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Evaluation of the Near-Term Commercial Potential of Technologies Being Developed by the Office of Building Technologies

Volume I - Screening of Technologies

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March 1991

Prepared for the U.S. Department of Energy
under Contract DE-AC06-76RLO 1830

Pacific Northwest Laboratory
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EVALUATION OF THE NEAR-TERM COMMERCIAL POTENTIAL OF TECHNOLOGIES BEING DEVELOPED BY THE OFFICE OF BUILDING TECHNOLOGIES

Volume I - Screening of Technologies

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(a) Portland General Electric
Portland, Oregon

EXECUTIVE SUMMARY

This project developed an inventory of the Office of Building Technologies (OBT) from a survey administered in 1988 to program managers and principal investigators from OBT. Information provided on these surveys was evaluated to identify equipment and practices that are near-term opportunities for technology commercialization and to determine whether they needed some form of assistance from OBT to be successful in the marketplace.

The near-term commercial potential of OBT technologies was assessed by using a technology selection screening methodology. The screening first identified those technologies that were ready to be commercialized in the next two years. The second screen identified the technologies that had a simple payback period of less than five years, and the third identified those that met a current need in the marketplace. Twenty-six OBT technologies met all the criteria.

These commercially promising technologies were further screened to determine which would succeed on their own and which would require further commercialization support. Additional commercialization support was recommended for OBT technologies where serious barriers to adoption existed or where no private sector interest in a technology could be identified.

Twenty-three technologies were identified as requiring commercialization support from OBT. These are categorized by each division within OBT and are shown in Table S.1.

The methodology used could easily be adapted to screen other DOE-developed technologies to determine commercialization potential and to allocate resources accordingly. It provides a systematic way to analyze numerous technologies and a defensible and documented procedure for comparing them. It is designed to be used in a dynamic environment so that changing parameters and needs can be incorporated. The process of evaluation should be ongoing; the procedure documented in this report is designed to be performed regularly and whenever the energy environment changes substantially.

TABLE S.1. Technologies Requiring Commercialization Assistance from OBT

Building Equipment Division

Optimized Ground-Coupled Heat Pump

Building Services Division

Core Commercial Daylighting
Friction Reduction Activities
Urban Heat Islands
Diagnostic Protocols and Analysis Methods
Radiant Barrier Climate Guide
Shared Savings
Strategies for Emerging Issues
Technology Assessment and Market Penetration

Building Systems Division

Roof Surface Treatment Guidelines
Aerated Autoclaved Concrete
Superlite
Advanced Residential Ventilation Systems
Moisture Guidelines for Residences
Multi-zonal Infiltration and Ventilation Measures
Perfluorocarbon Tracer System
Advanced Leakage Techniques
Sick Building Syndrome Protocol
Mathematical Modeling of Indoor Air Quality
HVAC/Lighting Interactions
Small Office Buildings Handbook
Advanced Low-E Coating
Commercial Standards

Volume II of this study presents the full results of the equipment and practice survey of program managers and principal investigators.

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FIGURES

TABLES

1.0 INTRODUCTION

The Office of Building Technologies (OBT) is developing a variety of technologies. A preliminary assessment conducted in FY 1988 identified over 100 types of equipment and practices now under development by OBT. Like other organizations involved in developing technologies, OBT can actively support the transfer of only a limited number of these. Pacific Northwest Laboratory (PNL)[(a)] has developed a mechanism to effectively screen and identify technologies that have near-term commercial promise.

Private corporations use new product development process to select technologies for further development. The process can provide insight into the information needs required for technology development in the federal government as well. It helps managers identify and direct resources to those technologies having the highest probability of being commercially successful.

The academic literature contains a number of new product development models (Crawford 1983; Urban and Hauser 1980). Although conceptual variations among these models exist, they function quite similarly and are consistent with the actual procedures employed in developing new products (see also Roberson and Weijo 1988).

Though the requirements for any specific technology can vary, a general model can be identified. One example of this process is highlighted in Figure 1.1. This process includes the following steps:

1. Identify technology applications
2. Screening
3. Concept testing and diagnostic evaluation
4. Marketing strategy
5. Business analysis
6. Product development

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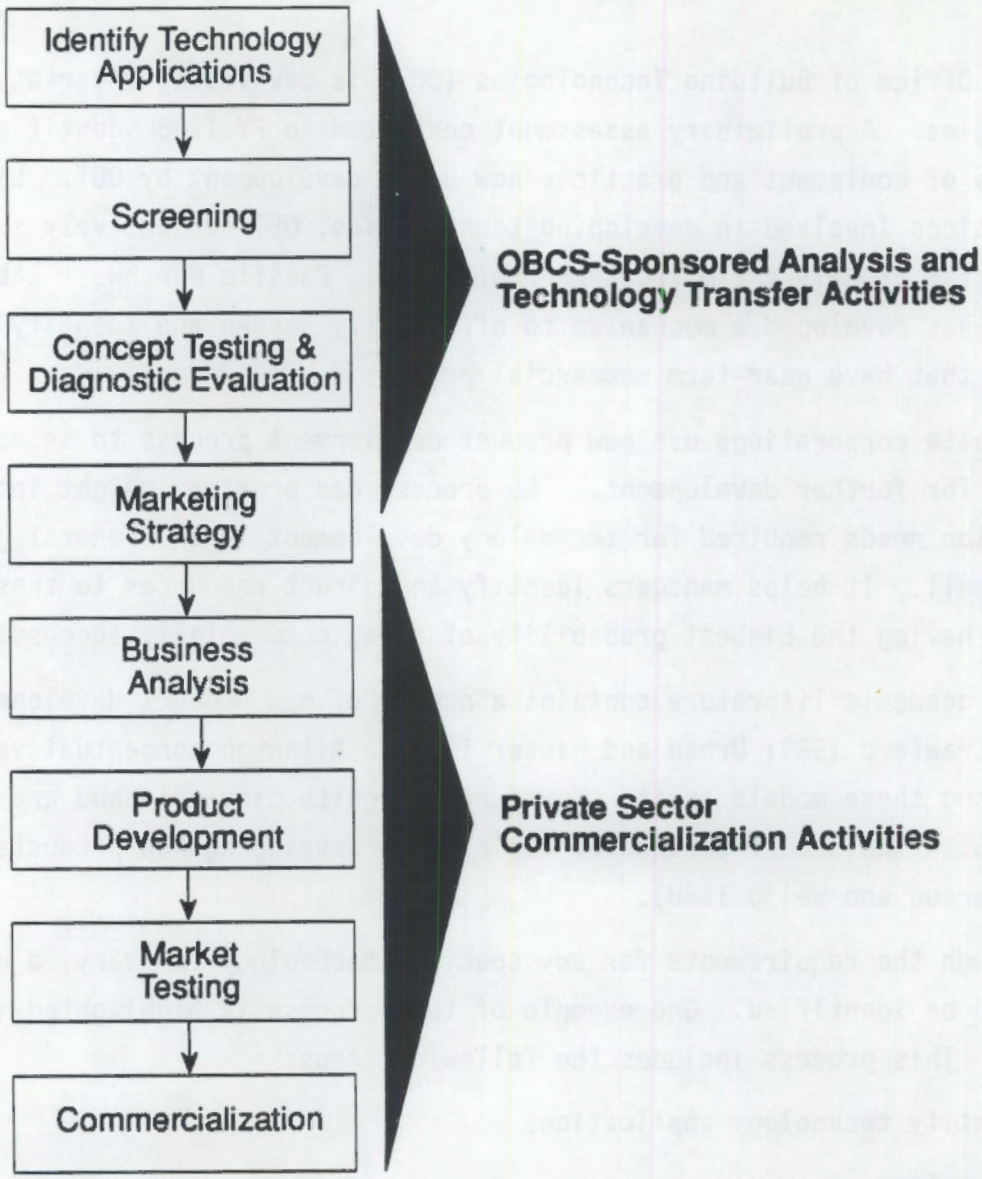

FIGURE 1.1. New Product Development Approach to Technology Commercialization

7. Market testing

8. Commercialization

The technology screening methodology PNL developed for OBT uses a similar framework. It has been used to identify technologies with near-term commercial potential that may require some type of assistance from OBT to be successful in the marketplace. First, a list of equipment and practices under

development by OBT was developed. Then a survey form was administered to OBT program managers and principal investigators. Information provided by these surveys identified those equipment and practices with near-term opportunities for technology commercialization. The equipment and practices were also assessed as to whether they might need some type of commercialization assistance from OBT.

If followed, this model will assist OBT in its efforts to transfer technology in the early stages of new product development. Manufacturers and trade association may then become the champions of commercialization during the later stages.

The methodology and the results of its application are described in the remainder of Volume I of this report. Chapter 2.0 describes the methodology employed to screen technologies. Chapter 3.0 identifies technologies that are commercially promising in the near-term. Chapter 4.0 identifies which promising technologies can succeed on their own and which require commercialization assistance. Chapter 5.0 provides final conclusions and recommendations for commercialization strategies. The equipment and practice survey form is presented in Appendix A. Appendix B contains tables that reflect the results of each step in the screening process. Volume II contains the complete results from the equipment and practice survey of program managers and principal investigators.

2.0 METHODOLOGY

An analysis conducted in FY 1988 revealed a lack of information required to effectively screen OBT technologies. A goal of this project was to develop a data base that would provide a consistent set of information across all OBT technologies. This information could then be used to screen OBT technologies for funding priorities and to identify a given technology's progress toward commercialization, assuming the data base was kept current. The methodology used to gather the information and the criteria used to screen the technologies and practices is described below.

2.1 DATA COLLECTION

A standardized data collection (survey) form was developed for OBT technologies. This survey form is presented in Appendix A. The OBT Analysis and Technology Transfer Advisory Group provided technical review and comments on the survey form.

The form was designed to simplify the collection of information; it is very short and can be completed in ten minutes. Answers to questions included in this survey generally required either selecting a response range or merely checking an applicable yes/no category. Thus, it encourages the collection of data that provide reasonable estimates to aid identification of the most promising technologies. OBT program managers and principal investigators completed a form for each identified technology.

The survey included questions that would permit analysts to characterize the technology and to determine whether each screening criterion was met. Information collected on the survey included the following:

1. Name and description of the technology
2. Characterization of the technology (equipment/practice)
3. Energy savings characteristics (saves energy directly/indirectly or not at all)
4. When the technology will be ready for commercialization
5. Whether the technology will require commercialization assistance

6. Estimated payback period for the technology
7. Market sectors that would benefit from the technology
8. Who is most likely to buy the equipment or use the practice
9. Important commercialization barriers to overcome
10. Energy-related benefits of the technology to customers
11. Non-energy benefits of the technology to customers
12. Commercial/professional organization interest in the technology

The results of the survey can be found in Volume II of this report.

Several important caveats should be carefully kept in mind in assessing the results from the survey instrument. The first is that this survey was administered in 1988; if the survey were conducted today, DOE program managers might respond differently, simply due to increased availability of knowledge about technical and economic performance and potential market success. For example, a program manager might have changed his or her assessment of the technology's simple payback, based upon field tests conducted since 1988. In addition, since the world is a dynamic environment, assessments about potential benefits may have changed from 1988, reflecting different national priorities. Second, the survey instrument, by design, does not ask for regional detail about technologies; instead, the questions are posed at the national level. For example, program managers are asked to identify the simple payback of the technology in a national average sense in broad periods of time. As a consequence, their response should not be construed to imply that this payback would hold in all regions of the country and at all possible energy prices. And third, the results of the survey should not be considered authoritative; if technical staff in industry or in universities were queried instead, to take two examples, it is likely that different responses would result.

2.2 SCREENING CRITERIA

The screening was designed to result in technologies being grouped into one of three distinct categories:

1. defer commercialization support until later
2. commercialization support needed from OBT
3. technology should succeed without further support.

The categories vary in terms of the level and timing of commercialization assistance required from OBT.

Figure 2.1 depicts the screening model used to place technologies into one of the three categories. Data collected in the survey is used as the needed input for the actual screening.

The first three screening criteria are designed to identify those applications where commercialization support should be deferred until a later date. The first criterion determined whether the technology was ready to be

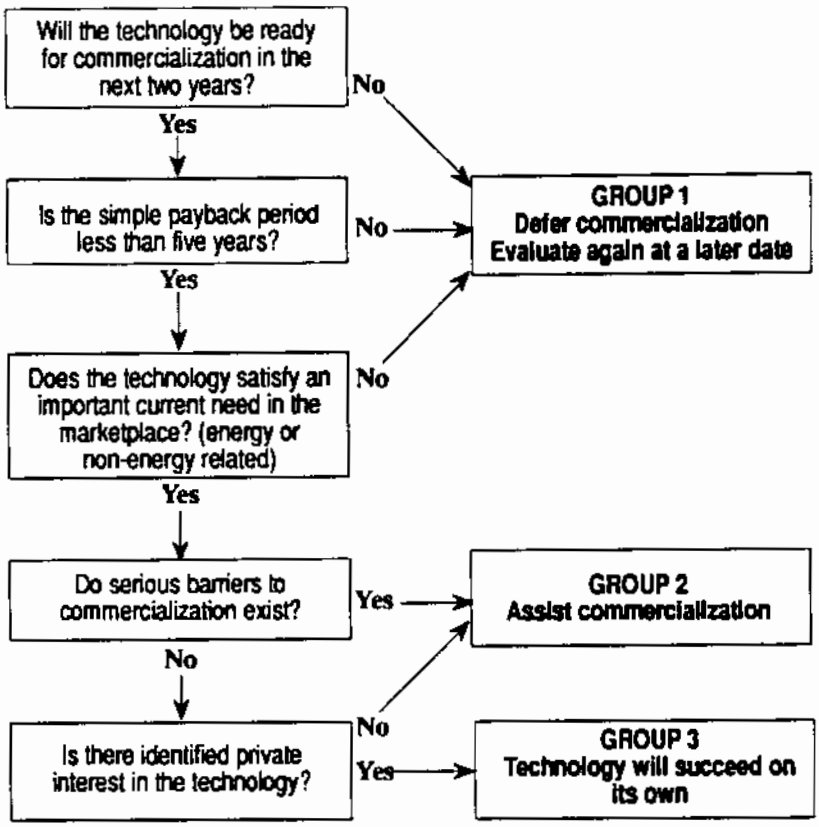

FIGURE 2.1. Technology Screening Model

commercialized within two years. The second criterion identified technologies that have a simple payback period of less than five years (or where payback is not applicable). The third criterion considered whether the technology satisfied a current need in the marketplace. If a technology did not meet each criterion, it was not considered ready for commercialization.

For those technologies that met the above criteria, two additional criteria were applied to determine whether this equipment or practice needed OBT commercialization assistance. The fourth criterion identified those technologies that have major barriers to commercialization. The fifth criterion identified the extent of private interest in a technology. If serious commercialization barriers or lack of private interest were hindering a technology, OBT commercialization assistance was recommended.

Those technologies that met all five screening criteria should succeed on their own without commercialization assistance from OBT. Their progress toward commercialization, however must be carefully monitored. If problems arise which seriously deter commercial success, OBT support would then be advised.

2.3 DATA ANALYSIS

The analysis conducted for this study considered over 100 technologies and followed the outlined methodology. Each equipment or practice was screened against the established criteria and placed into one of the three categories described above.

3.0 TECHNOLOGIES WITH NEAR-TERM COMMERCIAL PROMISE

The first three screening criteria were developed to identify OBT technologies that are near-term prospects for commercialization. The results of the first screen are presented below. The information was obtained from the survey administered to OBT program managers and principal investigators.

3.1 DATE TECHNOLOGY IS READY FOR COMMERCIALIZATION

At any point in time, only a limited number of technologies are ready to be commercialized. The first screening criterion separates those technologies that are nearly ready for commercialization from those that are not. (See Figure 3.1.) The portfolio of OBT technologies can be grouped into three time perspectives. The first group has finished the basic and applied research stages of development and is now ready for commercialization assistance. A second group of technologies will be ready for commercial assistance in the next few years. The final group of technologies may not have commercial value for a decade or more. Technologies that will be ready within the next two years will benefit from active technology transfer. Commercial support for long-term, high-risk technologies should be deferred until market entry is closer at hand.

To determine when technologies would be ready for commercialization Question 2 in the survey asked the program managers and principal investigators: "In your opinion, when will this technology be ready to commercialize?" Those technologies that were considered to be ready for commercialization within the next two years are listed in Table 3.1. Since the remaining

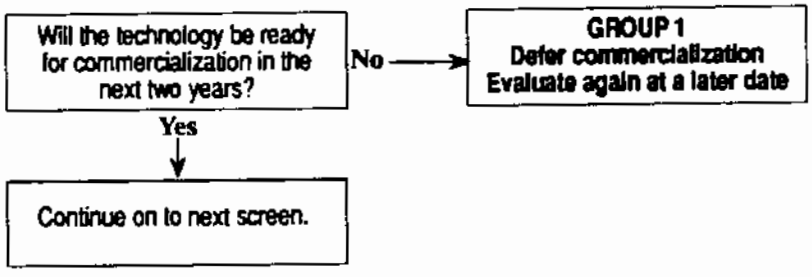

FIGURE 3.1. First Screen in the Technology Screening Model

TABLE 3.1. OBT Technologies that Will Be Ready for Commercialization Within Two Years

	Ready Now	1 - 2 Years
Building Equipment Division	Optimized Ground Coupled Heat Pump	Solid Fuel Appliance Measurement Methods
Building Services Division	Diagnostic Protocols and Analysis Methods Shared Savings Urban Heat Islands	Analytical Tools Btu Meter Core Commercial Daylighting Diagnostic Tool Development Energy Tracking System Friction Reduction Additives Integrated Utility Planning Processes Multifamily Audit Handbook Radiant Barrier Climatic Guide Radiant Barrier Modeling Strategies for Emerging Issues Technical Assessment and Market Penetration
Building Systems Division	Acoustic Testing of Attic Insulation Aerated Autoclave Insulation Commercial Standards Corrosiveness of Insulation Field Thermal Performance Methodology Foundation Design Tools Including Handbooks HVAC/Lighting Interactions Large Scale Climate Simulator (LSCS) Loose Fill Attic Insulation Settling Maintenance and Upgrading of DOE-2 Multi-Zonal Infiltration and Ventilation Measurement PROPOR Radiant Barrier Systems Roof Research Center - A National User Facility Roof Thermal Research Apparatus (RTRA) Small Office Building Handbook Superlite Window 3.1 Computer Program	Advanced Durable Low-E Coatings Advanced Leakage Techniques Advanced Residential Ventilation Systems High-R Windows Mathematical Modeling of Indoor Air Quality Moisture Guidelines for Residences Perfluorocarbon Tracer System Roof Surface Treatment Guidelines Sick Building Syndrome Protocol Simplified Thermal Analysis of Roofs (STAR) Thermal Bridges Design Catalog

technologies did not pass the first screening criterion, they were excluded from further screening. All the technologies are listed in Appendix B, Table B.1. They have been grouped into five categories based on the number of years before the technology will be ready for commercialization.

Forty-six technologies passed through the first screen. Of those 22, are ready for commercialization now and 24 will be ready for commercialization in one to two years.

3.2 SIMPLE PAYBACK PERIOD

The 46 technologies remaining after the first screen were run through the second screen--payback criterion. (See Figure 3.2.) Previous energy research has found that consumers typically demand a rapid payback period for energy conservation investments. Ruderman, Levine and McMahon (1987) report discount rates of between 20% and 200% for appliance conservation investments. This suggests that payback periods for conservation investments should ideally be under two years and definitely under five years. Ruderman, Levine and McMahon provide several explanations for consumer under-investment in efficiency:

> "We conclude that the market for energy efficiency is not performing well. We propose and discuss several explanations for the under-investment in efficiency: 1) lack of information about the costs and benefits of energy efficiency; 2) difficulty in obtaining the additional capital to purchase more expensive energy-efficiency appliances; 3) expected savings too small to be of interest to purchasers; 4) prevalence of third-party purchasers; 5) the loading of highly efficient equipment with other features or a scarcity of highly-efficient equipment; 6) long manufacturing lead time; and 7) marketing strategies that may discourage the purchase of more efficient products."

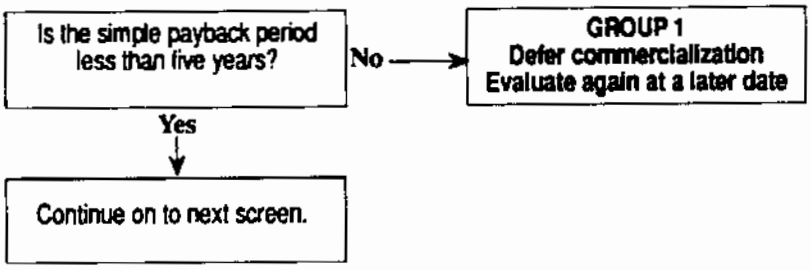

FIGURE 3.2. Second Screen in the Technology Screening Model

The basis for the screening came from responses to Question 4 in the survey: "Please estimate this technology's simple payback period to the customer." Simple payback period was defined as the length of time needed to recover the customer's capital investment in a technology. Table 3.2 lists the technologies that are listed in Table 3.1 and that are considered to have payback periods of five years or less. Technologies where payback periods are not applicable are also listed. This "not applicable" category of technologies primarily includes research tools, software, procedures, and mathematical models which do not directly save energy.

After this screen, 44 technologies remained. The simple payback periods for all of the technologies in the study are shown in Appendix B, Table B.2.

3.3 CURRENT NEEDS IN THE MARKETPLACE

The third screening criterion focuses on market needs. (See Figure 3.3.) Like many DOE programs, OBT faces an interesting dilemma. It must support a long-term energy research program in an arena of volatile energy prices. Conservation does not sell when oil prices are $12 to $18 per barrel. However, at any given time, other issues are important to the energy industry. Thus, OBT must identify and promote those technologies that provide solutions to current problems. As the importance of problems within the energy industry changes, the mix of technologies receiving commercialization support must change. Thus, the near-term technology transfer effort must always be opportunistic in its focus.

The market needs considered are of two types: energy-related and non-energy-related. In the survey, respondents were asked, "What do you think are the energy-related benefits of this equipment or practice to customers?" They were also asked to report what they thought were the non-energy benefits of this technology (Questions 7 and 8). The energy-related benefits listed in the survey were:

- reduces energy bills
- reduces usage of a scarce fuel
- reduces peak energy loads

TABLE 3.2. OBT Technologies that Have Simple Payback Periods of Five Years or Less and Will Be Ready for Commercialization Within Two Years[a]

Building Equipment Division

Not Applicable	0-2 Years	3-5 Years
Solid Fuel Appliance Measurement Methods		Optimized Ground Coupled Heat Pump

Building Services Division

Not Applicable	0-2 Years	3-5 Years
Analytical Tools	Btu	Diagnostic Protocols and Analysis Methods
Diagnostic Tool Development	Core Commercial Daylighting	Multifamily Audit Handbook
Energy Tracking System		Shared Savings
Friction Reduction Additives		Urban Heat Islands
Integrated Utility Planning Processes		
Radiant Barrier Modeling		
Radiant Barrier Climatic Guide		
Strategies for Emerging Issues		
Technology Assessment and Market Penetration		

Building Systems Division

Not Applicable	0-2 Years	3-5 Years
Acoustic Testing of Attic Insulation	Advanced Residential Ventilation Systems	Advanced Durable Low-E Coatings
Advanced Leakage Techniques	Commercial Standards	Aerated Autoclaved Concrete
Corrosiveness of Insulation	Foundation Design Tools, Including Handbooks	Field Thermal Performance Methodology
Maintenance and Upgrading of DOE-2	Small Office Building Handbook	High-R Windows
Mathematical Modeling of Indoor Air Quality	Superlite	HVAC/Lighting Interactions
Moisture Guidelines for Residences		Roof Research Center - A National User Facility
Multi-Zonal Infiltration and Ventilation Measurement		Roof Thermal Research Apparatus (RTRA)
Perfluorocarbon Tracer System		Thermal Bridges Design Catalog
Sick Building Syndrome Protocol		
Window 3.1 Computer Program		

(a) No response was received for either the PROPOR or the Simplified Thermal Analysis of Roofs (STAR) technologies

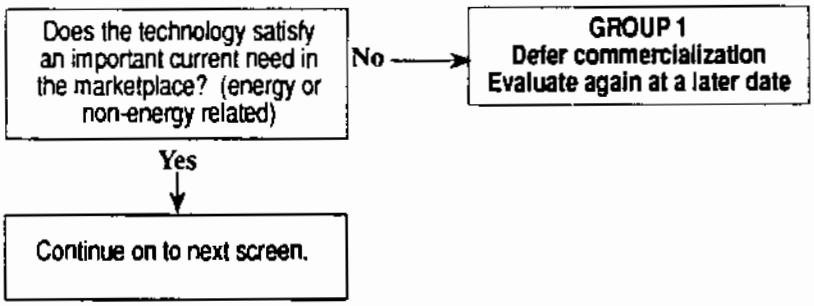

FIGURE 3.3. Third Screen in the Technology Screening Model

- creates a backup fuel capability.

The non-energy-related benefits listed include:

- provides healthier indoor air environment
- increases thermal comfort
- increases visual comfort
- reduces noise/sound levels
- enhances building attractiveness
- eases building operation & maintenance
- improves system reliability
- reduces first cost for product.

Either the chosen energy-related or non-energy-related benefit was allowed to serve as an indication that the technology met a current market need. For this screening, the energy-related benefit that was chosen was "reduces peak energy loads" and the non-energy-related benefit was "provides healthier indoor air environment." Within the two market need categories, any of the above listed criteria could be chosen to replace the criteria used. The criteria chosen should reflect the market needs of that time period.

Of the 44 technologies listed previously in Table 3.2, 18 could reduce peak energy loads. These technologies are listed in Table 3.3. (The energy benefits of all of the technologies are listed in Appendix B, Table B.3.)

TABLE 3.3. OBT Technologies That Reduce Peak Energy Usage, Have Simple Payback Periods of Five Years or Less, and Will Be Ready for Commercialization Within Two Years

Building Equipment Division

Optimized Ground Coupled Heat Pump

Building Services Division

Analytical Tools
Core Commercial Daylighting
Diagnostic Protocols and Analysis Methods
Friction Reduction Additives
Integrated Utility Planning Processes
Radiant Barrier Climatic Guide
Shared Savings
Strategies for Emerging Issues
Technology Assessment and Market Penetration
Urban Heat Islands

Building Systems Division

Advanced Durable Low-E Coatings
Aerated Autoclaved Concrete
Commercial Standards
HVAC/Lighting Interactions
Roof Surface Treatment Guidelines
Small Office Building Handbook
Superlite

The non-energy-related market criterion used to screen OBT technologies "provides a healthier indoor air environment." Of the 44 technologies remaining after the first two screens (see Table 3.2), 8 provided healthier indoor air environments. These technologies are listed in Table 3.4. (The non-energy benefits of all the technologies are listed in Appendix B, Table B.4.) These 8 technologies were different from the 18 technologies that offered to reduce peak energy usage. Therefore, 26 technologies showed indications of meeting a current market need in addition to being ready for commercialization within two years and having simple payback periods of five years or less.

TABLE 3.4. OBT Technologies That Provide Healthier Indoor Air Environments, Have Simple Payback Periods of Five Years or Less, and Will be Ready for Commercialization Within Two Years[a]

Building Systems Division

Advanced Leakage Techniques
Advanced Residential Ventilation Systems
Foundation Design Tools Including Handbooks
Mathematical Modeling of Indoor Air Quality
Moisture Guidelines for Residences
Multi-Zonal Infiltration and Ventilation Measurement
Perfluorocarbon Tracer System
Sick Building Syndrome Protocol

(a) None of the technologies in the Building Services Division or the Building Equipment Division met all three criteria.

3.4 IDENTIFICATION OF NEAR-TERM PROMISING TECHNOLOGIES

Technologies that are commercially promising in the near-term are those that meet all three of the above established criteria: 1) they are ready for commercialization in two years, 2) have a simple payback period of five years or less, and 3) satisfy an important current need in the marketplace (both energy- and non-energy-related.) Table 3.5 summarizes the technologies that met these criteria.

TABLE 3.5. OBT Technologies That Are Commercially Promising in the Near-Term

Building Equipment Division

Optimized Ground Coupled Heat Pump

Building Services Division

Analytical Tools
Core Commercial Daylighting
Diagnostic Protocols and Analysis Methods
Friction Reduction Additives
Integrated Utility Planning Processes
Radiant Barrier Climatic Guide
Shared Savings
Strategies for Emerging Issues
Technology Assessment and Market Penetration
Urban Heat Islands

Building Systems Division

Advanced Durable Low-E Coatings
Advanced Leakage Techniques
Advanced Residential Ventilation Systems
Aerated Autoclaved Concrete
Commercial Standards
Foundation Design Tools Including Handbooks
HVAC/Lighting Interactions
Mathematical Modeling of Indoor Air Quality
Moisture Guidelines for Residences
Multi-Zonal Infiltration and Ventilation Measurement
Perfluorocarbon Tracer System
Roof Surface Treatment Guidelines
Sick Building Syndrome Protocol
Small Office Building Handbook
Superlite

4.0 TECHNOLOGIES THAT WILL SUCCEED ON THEIR OWN

Not all promising technologies will require commercialization assistance. In those instances where few commercial barriers exist or where private industry has been involved in the development process, no additional resources are required to support commercialization. If commercialization barriers do exist and/or no private sector interest is identified, additional resources must be allocated to support the commercialization of the technologies. The fourth and fifth screening criterion will separate the remaining technologies into these categories. Both of these criteria are discussed below.

4.1 COMMERCIALIZATION BARRIERS

At any point in time, a variety of factors can impinge on or interfere with the commercial success of a technology. Question 6 in the survey asked the program managers and principal investigators, "What do you think are the important commercialization barriers to overcome?" The program managers and principal investigators were asked to check all of the barriers that pertained to the commercialization of the technology. The barriers are listed below in Table 4.1. A distinction was made between those that will be relatively easy to overcome and those that will not.

TABLE 4.1. Commercialization Barriers

Simplest Barriers
Lack of awareness about equipment/practice
Lack of understanding about equipment/practice
Large number of decision makers involved
Reliability concerns about technology

Potentially Serious Barriers
Environmental concerns
Conflicts with existing building codes
Legal and regulatory difficulties
Unavailability of financing
High perceived risk because new/different
High first cost for technology

If it had one or more potentially serious barriers, the technology was determined to need OBT technology transfer assistance. (See Figure 4.1.) The remaining technologies were considered technologies that could survive without OBT help and were evaluated in the final screening. Of the 26 technologies with near-term commercial promise (shown in Table 3.5) 19 had one or more barriers that were classified as potentially serious. These technologies are shown in Table 4.2. The barriers identified for all of the technologies are shown in Appendix B, Table B.5.

4.2 PRIVATE SECTOR INTEREST IN PROMISING TECHNOLOGIES

Even if few barriers exist, the likelihood of commercial success will be limited if there is no private sector interest in a technology. The most successful commercialization strategy includes involvement by the private sector at the very earliest stages of research and development.

The OBT technologies were analyzed to determine where significant private sector or trade association interest had been identified. (See Figure 4.2.) Question 9 in the survey asked the program managers and principal investigators, "To your knowledge, have any commercial or professional organizations indicated an interest in either licensing or using this equipment or practice?" Answers to this question provided input for the fifth screening criterion. Only those seven technologies that have no serious barriers went to this screen. If the program managers or principal investigators answered affirmatively, the technology was considered to be on its own, not needing any commercialization assistance from OBT.

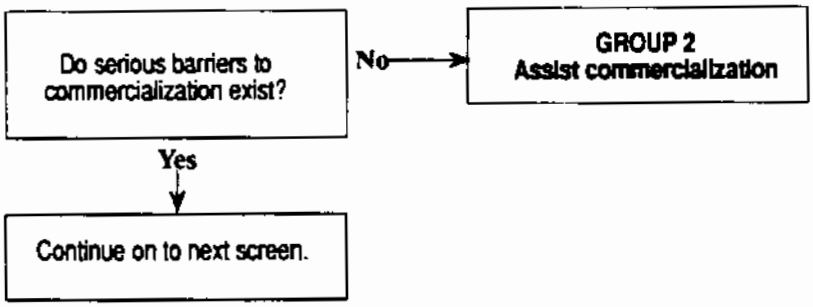

FIGURE 4.1. Fourth Screen in the Technology Screening Model

TABLE 4.2. Technologies with Serious Barriers to Commercialization

Building Equipment Division

Optimized Ground Coupled Heat Pump

Building Services Division

Core Commercial Daylighting
Diagnostic Protocols and Analysis Methods
Friction Reduction Additives
Shared Savings
Strategies for Emerging Issues
Technology Assessment and Market Penetration
Urban Heat Islands

Building Systems Division

Advanced Durable Low-E Coatings
Advanced Leakage Techniques
Advanced Residential Ventilation Systems
Aerated Autoclaved Concrete
Commercial Standards
HVAC/Lighting Interactions
Mathematical Modeling of Indoor Air Quality
Moisture Guidelines for Residences
Multi-Zonal Infiltration and Ventilation Measurement
Small Office Building Handbook
Superlite

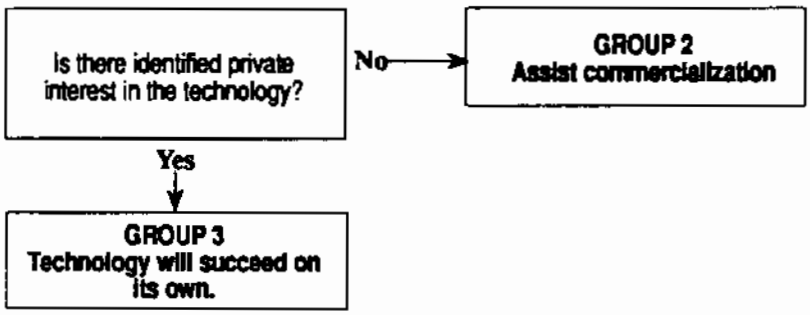

FIGURE 4.2. Fifth Screen in the Technology Screening Model

(The commercial or professional organizations indicating an interest in either licensing or using the equipment or practice are shown in Appendix B, Table B.6, for interest and future tracking of the technology.) The remaining four technologies (listed in Table 4.3) have near-term commercial potential, but have serious barriers and no interested backers.

4.3 SUMMARY

The 23 technologies listed in Table 4.4 are the technologies that warrant immediate commercialization support. (Table 4.4 is the union of Tables 4.2 and 4.3.) The technologies that are not included in this list have either already gained support through private industry, do not face serious barriers to implementation, or are not ready for commercialization.

The technologies requiring assistance have promising commercialization prospects, but without OBT support will most likely remain in the laboratories and not gain widespread market use. A few of the technologies that did not indicate having private support, actually have already received other DOE commercialization support. The following technologies have already been selected as projects needing government aid in commercializing: optimized ground coupled heat pump, shared savings, commercial standards, and small office building handbook.

Three technologies were classified as able to survive on their own. They are analytical tools; integrated utility planning processes; and foundation design tools, including handbooks.

TABLE 4.3. Technologies in which There is No Private Interest in Licensing or Using

Building Services Division
Radiant Barrier Climatic Guide
Building Systems Division
Perfluorocarbon Tracer System
Roof Surface Treatment Guidelines
Sick Building Syndrome Protocol

TABLE 4.4. Technologies Requiring Assistance

Building Equipment Division

Optimized Ground Coupled Heat Pump

Building Services Division

Core Commercial Daylighting
Diagnostic Protocols and Analysis Methods
Friction Reduction Additives
Radiant Barrier Climatic Guide
Shared Savings
Strategies for Emerging Issues
Technology Assessment and Market Penetration
Urban Heat Islands

Building Systems Division

Advanced Durable Low-E Coatings
Advanced Leakage Techniques
Advanced Residential Ventilation Systems
Aerated Autoclaved Concrete
Commercial Standards
HVAC/Lighting Interactions
Mathematical Modeling of Indoor Air Quality
Moisture Guidelines for Residences
Multi-Zonal Infiltration and Ventilation Measurement
Perfluorocarbon Tracer System
Roof Surface Treatment Guidelines
Sick Building Syndrome Protocol
Small Office Building Handbook
Superlite

5.0 CONCLUSIONS AND RECOMMENDATIONS

Use of the screening methodology reduced the number of technologies which should receive attention from over 100 to a more manageable number of 23. Of these 23, 4 are already receiving substantial aid from DOE.

The screening process should not be used as a one-time process, but rather should be constantly reviewed. The review and screening process helps to identify those technologies that are currently the most promising commercialization prospects; however, the market changes rapidly and, consequently, so do its needs. New technologies emerge, some previously supported projects become championed by industry, others become obsolete as market situations change, and still others that were previously excluded become market-ready.

Although this methodology was designed specifically for OBT technologies, it could easily be adapted to support other DOE project/technology funding decisions. The method provides a systematic way to prioritize commercialization opportunities within a limited budget framework.

6.0 REFERENCES

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APPENDIX A

EQUIPMENT AND PRACTICE FORM

APPENDIX A

EQUIPMENT AND PRACTICE FORM

Appendix A consists of the Equipment and Practice Form. This is a standardized data collection form that was given to OBT program managers and principal investigators. The form was to be completed for each identified technology. Answers to the questions permitted characterization of the technology and determination of whether each screening criterion was met. The results of the survey can be found in Volume II of this study.

EQUIPMENT AND PRACTICE FORM

Instructions: Please complete a separate form for each unique equipment or practice being developed or studied in your program. Please complete forms for items even if they do not save energy.

Project Identification:

(a) Program: _____ (b) Subprogram: _____

(c) Key Activity: _____

(d) Project: _____

1. Equipment or Practice:

   a) Name of equipment or practice:

   b) Description of equipment or practice:

   c) Would you characterize this technology as primarily an equipment (i.e., hardware) or a practice (i.e., software or knowledge-based): **(Please check only one)**

      _____ Equipment
      _____ Practice

   d) Describe the energy characteristics of this equipment or practice **(please select one)**:

      _____ Saves energy directly - Estimate the savings of this technology over state-of-the-art equipment/practices _____% savings (to the nearest 5%).

      _____ Indirectly saves energy by solving a problem created by the installation of energy-saving technologies (e.g., indoor air pollution).

_____ Does not save energy (e.g., equipment developed to study the energy characteristics of a building.

2. In your opinion, when will this technology be ready to commercialize? (please select one)

Is ready now ___ 1 to 2 years ___ 3 to 5 years ___
6 to 10 years ___ More than 10 years ___

3. In your opinion, will this equipment or practice require commercialization assistance from OBT for it to succeed in the marketplace? (select one)

_____ Will require OBT assistance
_____ Will succeed on its own

4. Please estimate this technology's simple payback period to the customer. (Note: The simple payback period is the length of time it takes to recover the customer's capital investment in a technology. Thus, if $100 is invested and provides an average savings of $25/year, the payback is four years.)

0 to 2 years ___ 3 to 5 years ___
6 to 10 years ___ More than 10 years ___ Not applicable ___

5. Market/Applications for Equipment or Practice:

a) Which market sectors are most likely to benefit from the use of this equipment or practice? (please check all that apply)

	Application	
	New	Retrofit/Replacement
Residential Buildings		
Single-family	___	___
Multi-family	___	___
Manufactured home	___	___
Commercial Buildings		
Less than 10,000 sq.ft.	___	___
10,000-100,000 sq.ft.	___	___
Greater than 100,000 sq.ft.	___	___
Communities	___	___
Other (please list) _____	___	___

b) Who is most likely to buy the product or use the practice? (please check all that apply)

___ Single-family homeowners
___ Multi-family homeowners
___ Commercial building owners or managers

___ Public or government building managers
___ Non-profit or government building managers
___ Builders, contractors or installers
___ Architects or engineers
___ Renters or tenants
___ Energy utilities
___ Industrial manufacturers
___ Government officials and regulators
___ Other (please describe)

6. What do you think are the important commercialization barriers to overcome? **(please check all that apply)**

___ Lack of awareness about equipment/practice
___ Lack of understanding about equip./practice
___ Large number of decision makers involved
___ Environmental concerns
___ Conflicts with existing building codes
___ Legal and regulatory difficulties
___ Unavailability of financing
___ High perceived risk because new/different
___ High first cost for technology
___ Reliability concerns about technology
___ Other **(please specify)** _____

7. What do you think are the energy-related benefits of this equipment or practice to customers? **(please check all that apply)**

___ Reduces energy bills
___ Reduces usage of scarce fuel
___ Reduces peak energy loads
___ Creates a backup fuel capability
___ Other **(please specify)** _____

8. What do you think are the non-energy benefits of this equipment or practice to customers? **(please check all that apply)**

___ Healthier indoor air environment
___ Greater thermal comfort
___ Greater visual comfort
___ Reduced noise/sound levels
___ Enhanced building attractiveness
___ Eases building operation & maintenance
___ Improves system reliability
___ Reduced first cost for product
___ Other **(please specify)** _____

9. Commercial or Professional Interest in Equipment or Practice

a) To your knowledge, have any commercial or professional organizations indicated an interest in either licensing or using this equipment or practice?

___ Yes
___ No

b) If yes, please list who they are: _____

10. Name and Telephone Number of Person Completing Form

Name of person completing form: _____

Telephone number (including area code): _____

APPENDIX B

RESULTS OF TECHNOLOGY SCREENING

APPENDIX B

RESULTS OF TECHNOLOGY SCREENING

Data from the Equipment and Practice Form were used as the needed input for the screening. The screening was designed to group technologies into one of three distinct categories:

1. defer commercialization support until later
2. commercialization support needed from OBT
3. technology should succeed without further support.

The categories vary in terms of the level and timing of commercialization assistance required from OBT.

Appendix B consists of tables representing the results of each step in the screening process. The results are broken down by each division within OBT. There are 29 technologies in the Building Equipment Division, 29 technologies in the Building Services Division, and 46 technologies in the Building Systems Division.

TABLE B.1. Time Needed to Ready Technology for Commercialization

BUILDING EQUIPMENT DIVISION

TECHNOLOGY IS READY NOW:
- OPTIMIZED GROUND COUPLED HEAT PUMP

TECHNOLOGY WILL BE READY IN 1 TO 2 YEARS:
- SOLID FUEL APPLIANCE MEASUREMENT METHODS

TECHNOLOGY WILL BE READY IN 3 TO 5 YEARS:
- ADVANCED CONDENSING HEAT EXCHANGERS
- ADVANCED LIGHTING CONTROLS
- COMMERCIAL AND RESIDENTIAL ZONING
- CONSERVATION MEASURES THROUGH FORCED-AIR DISTRIBUTION
- DIRECT VENT TECHNOLOGY
- DYNAMIC LIGHTING DESIGN
- IN VITRO DIAGNOSTICS
- ISOTOPICALLY ENRICHED FLUORESCENT
- LOW-FIRING RATE OIL BURNER TECHNOLOGY
- PERFORMANCE CONTROL STRATEGIES
- VARIABLE-SPEED COMPRESSORS & FANS
- WOOD COMBUSTION SYSTEMS

TECHNOLOGY WILL BE READY IN 6 TO 10 YEARS:
- ABSORPTION FLUIDS
- ADVANCED CONCEPT ABSORPTION HEAT PUMP
- ADVANCED INSULATION
- ADVANCED PHOSPHOR MATERIALS
- CERAMIC FLUID PUMPS
- DESICCANT/HYBRID COOLING SYSTEMS
- EJECTOR COUPLED HP CYCLE
- ELECTRODELESS HIGH-INTENSITY DISCHARGE LIGHT
- FIFTEEN-TON BRAUN LINEAR ENGINE HP.
- FUEL-OIL ATOMIZATION/COMBUSTION
- HERMETIC COMPRESSOR SEALS
- INCANDESCENT REPLACEMENT BY H.I.D.
- STIRLING/RANK. DIA. COUPLED HP.
- SURFACE WAVE FLUORESCENT

TECHNOLOGY WILL BE READY IN MORE THAN 10 YEARS:
- NONAZEOTROPIC REFRIGERANT MIXTURES

TABLE B.1. (contd)

BUILDING SERVICES DIVISION

TECHNOLOGY IS READY NOW:
- DIAGNOSTIC PROTOCOLS AND ANALYSIS METHODS
- SHARED SAVINGS
- URBAN HEAT ISLANDS

TECHNOLOGY WILL BE READY IN 1 TO 2 YEARS:
- ANALYTICAL TOOLS
- BTU METER
- CORE COMMERCIAL DAYLIGHTING
- DIAGNOSTIC TOOL DEVELOPMENT
- ENERGY TRACKING SYSTEM
- FRICTION REDUCTION ADDITIVES
- INTEGRATED UTILITY PLANNING PROCESSES
- MULTIFAMILY AUDIT HANDBOOK
- RADIANT BARRIER CLIMATIC GUIDE
- RADIANT BARRIER MODELING
- STRATEGIES FOR EMERGING ISSUES
- TECHNOLOGY ASSESSMENT AND MARKET PENETRATION

TECHNOLOGY WILL BE READY IN 3 TO 5 YEARS:
- ABSORPTION CHILLER
- ACOUSTIC LEAK DETECTION SYSTEM
- ADVANCED RANKINE CYCLE HEAT PUMP
- COMMERCIAL BUILDING RETROFIT PROCEDURES
- HEAT PUMP (QUASI OPEN CYCLE)
- MOBILE HOME RETROFIT PROCEDURES
- MULTIFAMILY RETROFIT PROCEDURES
- OPERATING AND MAINTENANCE PROCEDURES
- PUBLIC HOUSING RETROFIT PROCEDURES
- VACUUM STEAM RADIATORS

TECHNOLOGY WILL BE READY IN 6 TO 10 YEARS:
- ADVANCED DUCT SEALING TECHNIQUES
- DOWN-HOLE HEAT EXCHANGER
- ICE SLURRY EVAPORATOR
- NON-METALLIC PIPING SYSTEM

BUILDING SYSTEMS DIVISION

NON-RESPONSE TO QUESTION 2:
- COMPOSITE/PRE-BUILT WALL SYSTEMS
- FOAM AGING AND R-VALUE PREDICTION
- MOISTURE IMPACTS ON MATERIALS
- RADIATIVE HEAT TRANSFER
- SWITCHABLE E MATERIALS
- THERMAL CONDUCTIVITY MEASUREMENTS OVER RANGE OF ENVIRONMENTAL TEMPS.

TABLE B.1. (contd)

TECHNOLOGY IS READY NOW:
- ACOUSTIC TESTING OF ATTIC INSULATION
- AERATED AUTOCLAVED CONCRETE
- COMMERCIAL STANDARDS
- CORROSIVENESS OF INSULATION
- FIELD THERMAL PERFORMANCE METHODOLOGY
- FOUNDATION DESIGN TOOLS INCLUDING HANDBOOKS
- HVAC/LIGHTING INTERACTIONS
- LARGE SCALE CLIMATE SIMULATOR (LSCS)
- LOOSE FILL ATTIC INSULATION SETTLING
- MAINTENANCE AND UPGRADING OF DOE-2
- MULTI-ZONAL INFILTRATION AND VENTILATION MEASUREMENT
- PROPOR
- RADIANT BARRIER SYSTEMS
- ROOF RESEARCH CENTER - A NATIONAL USER FACILITY
- ROOF THERMAL RESEARCH APPARATUS (RTRA)
- SMALL OFFICE BUILDING HANDBOOK
- SUPERLITE
- WINDOW 3.I COMPUTER PROGRAM

TECHNOLOGY WILL BE READY IN I TO 2 YEARS:
- ADVANCED DURABLE LOW-E COATINGS
- ADVANCED LEAKAGE TECHNIQUES
- ADVANCED RESIDENTIAL VENTILATION SYSTEMS
- HIGH-R WINDOWS
- MATHEMATICAL MODELING OF INDOOR AIR QUALITY
- MOISTURE GUIDELINES FOR RESIDENCES
- PERFLUOROCARBON TRACER SYSTEM
- ROOF SURFACE TREATMENT GUIDELINES
- SICK BUILDING SYNDROME PROTOCOL
- SIMPLIFIED THERMAL ANALYSIS OF ROOFS (STAR)
- THERMAL BRIDGES DESIGN CATALOG

TECHNOLOGY WILL BE READY IN 3 TO 5 YEARS:
- ADVANCED DESIGN TOOLS
- ALTERNATIVE CFC-BASED INSULATIONS IN WALL AND FOUNDATION SYSTEMS
- IMBEDDED HEAT FLUX TRANSDUCERS
- NON-INTRUSIVE MOISTURE PROBE
- PASSIVE SAMPLER OF VOLATILE ORGANIC COMPOUNDS (VOC)

TECHNOLOGY WILL BE READY IN 6 TO I0 YEARS:
- ENERGY KERNEL SYSTEM
- MANUFACTURED HOUSING INSULATION
- MOISTURE MEASUREMENT METHODOLOGY
- POWDER-FILLED EVACUATED INSULATION PANELS
- SUBSTITUTE FOAMING AGENTS FOR INSULATION

TECHNOLOGY WILL BE READY IN MORE THAN I0 YEARS:
- VARIABLE R MATERIALS

TABLE B.2. Simple Payback Period for All Technologies

BUILDING EQUIPMENT DIVISION

NO RESPONSE TO QUESTION 4:
- SURFACE WAVE FLUORESCENT

NON-APPLICABLE:
- DYNAMIC LIGHTING DESIGN
- SOLID FUEL APPLIANCE MEASUREMENT METHODS

0 TO 2 YEAR SIMPLE PAYBACK PERIOD:
- ADVANCED PHOSPHOR MATERIALS
- ADVANCED CONDENSING HEAT EXCHANGERS
- COMMERCIAL AND RESIDENTIAL ZONING
- DIRECT VENT TECHNOLOGY
- IN VITRO DIAGNOSTICS
- ISOTOPICALLY ENRICHED FLUORESCENT
- PERFORMANCE CONTROL STRATEGIES

3 TO 5 YEAR SIMPLE PAYBACK PERIOD:
- ABSORPTION FLUIDS
- ADVANCED CONCEPT ABSORPTION HEAT PUMP
- ADVANCED INSULATION
- ADVANCED LIGHTING CONTROLS
- ELECTRODELESS HIGH-INTENSITY DISCHARGE LIGHT
- INCANDESCENT REPLACEMENT BY H.I.D.
- CERAMIC FLUID PUMPS
- CONSERVATION MEASURES THROUGH FORCED-AIR DISTRIBUTION
- DESICCANT/HYBRID COOLING SYSTEMS
- EJECTOR COUPLED HP CYCLE
- FIFTEEN-TON BRAUN LINEAR ENGINE HP.
- FUEL-OIL ATOMIZATION/COMBUSTION
- HERMETIC COMPRESSOR SEALS
- LOW-FIRING RATE OIL BURNER TECHNOLOGY
- OPTIMIZED GROUND COUPLED HEAT PUMP
- STIRLING/RANK. DIA. COUPLED HP.
- WOOD COMBUSTION SYSTEMS

6 TO 10 YEAR SIMPLE PAYBACK PERIOD:
- NONAZEOTROPIC REFRIGERANT MIXTURES
- VARIABLE-SPEED COMPRESSORS & FANS

BUILDING SERVICES DIVISION

NON-APPLICABLE:
- ANALYTICAL TOOLS
- DIAGNOSTIC TOOL DEVELOPMENT
- ENERGY TRACKING SYSTEM
- FRICTION REDUCTION ADDITIVES
- INTEGRATED UTILITY PLANNING PROCESSES
- RADIANT BARRIER CLIMATIC GUIDE
- RADIANT BARRIER MODELING

TABLE B.2. (contd)

STRATEGIES FOR EMERGING ISSUES
TECHNOLOGY ASSESSMENT AND MARKET PENETRATION

0 TO 2 YEAR SIMPLE PAYBACK PERIOD:
BTU METER
CORE COMMERCIAL DAYLIGHTING
OPERATING AND MAINTENANCE PROCEDURES
VACUUM STEAM RADIATORS

3 TO 5 YEAR SIMPLE PAYBACK PERIOD:
ABSORPTION CHILLER
ACOUSTIC LEAK DETECTION SYSTEM
ADVANCED DUCT SEALING TECHNIQUES
ADVANCED RANKINE CYCLE HEAT PUMP
COMMERCIAL BUILDING RETROFIT PROCEDURES
DIAGNOSTIC PROTOCOLS AND ANALYSIS METHODS
HEAT PUMP (QUASI OPEN CYCLE)
ICE SLURRY EVAPORATOR
MOBILE HOME RETROFIT PROCEDURES
MULTIFAMILY AUDIT HANDBOOK
MULTIFAMILY RETROFIT PROCEDURES
PUBLIC HOUSING RETROFIT PROCEDURES
SHARED SAVINGS
URBAN HEAT ISLANDS

6 TO 10 YEAR PAYBACK PERIOD:
NON-METALLIC PIPING SYSTEM

MORE THAN 10 YEAR PAYBACK PERIOD:
DOWN-HOLE HEAT EXCHANGER

BUILDING SYSTEMS DIVISION
NO RESPONSE TO QUESTION 4:
ADVANCED DESIGN TOOLS
PROPOR
THERMAL CONDUCTIVITY MEASUREMENTS OVER RANGE OF ENVIRONMENTAL TEMPS.
SIMPLIFIED THERMAL ANALYSIS OF ROOFS (STAR)

NON-APPLICABLE:
ACOUSTIC TESTING OF ATTIC INSULATION
ADVANCED LEAKAGE TECHNIQUES
ALTERNATIVE CFC-BASED INSULATIONS IN WALL AND FOUNDATION SYSTEMS
CORROSIVENESS OF INSULATION
ENERGY KERNEL SYSTEM
FOAM AGING AND R-VALUE PREDICTION
IMBEDDED HEAT FLUX TRANSDUCERS
LOOSE FILL ATTIC INSULATION SETTLING
MAINTENANCE AND UPGRADING OF DOE-2

TABLE B.2. (contd)

MATHEMATICAL MODELING OF INDOOR AIR QUALITY
MOISTURE GUIDELINES FOR RESIDENCES
MOISTURE IMPACTS ON MATERIALS
MULTI-ZONAL INFILTRATION AND VENTILATION MEASUREMENT
PASSIVE SAMPLER OF VOLATILE DRGANIC COMPOUNDS (VOC)
PERFLUOROCARBON TRACER SYSTEM
RADIANT BARRIER CLIMATIC GUIDE
RADIATIVE HEAT TRANSFER
SICK BUILDING SYNDROME PROTOCOL
SUBSTITUTE FOAMING AGENTS FOR INSULATION
WINDOW 3.1 COMPUTER PROGRAM

0 TO 2 YEAR PAYBACK PERIOD:
ADVANCED RESIDENTIAL VENTILATION SYSTEMS
COMMERCIAL STANDARDS
FOUNDATION DESIGN TOOLS INCLUDING HANDBOOKS
SMALL OFFICE BUILDING HANDBOOK
SUPERLITE

3 TO 5 YEAR PAYBACK PERIOD:
ADVANCED DURABLE LOW-E COATINGS
AERATED AUTOCLAVED CONCRETE
FIELD THERMAL PERFORMANCE METHODOLOGY
HIGH-R WINDOWS
HVAC/LIGHTING INTERACTIONS
MANUFACTURED HOUSING INSULATION
MOISTURE MEASUREMENT METHODOLOGY
NON-INTRUSIVE MOISTURE PROBE
ROOF RESEARCH CENTER - A NATIONAL USER FACILITY
ROOF SURFACE TREATMENT GUIDELINES
ROOF THERMAL RESEARCH APPARATUS (RTRA)
THERMAL BRIDGES DESIGN CATALOG

6 TO 10 YEAR PAYBACK PERIOD:
COMPOSITE/PRE-BUILT WALL SYSTEMS
LARGE SCALE CLIMATE SIMULATOR (LSCS)
POWDER-FILLED EVACUATED INSULATION PANELS
RADIANT BARRIER SYSTEMS
SWITCHABLE E MATERIALS
VARIABLE R MATERIALS

TABLE B.3. Energy-Related Benefits of All Technologies

BUILDING EQUIPMENT/PRACTICE	Reduces Energy Bill	Reduces Use of Scarce Fuel	Reduces Peak Energy Load	Creates Backup Fuel Capability	Other
BUILDING EQUIPMENT DIVISION					
ABSORPTION FLUIDS OTHER BENEFITS: PART OF HEAT PUMP				X	
ADVANCED CONCEPT ABSORPTION HEAT PUMP	X	X	X		
ADVANCED CONDENSING HEAT EXCHANGERS	X	X			
ADVANCED INSULATION	X	X			
ADVANCED LIGHTING CONTROLS	X		X		
ADVANCED PHOSPHOR MATERIALS	X		X		
CERAMIC FLUID PUMPS[a]					
COMMERCIAL AND RESIDENTIAL ZONING	X	X	X		
CONSERVATION MEASURES THROUGH FORCED-AIR DISTRIBUTION	X	X	X		
DESICCANT/HYBRID COOLING SYSTEMS[a]					
DIRECT VENT TECHNOLOGY	X	X			
DYNAMIC LIGHTING DESIGN	X		X		
EJECTOR COUPLED HP CYCLE[a]					
ELECTRODELESS HIGH-INTENSITY DISCHARGE LIGHT	X		X		
FIFTEEN-TON BRAUN LINEAR ENGINE HP.	X	X	X		
FUEL-OIL ATOMIZATION/COMBUSTION	X	X		X	
HERMETIC COMPRESSOR SEALS[a]					

TABLE B.3. (contd)

BUILDING EQUIPMENT/PRACTICE	Reduces Energy Bill	Reduces Use of Scarce Fuel	Reduces Peak Energy Load	Creates Backup Fuel Capability	Other
IN VITRO DIAGNOSTICS	X	X	X		
INCANDESCENT REPLACEMENT BY H.I.D.	X		X		
ISOTOPICALLY ENRICHED FLUORESCENT	X		X		
LOW-FIRING RATE OIL BURNER TECHNOLOGY	X	X			
NONAZEOTROPIC REFRIGERANT MIXTURES	X	X	X		
OPTIMIZED GROUND COUPLED HEAT PUMP	X		X		
PERFORMANCE CONTROL STRATEGIES	X	X			
SOLID FUEL APPLIANCE MEASUREMENT METHODS	X	X		X	
STIRLING/RANK. DIA. COUPLED HP.	X	X	X		
SURFACE WAVE FLUORESCENT	X		X		
VARIABLE-SPEED COMPRESSORS & FANS	X	X	X		
WOOD COMBUSTION SYSTEMS	X	X		X	
BUILDING SERVICES DIVISION					
ABSORPTION CHILLER			X		
ACOUSTIC LEAK DETECTION SYSTEM		X			
ADVANCED DUCT SEALING TECHNIQUES OTHER BENEFITS: INCREASES EFFECTIVE LIFE OF HVAC EQUIPMENT	X	X	X		X
ADVANCED RANKINE CYCLE HEAT PUMP	X	X			

TABLE B.3. (contd)

BUILDING EQUIPMENT/PRACTICE	Reduces Energy Bill	Reduces Use of Scarce Fuel	Reduces Peak Energy Load	Creates Backup Fuel Capability	Other
ANALYTICAL TOOLS OTHER BENEFITS: REDUCES ENERGY CONSUMPTION	X		X		X
BTU METER	X				
COMMERCIAL BUILDING RETROFIT PROCEDURES	X				
CORE COMMERCIAL DAYLIGHTING		X		X	
DIAGNOSTIC PROTOCOLS AND ANALYSIS METHODS	X	X	X		
DIAGNOSTIC TOOL DEVELOPMENT OTHER BENEFITS: CAN PROVIDE EMPIRICAL EVIDENCE OF EFFICIENCY IMPROVEMENT POST-RETROFIT					X
DOWN-HOLE HEAT EXCHANGER		X			
ENERGY TRACKING SYSTEM	X				
FRICTION REDUCTION ADDITIVES	X	X	X		
HEAT PUMP (QUASI OPEN CYCLE)		X	X		
ICE SLURRY EVAPORATOR	X		X		
INTEGRATED UTILITY PLANNING PROCESSES OTHER BENEFITS: REDUCES ENERGY CONSUMPTION	X		X		X
MOBILE HOME RETROFIT PROCEDURES	X				
MULTIFAMILY AUDIT HANDBOOK	X				
MULTIFAMILY RETROFIT PROCEDURES	X				
NON-METALLIC PIPING SYSTEM		X			

TABLE B.3. (contd)

BUILDING EQUIPMENT/PRACTICE	Reduces Energy Bill	Reduces Use of Scarce Fuel	Reduces Peak Energy Load	Creates Backup Fuel Capability	Other
OPERATING AND MAINTENANCE PROCEDURES	X				
PUBLIC HOUSING RETROFIT PROCEDURES	X		X		
RADIANT BARRIER CLIMATIC GUIDE	X		X		
RADIANT BARRIER MODELING	X				
SHARED SAVINGS	X	X	X		
STRATEGIES FOR EMERGING ISSUES OTHER BENEFITS: REDUCES ENERGY CONSUMPTION	X		X		X
TECHNOLOGY ASSESSMENT AND MARKET PENETRATION OTHER BENEFITS: REDUCES ENERGY CONSUMPTION	X		X		X
URBAN HEAT ISLANDS OTHER BENEFITS: ENVIRONMENT-CO_2 EMISSIONS REDUCED	X		X		X
VACUUM STEAM RADIATORS		X	X		
BUILDING SYSTEMS DIVISION					
ACOUSTIC TESTING OF ATTIC INSULATION OTHER BENEFITS: MORE INSULATION PER DOLLAR					X
ADVANCED DESIGN TOOLS OTHER BENEFITS: INCREASE UTILIZATION OF ENERGY EFFICIENT DESIGNS	X	X			X
ADVANCED DURABLE LOW-E COATINGS	X	X	X		

TABLE B.3. (contd)

BUILDING EQUIPMENT/PRACTICE	Reduces Energy Bill	Reduces Use of Scarce Fuel	Reduces Peak Energy Load	Creates Backup Fuel Capability	Other
ADVANCED LEAKAGE TECHNIQUES OTHER BENEFITS: WOULD ALLOW FOR INCREASED ACCURACY OF ENERGY LIABILITY					X
ADVANCED RESIDENTIAL VENTILATION SYSTEMS OTHER BENEFITS: IMPROVE INDOOR AIR QUALITY	X				X
AERATED AUTOCLAVED CONCRETE	X	X	X		
ALTERNATIVE CFC-BASED INSULATIONS IN WALL AND FOUNDATION SYSTEMS					
COMMERCIAL STANDARDS	X	X	X		
COMPOSITE/PRE-BUILT WALL SYSTEMS	X				
CORROSIVENESS OF INSULATION OTHER BENEFITS: REDUCES DETERIORATION OF BUILDING STRUCTURES					X
ENERGY KERNEL SYSTEM	X		X		
FIELD THERMAL PERFORMANCE METHODOLOGY OTHER BENEFITS: ALERTS ABOUT ACTUAL THERMAL PERFORMANCE IN THE FIELD					X
FOAM AGING AND R-VALUE PREDICTION	X		X		
FOUNDATION DESIGN TOOLS INCLUDING HANDBOOKS	X	X			
HIGH-R WINDOWS	X	X			
HVAC/LIGHTING INTERACTIONS	X		X		

TABLE B.3. (contd)

BUILDING EQUIPMENT/PRACTICE	Reduces Energy Bill	Reduces Use of Scarce Fuel	Reduces Peak Energy Load	Creates Backup Fuel Capability	Other
IMBEDDED HEAT FLUX TRANSDUCERS OTHER BENEFITS: INCREASES UNDERSTANDING OF HEAT FLOW IN BUILDINGS					X
LARGE SCALE CLIMATE SIMULATOR (LSCS) OTHER BENEFITS: SAVES ENERGY OR EXTENDS SERVICE LIFE OF ROOFS BY SOLVING A PROBLEM OR RECOMMENDING A PRACTICE					X
LOOSE FILL ATTIC INSULATION SETTLING	X				
MAINTENANCE AND UPGRADING OF DOE-2 OTHER BENEFITS: PROVIDES CAPABILITY TO SIMULATE THERMAL PERFORMANCE OF BUILDINGS					X
MANUFACTURED HOUSING INSULATION	X		X		
MATHEMATICAL MODELING OF INDOOR AIR QUALITY OTHER BENEFITS: IMPROVED VENTILATION DESIGN				X	
MOISTURE GUIDELINES FOR RESIDENCES					
MOISTURE IMPACTS ON MATERIALS	X		X		
MOISTURE MEASUREMENT METHODOLOGY OTHER BENEFITS: INDIRECTLY SAVES ENERGY BY ALERTING TO LOSS OF ROOF THERMAL PERFORMANCE					X
MULTI-ZONAL INFILTRATION AND VENTILATION MEASUREMENT OTHER BENEFITS: OPTIMIZED VENTILATION DESIGNS					X

TABLE B.3. (contd)

BUILDING EQUIPMENT/PRACTICE	Reduces Energy Bill	Reduces Use of Scarce Fuel	Reduces Peak Energy Load	Creates Backup Fuel Capability	Other
NON-INTRUSIVE MOISTURE PROBE OTHER BENEFITS: ALERTS TO LOSS OF THERMAL PERFORMANCE AND ROOF LIFE, AND INDIRECTLY SAVES ENERGY					X
PASSIVE SAMPLER OF VOLATILE ORGANIC COMPOUNDS OTHER BENEFITS: MAY LEAD TO OPTIMIZED VENTILATION IN BUILDINGS				X	
PERFLUOROCARBON TRACER SYSTEM OTHER BENEFITS: OPTIMIZED VENTILATION					X
POWDER-FILLED EVACUATED INSULATION PANELS	X		X		
PROPOR					
RADIANT BARRIER SYSTEMS	X				
RADIATIVE HEAT TRANSFER OTHER BENEFITS: SAVES ENERGY INDIRECTLY THROUGH BETTER DESIGN					X
ROOF RESEARCH CENTER-A NATIONAL USER FACILITY OTHER BENEFITS: INDIRECTLY SAVES ENERGY OR EXTENDS ROOF LIFE BY SOLVING A PROBLEM OR RECOMMENDING A PRACTICE				X	
ROOF SURFACE TREATMENT GUIDELINES	X	X	X		
ROOF THERMAL RESEARCH APPARATUS (RTRA) OTHER BENEFITS: HELPS TO SAVE ENERGY BY SOLVING A PROBLEM OR RECOMMENDING A PRACTICE					X

TABLE B.3. (contd)

BUILDING EQUIPMENT/PRACTICE	Reduces Energy Bill	Reduces Use of Scarce Fuel	Reduces Peak Energy Load	Creates Backup Fuel Capability	Other
SICK BUILDING SYNDROME PROTOCOL OTHER BENEFITS: OPTIMAL VENTILATION					X
SMALL OFFICE BUILDING HANDBOOK OTHER BENEFITS: CONTROLS SIGNIFICANT VARIABLE ON RENTAL PROPERTY AND AN EDGE ON THE UNINFORMED COMPETITION	X		X		X
SIMPLIFIED THERMAL ANALYSIS OF ROOFS (STAR) OTHER BENEFITS: DETERMINES ACTUAL THERMAL PERFORMANCE AND TEMP. CONDITIONS OF COMPOSITE ROOFS IN THE FIELD					X
SUBSTITUTE FOAMING AGENTS FOR INSULATION OTHER BENEFITS: PROVIDES EFFECTIVE INSULATION IF CFC'S ARE BANNED	X				X
SUPERLITE	X	X	X		
SWITCHABLE E MATERIALS	X		X		
THERMAL BRIDGES DESIGN CATALOG	X	X			
THERMAL CONDUCTIVITY MEASUREMENTS OVER RANGE OF ENVIRONMENTAL TEMPS.					
VARIABLE R MATERIALS	X		X		
WINDOW 3.1 COMPUTER PROGRAM OTHER BENEFITS: DESIGN AND SELECTION OF ENERGY EFFICIENT WINDOWS	X				X

(a) No energy-related benefits identified.

TABLE B.4. Non-Energy Benefits of All Technologies

Technologies	Healthier IAQ	Greater Thermal Comfort	Greater Visual Comfort	Reduced Noise Levels	Enhanced Building Attractiveness	Easier Building O&M	Improved System Reliability	Reduced First Cost	Other
BUILDING EQUIPMENT DIVISION									
ABSORPTION FLUIDS OTHER: PART OF HEAT PUMP									X
ADVANCED CONCEPT ABSORPTION HEAT PUMP	X	X		X	X	X	X	X	
ADVANCED CONDENSING HEAT EXCHANGERS	X	X		X			X	X	
ADVANCED INSULATION							X		
ADVANCED LIGHTING CONTROLS		X							
ADVANCED PHOSPHOR MATERIALS									
CERAMIC FLUID PUMPS				X		X	X	X	
COMMERCIAL AND RESIDENTIAL ZONING	X	X		X	X	X	X		
CONSERVATION MEASURES THROUGH FORCED-AIR DISTRIBUTION	X	X		X		X	X	X	
DESICCANT/HYBRID COOLING SYSTEMS[a]									
DIRECT VENT TECHNOLOGY	X			X	X	X	X		
DYNAMIC LIGHTING DESIGN			X						
EJECTOR COUPLED HP CYCLE[a]									
ELECTRODELESS HIGH-INTENSITY DISCHARGE LIGHT						X			
FIFTEEN-TON BRAUN LINEAR ENGINE HP.		X		X	X		X		
FUEL-OIL ATOMIZATION/COMBUSTION	X	X	X	X		X	X	X	
HERMETIC COMPRESSOR SEALS[a]									
IN VITRO DIAGNOSTICS	X	X		X		X	X	X	

TABLE B.4. (contd)

Technologies	Healthier IAQ	Greater Thermal Comfort	Greater Visual Comfort	Reduced Noise Levels	Enhanced Building Attractiveness	Easier Building O&M	Improves System Reliability	Reduced First Cost	Other
INCANDESCENT REPLACEMENT BY H.I.D.						X			
ISOTOPICALLY ENRICHED FLUORESCENT									
LOW-FIRING RATE OIL BURNER TECHNOLOGY	X	X	X	X		X	X	X	
NONAZEOTROPIC REFRIGERANT MIXTURES		X		X			X		
OPTIMIZED GROUND COUPLED HEAT PUMP			X	X	X				
PERFORMANCE CONTROL STRATEGIES		X		X		X	X	X	
SOLID FUEL APPLIANCE MEASUREMENT METHODS OTHER: QUANTIFIES ENERGY SAVINGS		X							X
STIRLING/RANK. DIA. COUPLED HP.		X		X	X		X	X	
SURFACE WAVE FLUORESCENT						X			
VARIABLE-SPEED COMPRESSORS & FANS		X		X			X		
WOOD COMBUSTION SYSTEMS	X	X		X	X	X	X	X	
BUILDING SERVICES DIVISION									
ABSORPTION CHILLER						X	X		
ACOUSTIC LEAK DETECTION SYSTEM							X		
ADVANCED DUCT SEALING TECHNIQUES		X							
ADVANCED RANKINE CYCLE HEAT PUMP						X	X		
ANALYTICAL TOOLS OTHER: REDUCE CO_2 INPUT INTO THE ATMOSPHERE									X
BTU METER									

TABLE B.4. (contd)

Technologies	Healthier IAQ	Greater Thermal Comfort	Greater Visual Comfort	Reduced Noise Levels	Enhanced Building Attractiveness	Easier Building O&M	Improves System Reliability	Reduced First Cost	Other
COMMERCIAL BUILDING RETROFIT PROCEDURES				X					
CORE COMMERCIAL DAYLIGHTING			X						
DIAGNOSTIC PROTOCOLS AND ANALYSIS METHODS OTHER: PROVIDES CAPITAL TO INVEST IN BETTER OPPORTUNITIES		X		X					X
DIAGNOSTIC TOOL DEVELOPMENT									
DOWN-HOLE HEAT EXCHANGER									
ENERGY TRACKING SYSTEM						X			
FRICTION REDUCTION ADDITIVES						X	X		
HEAT PUMP (QUASI OPEN CYCLE)						X	X		
ICE SLURRY EVAPORATOR						X	X		
INTEGRATED UTILITY PLANNING PROCESSES OTHER: REDUCED CO_2 INPUT INTO THE ATMOSPHERE									X
MOBILE HOME RETROFIT PROCEDURES	X	X		X		X			
MULTIFAMILY AUDIT HANDBOOK		X	X	X			X		
MULTIFAMILY RETROFIT PROCEDURES		X		X		X			
NON-METALLIC PIPING SYSTEM						X	X	X	
OPERATING AND MAINTENANCE PROCEDURES							X		
PUBLIC HOUSING RETROFIT PROCEDURES	X	X		X	X	X	X		
RADIANT BARRIER CLIMATIC GUIDE									
RADIANT BARRIER MODELING									

TABLE B.4. (contd)

Technologies	Healthier IAQ	Greater Thermal Comfort	Greater Visual Comfort	Reduced Noise Levels	Enhanced Building Attractiveness	Easier Building O&M	Improves System Reliability	Reduced First Cost	Other
SHARED SAVINGS OTHER: PROVIDES CAPITAL TO INVEST IN BETTER OPPORTUNITIES		X		X					X
STRATEGIES FOR EMERGING ISSUES OTHER: REDUCED CO_2 INPUT INTO THE ATMOSPHERE									X
TECHNOLOGY ASSESSMENT AND MARKET PENETRATION OTHER: REDUCED CO_2 INPUT INTO THE ATMOSPHERE									X
URBAN HEAT ISLANDS OTHER: COOLER SUMMER AIR TEMPS IN URBAN AREAS; AESTHETICS OF CITY		X							X
VACUUM STEAM RADIATORS		X				X	X		
BUILDING SYSTEMS DIVISION									
ACOUSTIC TESTING OF ATTIC INSULATION									
ADVANCED DESIGN TOOLS		X	X	X	X		X		
ADVANCED DURABLE LOW-E COATINGS		X	X		X				
ADVANCED LEAKAGE TECHNIQUES	X	X							
ADVANCED RESIDENTIAL VENTILATION SYSTEMS	X								
AERATED AUTOCLAVED CONCRETE		X							
ALTERNATIVE CFC-BASED INSULATIONS IN WALL AND FOUNDATION SYSTEMS OTHER: HEALTHIER OUTDOOR ENVIRONMENT									X
COMMERCIAL STANDARDS		X	X		X				
COMPOSITE/PRE-BUILT WALL SYSTEMS		X			X				

TABLE B.4. (contd)

Technologies	Healthier IAQ	Greater Thermal Comfort	Greater Visual Comfort	Reduced Noise Levels	Enhanced Building Attractiveness	Easier Building O&M	Improves System Reliability	Reduced First Cost	Other
CORROSIVENESS OF INSULATION					X	X			
ENERGY KERNEL SYSTEM	X	X	X						
FIELD THERMAL PERFORMANCE METHODOLOGY						X	X		
FOAM AGING AND R-VALUE PREDICTION		X							
FOUNDATION DESIGN TOOLS INCLUDING HANDBOOKS OTHER: REDUCES MOISTURE/CONDENSATION	X	X				X			X
HIGH-R WINDOWS		X	X	X	X				
HVAC/LIGHTING INTERACTIONS OTHER: REDUCES USE OF COAL-GENERATED ELECTRICITY AND HENCE ENVIRONMENTAL IMPACT									X
IMBEDDED HEAT FLUX TRANSDUCERS									
LARGE-SCALE CLIMATE SIMULATOR (LSCS)		X				X	X	X	
LOOSE-FILL ATTIC INSULATION SETTLING		X							
MAINTENANCE AND UPGRADING OF DOE-2		X	X						
MANUFACTURED HOUSING INSULATION		X		X					
MATHEMATICAL MODELING OF INDOOR AIR QUALITY	X								
MOISTURE GUIDELINES FOR RESIDENCES	X	X							
MOISTURE IMPACTS ON MATERIALS	X	X			X				
MOISTURE MEASUREMENT METHDDOLOGY		X				X	X		
MULTI-ZONAL INFILTRATION AND VENTILATION MEASUREMENT	X								
NON-INTRUSIVE MOISTURE PROBE		X					X	X	

TABLE B.4. (contd)

Technologies	Healthier IAQ	Greater Thermal Comfort	Greater Visual Comfort	Reduced Noise Levels	Enhanced Building Attractiveness	Easier Building O&M	Improves System Reliability	Reduced First Cost	Other
PASSIVE SAMPLER OF VOLATILE ORGANIC COMPOUNDS (VOC)	X								
PERFLUOROCARBON TRACER SYSTEM	X								
POWDER-FILLED EVACUATED INSULATION PANELS									
PROPOR							X		
RADIANT BARRIER SYSTEMS		X						X	
RADIATIVE HEAT TRANSFER OTHER: INCREASES OUR UNDERSTANDING OF HEAT TRANSFER									X
ROOF RESEARCH CENTER - A NATIONAL USER FACILITY		X				X	X	X	
ROOF SURFACE TREATMENT GUIDELINES		X	X		X	X	X		
ROOF THERMAL RESEARCH APPARATUS (RTRA)		X				X	X		
SICK BUILDING SYNDROME PROTOCOL	X								
SIMPLIFIED THERMAL ANALYSIS OF ROOFS (STAR)						X	X		
SMALL OFFICE BUILDING HANDBOOK		X	X		X	X		X	
SUBSTITUTE FOAMING AGENTS FOR INSULATION OTHER: HEALTHIER AND MORE COMFORTABLE OUTDOOR ENVIRONMENT									X
SUPERLITE OTHER: IMPROVED WORKER PRODUCTIVITY			X		X				X
SWITCHABLE E MATERIALS		X	X						
THERMAL BRIDGES DESIGN CATALOG OTHER: REDUCES MOISTURE DAMAGE									X

TABLE B.4. (contd)

Technologies	Healthier IAQ	Greater Thermal Comfort	Greater Visual Comfort	Reduced Noise Levels	Enhanced Building Attractiveness	Easier Building O&M	Improves System Reliability	Reduced First Cost	Other
THERMAL CONDUCTIVITY MEASUREMENTS OVER RANGE OF ENVIRONMENTAL TEMPS.							X		
VARIABLE R MATERIALS									
WINDOW 3.1 COMPUTER PROGRAM		X	X		X				

(a) No non-energy-related barriers identified.

TABLE B.5. Commercialization Barriers for All Technologies

Technologies	Simple Barriers				Serious Barriers						
	Lack of Awareness	Lack of Understanding	Large Number of Decision Makers	Reliability Concerns	Environmental Concerns	Building Code Conflicts	Legal/ Regulatory Difficulties	Financing Unavailability	High Perceived Risk	High First Cost	Other
BUILDING EQUIPMENT DIVISION											
ABSORPTION FLUIDS OTHER BARRIERS: PART OF HEAT PUMP											X
ADVANCED CONCEPT ABSORPTION HEAT PUMP	X	X			X	X					
ADVANCED CONDENSING HEAT EXCHANGERS		X		X	X				X		
ADVANCED INSULATION OTHER BARRIERS: LACK OF A FEASIBLE MFR PROCESS									X		X
ADVANCED LIGHTING CONTROLS OTHER BARRIERS: LITTLE INCENTIVE TO USE	X	X	X	X					X	X	X
ADVANCED PHOSPHOR MATERIALS											
CERAMIC FLUID PUMPS OTHER BARRIERS: N/A PART OF HEAT PUMP											X
COMMERCIAL AND RESIDENTIAL ZONING	X	X		X	X	X	X	X	X		
CONSERVATION MEASURES THROUGH FORCED-AIR DISTRIBUTION	X	X		X		X			X		
DESICCANT/HYBRID COOLING SYSTEMS[a]											
DIRECT VENT TECHNOLOGY	X	X		X	X	X	X				
DYNAMIC LIGHTING DESIGN OTHER BARRIERS: LITTLE INCENTIVE TO USE	X	X	X						X		X

TABLE B.5. (contd)

Technologies	Simple Barriers				Serious Barriers						
	Lack of Awareness	Lack of Understanding	Large Number of Decision Makers	Reliability Concerns	Environmental Concerns	Building Code Conflicts	Legal/ Regulatory Difficulties	Financing Unavailability	High Perceived Risk	High First Cost	Other
EJECTOR COUPLED HP CYCLE[a]											
ELECTRODELESS HIGH-INTENSITY DISCHARGE LIGHT	X			X	X				X		
FIFTEEN-TON BRAUN LINEAR ENGINE HP.	X	X			X	X					
FUEL-OIL ATOMIZATION/COMBUSTION	X	X		X				X	X	X	
HERMETIC COMPRESSOR SEALS[a]											
IN VITRO DIAGNOSTICS	X	X		X		X			X		
INCANDESCENT REPLACEMENT BY H.I.D.	X								X	X	
ISOTOPICALLY ENRICHED FLUORESCENT OTHER BARRIERS: STARTUP OF SEPARATION BUSINESS											X
LOW-FIRING RATE OIL BURNER TECHNOLOGY		X		X	X			X	X	X	
NONAZEOTROPIC REFRIGERANT MIXTURES		X							X		
OPTIMIZED GROUND COUPLED HEAT PUMP										X	
PERFORMANCE CONTROL STRATEGIES	X	X		X					X	X	
SOLID FUEL APPLIANCE MEASUREMENT METHODS				X						X	
STIRLING/RANK. DIA. COUPLED HP.	X	X			X	X					
SURFACE WAVE FLUORESCENT	X			X	X		X		X		

TABLE B.5. (contd)

Technologies	Simple Barriers: Lack of Awareness	Simple Barriers: Lack of Understanding	Simple Barriers: Large Number of Decision Makers	Simple Barriers: Reliability Concerns	Serious Barriers: Environmental Concerns	Serious Barriers: Building Code Conflicts	Serious Barriers: Legal/ Regulatory Difficulties	Serious Barriers: Financing Unavailability	Serious Barriers: High Perceived Risk	Serious Barriers: High First Cost	Serious Barriers: Other
VARIABLE-SPEED COMPRESSORS & FANS OTHER BARRIERS: MANUFACTURERS DON'T PERCEIVE MARKET STRONG ENOUGH TO SUPPORT MASS PRODUCTION.										X	X
WOOD COMBUSTION SYSTEMS	X	X		X	X				X	X	
BUILDING SERVICES DIVISION											
ABSORPTION CHILLER		X		X					X	X	
ACOUSTIC LEAK DETECTION SYSTEM				X					X		
ADVANCED DUCT SEALING TECHNIQUES OTHER BARRIERS: EFFECTIVE/ INEXPENSIVE TECHNIQUES ARE YET TO BE DEVELOPED											X
ADVANCED RANKINE CYCLE HEAT PUMP		X		X							
ANALYTICAL TOOLS		X									
BTU METER									X		
COMMERCIAL BUILDING RETROFIT PROCEDURES OTHER BARRIERS: PROCEDURE HAS NOT YET BEEN DEVELOPED/EVALUATED									X		X
CORE COMMERCIAL DAYLIGHTING OTHER BARRIERS: TECHNIQUES DO NOT EXIST AT PRESENT											X

TABLE B.5. (contd)

Technologies	Simple Barriers: Lack of Awareness	Simple Barriers: Lack of Understanding	Simple Barriers: Large Number of Decision Makers	Simple Barriers: Reliability Concerns	Serious Barriers: Environmental Concerns	Serious Barriers: Building Code Conflicts	Serious Barriers: Legal/Regulatory Difficulties	Serious Barriers: Financing Unavailability	Serious Barriers: High Perceived Risk	Serious Barriers: High First Cost	Serious Barriers: Other
DIAGNOSTIC PROTOCOLS AND ANALYSIS METHODS OTHER BARRIERS: LOW PRIORITY ON ENERGY EFFICIENCY	X	X					X	X	X		X
DIAGNOSTIC TOOL DEVELOPMENT OTHER BARRIERS: INEXPENSIVE AND RELIABLE DEVICES DO NOT EXIST YET											X
DOWN-HOLE HEAT EXCHANGER	X	X		X	X					X	
ENERGY TRACKING SYSTEM OTHER BARRIERS: EQUIPMENT METHODOLOGY ARE NOT YET COMPLETELY DEVELOPED											X
FRICTION REDUCTION ADDITIVES		X			X						
HEAT PUMP (QUASI OPEN CYCLE)				X					X		
ICE SLURRY EVAPORATOR									X	X	
INTEGRATED UTILITY PLANNING PROCESSES			X								
MOBILE HOME RETROFIT PROCEDURES OTHER BARRIERS: PROCEDURE HAS NOT BEEN DEVELOPED FOR CERTAIN CLIMATIC ZONES											X
MULTIFAMILY AUDIT HANDBOOK	X	X						X			
MULTIFAMILY RETROFIT PROCEDURES	X	X	X				X				
NON-METALLIC PIPING SYSTEM	X			X					X	X	

TABLE B.5. (contd)

Technologies	Simple Barriers				Serious Barriers						
	Lack of Awareness	Lack of Understanding	Large Number of Decision Makers	Reliability Concerns	Environmental Concerns	Building Code Conflicts	Legal/ Regulatory Difficulties	Financing Unavailability	High Perceived Risk	High First Cost	Other
OPERATING AND MAINTENANCE PROCEDURES	X	X									
PUBLIC HOUSING RETROFIT PROCEDURES			X	X		X		X	X		
RADIANT BARRIER CLIMATIC GUIDE	X	X									
RADIANT BARRIER MODELING											
SHARED SAVINGS OTHER BARRIERS: LOW PRIORITY ON ENERGY EFFICIENCY	X	X					X	X	X		X
STRATEGIES FOR EMERGING ISSUES		X	X				X				
TECHNOLOGY ASSESSMENT AND MARKET PENETRATION		X	X	X			X				
URBAN HEAT ISLANDS OTHER BARRIERS: MUNDANE, SIMPLE, LACKS APPEAL OF COMPLEX	X		X				X				X
VACUUM STEAM RADIATORS		X		X							
BUILDING SYSTEMS DIVISION											
ACOUSTIC TESTING OF ATTIC INSULATION											
ADVANCED DESIGN TOOLS											
ADVANCED DURABLE LOW-E COATINGS OTHER BARRIERS: SCALING UP PROCESS FROM LAB TO PRODUCTION SCALE											X
ADVANCED LEAKAGE TECHNIQUES	X					X					

TABLE B.5. (contd)

Technologies	Simple Barriers				Serious Barriers						
	Lack of Awareness	Lack of Understanding	Large Number of Decision Makers	Reliability Concerns	Environmental Concerns	Building Code Conflicts	Legal/ Regulatory Difficulties	Financing Unavailability	High Perceived Risk	High First Cost	Other
ADVANCED RESIDENTIAL VENTILATION SYSTEMS	X	X		X						X	
AERATED AUTOCLAVED CONCRETE	X	X		X		X			X	X	
ALTERNATIVE CFC-BASED INSULATIONS IN WALL AND FOUNDATION SYSTEMS											
COMMERCIAL STANDARDS	X	X	X			X	X				
COMPOSITE/PRE-BUILT WALL SYSTEMS											
CORROSIVENESS OF INSULATION											
ENERGY KERNEL SYSTEM										X	
FIELD THERMAL PERFORMANCE METHODOLOGY	X	X						X			
FOAM AGING AND R-VALUE PREDICTION											
FOUNDATION DESIGN TOOLS INCLUDING HANDBOOKS											
HIGH-R WINDOWS OTHER BARRIERS: NEEDS FURTHER RESEARCH											X
HVAC/LIGHTING INTERACTIONS OTHER BARRIERS: EXISTING AMORTIZED PRODUCT LINES	X	X							X		X
IMBEDDED HEAT FLUX TRANSDUCERS				X					X	X	
LARGE-SCALE CLIMATE SIMULATOR (LSCS)	X	X		X				X		X	

TABLE B.5. (contd)

Technologies	Simple Barriers				Serious Barriers						
	Lack of Awareness	Lack of Understanding	Large Number of Decision Makers	Reliability Concerns	Environmental Concerns	Building Code Conflicts	Legal/ Regulatory Difficulties	Financing Unavailability	High Perceived Risk	High First Cost	Other
LOOSE-FILL ATTIC INSULATION SETTLING											
MAINTENANCE AND UPGRADING OF DOE-2											
MANUFACTURED HOUSING INSULATION	X	X								X	
MATHEMATICAL MODELING OF INDOOR AIR QUALITY OTHER BARRIERS: VERY SMALL NUMBER OF POSSIBLE USERS											
MOISTURE GUIDELINES FOR RESIDENCES		X				X					
MOISTURE IMPACTS ON MATERIALS											
MOISTURE MEASUREMENT METHODOLOGY	X	X		X							
MULTI-ZONAL INFILTRATION AND VENTILATION MEASUREMENT OTHER BARRIERS: EXTREMELY SMALL NUMBER OF POTENTIAL USERS	X										X
NON-INTRUSIVE MOISTURE PROBE	X	X		X				X		X	
PASSIVE SAMPLER OF VOLATILE ORGANIC COMPOUNDS (VOC)	X										
PERFLUORDCARBON TRACER SYSTEM	X			X							
POWDER-FILLED EVACUATED INSULATION PANELS	X	X		X					X	X	
PROPOR	X	X									

TABLE B.5. (contd)

Technologies	Simple Barriers				Serious Barriers						
	Lack of Awareness	Lack of Understanding	Large Number of Decision Makers	Reliability Concerns	Environmental Concerns	Building Code Conflicts	Legal/ Regulatory Difficulties	Financing Unavailability	High Perceived Risk	High First Cost	Other
RADIANT BARRIER SYSTEMS		X		X							
RADIATIVE HEAT TRANSFER											
ROOF RESEARCH CENTER - A NATIONAL USER FACILITY	X	X		X				X	X	X	
ROOF SURFACE TREATMENT GUIDELINES	X	X									
ROOF THERMAL RESEARCH APPARATUS (RTRA)		X						X			
SICK BUILDING SYNDROME PROTOCOL	X	X									
SIMPLIFIED THERMAL ANALYSIS OF ROOFS (STAR)	X	X		X							
SMALL OFFICE BUILDING HANDBOOK OTHER BARRIERS: HIGH COST OF RETRAINING DESIGNERS AND LACK OF FEES TO COMPENSATE FOR TRAINING; LACK OF RIGHT INFO.	X	X	X								X
SUBSTITUTE FOAMING AGENTS FOR INSULATION OTHER BARRIERS: INDETERMINATE STATUS OF CFC RESTRICTIONS				X					X	X	X
SUPERLITE	X	X		X					X		
SWITCHABLE E MATERIALS	X	X		X					X	X	
THERMAL BRIDGES DESIGN CATALOG											

TABLE B.5. (contd)

Technologies	Simple Barriers				Serious Barriers						
	Lack of Awareness	Lack of Understanding	Large Number of Decision Makers	Reliability Concerns	Environmental Concerns	Building Code Conflicts	Legal/ Regulatory Difficulties	Financing Unavailability	High Perceived Risk	High First Cost	Other
THERMAL CONDUCTIVITY MEASUREMENTS OVER RANGE OF ENVIRONMENTAL TEMPS.											
VARIABLE R MATERIALS		X		X					X	X	
WINDOW 3.1 COMPUTER PROGRAM											

(a) No barriers to commercialization identified.

TABLE B.6. Commercial or Professional Organizations' Interest in the Technologies

BUILDING EQUIPMENT DIVISION

NO INTEREST INDICATED:

ABSORPTION FLUIDS
ADVANCED LIGHTING CONTROLS
CERAMIC FLUID PUMPS
DESICCANT/HYBRID COOLING SYSTEMS
EJECTOR COUPLED HP CYCLE
ELECTRODELESS HIGH-INTENSITY DISCHARGE LIGHT
HERMETIC COMPRESSOR SEALS
INCANDESCENT REPLACEMENT BY H.I.D.
ISOTOPICALLY ENRICHED FLUORESCENT
SURFACE WAVE FLUORESCENT

INTEREST INDICATED:

ADVANCED CONCEPT ABSORPTION HEAT PUMP
ADVANCED CONDENSING HEAT EXCHANGERS
ADVANCED INSULATION
ADVANCED PHOSPHOR MATERIALS
COMMERCIAL AND RESIDENTIAL ZONING
CONSERVATION MEASURES THROUGH FORCED-AIR DISTRIBUTION
DIRECT VENT TECHLOGY
DYNAMIC LIGHTING DESIGN
FIFTEEN-TON BRAUN LINEAR ENGINE HP.
FUEL-OIL ATOMIZATION/COMBUSTION
IN VITRO DIAGNOSTICS
LOW-FIRING RATE OIL BURNER TECHLOGY
NONAZEOTROPIC REFRIGERANT MIXTURES
OPTIMIZED GROUND COUPLED HEAT PUMP
PERFORMANCE CONTROL STRATEGIES
SOLID FUEL APPLIANCE MEASUREMENT METHODS
STIRLING/RANK. DIA. COUPLED HP.
VARIABLE-SPEED COMPRESSORS & FANS
WOOD COMBUSTION SYSTEMS

BUILDING SERVICES DIVISION

NO INTEREST INDICATED:

ADVANCED DUCT SEALING TECHNIQUES
ADVANCED RANKINE CYCLE HEAT PUMP
COMMERCIAL BUILDING RETROFIT PROCEDURES
CORE COMMERCIAL DAYLIGHTING
DIAGNOSTIC PROTOCOLS AND ANALYSIS METHODS
DIAGNOSTIC TOOL DEVELOPMENT
DOWN-HOLE HEAT EXCHANGER

TABLE B.6. (contd)

ENERGY TRACKING SYSTEM
FRICTION REDUCTION ADDITIVES
HEAT PUMP (QUASI OPEN CYCLE)
ICE SLURRY EVAPORATOR
MOBILE HOME RETROFIT PROCEDURES
MULTIFAMILY AUDIT HANDBOOK
MULTIFAMILY RETROFIT PROCEDURES
NON-METALLIC PIPING SYSTEM
OPERATING AND MAINTENANCE PROCEDURES
PUBLIC HOUSING RETROFIT PROCEDURES
RADIANT BARRIER CLIMATIC GUIDE
RADIANT BARRIER MODELING
SHARED SAVINGS
VACUUM STEAM RADIATORS

INTEREST INDICATED:

ABSORPTION CHILLER
ACOUSTIC LEAK DETECTION SYSTEM
ANALYTICAL TOOLS
BTU METER
INTEGRATED UTILITY PLANNING PROCESSES
STRATEGIES FOR EMERGING ISSUES
TECHNOLOGY ASSESSMENT AND MARKET PENETRATION
URBAN HEAT ISLANDS

BUILDING SYSTEMS DIVISION

NO INTEREST INDICATED:

ACOUSTIC TESTING OF ATTIC INSULATION
ADVANCED DESIGN TOOLS
ADVANCED LEAKAGE TECHNIQUES
AERATED AUTOCLAVED CONCRETE
ALTERNATIVE CFC-BASED INSULATIONS IN WALL AND FOUNDATION SYSTEMS
COMPOSITE/PRE-BUILT WALL SYSTEMS
CORROSIVENESS OF INSULATION
ENERGY KERNEL SYSTEM
FIELD THERMAL PERFORMANCE METHODOLOGY
FOAM AGING AND R-VALUE PREDICTION
HVAC/LIGHTING INTERACTIONS
IMBEDDED HEAT FLUX TRANSDUCERS
LOOSE-FILL ATTIC INSULATION SETTLING
MAINTENANCE AND UPGRADING OF DOE-2
MANUFACTURED HOUSING INSULATIDN
MATHEMATICAL MODELING OF INDOOR AIR QUALITY
MOISTURE IMPACTS ON MATERIALS
MOISTURE MEASUREMENT METHODOLOGY
MULTI-ZONAL INFILTRATION AND VENTILATION MEASUREMENT

TABLE B.6. (contd)

NON-INTRUSIVE MOISTURE PROBE
PASSIVE SAMPLER OF VOLATILE ORGANIC COMPOUNDS (VOC)
PERFLUOROCARBON TRACER SYSTEM
POWDER-FILLED EVACUATED INSULATION PANELS
PROPOR
RADIANT BARRIER SYSTEMS
RADIATIVE HEAT TRANSFER
ROOF SURFACE TREATMENT GUIDELINES
SICK BUILDING SYNDROME PROTOCOL
SIMPLIFIED THERMAL ANALYSIS OF ROOFS (STAR)
SWITCHABLE E MATERIALS
THERMAL CONDUCTIVITY MEASUREMENTS OVER RANGE OF ENVIRONMENTAL TEMPS.
VARIABLE R MATERIALS

INTEREST INDICATED:

ADVANCED DURABLE LOW-E COATINGS
ADVANCED RESIDENTIAL VENTILATION SYSTEMS
COMMERCIAL STANDARDS
FOUNDATION DESIGN TOOLS INCLUDING HANDBOOKS
HIGH-R WINDOWS
LARGE-SCALE CLIMATE SIMULATOR (LSCS)
MOISTURE GUIDELINES FOR RESIDENCES
ROOF RESEARCH CENTER - A NATIONAL USER FACILITY
RDOF THERMAL RESEARCH APPARATUS (RTRA)
SMALL OFFICE BUILDING HANDBOOK
SUBSTITUTE FOAMING AGENTS FOR INSULATION
SUPERLITE
THERMAL BRIDGES DESIGN CATALOG
WINDOW 3.1 COMPUTER PROGRAM

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