in the efficiency of the U.S. economy. In 1992, these goals were driven by concerns about increasing reliance on imported energy (particularly in light of the Persian Gulf War of 1990-91) as well as by a desire to reduce the environmental impacts of energy use, particularly growing concerns about global climate change. The issues that drove EPAct are still with us today—U.S. dependence on oil imports is higher today than in 1992 (imports accounted for 52% of petroleum use in 1996, up from 46% in 1992—EIA 1997a) and climate change is high on the international and domestic policy agendas.

EPAct does appear to have had some impact on the federal budget for energy efficiency programs. In fiscal years 1993-1995, the Bush and Clinton Administrations requested, and Congress appropriated increased funds for energy efficiency programs. Relative to the 1992 appropriation, the 1995 appropriation was 48% higher. These extra funds covered increased research and development activity, as well as new and expanded programs to encourage and assist consumers and businesses to save energy. Multiple factors influenced these increased budgets, including EPAct, the Climate Change Action Plan, and the change in Administration following the 1992 election. However, in the 1996 fiscal year, the federal efficiency budget returned to approximately its 1992 level, as control of Congress changed hands and EPAct was forgotten.

Implementation of Specific Titles and Sections

In summary, we give a grade of "C" for overall EPAct implementation. There have been significant successes, but on balance, implementation falls significantly short of the legal mandate, let alone short of the overall intent. Our findings by title/subtitle are summarized in Table 7.

This summary masks considerable variation within and between programs. Among the successes are the following:

- Fourteen states upgraded their building codes; in addition, technical assistance by DOE has helped many states with code adoption and implementation.;
- Smooth implementation of commercial heating and cooling equipment and plumbing efficiency

TABLE 7
SUMMARY OF EPACT INTENT AND IMPLEMENTATION BY TITLE

IA Buildings B-

Intent—Requires states to adopt up-to-date commercial energy codes and to consider new residential energy codes; encourages HUD to adopt new manufactured housing standards; establishes regional building energy efficiency centers; promotes energy-efficient mortgages.

Implementation—30 states have updated their residential codes (up from 16 before EPAct) but only 28 states have implemented the commercial code requirement; HUD issued new energy standards for manufactured housing; Congress never funded the 10 regional centers for building energy efficiency; no home energy rating guidelines have been issued; however, an energy-efficient mortgage pilot program was launched.

IB Utilities B-

Intent—Encourages states, TVA, and WAPA to implement integrated resource planning and other policies to promote energy efficiency investments by utilities.

Implementation—A few states adopted new policies; TVA and WAPA customers prepared plans; but due to "tidal wave" of utility industry restructuring, these sections received limited attention and had limited impact.

IC Appliances C+

Intent—Adopts minimum efficiency standards for electric motors and lamps, commercial heating and cooling equipment and plumbing fixtures; requires DOE to consider standards for other products and develop labeling programs for additional products.

Implementation—Standards written into the law are now in place and generally functioning well although implementation delayed in some cases; consideration of new standards way behind schedule; labeling programs in place.

ID Industry C

Intent—Promotes energy efficiency in industrial facilities, particularly process-oriented industries, on a voluntary basis; establishes voluntary audit and insulation guidelines.

Implementation—Grants to smaller industrial associations were issued just last year; grants were also issued to states to promote process-oriented energy efficiency; voluntary audit and insulation guidelines were well conceived and implemented but with limited dissemination.

IE State/Local D

Intent—Establishes revolving loan fund for retrofitting state and local government buildings; requires training of building designers and contractors; promotes left-turn on red.

Implementation—DOE never requested funding for the loan fund; training for building designers and contractors did take place but very slowly; and left-

turn-on red requirements were added to the state energy conservation plan but neither DOE or NHTSA ever conducted the specified study.

IF Federal Facilities C+

Intent—Sets goals and calls for a wide range of activities aimed at increasing energy efficiency in federal facilities.

Implementation—While many good demonstration and incentive programs have resulted from EPAct, loopholes, limited financing, poor data collection practices, and lack of accountability have limited actual energy savings in federal facilities.

IG Misc. B

Intent—Collects additional energy efficiency information and study district heating and cooling opportunities.

Implementation—EIA has collected information and published annual reports on utility DSM efforts as well as renewable energy production; DOE completed a report on district heating and cooling saving opportunities but did not make this report available to the public.

XII Renewable Energy C

(energy efficiency provisions)

Intent—Improves federal actions and programs that promote export of energy-efficient products and services; further demonstrate commercially available energy efficiency technologies.

Implementation—DOE has done a relatively good job in implementing export promotion through COEECT, however, lack of funding hindered implementation; joint ventures program and analysis of energy technology requirements were never implemented.

XX–XXII Energy/Environment RD&D B

Intent—Authorizes continued RD&D on energy-efficient technologies that serve the buildings, industry, and transportation sectors.

Implementation—RD&D on-going; several new technologies have been commercialized and many others were advanced and appear promising.

ing codes). Also, states did not support implementation of Section 141 revolving loan fund. For these reasons, we give states an overall grade of "C".

Regarding the private sector, many companies have co-funded and participated in RD&D projects with DOE. Private companies have actively supported other initiatives such as the use of performance contracting for federal buildings retrofits. Also, most equipment manufacturers affected by the EPAct efficiency standards supported timely and meaningful implementation of these provisions. However, a few companies attempted to create and exploit loopholes in the lamp standards as well as frustrate effective implementation of the office equipment labeling provisions. For these reasons, we give the private sector an overall grade of "B-".

Our overall grade of "C" is based on combining the grades for each of the key actors, with weightings based on our perception of the relative importance of each. Specifically, we used the following weightings: DOE—35%, HUD—5%, other agencies—5%, Congress—30%, states—10%, and the private sector—15%.

The Big Picture

Unfortunately, EPAct's energy efficiency provisions have not fully achieved their original energy-saving objectives. Energy use increased approximately 10% from 1992-1996, an average of 2.4% annually, up from the 1.8% average annual increase in the prior decade. While the relative increase in energy use in recent years is partly explained by high economic growth, the underlying pattern is that efficiency improvements have slowed. During 1992-1996 the energy intensity (primary energy use per unit of GDP) fell only 0.8%, an average of 0.2% per year. During the prior decade, energy intensity declined an average of 1.1% annually.

Still, without EPAct, these trends would have been worse. Based on detailed energy saving estimates made when EPAct was passed, and adjusting for actions and changes over the past five years, we estimate that EPAct will reduce U.S. energy use in 2000 by approximately 1.0 quadrillion Btu, a savings of 1% relative to projected energy use that year. These savings will increase after 2000 as more efficient equipment and buildings fostered by EPAct make up an increasing share of the overall equipment and building stock.

Our current estimate of EPAct energy savings in 2000 is approximately 50% lower than our 1992 estimate. Based on the analyses discussed in previous sections of this report, it is clear that this shortfall is due to several causes including: (1) underfunding of EPAct programs; (2) lack of follow-through on the part of implementing agencies in some cases; (3) the voluntary nature of many EPAct provisions which turned out to be of limited practical value; and (4) changing external conditions such as utility industry restructuring.

For many other programs, activities are now proceeding and success cannot yet be evaluated.

Overall Grades

As noted previously, we give a grade of "C" for overall EPAct implementation. Our grades for each of the major players are shown in Table 8.

DOE has made a good faith effort to implement most of the EPAct provisions, with a few notable exceptions such as the HERS guidelines, the revolving loan fund for state and local building retrofits, and the transformer efficiency standards. Also, DOE's efforts have been flawed in a number of important areas (e.g., implementation of the commercial building code requirements, motor and lighting standards, and federal energy management provisions). In some cases, DOE was delayed or limited by lack of funding or other restrictions imposed by the Congress. For these reasons, we give DOE an overall grade of "C+".

HUD successfully implemented a number of provisions such as adopting efficiency standards for manufactured housing and for homes receiving FHA or RECD mortgages as well as the energy-efficient mortgage pilot program. But HUD ignored the Section 105 mortgage provision, which called for a study and determination. For these reasons, we give HUD an overall grade of "B-".

Other federal agencies have generally paid limited attention to EPAct. Examples include the poor efforts by TVA and WAPA to implement utility integrated resource planning, as well as the limited cooperation of key agencies such as GSA and the Defense Department in federal energy management. Therefore, we give "other agencies" an overall grade of "D+".

Congress consistently provided less funding than was requested by DOE for EPAct implementation as well as for other important energy efficiency programs in the FY94-98 time period (see Table 3). Furthermore, the deep funding cut and legislative riders in the FY96 Appropriations bill particularly hampered DOE's efforts. However, Congress did provide some additional funding for implementing most EPAct energy efficiency provisions during the early years of this time period. For these reasons, we give Congress an overall grade of "D+".

Some states complied with EPAct's building code and utility policy review requirements, but many did not (especially in the area of commercial build-

TABLE 8
GRADES FOR KEY ACTORS

Organization	Overall Grade
Department of Energy	C+
Dept. of Housing & Urban Development	B-
Other Agencies	D+
Congress	D+
States	C
Private Sector	B-

ing codes). Also, states did not support implementation of Section 141 revolving loan fund. For these reasons, we give states an overall grade of "C".

Regarding the private sector, many companies have co-funded and participated in RD&D projects with DOE. Private companies have actively supported other initiatives such as the use of performance contracting for federal buildings retrofits. Also, most equipment manufacturers affected by the EPAct efficiency standards supported timely and meaningful implementation of these provisions. However, a few companies attempted to create and exploit loopholes in the lamp standards as well as frustrate effective implementation of the office equipment labeling provisions. For these reasons, we give the private sector an overall grade of "B-".

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The Big Picture

Unfortunately, EPAct's energy efficiency provisions have not fully achieved their original energy-saving objectives. Energy use increased approximately 10% from 1992-1996, an average of 2.4% annually, up from the 1.8% average annual increase in the prior decade. While the relative increase in energy use in recent years is partly explained by high economic growth, the underlying pattern is that efficiency improvements have slowed. During 1992-1996 the energy intensity (primary energy use per unit of GDP) fell only 0.8%, an average of 0.2% per year. During the prior decade, energy intensity declined an average of 1.1% annually.

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Our current estimate of EPAct energy savings in 2000 is approximately 50% lower than our 1992 estimate. Based on the analyses discussed in previous sections of this report, it is clear that this shortfall is due to several causes including: (1) underfunding of EPAct programs; (2) lack of follow-through on the part of implementing agencies in some cases; (3) the voluntary nature of many EPAct provisions which turned out to be of limited practical value; and (4) changing external conditions such as utility industry restructuring.

Lessons Learned

In many ways, the energy efficiency provisions of EPAct were a "laundry list" of good intentions. However, Congress did not provide adequate funding to implement many of the provisions. And other provisions were ultimately voluntary in that they only required consideration of specific actions or even where actions were required, federal agencies and states could ignore them without fear of penalty. As a result, many of the provisions had very limited impact. In retrospect, EPAct probably had too many weak provisions which diluted implementation efforts. It probably would have been better to concentrate on a limited number of substantial and workable provisions.

By our estimation, only five provisions are likely to have cumulative energy savings of 0.2 quad or more by 2000—equipment efficiency standards (which alone accounts for half of the total savings achieved), commercial building codes, window testing and labeling, office equipment ratings, and energy efficiency RD&D (see Table 5). These are probably the areas that should be emphasized during the next few years of EPAct implementation.

Finally, our review clearly indicates that adopting legislation does not guarantee results. The legislation provides the blueprint, but without good program design and implementation, not to mention funding, the vision contained in the blueprint will not be realized. In particular, the administration needs to request and Congress needs to provide adequate funding to implement the new legislation. Likewise, agencies should not ignore legislated time schedules for developing new programs and implementing regulations, and Congress should exert adequate oversight to help keep agencies on track.

Next Steps

EPAct has achieved some significant energy efficiency gains, particularly in improving the efficiency of new commercial buildings and new energy-consuming equipment such as lamps, electric motors, commercial heating and cooling equipment, plumbing equipment, windows and office equipment. However, much remains to be done.

First, there are a number of EPAct provisions that we recommend be given high priority as implementation continues. Focusing on the following areas could increase significantly the overall energy savings ultimately provided by EPAct.

- Issue and enforce equipment efficiency standards, particularly completion of the distribution transformer rulemaking which is many years behind schedule;
- Work on upgrading building energy standards in the roughly 20 states that now have out-dated standards, perhaps with DOE witholding building code-related grants from states who are not moving toward compliance;
- Develop new, state-of-the-art model building standards, particularly new commercial building standards as

Recent studies by DOE (*Scenarios of U.S. Carbon Reductions*) and by the Alliance, ACEEE, and other groups (*Energy Innovations*) conclude that U.S. energy and carbon dioxide emissions can be cost-effectively reduced by more than 20-25% in 2010 relative to a "business-as-usual" scenario. These studies also conclude that achieving such savings can result in significant economic as well as environmental benefits. However, achieving such savings will require substantial action and strong policies, given recent trends of growing energy use and stagnating national energy intensity. EPAct provides the basis for some of these efforts, but much more needs to be done. Now is the time to build upon EPAct and enact additional policies that will advance cost-effective, pollution-cutting, and job-creating energy efficiency measures.

References

References to Introduction

AHAM (Association of Home Appliance Manufacturers). 1997. *Energy Efficiency and Consumption Trends.* Chicago, IL: Association of Home Appliance Manufacturers.

Appliance (*Appliance Magazine*). 1997. "A Portrait of the U.S. Appliance Industry 1997." *Appliance Magazine.* September, pp. 81-87.

ARI (Air-Conditioning and Refrigeration Institute). 1997. Personal Communication with David Martz. Arlington, VA: Air-Conditioning and Refrigeration Institute. September.

Cordes-Black, Leslie. 1997. Personal Communication. Washington, DC: U.S. Agency for International Development. Former Professional Staff, U.S. Senate Committee on Energy and Natural Resources. September.

Counihan, Richard. 1997. Personal Communication. City of Industry, CA: Edison Enterprises. Former Professional Staff, U.S. House Committee on Energy and Commerce. October.

DOC (U.S. Department of Commerce). 1997. *Current Industrial Reports—Fluorescent Lamp Ballasts.* MQ36C(96)-05. Washington, DC: Bureau of Census, U.S. Department of Commerce.

EIA (Energy Information Administration). 1994. *Annual Energy Outlook 1994.* DOE/EIA-0383(94). Washington, DC: Energy Information Administration.

———. 1995a. *Measuring Energy Efficiency in the United States' Economy: A Beginning.* DOE/EIA-0555(95)/2. Washington, DC: Energy Information Administration.

———. 1995b. *Housing Characteristics 1993.* DOE/EIA-0314(93). Washington, DC: Energy Information Administration.

———. 1996. *Annual Energy Outlook 1997.* DOE/EIA-0383(97). Washington, DC: Energy Information Administration.

———. 1997a. *Annual Energy Review 1996.* DOE/EIA-0384(96). Washington, DC: Energy Information Administration.

———. 1997b. *U.S. Electric Utility Demand-Side Management 1995.* DOE/EIA-0589(95). Washington, DC: Energy Information Administration.

———. 1997c. *Commercial Buildings Characteristics 1995.* Washington, DC: Energy Information Administration, available via worldwide web: www.eia.doe.gov/emeu/cbecs/char95.

GAMA (Gas Appliance Manufacturers Association). 1997. *Statistical Release—Gas Warm Air Furnaces.* Arlington, VA: Gas Appliance Manufacturers Association.

Geller, H. and J. Thorne. 1997. "U.S. Carbon Emissions Climb 3.3% in 1996." Washington, DC: American Council for an Energy-Efficient Economy.

Goldstein, David B. 1997. Personal Communication, San Francisco, CA: National Resource Defense Council. September.

Hadley, S. and E. Hirst. 1995. *Utility DSM Programs from 1989 Through 1998: Continuation or Cross Roads?* ORNL/CON-405. Oak Ridge, TN: Oak Ridge National Laboratory.

Krauss, Clifford. 1992. "Watered Down, Energy Bill Slogs On." *The New York Times.* Nov. 11, p. A24.

Meberg, B., S. Feldman, C. Stone, and E.M. Tolkin. 1997. "Converging on the Effects

of Utility Lighting Efficiency Programs." *1997 International Energy Program Evaluation Conference*, pp. 327-334. Chicago, IL.

Nadel, S. 1996. *Providing Utility Energy Services in an Era of Tight Budgets: Maximizing Long-Term Energy Savings While Minimizing Utility Costs.* Washington, DC: American Council for an Energy-Efficient Economy.

Peach, H.G., P. Brandis, C.E. Bonnyman, and A. Persson. 1996. "Market Transformation in Manufactured Housing: A Pacific Northwest Experience." *Proceedings of the 1996 ACEEE Summer Study on Energy Efficiency in Buildings.* Washington, DC: American Council for an Energy-Efficient Economy.

Prahl, R. and S. Pigg. 1997. "Do the Market Effects of Utility Energy Efficiency Programs Last? Evidence from Wisconsin." *1997 International Energy Program Evaluation Conference*, pp. 523-532. Chicago, IL.

U.S. Congress. 1989. *Congressional Record.* Senate Hearing Report 101-25, Pt. 1, p. 13.

References to Buildings Section

Appel, Margo. 1997. Personal Communication. Washington, DC: U.S. Department of Energy. September .

Building Codes Assistance Project. 1997. *Status of State Energy Codes.* Washington, DC: Building Codes Assistance Project.

Howard, B.D. and W.R. Prindle. 1991. *Better Building Codes for Energy Efficiency.* Washington, D.C.: Alliance to Save Energy.

Johnson, Jeffrey. 1997. Personal Communication. Richland, WA: Pacific Northwest National Laboratory. September.

McQueen, Kate. 1997. Personal Communication. Washington, DC: Building Codes Assistance Project. September.

Norland, D., T. Jones, and W.R. Prindle. 1997. *Opportunity Lost: Better Building Codes for Energy Efficiency.* Washington, DC: Alliance to Save Energy.

Turchen, Steven. 1997. Personal Communication. Washington, DC: U.S. Department of Energy, September.

References for Utility and Equipment Standards Section

Adams et al. 1997. "Letter to the Honorable Newt Gingrich." July 29.

American Supply Association et al. 1997. "Letter to the Honorable Newt Gingrich." American Supply Association et al. June 6.

Barnes, P.R., J.W. Van Dyke, B.W. McConnell, and S. Das. 1996. *Determination Analysis of Energy Standards for Distribution Transformers.* ORNL-6847. Oak Ridge, TN: Oak Ridge National Laboratory.

Clinton, W. and A. Gore. 1993. *The Climate Change Action Plan.* Washington, DC: The White House.

CPUC (California Public Utility Commission). 1994. "Order Instituting Rulemaking and Order Instituting Investigation on the Commission's Proposed Policies Regarding Restructuring California's Electric Service Industry and Reforming Regulation." R.94-04-031 and I.94-040-032. Sacramento, CA: California Public Utility Commission.

Dataquest (Dataquest Consulting). 1996. *Energy Star Compliant PCs, Copiers and Printers.* San Jose, CA: Dataquest Consulting.

DOE (U.S. Department of Energy). 1995. *Report to the President and Congress of the United States on the Current Status and Likely Impacts of Integrated Resource Planning.* DOE/EE-0056. Washington, DC: U.S. Department of Energy.

Douglas, Susan. 1997. Personal Communication. Silver Spring, MD: National Fenestration Rating Council. September.

Ervin, C.A. 1996. "Letter to Malcolm E. O'Hagan." U.S. Department of Energy. May 9, 1996.

Knollenberg, J. 1997. "A Bill to Amend the Energy Policy and Conservation Act to Eliminate Certain Regulation of Plumbing Systems." H.R. 859. Washington, DC: United States House of Representatives.

LBNL (Lawrence Berkeley National Laboratory). 1996. *Draft Report on Energy Conservation Potential for Small Electric Motors.* Berkeley, CA: Lawrence Berkeley National Laboratory.

NARUC (National Association of Regulatory Utility Commissioners). 1996. *NARUC Compilation of Utility Regulatory Policy 1995-1996.* Washington, DC: National Association of Regulatory Utility Commissioners.

NEMA (National Electric Manufacturers Association). 1997. *Summary of Various Promotion and Information Programs.* Rosslyn, VA: National Lighting Collaborative, National Electric Manufacturers Association.

Robison, David. 1990. "Field Measurements of Low Flow Showerheads." *Proceedings of the ACEEE 1990 Summer Study on Energy Efficiency in Buildings*, pp. 1:185-88. Washington, DC: American Council for an Energy-Efficient Economy.

Romm, J. 1997. "Policy Statement for Electric Motors Covered Under the Energy Policy and Conservation Act." September 10. Washington, DC: U.S. Department of Energy.

Wirthlin Group, The. 1995. *A Survey of Ultra-Low-Flush Toilet Users.* Irvine, CA: The Wirthlin Group.

References for Industrial Section

Ambs, Lawrence. 1997. Personal Communication. Amherst, MA: University of Massachusetts, Department of Mechanical Engineering. July 15.

Barnish, Tim. 1997. Personal Communication. Piscataway, NJ: Rutgers University. July 20.

Bartsch, Charlie. Personal Communication. Washington, DC: Northeast-Midwest Institute. July 10.

Demetrobs, Jim, 1997, personal communication, Washington, DC.

DOE (U.S. Department of Energy). 1994. *Costs and Benefits of Industrial Reporting and Voluntary Targets for Energy Efficiency.* DOE/PO-0013. Washington, DC: Office of Policy, Planning, and Program Evaluation, U.S. Department of Energy.

———. 1997. *Energy Policy Act Report: Sections 132 and 133, DOE Report to Congress.* Washington, DC: Office of Policy, Planning, and Program Evaluation, U.S. Department of Energy.

DOE-NREL (National Renewable Energy Laboratory). 1995. *1995 National Awards Program for Energy Efficiency and Renewable Energy.* DOE/GO-10095-200. Washington, DC: National Renewable Energy Laboratory

DOE-OIT (U.S. Department of Energy, Office of Industrial Technologies). 1996. *IMPACTS: Summary of Results from Programs Conducted by the Office of Industrial Technologies.* Washington, DC: Office of Industrial Technologies, Office of Energy Efficiency and Renewable Energy, U.S. Department of Energy.

———. 1997. *OIT Technology Partnerships: Enhancing the Competitiveness, Efficiency, and Environmental Quality of American Industry Through Technology Partnerships.* DOE/GO-10097-334. Washington, DC: Office of Industrial Technologies, Office of Energy Efficiency and Renewable Energy, U.S. Department of Energy.

DOE-ORNL (Oak Ridge National Laboratory). 1995. *Industrial Insulation for Systems Operating Above Ambient Temperature.* ORNL/M-4678. Oak Ridge, TN: Oak Ridge National Laboratory

Fero, Juliette. 1997. Personal Communication. Washington, DC: American Institute for Pollution Prevention. July 15.

References for State and Local Assistance Section

Genzer, J. 1997. Personal Communication. Washington, DC: National Association of State Energy Officials. September 22.

Reamy, G. 1997. Personal Communication. Washington, DC: Office of Energy Efficiency and Renewable Energy, U.S. Department of Energy. October 7.

Santora, R. 1997. Personal Communication. Washington, DC :Office of Energy Efficiency and Renewable Energy, U.S. Department of Energy. October 2.

References for Federal Management Section

Coleman, Phil. 1997. Personal Communication. Berkeley, CA: Lawrence Berkeley National Laboratory. September 12.

Collins, Ted. 1997. Personal Communication. Washington, DC: Federal Energy Management Program. October 1.

DOE (U.S. Department of Energy). 1997. *Annual Report to Congress on Federal Government Energy Management and Conservation Programs, Fiscal Year 1995.* Washington, DC: U.S. Department of Energy.

———. 1997. *Awarded Alternative Financing Contracts.* Washington, DC: U.S. Department of Energy.

———. 1997. *Buying Energy Efficient Products.* Washington, DC: U.S. Department of Energy.

———. 1997. "Free Savings Contracts Save Money, Energy, Cut Pollution." May 21, 1997 Press Release. Washington, DC: U.S. Department of Energy.

———. 1997. *Technical Assistance: Case Study.* Washington, DC: U.S. Department of Energy.

———. 1996. *Federal Energy Efficiency and Water Conservation Funding Study.* Washington, DC: U.S. Department of Energy.

Hanlon, Dan. 1997. Personal Communication. Washington, DC: Architect of the Capitol. October 2.

Romm, Joseph J. 1994. *Lean and Clean Management: How to Increase Profits and Productivity by Reducing Pollution.* New York, New York: Kodansha America.

Spees, Rick. 1997. Personal Communication. Washington, DC: Richard L. Spees, Inc. September.

Steer, Randy. 1997. Personal Communication. Washington, DC: Office of Management and Budget. October 3.

Thomas, Karen. 1997. Personal Communication. Washington, DC: Federal Energy Management Program. September.

Tibbs, Nellie. 1997. Personal Communication. Washington, DC: Federal Energy Management Program. September.

Tremper, Chris. 1997. Personal Communication. Arlington, VA: McNeil Technologies. September.

Ziskind, Mike. 1997. Personal Communication. Washington, DC: General Services Administration. August

References for Miscellaneous Section

Feigel, John. 1997. Personal Communication. Washington, DC: International District Energy Association. October 3.

Kaminsky, J. 1997. Personal Communication. Washington, DC: U.S. Department of Energy. October 7.

O'Brian, Betsy. 1997. Personal Communication. Washington, DC: U.S. Department of Energy. October 10.

Reference for Renewables Section

Rasumussen, John. 1997. Personal Communication. Washington, DC: Division of Energy, U.S. Department of Commerce. October 3.

References for RD&D Section

Brown, M.A. and K.H. Vaughan. 1995. *Science and Technology for a Sustainable Future: Accomplishments of the Energy Efficiency and Renewable Energy Program at the Oak Ridge National Laboratory.* ORNL/CON-410. Oak Ridge, TN: Oak Ridge National Laboratory.

DOE (U.S. Department of Energy). 1997. *FY 1998 Congressional Budget Request.* Vol. 4. Washington, DC: U.S. Department of Energy.

Fiskum, R. 1997. Personal Communication. Washington, DC: Office of Energy Efficiency and Renewable Energy, U.S. Department of Energy. September.

Hirsch, G.M. 1997. "Industrial Energy Efficiency in a Competitive Environment: Transforming the Motor System Market Through the Use of Partnership." *Proceedings of the ACEEE Summer Study on Energy Efficiency in Industry*, pp. 269-80. Washington, DC: American Council for an Energy-Efficient Economy.

Karney, R. 1997. Personal Communication. Washington, DC: Office of Energy Efficiency and Renewable Energy, U.S. Department of Energy. September

Mills, E. 1995. *From the Lab to the Marketplace: Making America's Buildings More Energy Efficient.* Berkeley, CA: Lawrence Berkeley Laboratory.

NRC (National Research Council). 1996. *Review of the Research Program of the Partnership for a New Generation of Vehicles—Second Report.* Washington, DC: National Research Council, National Academy Press.

OIT (Office of Industrial Technologies). 1996. *Impacts: Summary of Results from Programs Conducted by the Office of Industrial Technologies.* Washington, DC: Office of Energy Efficiency and Renewable Energy, U.S. Department of Energy.

———. 1997. *The Office of Industrial Technologies 1997.* Washington, DC: Office of Energy Efficiency and Renewable Energy, U.S. Department of Energy.

OTA (Office of Technology Assessment). 1995. *Advanced Automotive Technology: Visions of a Super-Efficient Family Car.* Washington, DC: Office of Technology Assessment, U.S. Congress.

Sperling, D. 1996-97. "Rethinking the Car of the Future." *Issues in Science and Technology.* Vol. XIII, No. 2, pp. 29-34.

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