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A Report to Congress on A Role for Federal Purchasing in Commercializing New Energy-Efficient and Renewable-Energy Technologies

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This report has been produced in response to the requirement of the *Energy Policy Act of 1992*, Section 152, which, in part, amends the *National Energy Conservation Policy Act* to insert the following new section:

> **SEC. 549. DEMONSTRATION OF NEW TECHNOLOGY**
> (c) STUDY. - The Secretary shall conduct a study to evaluate the potential use of the purchasing power of the Federal Government to promote the development and commercialization of energy efficient products. The study shall identify products for which there is a high potential for Federal purchasing power to substantially promote their development and commercialization, and shall include a plan to develop such potential. The study shall be conducted in consultation with utilities, manufacturers, and appropriate non-profit organizations concerned with energy efficiency. The Secretary shall report to the Congress on the results of the study not later than two years after the date of the enactment of this Act.

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Executive Summary

This study addresses a directive to the Department of Energy in the Energy Policy Act of 1992, to evaluate and report to Congress on the "potential use of the purchasing power of the Federal government to promote the development and commercialization of energy-efficient products." Contributors to the study have included Federal agency personnel, industry representatives, and members of the public. While these contributors offered diverse views, there was broad agreement that Federal purchasing can have a significant market-pull effect in commercializing new technologies--but there are numerous barriers to be overcome. This report outlines the actions that DOE can take, in partnership with other Federal agencies, to address the barriers and realize the opportunities from commercializing new technologies.

Because the Federal sector is the nation's largest energy user, Federal purchases of new, energy-saving technologies provide an important opportunity to combine technology leadership with energy savings to the Federal budget. Candidate products must have a high potential for use both within and outside of the Federal sector, and a reasonable potential to be cost-effective when produced on a commercial scale. For government purchasing to have the intended market-pull result, demand must be stable and predictable and the process must encourage active participation among Federal and non-Federal participants. Maintaining good communication with vendors and manufacturers is essential to identify opportunities, resolve any performance problems with the new technology, and assure that energy-efficient products will be available in adequate quantities to meet both Federal and non-Federal needs.

This report identifies a number of general guidelines and specific implementation actions which can simplify procurement of new technologies and help reduce or eliminate barriers to the successful commercial use of new, energy-efficient products. These include:

- identify an advocate within each participating Federal agency to promote the technology and develop and sustain a cooperative working relationship with industry;
- develop mechanisms for better communication among buyers, manufacturers, and suppliers;
- make specialized technical assistance available to Federal specifiers, program managers, and contractors who make product selections;
- make specialized training on procurement of new technology products available to Federal personnel and industry representatives;
- simplify the procurement process with innovative procurement agreements;
- use industry certification and standards where these support technical innovation;
- establish initial buyer demand through coordination of Federal needs; and
- identify and implement innovative financing mechanisms.

The Department will pursue these actions in partnership with other Federal agencies. An appendix lists examples of products that were identified by study contributors as promising candidates of new technologies for commercialization through Federal purchasing. The study contributors are listed in a second appendix. A third appendix lists key agency contacts, including

the Federal Environmental Executive, the Environmental Executives designated by Federal agencies, and the members of the Federal Interagency Energy Policy Committee.

Section 1. Introduction

The purpose of this study is to satisfy the requirements of Section 152 of the Energy Policy Act of 1992 (EPAct 92), which direct the Secretary of Energy to "evaluate the potential use of the purchasing power of the Federal government to promote the development and commercialization of energy efficient products" (U.S. Congress 1992). Here, purchasing power implies a market presence by the Federal government that is large enough to influence decisions by manufacturers and suppliers about new-product introduction. In recent years, as energy use has become more efficient in the United States in both the public and private sectors, a major contributor to this transition has been the development of innovative technologies and products that reduce the use of energy and/or that use renewable forms of energy. Although the Nation's efforts toward greater efficiency have been impressive, there are still many opportunities for the widespread introduction of even more energy-saving innovations.

The Federal Government is the Nation's largest energy user (FEMP 1995), consuming 385 trillion Btus of energy in its buildings and facilities in FY 1994. The Department of Energy's (DOE's) Federal Energy Management Program (FEMP) tracks energy use in 500,000 Federal buildings at 8,000 sites under 29 different agencies (DOE 1995). Title 1, Subtitle F (Federal Agency Energy Management) of EPAct 92 (U.S. Congress 1992), and Executive Order 12902, Energy Efficiency and Water Conservation at Federal Facilities (Clinton 1994), direct the Federal sector to reduce energy use by 30 percent in its buildings by Fiscal Year 2005 (compared to a 1985 baseline).

Within the Federal sector may be found residential, commercial, industrial, and agricultural facilities, and all of the energy- and water-consuming applications of the private sector. Because of this diversity in Federal facilities, there is an enormous potential for targeting government purchasing to promote the commercialization of new technologies and energy-efficient products. EPAct 92 calls on Federal agencies to purchase energy-efficient products that are cost-effective on a life-cycle basis, not only to reduce the energy cost of Federal operations but also to create energy-saving opportunities for business, industry, and consumers. The scale of Federal purchasing is immense: over $70 billion is spent annually for equipment and supplies, of which approximately 20 percent is for energy-related products, according to DOE estimates. Such purchases will contribute to the agencies' goal of 30 percent energy savings and simultaneously help to develop dynamic markets for these products. FEMP's energy-efficiency programs have already shown results toward meeting this goal: in FY 1995, agencies reported a 14.2 percent decrease in energy use per gross square foot relative to 1985 levels (DOE 1997).

Other authorities are also applicable to the need for greater energy efficiency in Federal procurement. In 1993, Executive Order 12845 (Clinton 1993) directed all Federal agencies to purchase PCs, monitors, and printers that qualified for a voluntary ENERGY STAR® label for energy-efficient office equipment, providing a stimulus that increased manufacturer participation in this program. Congress passed the Federal Acquisition Streamlining Act in 1994 to reduce the overall complexity of Federal purchasing, simplifying and decentralizing the process while retaining a core level of accountability (U.S. Congress 1994). This was complemented by a report issued as part of the Vice President's National Performance Review, which recommended additional changes to "reinvent" government procurement (Gore 1993). Executive Order 12902

also directs DOE to cooperate with other Federal agencies in a government-wide initiative on energy-efficient procurement (Clinton 1994). Executive Order 12873 (Clinton 1993) establishes the positions of the Federal Environmental Executive and Agency Environmental Executives who have the responsibility, in part, to coordinate all environmental programs in the areas of procurement and acquisition.

Although Federal purchasing may represent only a small percentage of the market for any one product, the government is the single largest buyer in the country (and the world) for energy products. In many cases, Federal purchases may provide an entry market significant enough for industry to respond by developing and producing new products. Some recent examples are provided in Section 4 of this report.

Why should the Federal Government assume a role in promoting new energy-efficient products? Such involvement is expected to:

- reduce the government's energy bills and, ultimately, those of all consumers and businesses;
- create new products and markets to make our industries more competitive nationally and internationally;
- create jobs to manufacture these products;
- increase the nation's energy security; and
- reduce the impact of energy use on the environment and the global climate.

This study will assess how the Federal government can play a creative, proactive role, in cooperation with other buyers and with manufacturers, in transforming interest and prospective demand into a market reality. From the Federal perspective, a number of issues have been considered; these include:

- the Federal procurement process, and existing practices that promote or discourage innovation (see Section 3);
- the barriers presented by law, policy, regulations, and current practices (see Section 6 for a discussion of barriers); and
- the types of technologies and products that could be candidates for proactive Federal purchasing (see Appendix A).

The study has benefitted from ideas contributed from Federal agencies, the energy industry, manufacturers, and energy-efficiency advocates (see Appendix B). In direct discussions with decision-makers, and in comments received at a public meeting and by written communication, we found a broad consensus that Federal purchasing can play an important, positive role in commercializing new products.[1] Drawing on this consensus, and our own analysis, a number of approaches have been identified for a Federal role in the commercialization of new technologies,

[1] The focus of this study is on Federal government purchasing. For a review of other strategies designed to help commercialize new energy-saving technologies, see DOE/EE 1995, Geller and Nadel 1994, and Westling 1995.

ranging from improving communication between buyers and sellers to seeking the most effective procurement approach (see Sections 7 and 8). The Department will work closely with other Federal agencies and the private sector to help commercialize these promising new technologies.

Section 2. The Challenge of Commercializing New Technologies

Since the 1970s, the United States has made major strides in using energy more efficiently and more effectively. This has been, in part, a result of new, energy-efficient products produced by U.S. manufacturers for use by the public, commercial enterprises, industry, and government at all levels. However, it is possible to do much more to reduce energy use while enjoying even greater value in the things we produce and use.

Although manufacturers continue to develop products that use less energy, they must make major investments in production facilities--often greater than the cost of developing the product--before these new products are brought to market. Sales volume is often the key to recovering this initial investment and establishing competitive prices, but for many new products the size of this initial market is hard to predict. Clearly, the emergence of a buyer for significant quantities of new, efficient products can be critical in the decision to produce these products.

Federal Purchasing Power

The Federal Government is the single largest customer in the world for most energy-related products, spending roughly $10-$20 billion annually for these products according to DOE estimates. For many manufacturers, the Federal market is already a major customer. Others who are trying to introduce new products may face a daunting task in penetrating this market. New technologies and untried products lack the "track record" of widespread commercial use that forms the basis for much Federal purchasing activity. Procuring an innovative new product often involves a degree of real or perceived risk, although there may be important opportunities presented by new technologies. Given the importance of new technology throughout the U.S. economy, there is enormous potential for using Federal purchasing power as a catalyst to bring new energy-efficient technologies more quickly into widespread commercial use. Thus, Federal market leadership in the early use of technology can work to the benefit of both government and industry.

The Federal government is the largest customer in the world for energy-using products, spending $10-20 billion annually.

Direct and Indirect Benefits

First and foremost, new cost-effective products will lower the cost of government operations, since energy cost savings continue for the entire life of the product. Similar savings will be reflected nationwide as other buyers purchase these new products, lowering the cost of "energy services" to citizens and industry and freeing the saved dollars for more productive use. Reducing energy demand will also increase our national energy security.

The early use of technology to establish Federal market leadership can work to the benefit of both government and industry.

Beyond these direct benefits is the additional stimulus to U.S. industries, enabling them to offer new, more efficient products, creating new manufacturing jobs, and making industry more competitive both domestically and internationally. Many foreign governments support their industries, directly or indirectly, in developing new technologies and translating these technologies into marketable products. To compete effectively, U.S. industries must be able to produce state-of-the-art products at competitive prices.

There are less direct benefits as well. Many nations are concerned about the impact of energy use on global climate. Throughout the United States, cities and urban regions face a major challenge in improving air and water quality. Government agencies at all levels must take steps to deal with these environmental issues. Many now realize that preventing pollution through efficiency offers the most cost-effective path to improved environmental quality.

Fortunately, experience shows that government participation in market-pull efforts can be successful. Several recent initiatives (discussed in Section 4) involve joint efforts by industry, consumer groups, and government to overcome various barriers to commercializing a new technology, including higher first-cost, uncertainty about market size, risk in meeting product performance and production goals. The success of these cooperative efforts demonstrates the very significant, positive role that the Federal Government can play, using the force of the marketplace.

Section 3. Procurement: A Focus on Process, Barriers, and Products

In preparing this report, DOE has focused on three areas in Federal procurement: process, barriers, and products. Although the Federal government is directed by law to consider energy efficiency in its procurement (see Introduction), government is only one component of the larger market. A new product must not only meet Federal requirements, but must have the potential to be successfully marketed to many others, including large institutional buyers, private businesses, and individual consumers. The combined purchases of these buyers can provide the long-term demand necessary for a product's commercial success.

However, each of the buyers may have special requirements or procurement procedures that must be considered before they can purchase new technologies. To better understand the various markets, we made an extensive effort to solicit the views of key decision-makers and procurement officials in both the public and private sectors. In the public arena, for example, we contacted procurement personnel working in a number of different disciplines across the Federal government. Contributions to the study came from policy makers; supply agencies; user agencies; other programs promoting energy-efficient or environmentally preferable products within the Federal, state, utility, and industrial sectors; and many organizations with special expertise. Moreover, industry representatives provided valuable input, with trade organizations collecting comments from their members, and a number of individual manufacturers taking part in the discussion. A complete list of these organizations is found in Appendix B. "Lessons learned" from past and current Federal programs have also been carefully considered.

Other perspectives were gained in response to a notice published in the Federal Register, and through invitations issued at interagency meetings. We invited interested parties to participate at a public meeting or via written comments. A mailing was sent to about 300 non-governmental recipients, announcing the public meeting and soliciting comments. The meeting took place on June 5, 1996, at DOE headquarters, where presentations were made by several agencies and 16 non-Federal organizations. The DOE Assistant Secretary for Energy Efficiency and Renewable Energy opened the meeting, which was chaired by the Director and senior staff of the Federal Energy Management Program. In addition to presentations at the public meeting, written comments were submitted by 34 organizations (see Appendix B).

Focusing on Process, Barriers, and Products

The information obtained from these stakeholders helped DOE identify the process, barriers, and products associated with the procurement of energy-efficient technologies.

The process of specifying and purchasing products includes an initial definition of user needs; determination of an acquisition process (e.g., use of a supply agency, purchase from a commercial source, contracting through a competitive solicitation); identification of sources; and selection of the product and supplier.

Barriers can emerge at any stage in purchasing. Federal procurement tends to be more procedurally complex than its commercial counterpart — because of social, economic and environmental policy considerations as well as statutory mechanisms designed to protect the interests of the public and other stakeholders. Barriers range from a lack of information on available new products to first-cost pressures, requirements for competitive procurement, and special preferences for certain suppliers. Other complications may arise when greater interaction with industry is required, as is often the case for new technologies. Products have to satisfy the Federal user's needs, and delivery schedules must be met. A more complete discussion of the barriers to Federal procurement will be found in Section 6.

A list of some new technologies and products that could be considered for commercialization through Federal purchasing is included in Appendix A. This list is by no means comprehensive (more than 4 million products are purchased by the Federal government!) but is intended to illustrate the range of possibilities. Not every product in the list is based on an exotic technology, as even very simple devices, or logical extensions of today's most efficient products, can offer important energy-saving opportunities. Moreover, the range of candidates is in constant flux as new products are developed and current ones expand their markets or are made obsolete by newer, even more promising designs. Products with the potential for commercialization may be identified as those with:

- a sufficiently large potential market to warrant commercial production;
- significant opportunities for purchase and use both within and outside the Federal government;
- a high potential to be cost-effective on a life-cycle basis (when produced on a commercial scale);
- the ability to meet applicable performance, safety, and reliability requirements;
- acceptability to industry as technically and economically feasible to manufacture, market, and service;
- no current commercial production, or having just reached commercial availability, or commercially available but significantly underutilized.

Within these very broad boundaries there are many energy-saving products that are likely to meet the needs of Federal agencies.

Section 4. Successful Use of Government Purchasing for Market-Pull

There are many precedents for the idea of the government participating in the market as a buyer seeking a new and better product to meet its needs. One obvious example is the extensive history of "developmental procurements" by the U.S. Armed Forces to acquire new state-of-the-art weapons and support systems that exceed the capabilities of products available to others. In some cases, Department of Defense (DoD) procurements of new technologies are structured to include Federal participation in research and product development, as well as to pay for production costs themselves.

Outside the defense sector, a number of other Federal agencies have initiated procurements specifically designed to influence the market by introducing new technologies. They include the following:

- **ENERGY STAR® Office Equipment Program** - This voluntary EPA program labels microcomputers (PCs), monitors, and printers that are equipped with automatic controls to reduce standby power below 30W. The EPA label, along with requirements in Executive Order 12845 that Federal agencies purchase only ENERGY STAR® office equipment (GSA 1993), have influenced industry to provide all buyers with products that meet the EPA label requirements (also see the discussion in Section 5).

- **Efficient A-line Bulb Procurement** - This DoD procurement, currently underway with technical support from EPA and DOE, is designed to develop an entry market for an efficient, low-cost, "drop-in replacement" for the common incandescent light bulb whose basic technology has not changed much since the product was first introduced early in the 20th century With a target of a 30 percent gain in efficiency, a 3000-hour lifetime, and a retail price of no more than $3, this product is designed to fill an important market sector for a large share of the 3 billion existing "sockets" that are not well-suited for the more efficient screw-base compact fluorescent lamp (Narel 1996).

- **Geothermal Heat Pump Program** - A DoD program to inform facility energy managers of the potential energy savings inherent in residential ground-source heat pumps has led to several procurements for military installations. The largest to date is an $18-million Shared Energy Savings procurement at Fort Polk, Louisiana, where ground-source systems will be used to heat and cool over 4,000 single- and multi-family housing units (Geothermal 1995).

- **Super-Efficient, Apartment-Sized Refrigerator Initiative** - Although not primarily a Federal program, this joint effort by the New York Power Authority, New York City Housing Authority, the Consortium for Energy Efficiency, and DOE encourages the production and market acceptance of super-efficient, apartment-sized (12-15 ft^3) refrigerators that save at least 30 percent in energy costs compared with conventional models. Participants have contracted for 20,000 units to be provided to the NYC Housing

Authority, with an additional 40,000 units to be made available at an attractive price to other publicly assisted housing organizations (Wisniewski 1996, Brown and Wisniewski 1996).

- **Experimental Technology Incentives Program (ETIP)** - This program of "policy experimentation" by the National Bureau of Standards (now the National Institute of Standards and Technology) identified and pilot-tested a possible role for Federal procurement to ".. create a demand 'pull' for new technologies in the process of fulfilling its routine requirements" (NBS 1982).

- **Buy Quiet Program** - This EPA procurement, focusing on lawnmowers with a low noise level, demonstrated the need for stakeholder participation and extensive ongoing buyer-seller communication in a market-pull program (Center 1990).

- **Automobile Airbag Procurement** - The 1985 procurement by the General Services Administration (GSA) of 5,000 automobiles equipped with driver-side airbags was a major factor in leading manufacturers to offer airbags on new automobiles and the Department of Transportation to mandate their use for driver safety (Center 1990). Airbags are now credited with saving 1,600 lives, although recent data have shown the need for technological changes to reduce airbag-related hazards for children and smaller drivers.

Section 5. Opportunities for Leveraging Federal Purchasing

For the past two decades, programs to promote energy efficiency in the public sector have relied primarily on direct investments in energy-saving projects, accompanied by training and technical assistance to help Federal program managers, facility managers, and operations and maintenance (O&M) staff better understand the benefits of energy efficiency and the tools and technologies available to help them. This emphasis on energy-saving projects has benefitted many facilities, and to some extent has helped changed design and construction practices for new Federal buildings. However, the project-by-project approach is costly and time-consuming and, by itself, is unlikely to offer the most direct path to achieving the overall government goal of 30 percent energy savings in Federal facilities within ten years. This is particularly true in an environment of increasingly restricted funding for energy-saving capital expenditures or direct Federal investments in improved O&M resources.

DOE's Federal Energy Management Program has recognized the need for more highly leveraged programs to keep pace with the energy-saving goals set forth by both Congress and the Administration. Several new FEMP initiatives focus on changes in procurement that can influence a large number of individual projects. One example is the recent emphasis on Area-wide Agreements for utility-sponsored energy savings performance contracts (ESPCs), which can provide off-budget financing for a number of projects at different sites and support one or many energy-saving measures at each site. Another change in Federal practice that also encourages energy savings across many projects is the introduction of standard methods for measuring and verifying energy savings (FEMP 1996).

Similarly, to encourage new technologies that are attractive to the Federal sector, FEMP has moved beyond its earlier role of sponsoring individual demonstrations only in Federal facilities. The New Technology Demonstration Program now includes a major effort to document and disseminate the results from applying new technologies in commercial and other non-Federal facilities (FEMP 1994). This gives Federal facility managers access to a much broader range of performance data at far lower cost to the government.

Energy-efficient government purchasing seeks to re-direct existing expenditures rather than requiring new appropriated funds.

Yet another highly leveraged strategy is to incorporate energy-efficiency criteria into the technical requirements for Federal purchasing. With the exception of longstanding policies favoring life-cycle costing (NIST 1995), such an approach has been largely overlooked as a mainstream strategy for Federal energy management--despite its enormous potential. "Energy-efficient procurement" is appealing because it seeks to redirect an existing stream of expenditures (e.g., on appliances, equipment, construction materials, vehicles) rather than requiring new funding to be

appropriated specifically for energy-saving projects. One aspect of redirecting existing purchases is to ensure that energy-efficient alternatives are available and cost-effective; this often calls for new technology to be readied for the Federal (and non-Federal) market.

As previously noted, the Federal government is a major customer for most energy-related products. While aggregate Federal purchasing may represent only a small part of the total domestic and international market, the actual dollar volume of sales to the government is often large enough to assure a manufacturer's interest in capturing or maintaining that business. For example, after Executive Order 12845 directed all Federal agencies to purchase computers with an ENERGY STAR® rating, the Federal market helped stimulate a sharp increase in efficient products that qualified for the label. Today, 75 percent of PCs, 93 percent of monitors, and 98 percent of printers sold for business use qualify for ENERGY STAR® labeling (Fanara 1996). Moreover, the labeling program has expanded to include office copiers, fax machines, several types of heating and cooling equipment, insulation, and (in partnership with the Department of Energy) residential appliances and lighting products.

While the Federal government may be restricted from formal joint procurement relationships with non-Federal organizations, there are still significant informal roles--providing technical assistance and coordinating independent interest in purchasing efficient products--which can help develop the potential market. Coordinating the development of technical specifications can establish important common ground for buyers from multiple levels of government, as well as industry and utility programs. Federal support of the Consortium for Energy Efficiency is a current example of this coordination role..

Further, when Federal demand for a new product coincides with the purchases of other large, institutional buyers the aggregate demand is even more likely to garner a response from manufacturers and suppliers. The Federal government can step forward as the "anchor buyer" of products meeting consensus specifications, setting the stage for others to follow. In one recent initiative, the Federal government worked with manufacturers and the Energy Efficient Procurement Collaborative to develop a generic specification for a Basic Ordering Agreement (BOA) for large chillers. The Energy Efficient Procurement Collaborative is a not-for-profit corporation which provides public and private sector purchasing professionals with energy efficiency information, decision tools, and technical services to help them make informed decisions.

This BOA enables aggregation of demand within the Federal government by providing a streamlined means for Federal agencies to replace their chiller equipment with high efficiency, ozone-friendly equipment—with an estimated government wide potential to save more than $2.0 billion over the life of the chiller equipment. The specification also serves as the model for procurement of energy-efficient chillers by other levels of government and non-government organizations, as well.

The preceding examples demonstrate the significant opportunities for Federal action to support the development and commercialization of new energy-efficient products, directly and indirectly.

Whether the procurement is a consequence of normal purchasing needs or the centerpiece of a program to leverage Federal purchasing with other sources of market demand, careful attention to what is being bought can help to create a market-pull for new and improved technologies.

Successful pursuit of these opportunities depends on satisfying two key requirements at the Federal level. The first is to ensure that buyer demand is reliable and feasible for suppliers to meet. In other words, a product may be a promising candidate for a new-technology procurement if:

- the Federal government needs it.
- users will want it and it is likely to be cost-effective,
- industry is interested in manufacturing and selling it,
- the investment requirements and potential for profit are in balance, and
- the market will be self-sustaining once the Federal commitment is ended.

Once the product market potential is confirmed, the second requirement is to ensure that program planning and execution are carried out on an agency- or government-wide level. Federal demand should be consolidated as much as possible to maximize the initial market, so that the combination of Federal demand with that of non-Federal buyers will create the greatest incentive for manufacturers to make the product available.

Section 6. Barriers to Federal Purchasing of New Technologies

The scale of Federal purchasing and a long history of efforts to assure that it is fair and insulated from political pressures have, over time, led to a procurement system that can be complex and lengthy. The main principles guiding Federal agency acquisition have been established through legislation, rulemaking, common practices, and in the general culture of the procurement community. As national priorities change, new regulations have been issued that may impose additional constraints. A Federal employee who wants to order an energy-efficient product may face a system that is both extremely complex and reflects competing Federal priorities.

Thanks to the Federal Acquisition Streamlining Act (U.S. Congress 1994) and the Vice President's National Performance Review (Gore 1993), there has been some progress in simplifying government procurement. For example, many Federal employees are now authorized to use credit cards for purchases up to a certain limit, and products may be obtained from either commercial sources or the Federal supply agencies. While these reforms simplify and decentralize purchasing decisions, they also create new challenges for any government-wide procurement policy, including energy efficiency, simply because of the increased number of decision-makers who must be informed and educated.

Reforms that simplify and decentralize purchasing also create new challenges for any government-wide policy.

Moreover, Federal purchasing of new, advanced technologies often involves special administrative complexities and restrictions well beyond those encountered in buying more conventional products. If Federal procurement is to successfully promote the commercial entry of a new technology, these barriers must be recognized, understood, and reduced or eliminated. The remainder of this section summarizes the barriers that exist.

Five Major Barriers to Federal Procurement

A. Cost and financing barriers

- *First-cost and conflicting incentives.* Although legislation and regulations authorize agencies to award procurements on the basis of lowest life-cycle cost (LCC), due to short-term needs and budget constraints it is often the product with lowest first-cost that wins. In part, this is due to a lack of knowledge on how to estimate life-cycle costs, and in part to a project manager's normal desire to stretch his or her limited budget as much as possible, with less concern for the impact on (someone else's) future operating costs.

- *Lack of infrastructure*. For products that incorporate new technologies, in particular, the lack of an infrastructure for their distribution, installation, and maintenance may increase the purchaser's real or perceived risk.

B. Constraints on how funds can be used

- *Inability to mix or trade off different funds*. A facility's capital funding generally cannot be combined with its operating funds, nor can either be consolidated with other types of funds (such as agency funds earmarked for energy efficiency) to allow the purchase of equipment that may be more expensive initially but have a much lower life-cycle cost.

C. Regulatory barriers

- *Regulations that fail to reflect policy*. Administration and agency policies that promote the purchase of energy-efficient technologies may not be supported by timely changes in Federal acquisition regulations or agency directives to encourage (or even allow) implementing actions. For example, DOE-proposed specific changes in the Federal Acquisition Regulations which specifically authorize implementing the procurement language in Executive Order 12902, Section 507, are still under consideration after 3 years due to multiple issues.

- *Regulations that favor the status quo*. Regulations favoring products that meet, but do not exceed, minimum (and lowest-cost) standards can discourage procurement of new, innovative, and even better-performing products. From the specifier's point of view, it is always safe to conform to a minimum specification, but calling for a better-performing product may be criticized as unnecessary government expense.

- *Set-asides that limit competition*. Procurements based on regulatory set-asides favoring certain categories of suppliers (e.g., minority or small businesses) can eliminate from consideration companies that offer the best new technical solutions to meet a given need.

D. Process barriers

Procurement processes are both complex and time-consuming, and may impose special requirements on new technologies:

- *Performance specifications*. New technologies and products may require added effort to prepare unique performance specifications. Standard methods for product testing and certification, built into Federal specifications, may not be suitable for a new technology or an innovative new product design. Yet, creating or revising specifications to match the new technology may call for specialized knowledge or

skills that are not readily available within Federal agencies.

- *Competitive sources.* New technologies and products are not always available from several competing sources (a general requirement for Federal purchases) so additional time and effort may be needed to justify a sole-source procurement. Avoidance of time-consuming challenges and appeals to these justifications and exceptions gives procurement officers yet another reason to be conservative in their approach to new products or unusual procedures.

- *Product performance risk.* For a new technology, lack of a commercial track record or of well-established industry standards or certification procedures make it more difficult to define good performance and increases the (perceived) risk of buying a poor product.

- *Procurement lead times.* Long procurement times and uncertainties in awarding contracts introduce risks for suppliers as well as buyers.

- *Availability.* New technologies and products are often not available through the Federal supply agencies; even when available, their energy-efficient features may not be emphasized.

- *Uncertainty about Federal demand.* The Federal government is not a monolithic buying agency, but instead is a collection of buyers including two principal buyer agencies - GSA and DLA. Because it is difficult for a prospective vendor to identify the most likely customers and procurement activities--individual facilities, a single agency, or multiple agencies--it is often difficult for them to estimate the likely government market for a new technology. And, given the recent history of fluctuating Federal budgets and shifting priorities, many vendors may be justifiably concerned with the stability of the Federal market.

E. Government and industry interaction

While the relationship between procurement personnel and industry suppliers is generally at "arm's length," initiatives to help commercialize new technologies or products may require closer interaction:

- *Technical information exchange.* New technologies often require extensive exchange of technical information early in the process in order to define performance and cost parameters that are feasible. Unlike conventional products, there is little relevant experience from past procurements.

- *Evaluation of manufacturer claims.* Federal supply agencies and their customers often have difficulty in evaluating performance claims by manufacturers of conventional products. This problem is even more challenging in the case of

completely new products, unique designs, or new technology applications.

- *Adversarial atmosphere*. The arms-length relationship and buyer-seller tension that is typical of competitive or negotiated procurements may be less than ideal for developing communication and trust--important factors in using government procurement as the basis for market entry of a new technology.

- *Sharing technical and market entry risk*. For procurements of new products there may be some inherent risk to both buyers and sellers. Certainly the government has the right to expect that the product will perform as specified, but the shared interests in introducing the product may justify some sharing of market entry risk.

Given these constraints, what steps might be taken to overcome them, making it possible for Federal purchasing to achieve its full potential as a positive market force in the commercialization of new technology? The next section offers some specific ideas, as a basis for new initiatives by the Department of Energy and other Federal agencies.

Section 7. General Guidelines for Procurement Success

Although no single approach is likely to fit all product types or technologies, there are general conditions that must be met by procurements aimed at promoting new, energy-efficient products:

- **Advocates must be effective and persistent** - Agency advocates and Environmental Executives must aggressively seek out opportunities within agencies and carefully educate the prospective buyers and users on how they could benefit. Agency Environmental Executives have the responsibility, as directed by Executive Order 12873, Federal Acquisition, Recycling, and Waste Prevention (Clinton 1993), for coordinating all environmental programs in the areas of procurement and acquisition. Advocates and Environmental Executives must also work with policy and regulatory personnel to anticipate procurement barriers and find creative solutions. In other words, they must be ready to act as a problem-solvers, ombudsmen, and arbitrators.

- **The Federal demand must be strong enough and last long enough** - There must be enough Federal demand, generally represented by one or a few "anchor buyers," so that the Federal contribution to the overall market demand can stimulate an initial industry commitment to produce and market the product.

- **Substantive, continuing interaction with industry is critical** - All Federal participants--advocates, specifiers, users, anchor-buyers, and procurement officers--need to be able to work closely with industry in reaching consensus on the size and duration of the Federal purchasing commitment. The framework for these discussions must accommodate the sometimes competing requirements for information exchange, protection of manufacturers' proprietary data, and compliance with acquisition regulations.

- **Look for the most effective procurement approach** - Many variables in the procurement process can be tailored to meet the needs of the government, manufacturers, and vendors. Examples include single- or multiple-stage solicitations, market-risk sharing, technology-specific performance contracting, cost concessions tied to purchasing volume, and indefinite-quantity contracts.

- **Look for the most effective means of serving the customer** - For the Federal user, it should be at least as easy to buy the new, improved product as the conventional one it replaces. There must also be some tangible benefit to the purchaser (and/or final user), beyond recognition as a "technology leader." Together, these measures can help assure that buyers will sustain market demand.

- **Expect the unexpected** - Buying new products, using unconventional procurement approaches, and perhaps changing some user habits will invariably be accompanied by new problems that in turn will require new and imaginative solutions.

Within these general guidelines, there is considerable latitude to structure a program that promotes new technology commercialization. The implementation actions outlined in Section 8 can be modified as needed.

Section 8. Implementation Actions

Virtually every contributor to this study--technical specialists, procurement executives, Federal-agency energy managers, industry representatives, energy-efficiency advocates, and others--agreed that there are important opportunities for Federal purchasing to help commercialize new, energy-efficient products. At the same time, there was a consensus that today's technical, purchasing, and funding/budget considerations are not always conducive to a leadership role by the government, and indeed, are often at odds with it.

Fortunately, a number of past examples show how new technology procurements can, in fact, overcome obstacles to success and provide guidance for future programs.. The following pages summarize procurement-related actions to help commercialize new, energy-efficient products.

Identifying an Advocate in Each Agency

A key ingredient in new-technology procurement is to have a "champion" to lead the process, an individual who is knowledgeable about the technology and the procurement system and is able to develop and sustain a cooperative working relationship among industry, the Federal supply agency (or commercial supplier), and the ultimate Federal customer. In cooperation with their respective agency Environmental Executive, each participating agency should identify a person to act as the advocate within that agency. The selection of the appropriate individual will most likely depend to some degree on the particular technology or product under consideration, as that person will coordinate with other participating agencies' representatives to identify user needs and to consolidate Federal demand.

Developing Mechanisms for Improved Communication

Information exchange is essential among all participants in a procurement: manufacturers, suppliers, and buyers. This is especially true for a new type of product or technology where changes in existing Federal regulations may be needed, along with a willingness to implement these changes. This must start with the definition of buyer needs and extend throughout the process of preparing specifications and preparing a solicitation. Information exchange should include the following:

- **Government-industry information exchange** - The government, as the customer, needs to clarify for potential suppliers both its cost and performance requirements and intended level of purchases. This is essential to establish that there is adequate demand to support an entry-market, and that governmental requirements for performance, cost, delivery, and after-market support services can be met. One mechanism for expanded information exchange could be the increased use of pre-proposal conferences with fewer procedural restrictions on topics that can be discussed. Another could be the use of informal buyer-seller forums on a given technology, but not associated with a specific procurement. These forums could be organized in conjunction with energy-efficiency and renewable-

energy conferences, or environmental product fairs sponsored by various Federal agencies. Both industrial groups and non-governmental organizations might be invited to help organize these product fairs, with associated workshop sessions that provide somewhat more structured environments for Federal buyers and sellers to interact. These kinds of activities already take place in various formats and venues, but more opportunities can be sought to focus on new products.

- **Information to buyers and users** - Those responsible for preparing product specifications need accurate and complete information about new technologies, in order for these to be considered along with more familiar, conventional products. Mechanisms for informing Federal buyers and specifiers about new technologies now include the Federal Technology Alerts and New Technology Demonstration Program reports prepared by DOE's Federal Energy Management Program, special catalogs by GSA/Federal Supply Service and Defense Logistics Agency (DLA) that feature new products, and groups such as the Interagency Energy Management Task Force. As more Federal purchasing moves to on-line systems such as the "GSA Advantage" site on the World Wide Web, these sources can be significantly supplemented by creative use of the new "electronic commerce" technology. Industry publications, conferences, and trade shows are also an important source of information, although Federal buyers and specifiers often have little basis on which to evaluate industry claims (see below).

Seeking Specialized Technical Assistance

Technical support from a qualified specialist may be required to help agencies evaluate new products, to ensure a new product or technology meets the needs of a Federal user while also meeting those of the larger non-Federal market, or to help an agency adapt its standard practices to take best advantage of the new technology. With procurement reform leading to the down-sizing of staffs in many agencies, this specialized help must often come from outside. Sources might include the existing network of DOE national laboratories that already provide technical support to FEMP; sources of expertise within industry itself (consistent with sound procurement practice); universities and other research centers; and cooperative efforts with other procurement organizations (e.g., the National Association of Procurement Officials, the National Institute of Government Procurement, the Energy-Efficient Procurement Collaborative).

Some important categories of technical expertise for procuring new technologies include:

- **Technical assistance and design support** - Federal specifiers, program managers, and contractors sometimes need access to special expertise in assessing a new technology or a specific Federal application. For design/build contracts involving new or renovated Federal facilities, the written scope of services should allow for technical design support in assessing energy savings and the cost-effectiveness of new, energy-efficient technologies.

- **Special training on procurement issues** - A wide range of organizations, including Federal agencies, trade associations, and the private sector, provide procurement training

opportunities for both Federal employees and industry. Although such training now addresses mainly the procurement process in general, it could be expanded to include issues unique to procurement of new technologies. This would also provide a common foundation for buyers and sellers to discuss and negotiate these issues within a specific procurement. With a certain amount of screening for competitive fairness and quality control, this training and additional on-line information might even be provided in part by industry associations, or vendors themselves.

- **Training in marketing to the Federal sector** - Many training programs are available which offer training for industry marketing and sales staff to help them better understand the basics of Federal procurement, and programs such as these could be adapted to address the marketing of new technologies. This would be especially valuable for smaller, start-up firms that are likely to offer innovative new products, to help prepare them with much-needed guidance on "how to sell my technology to the Federal government." Questions to be addressed might include, for example, "Is there one central customer (supply agency) or are there many separate ones requiring individual marketing efforts? Within a particular organization, who prepares the specifications; who writes the RFP; who is involved in the final selection? How does one estimate the total time required to complete a procurement and begin shipping the product?" Informational materials addressing some of these topics are already available at various agencies, to form the basis for a training curriculum for marketing new energy-efficient products in the Federal sector.

- **Creating a network of technical specialists** - Procurement agencies have expressed the need for technical support in evaluating performance claims for new technologies and products and for recommending new or updated test methods. A network of technical specialists, built on existing networks of researchers and National Laboratories, could be developed through an interagency, cooperative effort to meet this need. Participating agencies might include DOE/FEMP, with the DOE National Laboratories providing technical expertise in diverse energy-related technologies; other agencies with expertise in specialized technical areas (e.g., NASA regarding remote power-generation technologies, the National Institute of Standards and Technology offering specialized testing and evaluation resources); and the Federal supply agencies (GSA and DLA) to establish the types of information which are needed. Procedures would be needed to provide timely access to these resources without burdensome paperwork, and to assure that results are widely available to other potential Federal users.

- **Recognizing innovators** - To reward innovation and help overcome barriers, DOE and others could expand energy awards programs to provide recognition, at either the agency or government-wide level, for those who are willing to provide leadership in procurement of new technologies.

Simplifying Procurement Approaches

Concerns about the complexity of the procurement process are universal, shared by procurement officials and vendors alike. Much can be done at the procedural and policy levels to use simplified approaches:

- **Develop purchasing agreements to streamline individual procurements** - For new technologies, in particular, the transaction costs in time and effort, for both the buyer and vendor, could be reduced by establishing purchasing approaches such as Basic Ordering Agreements (BOAs), Indefinite-Delivery Indefinite-Quantity (IDIQ) contracts, or other streamlined methods. These typically involve competitive selection of a limited number of pre-qualified contractors, based on generic specifications for energy-saving technologies. These contractors are then allowed to negotiate with individual facilities for the award of delivery orders under the contracts. The buyer's task is simplified by placing delivery orders with technically qualified contractors. The contractor benefits from reduced lead-time and easier access to Federal customers. The contracts should also be available to contractors developing and renovating Federal facilities.

- **Use industry certification to minimize product-performance risk** - Industrial certification programs that measure and report energy-related performance can be used directly in product specifications or can be built into the terms of contracts. An example is the rating system used by the National Fenestration Rating Council, an industry-sponsored group that certifies thermal performance and light transmission of windows. A parallel program would involve periodic review of the Federal government's own technical specifications to update or delete those that are outmoded. Existing groups of specifiers and code-developers might take on this responsibility as part of a regular review cycle, perhaps with help from the National Laboratories, the National Institute of Standards and Technology, and sector-specific groups such as the National Institute of Building Sciences.

- **Reinforce life-cycle cost for product selection** - Policy guidance can be given at both the agency- and government-wide level to help reinforce the use of life-cycle cost as a selection criterion. For new technologies, in particular, LCC criteria should reflect the product's full lifetime. Rules on LCC might also be modified to account for future reductions in the product's purchase price, resulting from Federal purchases that accelerate market introduction or increase sales.

- **Facilitate pilot projects** - Pilot projects can help fill a vital need of prospective Federal buyers for more information on a new technology. While technological demonstrations are useful for showcasing the technology's performance, reliability, and maintainability, other types of pilot projects can address the procurement process itself. For example, a special provision might be added to the Federal acquisition regulations to waive certain sole-source or other procurement rules (e.g., up to a value of $100,000 in any one year), for a pilot project designed to test Federal purchasing of a new technology. A more detailed discussion of pilot projects is provided below.

Establishing Initial Buyer Demand

An agency advocate for a new technology, in cooperation with the agency's Environmental Executive, can play a pivotal role in developing a market large enough to justify commercial production, actively promoting the technology within the Federal sector. This might involve the following steps:

- **Develop interagency buyer groups** - Representatives of each participating agency should work with their agency's Environmental Executive, energy managers, and facility operators to assess applicability of the technology to their operations and the potential for dollar and energy savings, and with corresponding representatives of other Federal agencies to explore opportunities for combined purchasing.

- **Make an explicit commitment to purchase in quantity where feasible** - At an agency level, there may be opportunities to realize overall cost savings by purchasing new technologies in quantities large enough to stimulate commercial production, and then providing them to various operations at little or no cost. An example is the DoD procurement of high-efficiency light bulbs, where savings in facility electricity costs more than offset the cost of buying these new bulbs in quantity and giving them free of charge to military families occupying on-base housing.

In some cases Federal procurement of technology can lay the groundwork for programs by other levels of government, utilities, and industry groups, such as the Consortium for Energy Efficiency and the Energy-Efficient Procurement Collaborative, to develop market-aggregation programs.

Identifying and Implementing Innovative Financing Mechanisms

In the current environment of tight and shrinking Federal agency budgets, third-party financing can be the key to overcoming first-cost barriers for energy-efficient new technologies. Various approaches follow:

- **Consolidate different types of funds** - A principal impediment to the purchase of energy-efficient products is the restriction against combining funds from different sources, such as supplementing design and construction funds with operating funds for energy efficiency, or with shared-savings revenues from an energy service company or utility. Alternative approaches to combine various resources could open up opportunities for new technologies For example, full Life-Cycle Cost Analysis might be able to provide justification for combining capital and operating funds to pay for a project, although this may require new legislative authority.

- **Expand the use of technology-specific performance contracts** - Traditionally, projects that use energy saving performance contracts (ESPCs) do not also attempt to specify technical solutions. Instead, the Federal customer typically defers to the contractor to propose, finance, and "deliver" energy cost savings. However, an ESPC can also be a

effective procurement approach for third-party financing and performance assurance for a specific technical solution already identified by the customer as feasible and desirable. FEMP is developing such "technology-specific ESPCs" for use by other agencies, beginning with an ESPC agreement for third-party financing of solar technologies. This approach is especially well-suited to new technologies that involve major capital costs, as well as design, installation, and perhaps servicing.

- **Increase use of cost-sharing in Federal contracts** - An innovative financing approach developed for one new heating and cooling product could serve as a model for Federal purchases to commercialize other new technologies. A consortium of natural gas utilities, with assistance from the American Gas Association, agreed to contribute to the developmental costs of a new generation of gas-fired heat pumps. The utilities' role was similar to that of limited-equity partners in commercial ventures: in exchange for their initial investment they were to receive a share of the revenues once product sales reached a certain level. Similar arrangements might be used for Federal purchases of a new technology. As an alternative to cost-sharing of development of a new technology, a Federal buyer might agree to pay a higher cost to purchase the initial production units, but with provisions for recovering some of these costs through lower prices, direct rebates, or other financial benefits from the manufacturer once production and sales reach a specified level. This approach allows the buyers and the manufacturer to share the risk of market development, but also to share in financial benefits from a successful market introduction.

- **Make creative use of equipment leasing** - Equipment leasing offers another approach to the "creative financing" of new technologies. Federal agencies, among others, now commonly lease certain types of equipment (e.g., office copiers), but leasing strategies could also be a means of overcoming first-cost barriers to other types of energy-saving equipment. For example, some firms offering ground-source heat pumps have recently experimented with lease-purchase agreements for the ground-loop part of the system. Extending this model, leasing might be used for other types of efficient energy-using equipment that is installed more or less permanently at a Federal facility. However, to make effective use of leasing may require consultation with OMB to resolve a number of budget and administrative issues.

As the Department of Energy proceeds with implementation of pilot projects, we will draw on the menu of actions outlined above, adding to and refining them as circumstances require, in close consultation with other participating agencies and the Office of Management and Budget.

Pilot Projects

Probably the best way to identify the most workable approaches to Federal technology procurement is to actually do some well-chosen and carefully evaluated pilot projects "from start to finish." These should begin with an initial selection of a technology, continue through the detailed assessment of both the technology and its market potential in the Federal and commercial sectors, and include the selection or design of an appropriate procurement mechanism. Product

identification can come from one or a combination of three sources:

- initial government evaluation of the technology indicates significant potential for energy and dollar savings,
- one or more agencies have expressed a need which the technology could meet, and/or
- members of the industry are actively promoting it as superior to current products and readily produced.

Early in the process, however, the emergence of one (or more) agency as an anchor buyer is essential for any project to go forward. There must be a clear need for the product on the government's part for a procurement to be warranted, and that need must be big enough to induce the industry to commit to production. Furthermore there needs to be enough open, effective information exchange between the government and industry to establish a common understanding of how the product should perform, what the demand for the product will be over time, what cost and delivery schedules are necessary and can be met, and what cost, risk, and financial benefit sharing between the government and the contractor can justify participation by both parties.

Pilot projects of this sort will require a commitment of resources--people, time, and dollars--by both the sponsoring agency and the agencies which are the anchor buyers (unless these are the same). Especially important for a pilot project, as demonstrated by the Experimental Technology Incentives Program (ETIP) experience (NBS 1982), is a management commitment within the leading agencies to support both the program and the role of the agency advocates. Management support may be needed not only to assure adequate resources for the duration of the project, but also to press for administrative flexibility and in some cases to shield the project, especially in its early stages, from undue external pressures.

The choice of suitable technologies for pilot projects in Federal procurements will depend on a number of factors, but primarily on the product's technical soundness, commercial potential, the level of interest expressed by one or more agencies to serve as anchor buyers, and the industry ability to provide the product at a cost and within a schedule which meets the government's needs. DOE, in the role of a technology advocate who also wants to maximize the benefits of a few pilot projects, can encourage projects that involve technologies with different characteristics, such as

- a conventional product offering an incremental but significant improvement in energy efficiency or performance (e.g., efficient building-scale transformers, compact-fluorescent task lights for an office cubicle);

- an emerging technology that requires higher-volume production and sales to achieve economies of scale (e.g., heat-pump water heaters, solar photovoltaic panels, or horizontal-axis clothes washers); or

- a procurement that requires a "systems approach" to maximize a technology's energy-saving or cost-saving value (e.g., fuel-cell cogeneration, energy-efficient modular buildings,

or spectrally selective glazing tied to adaptive building controls).

A complete pilot project will typically include several of the actions addressed above.

Section 9. Conclusions

This study examines ways to meet the government's mandate in the Energy Policy Act of 1992 (EPAct 92) to "evaluate the potential use of the purchasing power of the Federal government to promote the development and commercialization of energy efficient products" (U.S. Congress 1992). It also addresses other legislative and administrative directives calling on the Federal government to reduce its energy consumption and to emphasize energy efficiency in its purchasing.

Because the Federal sector is the largest energy user in the nation, Federal purchases of new, energy-saving technologies provide a tremendous opportunity for combining commercialization potential with energy savings. For purposes of this study, the focus is on new technologies and products with a significant potential to save energy (or to use renewable-energy sources).

A cornerstone for success is a product with a high potential for use both within and outside of the Federal sector, and a reasonable likelihood to be cost-effective when manufactured on a commercial scale. Increased market leverage depends on the stability and predictability of signals from the Federal government and other major buyers--not just the scale of their purchases. The more reliable the demand for efficient products, the easier it will be for manufacturers to plan and invest to meet this demand, and the more profitable it will be for the private sector to supply them at an acceptable price.

For government purchasing to have the intended market-pull result, it must be part of a visible, open process that encourages active participation by non-Federal purchasers and timely feedback to manufacturers and sellers. Maintaining good communication with vendors and manufacturers is essential to identify opportunities, resolve any performance problems with the new technology, and assure that energy-efficient products will be available in adequate quantities to meet both Federal and non-Federal needs. A well-designed program for promoting product commercialization through Federal purchasing can and should address all of these issues.

Federal procurement of new energy-saving technologies involves process issues, barriers that can arise and must be surmounted, and products that must meet Federal needs as well as those of the larger market. There was a consensus among the agencies and others contributing to this study that, while the Federal procurement can be difficult to navigate, there are important opportunities for government purchasing to speed the commercial availability of new technologies.

DOE will draw on the results of this study in undertaking actions, in partnership with other Federal agencies, to promote the successful introduction of new technologies in the form of energy-efficient, cost-effective products.

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Section 11: Appendices

Appendix A
Examples of Products with Commercialization Potential through Federal Purchasing Power

The products in this list have been identified by several sources including verbal and written contributions from study participants (study partic.); DOE/FEMP's New Technology Demonstration Program (NTDP); and research and development efforts by DOE, its contractors, and other Federal agencies (R&D). This is not an exhaustive list of all the products with a high potential for Federal purchasing to promote their commercialization, and therefore is subject to expansion as additional products and technologies are identified and as manufacturers develop new designs.

Buildings & Equipment Technologies	Source
Structure:	
- integrated solar wall panel (air pre-heat)	NTDP, study partic.
- windows with low U-value frames	study partic.
- window retrofits	study partic., R&D
- manufactured buildings & structural components	R&D
- energy-efficient modular small buildings (classrooms, etc.)	R&D
- reflective roof systems	NTDP, study partic.
- night-cooled hydronic cooling systems	NTDP
- insulated liquid coating (roofs, mechanical systems)	NTDP
Heating, Ventilation & Air Conditioning	
- ground-source heat pump technology	NTDP, study partic.
- natural gas heating & cooling systems	NTDP, study partic.
- gas-engine-driven heat pumps	NTDP
- gas-engine-driven cooling systems, rooftop & split system	NTDP
- gas-fired desiccant systems	NTDP, study partic.
- dehumidifier heat pipe	NTDP
- integrated heat pump systems for space heating & cooling and water heating	NTDP, study partic., R&D
- efficient part-load chiller systems (variable speed drive)	study partic.
- high-efficiency, direct-fired gas heating systems	study partic.
- integrated building control systems	study partic., R&D
- ozone cooling tower water treatment	NTDP
- parabolic solar collector	NTDP
- HVAC equipment cycling controller	NTDP
- humidification technologies	NTDP
- flame retention burners	NTDP
- sub-cooling auxiliary cooling equipment	NTDP

Buildings & Equipment Technologies (cont.)	Source
Hot Water Heating	
- heat pump water heaters	NTDP, study partic.
- drain water heat recycling systems	study partic.
- water heater conversion systems (electric to natural gas)	NTDP
- water conservation technologies	NTDP
- solar water heating	NTDP
Lighting & Electrical Systems	
- sensor-controlled dimming lighting systems w/ daylighting	NTDP, study partic.
- high efficiency building scale distribution transformers	study partic., R&D
- sulfur-lamp lighting	R&D
- polarized (full spectrum) lighting	NTDP
- continuously dimming ballasts	NTDP
- lighting controlling technologies	NTDP
- building electrical load adjustment devices	NTDP
Appliances & Other	
- efficient A-line replacement lamps	R&D
- water saving toilets - 2 flushing volumes	study partic.
- horizontal axis clothes washers	R&D
- ice making efficiency improving technologies	NTDP
- microwave dryers	NTDP
Industrial Food Service Technologies	
- variable load-based evaporator fan controller (walk-in refrigeration)	NTDP, study partic.
Vehicles & Transportation Technologies	
- low rolling resistance tires	R&D
- fuel cell powered electric vehicles	R&D
- electric vehicles & advanced battery electric vehicles	R&D
- electric bicycles	R&D
- renewable fuels (e.g. ethanol, biodiesel)	R&D
Other Technologies	
- sulfur lamps for street & outdoor lighting	R&D
- grey water recycling equipment & systems	NTDP
- switched reluctance motor systems	study partic.

On-Site Power Generation Technologies	Source
- photovoltaic-powered outdoor lighting	NTDP, study partic.
- photovoltaic power generation	study partic.
- photovoltaic shingles	R&D
- stationary fuel cell power plants	NTDP, R&D

Appendix B
Contributors to This Study

Stakeholders Consulted for Input into Report

Policy makers - the Office of Management and Budget (OMB) Office of Federal Procurement Policy, the Federal Environmental Executive, and DOE procurement policy executives;

Supply agencies - Defense Logistics Agency/Department of Defense, General Services Agency, and procurement specialists within DOE;

User agencies - including members of the Products Working Group of the DOE Federal Energy Management Program's Interagency Task Force;

Other programs promoting energy-efficient or environmentally preferable products, such as the Federal Procurement Challenge and New Technology Demonstration Program at DOE; the Energy-Saver appliances program, also at DOE; the joint Environmental Protection Agency (EPA)-DOE Energy Star labeling program, and EPA's support for Federal purchase of recycled and environmentally preferable products;

Joint Federal/state/utility/industry programs - the Alliance to Save Energy, the Energy- efficient Procurement Collaborative, the utility-sponsored Consortium for Energy Efficiency, and the Government Procurement Project of the Center for Study of Responsive Law; and

Specialized organizations such as the National Institute of Building Sciences.

Organizations Participating in Public Meeting or Submitting Written Statements

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