

# **NOTICE**

**Modifications to this Funding Opportunity Announcement (FOA) may have been made since this version was posted. Applicants are strongly advised to consult the FOA version posted on [www.FedConnect.com](http://www.FedConnect.com), the official application website, for the latest changes regarding the application materials, dates, and other requirements.**

The FedConnect system can be accessed through the following steps:

1. Go to <http://www.FedConnect.net/>
2. Click on "Search Public Opportunities"
3. Select "Reference Number" in the Search Criteria drop down box and then enter the Reference Number of the funding opportunity you are interested in (DE-FOA-XXXXXXX), followed by clicking the "Search" button
4. Click on the Title hyperlink after search results are displayed
5. On the right side of the screen, click on "BODY" under the "Solicitation" or "Amendment" folder; if multiple amendments exist, click on the most recent award amendment for the latest changes.

If you are new to the Federal grant application process, it can take 21 days or more to complete all of the registration processes needed to submit questions or application. These activities include acquiring a DUNS number, completing a Central Contract Registration (CCR), and FedConnect.com registration. Hence, if you are considering applying for this or another Funding Opportunity, we recommend beginning the registration process as soon as possible.

For further assistance throughout the application process, contact the following numbers:

- **General inquiries:** 1-888-DOE-RCVY (1-888-363-7289), <https://recoveryclearinghouse.energy.gov/>
- **Central Contract Registration (CCR) system:** 1-888-227-2423, <http://www.ccr.gov/Help.aspx>
- **FedConnect:** 1-800-899-6665, [support@fedconnect.net](mailto:support@fedconnect.net)
- **Specifics on FOA:** see "Questions" portion of the FOA

**FINANCIAL ASSISTANCE  
FUNDING OPPORTUNITY ANNOUNCEMENT**



**U. S. Department of Energy  
National Energy Technology Laboratory**

***“Recovery Act: Advanced Energy Efficient Building  
Technologies”***

**Funding Opportunity Number: DE-FOA-0000115**

**Announcement Type: Initial**

**CFDA Number: 81.086 Conservation Research and Development**

**Issue Date: 06/29/2009**  
**Letter of Intent Due Date: Not Applicable**  
**Pre-Application Due Date: Not Applicable**  
**Application Due Date: 08/18/2009 at 8:00:00 PM Eastern Time**

*This Announcement will remain open until the Application Due Date indicated above however, applications may be submitted any time before this Announcement closes.*

*It is also recommended that application submission begin well in advance (at least 48 hours) of the Announcement closing.*

## NOTE: REGISTRATION/SUBMISSION REQUIREMENTS

### **Registration Requirements**

There are several one-time actions you must complete in order to submit an application in response to this Announcement (e.g., obtain a Dun and Bradstreet Data Universal Numbering System (DUNS) number, register with the Central Contractor Registration (CCR), and register with FedConnect). Applicants, who are not registered with CCR and FedConnect, should allow at least 10 days to complete these requirements. It is suggested that the process be started as soon as possible.

**Applicants must obtain a DUNS number. DUNS website: <http://fedgov.dnb.com/webform>.**

**Applicants must register with the CCR. CCR website: <http://www.ccr.gov/>**

**Applicants must register with FedConnect to submit their application. FedConnect website: [www.fedconnect.net](http://www.fedconnect.net)**

### **Questions**

Questions relating to the **system requirements or how an application form works** must be directed to Grants.gov at 1-800-518-4726 or [support@grants.gov](mailto:support@grants.gov).

Questions regarding the **content** of the announcement must be submitted through the FedConnect portal. You must register with FedConnect to respond as an interested party to submit questions, and to view responses to questions. It is recommended that you register as soon after release of the FOA as possible to have the benefit of all responses. More information is available at <http://www.compusearch.com/products/fedconnect/fedconnect.asp>. DOE/NNSA will try to respond to a question within 3 business days, unless a similar question and answer have already been posted on the website.

Questions pertaining to the **submission** of applications through FedConnect should be directed by e-mail to [support@FedConnect.net](mailto:support@FedConnect.net) or by phone to FedConnect Support at 800-899-6665.

### **Application Preparation and Submission**

**Applicants must download the application package, application forms and instructions, from Grants.gov. Grants.gov website: <http://www.grants.gov/>**

(Additional instructions are provided in Section IV A of this FOA.)

**Applicants must submit their application through the FedConnect portal. FedConnect website: [www.fedconnect.net](http://www.fedconnect.net)**

(Additional instructions are provided in Section IV H of this FOA.)

**Applicants must apply to one of the specific Technical Subtopics (1.1, 1.2, 1.3, 1.4, 2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 3.4, 4.1, 4.2, 4.3, 5.1, 5.2, 5.3, 5.4, 6.1 or 6.2) identified under each Area of Interest. The required format for the title will be: "Technical Subtopic [1.1 or 1.2 or 1.3, etc.] (Project Title)" See Section IV, C. 1 and 2.**

## TABLE OF CONTENTS

<b>SECTION I - FUNDING OPPORTUNITY DESCRIPTION</b> .....	4
<b>SECTION II - AWARD INFORMATION</b> .....	19
A. TYPE OF AWARD INSTRUMENT .....	19
B. ESTIMATED FUNDING.....	19
C. MAXIMUM AND MINIMUM AWARD SIZE .....	19
D. EXPECTED NUMBER OF AWARDS .....	19
E. ANTICIPATED AWARD SIZE .....	19
F. PERIOD OF PERFORMANCE .....	19
G. TYPE OF APPLICATION .....	19
<b>SECTION III - ELIGIBILITY INFORMATION</b> .....	20
A. ELIGIBLE APPLICANTS .....	20
B. COST SHARING .....	20
C. OTHER ELIGIBILITY REQUIREMENTS.....	20
<b>SECTION IV - APPLICATION AND SUBMISSION INFORMATION</b> .....	22
A. ADDRESS TO REQUEST APPLICATION PACKAGE.....	22
B. LETTER OF INTENT AND PRE-APPLICATION .....	22
C. CONTENT AND APPLICATION FORMS.....	22
D. SUBMISSIONS FROM SUCCESSFUL APPLICANTS .....	39
E. SUBMISSION DATES AND TIMES .....	39
F. INTERGOVERNMENTAL REVIEW .....	39
G. FUNDING RESTRICTIONS .....	39
H. OTHER SUBMISSION AND REGISTRATION REQUIREMENTS.....	39
<b>SECTION V - APPLICATION REVIEW INFORMATION</b> .....	41
A. CRITERIA.....	41
B. REVIEW AND SELECTION PROCESS.....	45
C. ANTICIPATED NOTICE OF SELECTION AND AWARD DATES.....	46
<b>SECTION VI - AWARD ADMINISTRATION INFORMATION</b> .....	47
A. AWARD NOTICES .....	47
B. ADMINISTRATIVE AND NATIONAL POLICY REQUIREMENTS.....	47
C. REPORTING .....	49
<b>SECTION VII - QUESTIONS/AGENCY CONTACTS</b> .....	50
A. QUESTIONS .....	50
B. AGENCY CONTACT .....	50
<b>SECTION VIII - OTHER INFORMATION</b> .....	51
A. MODIFICATIONS .....	51
B. GOVERNMENT RIGHT TO REJECT OR NEGOTIATE .....	51
C. COMMITMENT OF PUBLIC FUNDS .....	51
D. PROPRIETARY APPLICATION INFORMATION.....	51
E. EVALUATION AND ADMINISTRATION BY NON-FEDERAL PERSONNEL.....	51
F. INTELLECTUAL PROPERTY DEVELOPED UNDER THIS PROGRAM.....	51
G. NOTICE OF RIGHT TO REQUEST PATENT WAIVER .....	52
H. NOTICE REGARDING ELIGIBLE/INELIGIBLE ACTIVITIES.....	52
<b>ATTACHMENT A - GUIDE FOR EVALUATION OF ENERGY SAVINGS POTENTIAL</b> .....	51

## **SECTION I - FUNDING OPPORTUNITY DESCRIPTION**

### **AMERICAN RECOVERY AND REINVESTMENT ACT OF 2009 (ARRA 2009)**

Projects under this Funding Opportunity Announcement (FOA) will be funded, in whole or in part, with funds appropriated by the American Recovery and Reinvestment Act of 2009, Pub. L. 111-5, (Recovery Act or Act). The Recovery Act's purposes are to stimulate the economy and to create and retain jobs. The Act gives preference to activities that can be started and completed expeditiously. Accordingly, special consideration will be given to projects that promote and enhance the objectives of the Act, especially job creation, preservation and economic recovery, in an expeditious manner.

Be advised that special terms and conditions may apply to projects funded by the Act relating to:

- Reporting, tracking and segregation of incurred costs;
- Reporting on job creation and preservation;
- Publication of information on the Internet;
- Access to records by Inspectors General and the Government Accountability Office;
- Prohibition on use of funds for gambling establishments, aquariums, zoos, golf courses or swimming pools;
- Ensuring that iron, steel and manufactured goods are produced in the United States;
- Ensuring wage rates are comparable to those prevailing on projects of a similar character;
- Protecting whistleblowers and requiring prompt referral of evidence of a false claim to an appropriate inspector general; and
- Certification and Registration.

These special terms and conditions will be based on provisions included in Titles XV and XVI of the Act. The special terms and conditions can be found at

[http://management.energy.gov/policy\\_guidance/1672.htm](http://management.energy.gov/policy_guidance/1672.htm).

The Office of Management and Budget (OMB) has issued Implementing Guidance for the Recovery Act. See [M-09-10, Initial Implementing Guidance for the American Recovery and Reinvestment Act of 2009](#) and [M-09-15, Updated Implementing Guidance for the American Recovery and Reinvestment Act of 2009](#). OMB will be issuing additional guidance concerning the Act in the near future. Applicants should consult the DOE website, [www.energy.gov](http://www.energy.gov), the OMB website <http://www.whitehouse.gov/omb/>, and the Recovery website, [www.recovery.gov](http://www.recovery.gov) regularly to keep abreast of guidance and information as it evolves.

Recipients of funding appropriated by the Act shall comply with requirements of applicable Federal, State, and local laws, regulations, DOE policy and guidance, and instructions in this FOA, unless relief has been granted by DOE. Recipients shall flow down the requirements of applicable Federal, State and local laws, regulations DOE policy and guidance, and instructions in this FOA to subrecipients at any tier to the extent necessary to ensure the recipient's compliance with the requirements.

Be advised that Recovery Act funds can be used in conjunction with other funding as necessary to complete projects, but tracking and reporting must be separate to meet the reporting requirements of the Recovery Act and related OMB Guidance. Applicants for projects funded by sources other than the Recovery Act should plan to keep separate records for Recovery Act funds and to ensure those records comply with the requirements of the Act. Funding provided through the Recovery Act that is supplemental to an existing grant is one-time funding.

Applicants should require their first tier subawardees to obtain a DUNS number (or update the existing DUNS record) and register with the Central Contractor Registration (CCR).

#### **A. FUNDING OPPORTUNITY ANNOUNCEMENT OBJECTIVES**

The Department of Energy (DOE), National Energy Technology Laboratory (NETL), on behalf of the Office of Energy Efficiency and Renewable Energy's (EERE) Building Technologies Program (BTP), is seeking applications under six broad Areas of Interest. Each Area of Interest includes several specific Technical Subtopics (which are described in further detail throughout this section) as follows:

**Area of Interest 1: Advanced Building Control Strategies, Communications and Information Technologies for Net-Zero Energy Buildings**

- Technical Subtopic 1.1: Advanced Building Control Strategies and Interfaces
- Technical Subtopic 1.2: Advanced Whole-Building Control Systems and Information Technology
- Technical Subtopic 1.3: Advanced Component Level Software and Hardware Development
- Technical Subtopic 1.4: Energy Control and Optimization Algorithms and Tools

**Area of Interest 2: Analysis, Design and Technical Tools**

- Technical Subtopic 2.1: Systems Engineering Tools for Very-Low Energy Buildings
- Technical Subtopic 2.2: Scientific and Engineering Foundations for Designing and Operating Very-Low Energy Buildings
- Technical Subtopic 2.3: Miscellaneous Electric Load (MEL) Prediction and Modeling

**Area of Interest 3: Building Envelope and Windows**

- Technical Subtopic 3.1: Window and Daylighting Technology Development
- Technical Subtopic 3.2: Envelope Technology Development
- Technical Subtopic 3.3: Building Envelope and Window Case Studies and Demonstrations
- Technical Subtopic 3.4: Production Engineering for R5 and Higher Windows

**Area of Interest 4: Residential and Commercial HVAC and Crosscutting Air Conditioning and Refrigeration Research**

- Technical Subtopic 4.1: Residential HVAC
- Technical Subtopic 4.2: Commercial HVAC
- Technical Subtopic 4.3: Crosscutting Air Conditioning and Refrigeration Research

**Area of Interest 5: Water Heating, Residential and Commercial Appliances and MELs**

- Technical Subtopic 5.1: Water Heating
- Technical Subtopic 5.2: Residential Appliances
- Technical Subtopic 5.3: Commercial Appliances
- Technical Subtopic 5.4: Miscellaneous Electric Load Reduction

**Area of Interest 6: Solar Heating and Cooling (SHC)**

- Technical Subtopic 6.1: Residential SHC R&D
- Technical Subtopic 6.2: Commercial SHC R&D

DOE estimates that approximately \$25-\$75 million shall be available for awards under this Funding Opportunity Announcement (FOA). DOE will seek at least 20-50 percent applicant cost share with performance periods between 1 to 3 years. Applications with a minimum of 20% cost share (except as noted in Section III – Eligibility Information, Part B - Cost Share) are sought for all Technical Subtopics EXCEPT for Technical Subtopics 3.3 and 3.4. Applications with a minimum of 50% cost share (except as noted in Section III – Eligibility Information, Part B - Cost Share.) are sought for Technical Subtopics 3.3 and 3.4. Awards with durations more than 12 months shall include continuation decision points and may

be partially funded in future fiscal years, dependent upon availability of funds.

## **B. BACKGROUND INFORMATION**

This FOA is authorized by Public Law (PL) 95-91 DOE Organization Act as amended by PL 109-58 Energy Policy Act 2005. This FOA is in response to the Department of Energy's American Recovery and Reinvestment Act (ARRA) of 2009 (Pub. L. No. 111-5, Title IV) priorities and goals for:

1. Science and Discovery: Invest in science to achieve transformational discoveries;
2. Clean, Secure Energy: Change the landscape of energy demand and supply;
3. Economic Prosperity: Create millions of green jobs and increase competitiveness;
4. National Security and Legacy: Maintain nuclear deterrent and prevent proliferation; and
5. Climate Change: Position U.S. to lead on climate change policy, technology, and science.

The Advanced Building Technologies FOA directly supports four of the five DOE ARRA funding priorities and goals. The Science and Discovery goal will be met by developing innovative technologies and energy efficiency systems for both new and existing residential and commercial buildings and by making breakthrough concepts market-ready through research, development and deployment. The second and fifth DOE ARRA priorities, Clean, Secure Energy and Climate Change, will be met through decreased energy use, resulting in fewer greenhouse gas emissions and less energy imports, and by increasing the energy efficiency of homes and commercial buildings. The third DOE ARRA priority, Economic Prosperity, will be addressed by positioning the U.S. as a leader in building energy efficient technologies, establishing a "green" workforce and technical expertise and deploying technologies that reduce the energy cost burden on homeowners and building operators.

In addition to the DOE ARRA funding goals, the advanced building technologies and deployment mechanisms supported by this FOA will accelerate Building Technology Program (BTP) research goals towards achieving net-zero energy homes and buildings through an increased focus on systems design, integration and controls. This FOA will also enable the DOE BTP to initiate an aggressive effort to target existing residential and commercial buildings for energy efficiency enhancements, a largely unaddressed opportunity for immediate energy savings. Advanced research and development (R&D) Areas of Interest addressed in this FOA are: 1) Advanced Building Controls, Communications and Information Technologies for Net-Zero Energy Buildings; 2) Analysis, Design and Technical Tools; 3) Building Envelope and Windows; 4) Residential and Commercial Heating, Ventilation and Air Conditioning (HVAC) and Crosscutting Air Conditioning and Refrigeration Research; 5) Water Heating, Residential and Commercial Appliances and Miscellaneous Electric Loads (MELs); and 6) Solar Heating and Cooling (SHC).

Projects funded through these Areas of Interest will accelerate and enable concurrent DOE BTP R&D on multiple advanced building technologies with levels of maturity ranging from applied research and analysis through engineering/prototype development and field testing and demonstration. New energy efficient building technologies will enter the market sooner and the cost of the best available technologies will be reduced for both new and existing buildings as a result. These projects will also accelerate the development and availability of high-risk/high-payoff energy efficient building technologies that would not occur without industry/government partnerships. By advancing the activity and focus of DOE BTP R&D, these projects will accelerate technical progress towards, and reduce the risk of achieving target timeframes for, widespread availability of net-zero energy homes and buildings.

## **C. PROGRAM AREAS OF INTEREST**

Each application shall address a specific Technical Subtopic within a particular Area of Interest. If you wish to submit an application for more than one Technical Subtopic, then separate applications are required. **NOTE: An application which contains more than a single Technical Subtopic will be considered non-responsive.**

The specific Areas of Interest and their associated Technical Subtopics that are being sought through this

FOA are:

**Area of Interest 1: Advanced Building Control Strategies, Communications and Information Technologies for Net-Zero Energy Buildings**

The goal of the DOE BTP is to achieve market ready net-zero energy residential buildings by 2020 and net-zero energy commercial buildings by 2025. Buildings need to be designed, built, operated, and maintained as an integrated system to achieve more energy efficient, and eventually, net-zero energy buildings. Just as automobiles rely on sensors and controls to optimize performance, fuel economy, and safety, buildings too can be built, operated and ultimately controlled to improve comfort, safety, and energy efficiency. As homes and commercial buildings approach net-zero energy performance capability, advanced whole-building controls, communications and information technologies will be needed to ensure that these buildings operate to their full potential. Although some building sub-systems (e.g., lighting and HVAC) currently employ sensors and controls, there is a lack of strategies to integrate and extend sensors and controls across the entire building's systems and operations.

Area of Interest 1 seeks to support the development of advanced building control strategies, communications, and information technologies to transform the design, operation and maintenance of both new and existing buildings. Proposed technologies must be economically justified from a lifecycle cost analysis, durable, reliable, demonstrate a credible pathway to energy savings in a variety of building types and operational modes, and be easily integrated into residential and/or commercial buildings.

High performance buildings will require reliable and standardized communications, information technology infrastructure and protocols at both the component and control level. Controls need to be integrated through computerized building management systems that optimize energy use and interface with renewable systems and the grid. Advanced controls should be able to diagnose and correct problems without user intervention, pinpoint operational issues, suggest corrective actions, and potentially dispatch repair technicians. Fault detection and diagnostics will ensure that net-zero energy buildings have the potential to perform as designed over time, and adapt to changes in configuration and use over the life of the building. Whole-building advanced control systems, linked to building information models, will enable subsystem optimization to achieve designed energy and environmental performance intent, increase occupant comfort and productivity, and identify and address operational issues as they arise. A fully integrated building will control lighting, heating, cooling, and ventilation needs based on occupancy, activity and external conditions. Area of Interest 1 requests applications for projects in response to the following 4 Technical Subtopics:

***Technical Subtopic 1.1: Advanced Building Control Strategies and Interfaces (This Technical Subtopic seeks 20% cost share.)***

Projects are requested for new concepts or ideas for building communications protocols, automated logic control systems and sensor networks that can provide energy savings in a variety of building types and operational modes.

***Technical Subtopic 1.2: Advanced Whole-Building Control Systems and Information Technology (This Technical Subtopic seeks 20% cost share.)***

Projects are requested for new concepts and ideas for development of integrated whole-building controls and information technologies for new construction and retrofits of existing buildings to: detect and repair, or alert users as to pending problems; manage and control low-energy buildings; maximize energy storage utilization strategies; maximize energy savings and peak demand reductions; integrate on-site generation and renewable energy sources, and enable two-way communication with the electrical grid (Smart Grid <http://www.oe.energy.gov/smartgrid.htm>). These advanced whole-buildings control systems should be capable of automatically detecting and configuring building subsystems and equipment, components and sensors that have conforming "plug and play" capabilities.



**Technical Subtopic 1.3: Advanced Component Level Software and Hardware Development (This Technical Subtopic seeks 20% cost share.)**

Projects are requested that will lead to “plug and play” capability for building components and equipment. “Plug and play” capability will enable individual components and equipment to interact with integrated whole-building control system capabilities to: detect and repair, or alert users as to pending problems; manage and control low-energy buildings; maximize energy storage utilization strategies; maximize energy savings and peak demand reductions; integrate on-site generation and renewable energy sources; and enable two-way communication with the electrical grid (Smart Grid).

**Technical Subtopic 1.4: Energy Control and Optimization Algorithms and Tools (This Technical Subtopic seeks 20% cost share.)**

Projects are requested for new concepts or ideas or to develop integrated modeling and predictive control technologies for whole-building control information technology (IT) software and hardware technologies to: estimate occupancy; manage system component energy usage; reduce peak energy demand; manage active and passive thermal storage systems; maintain energy storage utilization and potential as a function of building type and climate zone; and control building critical thermodynamic states and systems power consumption.

**Area of Interest 2: Analysis, Design and Technical Tools**

Area of Interest 2 seeks to improve the capability and availability of analysis, design and technical tools for both residential and commercial buildings. Analysis, design and technical tools enable optimal use of advanced building technologies, materials and controls in both new and existing buildings. Building energy performance, particularly in net-zero energy buildings, is the result of complex interactions between many elements, including climate, envelope heat and moisture transfer, internal heat gains, lighting power, HVAC equipment, controls, thermal and visual comfort, and energy cost. These interactions cannot be adequately understood and quantified without simulation tools.

Increasingly powerful simulation tools are required to evaluate new net-zero energy building demand-reduction and energy-supply technologies and support technology implementation and control decisions throughout the life cycle of building design through operation. The development of design and operation tools to optimize the interactions of advanced building technologies and ensure that they are installed and operated effectively is critical to building operations. Projects should consider compatibility with other building design and energy simulation tools to facilitate their deployment. Concepts applicable to both new construction and building retrofits are of particular interest. It is also vital to consider designers of high volume, high visibility, and large buildings to demonstrate the value and support the deployment of building simulation tools in the market. Area of Interest 2 requests applications for projects in response to the following 3 Technical Subtopics:

**Technical Subtopic 2.1: Systems Engineering Tools for Very-Low Energy Buildings (This Technical Subtopic seeks 20% cost share.)**

Projects are requested for analysis, design and technical tools to: incorporate advanced building technologies into whole building optimization and simulation; establish accurate test and verification procedures for technology validation and commercialization; measure and compare building performance to baseline simulations, benchmarking and historical data; model multivariate predictive controls for optimization of dynamic system elements; integrate and model active and passive systems; design and integrate building energy storage systems; and improve simulation visualization capabilities.

**Technical Subtopic 2.2: Scientific and Engineering Foundations for Designing and Operating Very-Low Energy Buildings (This Technical Subtopic seeks 20% cost share.)**

Because designing and operating very-low energy buildings is not entirely intuitive, projects are requested to develop the scientific and engineering foundations of integrated systems that consider all the energy-related impacts and interactions of building components, including the building site, the building envelope (walls, windows, doors, and roof), heating, ventilation, and air-conditioning systems; and lighting, controls, and equipment. Scientific and engineering practices are anticipated to vary by climate zones.

**Technical Subtopic 2.3: Miscellaneous Electric Load (MEL) Prediction and Modeling (This Technical Subtopic seeks 20% cost share.)**

Projects are requested for tools to estimate and model miscellaneous electric loads. MELs are small individually but can have a significant impact on total building energy use due to large aggregate loads. MEL electricity impacts can include several modes of operation and energy consumption, e.g., a low-power (e.g. standby) and active modes. A consistent approach for predicting and modeling MEL energy use while considering systems interactions are needed to reduce total energy use in buildings.

**Area of Interest 3: Building Envelope and Windows**

Area of Interest 3 seeks to improve the energy efficiency of residential and commercial building windows and envelope components. Residential and commercial buildings are the largest energy consuming sector, accounting for about 40 percent of total U.S. annual energy use (39.7 quadrillion British Thermal Units (Btu's) of energy (quads)). Residential buildings consume 22 percent and commercial buildings 18 percent of the building sector total. A building's envelope (roofs, walls, and foundations) and windows typically account for 36 percent of overall energy use, or about 14.3 quads in residential and commercial buildings combined, at an annual cost of \$133 Billion. When the impacts of using advanced strategies such as natural daylighting on building ventilation and lighting is considered, building envelope and windows can actually impact 51 percent of the building energy loads. Improving envelope and windows performance will greatly contribute to the DOE BTP net-zero energy buildings goals by significantly reducing space heating and cooling energy losses.

Envelope and windows technology projects are generally component based. While DOE fully embraces a whole-house or building application, the DOE BTP integration team activities are focused on system based approaches. Whole-house or building case studies are applicable to this area of interest, but the intent is to promote improvements to a specific or group of envelope components. While developing whole-building controls and systems will help optimize component behavior, advances in the components themselves are necessary to achieve significant energy savings and performance enhancements in buildings. Projects can be residential or commercial, and applicable to both the new and retrofit markets. Technologies that have broad application across climate regions will be considered the most promising. Area of Interest 3 requests applications for projects in response to the following 4 Technical Subtopics:

**Technical Subtopic 3.1: Window and Daylighting Technology Development (This Technical Subtopic seeks 20% cost share.)**

Projects are requested to produce fundamental window and daylighting technology improvements for net-zero energy homes and buildings. Key DOE BTP project priorities are improved energy performance and cost and durability issues and barriers. Additional details on goals for high-performance windows and daylighting can be found in the BTP Multi-Year Program Plan at <http://apps1.eere.energy.gov/buildings/publications/pdfs/corporate/myp08complete.pdf>. Technologies of particular interest under this technical subtopic include:

- Highly insulated windows with an overall heat transfer coefficient (U-Value) of 0.10 (or thermal resistance, R, of 10) at a consumer price premium of \$5 per square foot above standard double pane low-e products in the near term and \$3 per square foot in the 2020 timeframe. A key technical obstacle to highly insulated windows is that as performance improves and thermal resistance approaches R10, the solar heat gain coefficient (SHGC) is significantly reduced due to multiple glazing layers. Thus, higher solar heat gain while achieving R10 performance is a key objective for net-zero energy building windows for northern climates, making vacuum glazing of particular interest. However, the DOE BTP is open to any innovative technology that solves the SHGC problem. While R10 is a primary goal, windows that offer high cost/benefit ratios that are R7 or higher are also of interest, especially for mixed climate applications.
- Dynamic windows that provide a large SHGC range from 0.09 to 0.53 or higher at a consumer price premium of \$20 per square foot above standard insulated glass units in the near term and \$5 per square foot in the 2020 timeframe. Dynamic windows need to approach a price premium of approximately \$5 per square foot to be market viable. Therefore, fundamental new coating technologies that offer dramatic production cost reductions are a key DOE BTP focus. The ultimate dynamic window would be one that can control visible and near infrared light independently, thus allowing full control of energy flows and daylighting. Passive devices are also of interest. However, a passive window's consumer price premium must be lower due to lower expected energy savings and lack of energy control to be viable.
- Daylighting systems that can harvest visible light while rejecting near infrared. A key envelope technology need is daylighting systems that are easy to install and maintain. While dynamic glazing will improve daylighting possibilities for spaces near windows, the DOE BTP is interested in harvesting daylight deeper into the core of buildings. The long term DOE BTP daylighting goal is to reduce lighting energy use by 60 percent at a depth of at least 30 feet from the exterior wall at a price premium of \$6 per square foot of window area.

**Technical Subtopic 3.2: Envelope Technology Development  
(This Technical Subtopic seeks 20% cost share.)**

Building envelopes are constructed using a variety of building materials, including insulation, membranes, sealants, and a large array of structural, cladding, and finishing systems. Any improvements in these materials that lead to significant system performance improvements are applicable. High performing insulation with increased R/inch or consumer price reduction of high performance systems are of particular interest. There is also a need for roofing systems that can harness diurnal and seasonal dynamics to reduce heating and cooling loads. Variable emissivity coatings for under roof deck applications would be beneficial; however, they would have to be highly durable and low cost. Solutions to cost and aesthetics barriers to thermochromic surface coatings are also of interest. Additional details on DOE goals for envelope technology development can be found in the DOE BTP Multi-Year Program Plan at <http://apps1.eere.energy.gov/buildings/publications/pdfs/corporate/myp08complete.pdf>. Envelope technology development projects of particular interest under this Technical Subtopic include:

- Envelope system improvements and fundamental new technologies for net-zero energy homes. These technologies include cost-effective R30 walls and R50 roofs with dynamic capability/thermal mass. While there are promising new high performance foundation systems for new construction, there is still the need for higher performing and lower cost systems. Practical insulated foundation systems with at least R10 are also of interest. R values, for the purposes of envelope technology development, represent the entire building component R value not including cavities as prescribed by building codes. DOE BTP priorities are focused on advanced technologies, addressing design issues, including size and moisture, and establishing a pathway to commercialization of advanced technologies.

- Innovation of new systems designed specifically for the retrofit market for any building envelope, window or façade system. Many building products are highly cost effective for new construction, but are not economically viable in the retrofit market due to the complexity of installation and high retrofit labor costs. The DOE BTP is particularly interested in new retrofit envelope components or systems that can be installed more easily, at lower cost, and with higher installed energy performance. While developed envelope components or systems can offer higher performance, the DOE BTP is also interested in envelope components or systems with modest performance gains but at very low price premiums for lower income consumers.

**Technical Subtopic 3.3: *Building Envelope and Window Case Studies and Demonstrations (This Technical Subtopic seeks 50% cost share.)***

Collaborative projects are requested to showcase newly available high performance building envelope and window technologies that lack market penetration (less than a few percentage points market share) and adequate scientifically documented real-world application/installation performance. The intent is to demonstrate installation performance and document energy savings, peak energy demand and load reduction, and any non-energy benefits. Proposed projects must present an economic/business model for successful replication of the demonstrated application. The intent is not to show unique performance for special technologies with donated products, but to validate a technology's readiness for widespread market acceptance. New technologies that are innovative and high performance that have sufficient scientific case study documentation are not applicable.

**Technical Subtopic 3.4: *Production Engineering for R5 and Higher Windows (This Technical Subtopic seeks 50% cost share.)***

Projects are requested to develop high volume R5 highly insulating windows for the residential market and the "punched opening" (framed window) commercial market. The windows are expected to achieve a whole window National Fenestration Council Rating U-value between 0.19 and 0.22 for fixed and double hung windows, respectively, and demonstrate a SHGC greater than 0.30 for residential and any SHGC for commercial applications. Many factors influence window price, including framing materials, warranty, structural performance ratings, etc. However, from a macro nominal perspective, a rough estimate for a typical new 12 square foot window is approximately \$200. Although highly dependent on energy cost and climate region, the price of the same 12 square foot highly insulated window cannot exceed \$250 to be cost effective for most consumers. Projects may include one or all of the major phases of production engineering, including product design refinement, production equipment design, pilot production line installation at a major insulating glass unit or window company factory, and promotion of the R5 window products.

**Area of Interest 4: Residential and Commercial HVAC and Crosscutting Air Conditioning and Refrigeration Research**

Area of Interest 4 seeks to dramatically increase the efficiency of HVAC systems and pursue technologies that apply to both air conditioning and refrigeration. HVAC Systems which enable the cost-effective construction of net-zero energy homes or provide a pathway toward net-zero energy commercial buildings are of particular interest.

Equipment and systems used to provide thermal comfort and adequate indoor air quality consume about 30% of the total primary energy used in residential and commercial buildings. Reducing space conditioning energy usage, which accounts for approximately 39% of primary energy consumption in residential buildings, is essential to achieving DOE BTP net-zero energy home goals. Significant space conditioning energy reductions can be achieved by increasing equipment efficiency, distributing thermal energy more efficiently, ensuring that optimal equipment performance is maintained throughout the

equipment lifetime, and more closely meeting the comfort needs of building occupants.

The rated efficiency of some types of heating and cooling equipment has improved significantly in recent years. However, there is still a need for cost effective and affordable advanced materials, components, refrigeration cycles, and system designs to improve efficiency. Rather than focusing solely on rated equipment efficiency, as measured by Energy Efficiency Rating (EER) or Seasonal Energy Efficiency Ratio (SEER), it is necessary to understand and improve the energy consumption of entire systems throughout the entire operating regime to reduce annual energy consumption of the complete HVAC system. Proposers should ensure that concepts address this system approach. Because HVAC systems operate at conditions other than full load most of the time, technologies or systems that maximize partial load efficiency, but not to a measurable decrement of the peak load performance, are of particular interest.

Even the most energy efficient equipment frequently suffers from significant performance losses in the field from installation deficiencies, operational effects and long-term degradation. For example, performance losses in the field often arise from incorrect refrigerant charge, improper indoor air flow, overcapacity, and fouling of filters and heat exchangers in unitary air-conditioners and heat pumps. New technology is needed to minimize these types of losses and to facilitate proper installation, commissioning and performance monitoring for all types of equipment.

Increasing concerns and new regulations regarding indoor air quality have increased requirements for outdoor air in commercial buildings, which also increases building energy consumption. Homes constructed in recent years, and the net-zero energy homes envisioned for the future, have relatively tight envelopes, which can result in poor indoor air quality and create humidity control problems. Consequently, there is a need for improved technology for cost effectively controlling humidity and improving overall indoor air quality in new and existing residential and commercial buildings, while simultaneously reducing overall energy consumption.

Because the building stock increases by only a few percent annually, concepts which are only applicable to new construction will have limited energy savings potential. Therefore, concepts which are applicable to both new construction and retrofits of existing buildings are particularly encouraged. Area of Interest 4 requests applications for projects in response to the following 3 Technical Subtopics:

***Technical Subtopic 4.1: Residential HVAC (This Technical Subtopic seeks 20% cost share.)***

Projects are requested for residential HVAC systems which promise dramatic improvements in energy efficiency with modest consumer price premiums and which are suitable for net-zero energy homes. Particular technologies of interest include, but are not limited to:

- Very High Performance Air Conditioning (VHPAC) Systems for Net-Zero Energy Homes (including heat pump technology): A VHPAC system would achieve a 30% reduction in annual energy use and an incremental installed price premium of \$1000 relative to a current SEER 18/EER 13.4 2-speed system with tight ducts in conditioned space. The VHPAC performance goal is an overall system performance goal and includes savings from efficiency (improvements in coefficient of performance (COP)), zoning, night cooling, evaporative cooling, heat recovery, and capacity modulation.
- Multi-function HVAC and water heating systems: Innovative approaches to combining space conditioning and water heating, targeting 50% reduction in annual energy consumption relative to today's standard construction practices, are sought. These systems must also maintain uniform comfort, humidity control, and indoor air quality, and be suitable for the lower cooling loads (< 2 tons) expected in highly insulated net-zero energy homes.

- **Thermal Distribution Systems:** Problems with thermal distribution systems, including duct system designs, insulation materials and installation practices are a major source of system inefficiency. Technology is needed to reduce losses in distribution systems, including a reduction by a factor of 3 to 5 in total duct thermal losses under peak loading conditions for duct systems and air handlers that cannot be moved into conditioned spaces.
- **High Performance Cold Climate Heat Pumps:** In cold climate regions where natural gas is not available, advanced cold climate heat pumps are needed which can maintain both capacity and COP down to very low ambient temperatures. These system designs could include multi-stage units, ground source heat pumps, alternative refrigerants, and other innovative approaches that maintain performance and cost competitiveness. The units should be sized for expected net-zero energy home heating loads (i.e. 40,000 - 60,000 BTU/hour at nominal 47°F rating conditions). Performance targets are as follows:

Cold Climate Heat Pumps Performance Targets		
Ambient Temperature (°F)	Minimum COP	Maximum % capacity degradation from nominal
47 (nominal rating point)	4	0
17	3.5	10
-13	3	25

**Technical Subtopic 4.2: Commercial HVAC (This Technical Subtopic seeks 20% cost share.)**

The goal of DOE BTP program is to achieve market ready net-zero energy commercial buildings by 2025. The precise HVAC requirement for such buildings will vary considerably depending on the building type, but it is evident that new approaches to comfort conditioning and ensuring indoor air quality will be necessary. Projects are requested to demonstrate the potential to achieve commercial HVAC energy consumption reductions of 30-50% compared to typical direct expansion, 11 EER, rooftop equipment with conventional ventilation systems in low-rise buildings. Projects are requested for larger, high-rise building, reductions in HVAC energy consumption of 30-50% compared to current chilled water systems paired with conventional ventilation equipment that meet American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) 90.1 requirements. Particular technologies of interest for commercial systems include, but are not limited to:

- **Radiant Cooling:** Radiant cooling can significantly reduce energy consumption by reducing air moving power and operating at higher evaporator temperatures (thus reducing compressor power consumption). Radiant cooling technology can work well in dry climates, but a separate dehumidification system is necessary in humid climates. Radiant cooling systems are available but further development is needed, as well as demonstration of the feasibility and cost-effectiveness of the technology in various climate zones.
- **Fuel-fired Heat Pumps:** Fuel-fired heat pumps can provide substantial reductions in primary energy consumption for heating and cooling through cycles such as absorption, Rankine, and Stirling-Stirling. Proposals which demonstrate the potential for dramatic improvements in efficiency or cost reduction relative to existing products are encouraged.
- **Desiccant Cooling:** Desiccant cooling systems can be powered by waste heat from distributed power generation equipment or refrigeration systems. Desiccants remove humidity from the space, enabling the standard air conditioning systems to operate far more efficiently, while greatly enhancing occupant comfort. New desiccant technologies are becoming available, including new liquid desiccants and polymer desiccant membranes. Coupling these desiccant systems with typical rooftop air conditioners would provide numerous benefits.

**Technical Subtopic 4.3: Crosscutting Air Conditioning and Refrigeration Research  
(This Technical Subtopic seeks 20% cost share.)**

Many technologies apply to both air conditioning and refrigeration. Proposals are requested for the technologies described below, but applicants must describe the primary markets that their research will target and explain how they will meet the quantitative targets discussed for air conditioning in the HVAC area subtopics (4.1 and 4.2) or refrigeration systems for the Appliances area subtopics (5.2 and 5.3).

- **Nanotechnology:** Research is requested for nanotechnology applications in air conditioning and refrigeration systems. Nanoparticles could be added to refrigerants or lubricants to enhance heat transfer, as has been shown in some early stage research. Nanostructures for heat exchangers could enhance boundary layer stirring or enable very thin fin structures to be manufactured, enabling greater heat transfer per unit of area.
- **Zero Global Warming Potential Refrigerants:** Considerable interest is being generated in non-fluorocarbon refrigerants which have negligible direct global warming potential. Carbon dioxide is one option that has been the subject of considerable research, but its inherent thermodynamic cycle efficiency is lower than that of conventional refrigerants unless other means are used to boost efficiency. Using water as a refrigerant has also been explored, but such systems appear to be very complex, large, and costly. Research is requested to explore ways to achieve high efficiencies with such “natural” refrigerants or other refrigerants which have negligible direct global warming potential.
- **Non-vapor Compression Cooling Systems:** Alternative refrigeration cycles such as magnetocaloric, thermoacoustic, and thermoelectric cooling have all been explored for many years, with very limited commercial success. Research is requested that leverages recent technological advances in materials or electronics, and that demonstrate how to overcome the barriers encountered in previous research to achieve successful commercialization. However, proposals which simply repeat prior research will not be considered.

**Area of Interest 5: Water Heating, Residential and Commercial Appliances and MELs**

Area of Interest 5 seeks to increase the efficiency of water heating equipment and appliances and to reduce parasitic miscellaneous electric loads. Technologies that contribute to and enhance the pathway to net-zero energy homes and commercial buildings are of particular interest. Area of Interest 5 requests applications for projects in response to the following 4 Technical Subtopics:

**Technical Subtopic 5.1: Water Heating (This Technical Subtopic seeks 20% cost share.)**

Water heating accounts for about 10% of the primary energy use in all buildings, including 13% in the residential sector. Consequently, high efficiency options are essential for net-zero energy homes to become a cost effective reality. Electric heat pump water heaters use about half the energy of typical electric resistance water heaters but have very high consumer price premiums and negligible market share. Conventional gas water heater efficiencies have been fairly stagnant, though some products have achieved very high efficiencies. However, in the residential sector, these products typically cost at least double that of standard units. DOE BTP is interested in the development of the next generation of water heating products that have dramatically lower consumer price premiums while offering substantial energy savings. Fuel fired heat pumps or integration with renewable energy sources are possible methods of increasing energy savings. Projects are requested for the following in support of the DOE BTP net-zero energy home goals (similar approaches for commercial water heating applications will also be considered):

- Domestic hot water heating systems suitable for cold climates which can achieve a 30% reduction in annual energy usage relative to a tankless gas water heater with an Energy Factor (EF) rating of 0.8 at an incremental installed price not to exceed \$2000.
- Low loss hot water distribution systems with occupancy based controls to reduce standby losses and low-cost, easy-to-install integrated waste heat recovery, which can achieve approximately 20% system energy savings relative to conventional distribution systems.

**Technical Subtopic 5.2: Residential Appliances (This Technical Subtopic seeks 20% cost share.)**

Household appliances such as refrigerators and laundry equipment consume substantial amounts of energy in the residential sector. In a net-zero energy home, space conditioning energy loads are reduced dramatically, so appliance loads become even more critical. Although refrigerator efficiencies have improved considerably in recent years due to increasingly stringent minimum efficiency standards and the availability of Energy Star<sup>®</sup> units, refrigeration still accounts for over 7% of residential primary energy usage. Laundry equipment, mostly for clothes drying, accounts for about 5% of residential primary energy usage (excluding water heating energy). However, few high efficiency options are available for clothes dryers.

Projects are requested for residential refrigerators that reduce energy consumption by 30-50% relative to Federal minimum efficiency standards, with manufacturing cost premiums of <\$100 and clothes dryers, at modest manufacturing cost premiums, that reduce energy consumption by at least 25% (natural gas) or 50% (electric). Proposals must include sufficient information on the applicant's cost structure to allow evaluation of the potential to meet this manufacturing cost premium target. For concepts that have been considered in the past, it is essential that proposers demonstrate knowledge of prior efforts and explain how they will overcome technical and economic barriers that have prevented successful commercialization in prior development efforts. Furthermore, concepts with measurable non-energy benefits, which are important for market success, are particularly encouraged.

**Technical Subtopic 5.3: Commercial Appliances (This Technical Subtopic seeks 20% cost share.)**

Highly efficient commercial refrigeration has emerged as a critical need in the DOE BTP Net-Zero Energy Commercial Building Initiative. In certain commercial sectors, such as food sales and foodservice, refrigeration is particularly important and dramatic improvements are necessary to enable net-zero energy commercial buildings. Commercial refrigeration projects are requested in the following areas:

- Supermarket refrigeration systems and components, including compressor racks and display cases, which reduce energy consumption by 30-50% relative to conventional systems. Approaches may include ground coupled systems, advanced control strategies, secondary refrigeration loops using non-fluorocarbon refrigerants, or innovative waste heat recovery processes which may be used for desiccant regeneration.
- Advanced insulation for self-contained and closed-door supermarket rack refrigeration equipment. Technologies such as aerogels and vacuum insulated panels (VIPs) are available but are very complex and expensive to manufacture. VIPs are also very fragile. However, it is conceivable that "active" vacuum panels could be developed that use small vacuum pumps to maintain sufficient vacuum as leakage occurs, enabling far simpler and cheaper manufacturing of the panels. Breakthroughs are sought which provide dramatic improvements in the manufacturing costs of advanced insulated doors and panels.



**Technical Subtopic 5.4: Miscellaneous Electric Load Reduction (This Technical Subtopic seeks 20% cost share.)**

Projects are requested to establish the absolute energy usage and trends for discrete categories of MELs and develop conservation or efficiency approaches to reduce energy use from the largest consuming categories. The Energy Information Agency’s “Annual Energy Outlook 2008” (<http://www.eia.doe.gov/oiaf/archive/aeo08/index.html>) estimates that the combination of non-PC office equipment and “other” MEL energy consumption will grow 57% between 2009 and 2030. For this reason, DOE BTP is focusing on these two end-use categories. All types of electrical devices that contribute to miscellaneous electric loads need to be examined to maximize transformer and other component efficiencies and minimize standby losses. The DOE BTP targets (see table) are to reduce miscellaneous electric loads by 60 percent at nighttime and 25 percent during peak hours.

Characteristics	Units	Calendar Year	
		2009 Baseline	ZEB Target
Miscellaneous Electric Loads	Percent Nighttime Energy Reduction	Minimum Code (to Energy Star)	60
	Percent Peak Energy Reduction	Minimum Code (to Energy Star)	25
	Standby Power (Watt)		<1

**Area of Interest 6: Solar Heating and Cooling (SHC)**

Area of Interest 6 seeks to develop and deploy the next generation of solar heating, cooling, dehumidification, energy storage and hot water heating products and installations in support of the DOE BTP net-zero energy buildings goals. Concepts which are applicable to both new construction and building retrofits are particularly encouraged. Enhanced integration of SHC products into the building envelope, conventional building HVAC systems and the building construction process is critical (e.g., incorporating plug-and-play, appliance like features). Proposed products should have substantially improved installed price, reliability, durability, and maintainability than existing products. It is likely that most system concepts will be solar-assisted, meaning that they will be hybrid systems incorporating both solar and conventional technologies. Particular technologies of interest include, but are not limited to:

- Solar Water Heating, Space Heating and Cooling
  - Advanced concepts for integrated space conditioning and water heating systems.
  - Low-cost concepts for high temperature evacuated tube or concentrating solar collectors, or alternative high temperature designs.
  - Low cost polymer-based solar thermal components and systems with improved cost effectiveness, especially for cold climate zones.
  - Advanced thermal energy storage systems optimized for SHC conditions, using phase-change materials, nanotechnologies, sorption storage, thermo-chemical technologies, or central community scale storage approaches.
  - Improved building integration of solar collectors to create true building integrated systems to address cost, aesthetics, durability, building process, maintenance and operational issues.
  - Improved solar collectors, incorporating approaches such as advanced glazing materials and antireflective coatings, as well as spectrally selective coatings for absorbers.
  
- Solar Cooling
  - Advanced solar cooling systems including solar-assisted absorption and solar adsorption cycles, particularly for residential and light commercial applications.
  - Solar-assisted liquid or solid desiccant-based cooling systems.

- Packaged hybrid thermally-driven and vapor compression cooling systems (e.g. cascaded compression/absorption or compression/adsorption cycles).
  - Dual source solar assisted heat pumps with advanced control switching between ambient air and ground coupling energy sources.
- Combination thermal-electric hybrid module concepts using renewable electric generation technologies such as photovoltaics (PV) and concentrating solar power (CSP) with a focus on innovative thermal management techniques for the solar thermal element of the module. Note that PV and CSP module research is not eligible for funding under this Announcement.

Area of Interest 6 requests applications for projects in response to the following 2 Technical Subtopics:

***Technical Subtopic 6.1: Residential SHC R&D (This Technical Subtopic seeks 20% cost share.)***

Proposals are sought for residential SHC and water heating systems which are suitable for both net-zero energy and existing homes. Concepts may address space heating or cooling only, both heating and cooling, or water heating. Combined space conditioning and water heating systems are also of interest. Projects are requested for system concepts or enabling components, technologies or manufacturing processes that significantly enhance residential building-integrated, easily installed SHC products that increase their cost-effectiveness, reliability, durability, management and operation. Plug-and-play appliance-like features that enhance integration of SHC products into the building envelope, conventional residential building HVAC systems and construction processes are encouraged.

The DOE BTP SHC system development target is to reduce overall annual energy consumption by 50% relative to baseline systems and standard construction practices. HVAC baseline targets systems are 13 SEER and 7.7 Heating Seasonal Performance Factor (HSPF) central air conditioner/heat pumps. Water heating system baseline targets are a 50% reduction in annual energy usage relative to 0.6 EF gas water heaters for mild climates and a 30% reduction in annual energy usage relative to 0.8 EF tankless water heaters at an incremental installed price premium not to exceed \$2000 for cold climates. Systems must also maintain uniform comfort, humidity control, and indoor air quality. Space conditioning systems suitable for the lower heating and cooling loads (< 2 tons cooling, 40,000 – 60,000 BTU/hr heating) in highly insulated net-zero energy homes present a market opportunity for new cost-competitive SHC systems. The incremental installed consumer price of developed systems should show the potential to achieve, at high volume production, a simple payback period of less than 10 years. SHC systems suitable for cold climates are particularly challenging and are, therefore, of particular interest.

***Technical Subtopic 6.2: Commercial SHC R&D (This Technical Subtopic seeks 20% cost share.)***

The DOE BTP goal is to achieve market ready net-zero energy commercial buildings by 2025. The HVAC requirement for such buildings will vary considerably depending on building type, but new approaches to comfort conditioning and indoor air quality will be necessary. Projects are requested for commercial building SHC systems which demonstrate the potential to achieve:

- Reductions in HVAC energy consumption of 30-50% compared to typical direct expansion, 11 EER at 80% combustion efficiency, rooftop equipment with conventional ventilation systems in low rise buildings.
- Reductions in HVAC energy consumption of 30-50% compared to current chilled water systems which meet ASHRAE 90.1 requirements and are paired with conventional ventilation equipment in larger high rise buildings.

Although it is likely that such systems will require substantial price premiums compared to conventional equipment, applicants must demonstrate the potential to reduce price premiums in the long term, at large production volumes, such that the proposed systems can become commercially viable.

## **SECTION II - AWARD INFORMATION**

### **A. TYPE OF AWARD INSTRUMENT**

DOE anticipates awarding cooperative agreements under this program Announcement (See Section VI.B.2 Statement of Substantial Involvement).

### **B. ESTIMATED FUNDING**

Approximately \$25,000,000 to \$75,000,000 is expected to be available for new awards under this Announcement.

### **C. MAXIMUM AND MINIMUM AWARD SIZE**

- Ceiling (the maximum amount for an individual award made under this Announcement):  
None
- Floor (the minimum amount for an individual award made under this Announcement):  
None

### **D. EXPECTED NUMBER OF AWARDS**

DOE anticipates making forty-five (45) to ninety (90) awards under this Announcement depending on the size of the awards.

### **E. ANTICIPATED AWARD SIZE**

DOE anticipates that awards will be in the \$250,000 to \$2,000,000 range (DOE Share) for the total project period.

### **F. PERIOD OF PERFORMANCE**

DOE anticipates that awards will have project performance periods of one (1) to three (3) years.

### **G. TYPE OF APPLICATION**

DOE will accept only new applications under this Announcement.

### **SECTION III - ELIGIBILITY INFORMATION**

#### **A. ELIGIBLE APPLICANTS**

All types of entities are eligible to apply, except other Federal agencies, Federally Funded Research and Development Center (FFRDC) Contractors, and nonprofit organizations described in section 501(c)(4) of the Internal Revenue Code of 1986 that engaged in lobbying activities after December 31, 1995.

#### **B. COST SHARING**

DOE seeks cost share at least 20% of the total allowable costs for research and development projects; however, DOE will accept cost share of not less than 10% for academic institutions, non-profit organizations and state and local governments and 0% for Indian tribes or Tribal Energy Resource Development Organizations. DOE seeks cost share at least 50% of the total allowable costs for demonstration and commercial application projects; however, DOE will accept cost share of not less than 25% for private industry Recipients and not less than 10% for academic institutions, non-profit organizations, Indian tribes or Tribal Energy Resource Development Organizations, and state and local governments. All cost share must come from non-Federal sources unless otherwise allowed by law. The sum of the Government share, including FFRDC contractor costs if applicable, and the Recipient share of allowable costs equals the total allowable cost of the project.

#### **C. OTHER ELIGIBILITY REQUIREMENTS**

- **FEDERALLY FUNDED RESEARCH AND DEVELOPMENT CENTER (FFRDC) CONTRACTORS**

FFRDC contractors are not eligible for an award under this announcement, but they may be proposed as a team member on another entity's application subject to the following guidelines:

Authorization for non-DOE/NNSA FFRDCs. The Federal agency sponsoring the FFRDC contractor must authorize in writing the use of the FFRDC contractor on the proposed project and this authorization must be submitted with the application. The use of a FFRDC contractor must be consistent with the contractor's authority under its award and must not place the FFRDC contractor in direct competition with the private sector.

Authorization for DOE/NNSA FFRDCs. The cognizant contracting officer for the FFRDC must authorize in writing the use of a DOE/NNSA FFRDC contractor on the proposed project and this authorization must be submitted with the application. The following wording is acceptable for this authorization.

“Authorization is granted for the \_\_\_\_\_ Laboratory to participate in the proposed project. The work proposed for the laboratory is consistent with or complimentary to the missions of the laboratory, will not adversely impact execution of the DOE/NNSA assigned programs at the laboratory, and will not place the laboratory in direct competition with the domestic private sector.”

Value/Funding. The value of, and funding for, the FFRDC contractor portion of the work will not normally be included in the award to a successful applicant. Usually, DOE/NNSA will fund a DOE/NNSA FFRDC contractor through the DOE field work proposal system and other FFRDC contractors through an interagency agreement with the sponsoring agency.

Cost Share. The applicant's cost share requirement will be based on the total cost of the project, including the applicant's and the FFRDC contractor's portions of the effort.

FFRDC Contractor Effort:

The FFRDC contractor effort, in aggregate, shall not exceed 20% of the total estimated cost of the project, including the applicant's and the FFRDC contractor's portions of the effort.

Responsibility. The applicant, if successful, will be the responsible authority regarding the settlement and satisfaction of all contractual and administrative issues, including but not limited to, disputes and claims arising out of any agreement between the applicant and the FFRDC contractor.

- **PERFORMANCE OF WORK IN UNITED STATES**

The Recipient agrees that at least 75% of the direct labor cost for the project (including subcontractor labor) shall be incurred in the United States, unless the Recipient can demonstrate to the satisfaction of the Department of Energy that the United States economic interest will be better served through a greater percentage of the work being performed outside the United States.

## **SECTION IV - APPLICATION AND SUBMISSION INFORMATION**

### **A. ADDRESS TO REQUEST APPLICATION PACKAGE**

Application forms and instructions are available at Grants.gov. To access these materials, go to <http://www.grants.gov>, select "Apply for Grants," and then select "Download Application Package." Enter the CFDA and/or the funding opportunity number located on the cover of this Announcement and then follow the prompts to save the application package. Once you have SAVED the application package and completed all the required documentation, you will submit your application via the FedConnect portal. **DO NOT use the Save & Submit selection in Grants.gov.**

### **B. LETTER OF INTENT AND PRE-APPLICATION**

#### **1. Letter of Intent.**

Letters of Intent are not required.

#### **2. Pre-application**

Pre-applications are not required.

### **C. CONTENT AND APPLICATION FORMS**

You must complete the mandatory forms and any applicable optional forms (e.g., Disclosure of Lobbying Activities (SF-LLL)) in accordance with the instructions on the forms and the additional instructions below. Files that are attached to the forms must be in Adobe Portable Document Format (PDF) unless otherwise specified in this announcement.

**Applicants must apply to one of the specific Technical Subtopics (1.1, 1.2, 1.3, 1.4, 2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 3.4, 4.1, 4.2, 4.3, 5.1, 5.2, 5.3, 5.4, 6.1 or 6.2) identified under each Area of Interest. The required format for the title will be: "Technical Subtopic [1.1 or 1.2 or 1.3, etc.] (Project Title)" See Section IV, C. 1 and 2.**

#### **1. SF 424 (R&R)**

Complete this form first to populate data in other forms. Complete all the required fields in accordance with the pop-up instructions on the form. The list of certifications and assurances referenced in Field 17 can be found on the DOE Financial Assistance Forms Page at [http://management.energy.gov/business\\_doe/business\\_forms.htm](http://management.energy.gov/business_doe/business_forms.htm) under Certification and Assurances.

#### **2. RESEARCH AND RELATED OTHER PROJECT INFORMATION**

Complete questions 1 through 6 and attach files. The files must comply with the following instructions:

##### **Project Summary/Abstract (Field 7 on the Form)**

The project summary/abstract must contain a summary of the proposed activity suitable for dissemination to the public. It should be a self-contained document that identifies the name of the applicant, the project director/principal investigator(s), the project title, the objectives of the project, a description of the project, including methods to be employed, the potential impact of the project (i.e., benefits, outcomes), and major participants (for collaborative projects). This

document must not include any proprietary or sensitive business information as the Department may make it available to the public. The project summary must not exceed 1 page when printed using standard 8.5" by 11" paper with 1" margins (top, bottom, left and right) {single spaced} with font not smaller than 11 point. To attach a Project Summary/Abstract, click "Add Attachment."

**Project Narrative (Field 8 on the Form)**

The project narrative **must not exceed 25 pages, double spaced**, when printed using standard 8.5" by 11" paper with 1 inch margins (top, bottom, left, and right). EVALUATORS WILL REVIEW ONLY THE NUMBER OF PAGES SPECIFIED IN THE PRECEDING SENTENCE. The font must not be smaller than 11 point. Do not include any Internet addresses (URLs) that provide information necessary to review the application. See Part VIII.D for instructions on how to mark proprietary application information. Save the information in a single file named "Project.pdf," and click on "Add Mandatory Other Attachment" to attach.

The project narrative will address the technical and management aspects of the assistance action, the Applicant's capabilities and what the Applicant will do to satisfy the requirements of the funding opportunity announcement. Because the information contained in this section will be used to evaluate the applicant's technical understanding of the work to be performed, technical approach, and potential for successfully completing the defined project, it should be specific and complete in every detail. The project narrative should be practical and be prepared simply and economically, providing a straightforward, concise delineation of what it is the Applicant will do to satisfy the requirements of the funding opportunity announcement.

DOE WILL EVALUATE AND CONSIDER ONLY THOSE APPLICATIONS THAT ADDRESS SEPARATELY EACH OF THE MERIT REVIEW CRITERION AND SUB-CRITERION.

**The Project Narrative will vary depending on the Technical Subtopic. The following list of Project Narrative Instructions apply to Technical Subtopics 1.1, 1.2, 1.3, 1.4, 2.1, 2.2, 2.3, 3.1, 3.2, 4.1, 4.2, 4.3, 5.1, 5.2, 5.3, 5.4, 6.1 or 6.2 (see below for separate Project Narrative preparation instructions for Technical Subtopics 3.3 and 3.4):**

The Applicant shall use the following table of contents when preparing the project narrative to facilitate the review process and ensure that all the review criteria are addressed:

	<u>Page</u>
Table of Contents.....	i
List of Tables.....	ii
List of Figures.....	iii
List of Acronyms.....	iv

**TECHNICAL DISCUSSION**

1. TECHNICAL MERIT AND APPROACH.....	#
1.1 Project Description, Goals and Objectives .....	#
1.2 Relationship to Announcement Objectives .....	#
1.3 Current State of Knowledge or Technology.....	#
1.4 Project Performance Goals .....	#
1.5 Work Plan .....	#
1.6 Labor Hours.....	#
1.7 Project Schedule and Milestones .....	#
1.8 Travel.....	#
1.9 Project Risks.....	#
2. ENERGY, ENVIRONMENTAL AND ECONOMIC BENEFITS.....	#
2.1 Energy Savings .....	#
2.2 Environmental Benefits.....	#



2.3 Economic Impacts .....	#
3. PARTICIPANT ROLES, CAPABILITIES AND INDUSTRY EXPERIENCE .....	#
3.1 Organizational Qualifications and Industry Experience .....	#
3.2 Personnel Qualifications and Experience .....	#
3.3 Organizational Structure .....	#
3.4 Facilities and Equipment .....	#
4. COMMERCIALIZATION AND MARKET POTENTIAL .....	#
4.1 Commercialization Strategy.....	#
4.2 Market Potential.....	#

**APPENDICES (WILL NOT COUNT IN THE 25 DOUBLE SPACED PAGE LIMITATION)**

A. STATEMENT OF PROJECT OBJECTIVES.....	A1
B. KEY PERSONNEL RESUMES.....	B1
C. LETTERS OF COMMITMENT.....	C1
D. BIBLIOGRAPHY & REFERENCES CITED .....	D1

**PROJECT NARRATIVE [Twenty-five (25) page limitation, double spaced]**

This section shall contain the major portion of the Technical Application and be prepared in the format of the preceding table of contents. It shall be presented in as much detail as practical and include the following information:

- 1. Technical Merit and Approach** - This section shall describe the goals and objectives of the proposed work, demonstrate the Applicant’s understanding of the DOE’s objectives set forth in the Announcement and provide a clear description of the technical approach that will be implemented to accomplish the project objectives. Sufficient information shall be provided to enable DOE reviewers to score the application based on Criterion 1 identified in Part V.
  - 1.1. Project Description, Goals and Objectives - The Applicant shall provide a clear narrative description of the project and its goals and objectives and the scientific and technical basis that provides supporting rationale for the proposed work.
  - 1.2. Relationship to Announcement Objectives - The Applicant shall provide a clear narrative description of the relationship of the proposed work to the DOE’s goals and objectives for this Announcement and the Technical Subtopic being addressed.
  - 1.3. Current State of Knowledge or Technology - The Applicant shall discuss the current state of knowledge and/or technology that serves as background information for the proposed work. The discussion should include identification of any technology or information gaps in the existing technology and provide background on the technologies or knowledge that will be used to address the gaps.
  - 1.4. Project Performance Goals - The Applicant shall discuss how the proposed work will advance the current technology relative to performance, cost reduction and/or ease of installation.
  - 1.5. Work Plan - The Applicant shall provide a thorough and detailed narrative description of the planned work. This description should be an expanded version of the Statement of Project Objectives provided in Appendix A and use the headings contained therein (e.g., Objectives, Scope of Work, and Tasks to be Performed). It should be written in the active voice using consistent wording that divides the work into logical tasks and subtasks necessary to accomplish the project’s objectives. The Applicant shall provide a clear description of the work to be performed under each task and subtask. The description shall identify the product(s) and deliverables that will result from each task

and its relation to the overall project. For multi-phase projects, the Applicant shall define the criteria for determining successful completion of each phase.

- 1.6. Labor Hours - The Applicant shall provide a table listing the estimated labor hours and labor categories (e.g., Project Manager, Principal Investigator, Engineer, Technician, and Clerical) required for each task in the Statement of Project Objectives. The Applicant shall also include a table showing labor hours and labor categories for any proposed subcontracting or consulting effort for each task. These categories should be easily cross-referenced with the key personnel.
  - 1.7. Project Schedule and Milestones - The Applicant shall provide a Gantt chart project schedule and milestones, and describe the interrelationships of the project tasks. All significant milestones shall be defined in a milestone log depicted on the schedule and include performance metrics to gauge technical progress towards the project's goals and objectives.
  - 1.8. Travel - The Applicant shall describe any proposed travel. The purpose of the trip, number of trips, the origin and destination, trip duration, and the number of personnel shall be included in the explanation. The Applicant shall make provision for a project kick-off meeting and annual project briefings at the National Energy Technology Laboratory in either Morgantown, WV or Pittsburgh, PA.
  - 1.9. Project Risks - The Applicant shall describe any project risks that could significantly affect the schedule, completion of planned milestones or project outcome.
- 2. Energy, Environmental and Economic Benefits** - This section shall describe anticipated or potential energy, environmental and economic benefits. Potential energy savings and reductions in carbon dioxide emissions from the proposed technology shall be determined according to the guidelines contained in Attachment A, Guide for Evaluation of Energy Savings Potential dated 1/19/2005. Sufficient information shall be provided to enable DOE reviewers to score the application based on Criterion 2 identified in Part V.
- 2.1. Energy Savings - The Applicant shall describe potential energy savings and technical performance expected from the proposed technology or product.
  - 2.2. Environmental Benefits - The Applicant shall describe potential environmental benefits resulting from the proposed technology or product, including, but not limited to: reduced global warming potential, increased protection of the stratospheric ozone layer, lower direct releases of water, air and ground pollutants, improved indoor air quality, improved recyclability and beneficial human health impacts.
  - 2.3. Economic Impacts - The Applicant shall describe potential direct economic impacts for the proposed project beyond the monetary value of the estimated energy savings, such as jobs retained and/or created through project implementation and, if successful, product or technology commercialization.
- 3. Participant Roles, Capabilities and Industry Experience** - In this section the Applicant shall provide sufficient information on the Applicant roles, capabilities and industry experience to enable DOE reviewers to score the application based on Criterion 3 identified in Part V.
- 3.1. Organizational Qualifications and Industry Experience - The Applicant shall provide a brief description of the corporate credentials and industry experience of the proposed organization, including any participating or teaming organizations, in the development, demonstration, commercialization or transfer of similar projects or technologies to the proposed market. Ongoing or completed projects of a similar nature, size and scope undertaken by the Applicant and any participating organizations should be discussed.

- 3.2. Personnel Qualifications and Experience - The Applicant shall provide a brief description of the credentials, capabilities, experience (technical and managerial) and availability of the key personnel as they relate to the tasks and subtasks in the work plan and schedule of the proposed project. The roles of key personnel and the percentage of time being devoted to the project should be clearly identified. Resumes of key project personnel shall be included in Appendix B.
  - 3.3. Organizational Structure - The Applicant shall provide a brief description and organizational chart identifying the project’s technical and administrative responsibilities and lines of authority for the participating organizations and key personnel as they relate to the tasks and subtasks in the work plan. The level of commitment from proposed team members should be discussed and evidenced by letters of commitment or support included in Appendix C.
  - 3.4. Facilities and Equipment - The Applicant shall provide a description of the type, quality, availability and appropriateness of facilities, equipment, and materials necessary to accomplish the proposed project and whether they are available or to be purchased.
- 4. Commercialization Potential** - In this section the Applicant shall provide sufficient information on the commercialization potential of successful project results to enable DOE reviewers to score the application based on Criterion 4 identified in Part V:
- 4.1. Commercialization Strategy - The Applicant shall provide a commercialization strategy for successful project results (hardware, data, software, system designs, etc.), including intellectual property rights management, or technology transfer to the appropriate market and/or institutional alliances. The Applicant should describe any current relationships, interactions, or activities with key markets that will be targets for the proposed project.
  - 4.2. Market Potential - The Applicant shall provide an analysis or discussion of the potential for the project results to impact the target market, without major market restructuring, while considering potential technical, regulatory, economic, environmental, production or other issues that may impact market success.

**The Project Narrative will vary depending on the Technical Subtopic. The following list of Project Narrative Instructions apply to Area of Interest 3, Technical Subtopic 3.3:**

The Applicant shall use the following table of contents when preparing the project narrative to facilitate the review process and ensure that all the review criteria are addressed:

	<u>Page</u>
Table of Contents.....	i
List of Tables.....	ii
List of Figures.....	iii
List of Acronyms.....	iv

**TECHNICAL DISCUSSION**

1. TECHNICAL MERIT AND APPROACH.....	#
1.1 Project Description, Goals and Objectives .....	#
1.2 Relationship to Announcement Objectives .....	#
1.3 Current Status of Technology.....	#
1.4 Project Performance Goals .....	#
1.5 Case Study Rationale.....	#
1.6 Product Applications.....	#

1.7 Work Plan .....	#
1.8 Labor Hours.....	#
1.9 Project Schedule and Milestones .....	#
1.10 Travel.....	#
1.11 Project Risks.....	#
2. ENERGY, ENVIRONMENTAL AND ECONOMIC BENEFITS .....	#
2.1 Energy Savings .....	#
2.2 Environmental Benefits.....	#
2.3 Economic Impacts .....	#
3. PARTICIPANT ROLES, CAPABILITIES AND INDUSTRY EXPERIENCE.....	#
3.1 Organizational Qualifications and Industry Experience .....	#
3.2 Personnel Qualifications and Experience .....	#
3.3 Organizational Structure .....	#
3.4 Facilities and Equipment .....	#
4. MARKET POTENTIAL .....	#
4.1 Marketing Strategy .....	#

**APPENDICES (WILL NOT COUNT IN THE 25 DOUBLE SPACED PAGE LIMITATION)**

A. STATEMENT OF PROJECT OBJECTIVES.....	A1
B. KEY PERSONNEL RESUMES.....	B1
C. LETTERS OF COMMITMENT.....	C1
D. BIBLIOGRAPHY & REFERENCES CITED .....	D1

**PROJECT NARRATIVE [Twenty-five (25) page limitation, double spaced]**

This section shall contain the major portion of the Technical Application and be prepared in the format of the preceding table of contents. It shall be presented in as much detail as practical and include the following information:

- 1. Technical Merit and Approach** - This section shall describe the goals and objectives of the proposed work, demonstrate the Applicant’s understanding of the DOE’s objectives set forth in the Announcement and provide a clear description of the technical approach that will be implemented to accomplish the project objectives. Sufficient information shall be provided to enable DOE reviewers to score the application based on Criterion 1 identified in Part V.
  - 1.1. Project Description, Goals and Objectives - The Applicant shall provide a clear narrative description of the project and its goals and objectives and the scientific and technical basis that provides supporting rationale for the proposed work.
  - 1.2. Relationship to Announcement Objectives - The Applicant shall provide a clear narrative description of the relationship of the proposed work to the DOE’s goals and objectives for this Announcement and the Technical Subtopic being addressed.
  - 1.3. Current State of Knowledge or Technology - The Applicant shall discuss the current state of knowledge and/or technology that serves as background information for the proposed work. The discussion should include identification of any technology or information gaps in the existing technology and provide background on the technologies or knowledge that will be used to address the gaps.
  - 1.4. Project Performance Goals - The Applicant shall discuss how the proposed work will advance the current technology relative to performance, cost reduction and/or ease of installation.

- 1.5. Case Study or Demonstration Rationale - The Applicant shall discuss deficiencies in current case studies or application/installation performance data for the proposed technology and how successful project completion will validate the technology's readiness for increased market penetration.
  - 1.6. Product Applications - The Applicant shall discuss market applicability (new and/or retrofit, residential and/or commercial buildings) of the proposed technology.
  - 1.7. Work Plan - The Applicant shall provide a thorough and detailed narrative description of the planned work. This description should be an expanded version of the Statement of Project Objectives provided in Appendix A and use the headings contained therein (e.g., Objectives, Scope of Work, and Tasks to be Performed). It should be written in the active voice using consistent wording that divides the work into logical tasks and subtasks necessary to accomplish the project's objectives. The Applicant shall provide a clear description of the work to be performed under each task and subtask. The description shall identify the product(s) and deliverables that will result from each task and its relation to the overall project. For multi-phase projects, the Applicant shall define the criteria for determining successful completion of each phase.
  - 1.8. Labor Hours - The Applicant shall provide a table listing the estimated labor hours and labor categories (e.g., Project Manager, Principal Investigator, Engineer, Technician, and Clerical) required for each task in the Statement of Project Objectives. The Applicant shall also include a table showing labor hours and labor categories for any proposed subcontracting or consulting effort for each task. These categories should be easily cross-referenced with the key personnel.
  - 1.9. Project Schedule and Milestones - The Applicant shall provide a Gantt chart project schedule and milestones, and describe the interrelationships of the project tasks. All significant milestones shall be defined in a milestone log depicted on the schedule and include performance metrics to gauge technical progress towards the project's goals and objectives.
  - 1.10. Travel - The Applicant shall describe any proposed travel. The purpose of the trip, number of trips, the origin and destination, trip duration, and the number of personnel shall be included in the explanation. The Applicant shall make provision for a project kick-off meeting and annual project briefings at the National Energy Technology Laboratory in either Morgantown, WV or Pittsburgh, PA.
  - 1.11. Project Risks - The Applicant shall describe any project risks that could significantly affect the schedule, completion of planned milestones or project outcome.
- 2. Energy, Environmental and Economic Benefits** - This section shall describe anticipated or potential energy, environmental and economic benefits. Potential energy savings and reductions in carbon dioxide emissions from the proposed technology shall be determined according to the guidelines contained in Attachment A, Guide for Evaluation of Energy Savings Potential dated 1/19/2005. Sufficient information shall be provided to enable DOE reviewers to score the application based on Criterion 2 identified in Part V.
- 2.1. Energy Savings - The Applicant shall describe potential energy savings and technical performance expected from the proposed technology or product.
  - 2.2. Environmental Benefits - The Applicant shall describe potential environmental benefits resulting from the proposed technology or product, including, but not limited to: reduced global warming potential, increased protection of the stratospheric ozone layer, lower direct releases of water, air and ground pollutants, improved indoor air quality,

improved recyclability and beneficial human health impacts.

- 2.3. Economic Impacts - The Applicant shall describe potential direct economic impacts for the proposed project beyond the monetary value of the estimated energy savings, such as jobs retained and/or created through project implementation and, if successful, product or technology commercialization.

**3. Participant Roles, Capabilities and Industry Experience** - In this section the Applicant shall provide sufficient information on the Applicant roles, capabilities and industry experience to enable DOE reviewers to score the application based on Criterion 3 identified in Part V.

- 3.1. Organizational Qualifications and Industry Experience - The Applicant shall provide a brief description of the corporate credentials and industry experience of the proposed organization, including any participating or teaming organizations, with similar demonstration projects, including scientific measurement of energy and peak energy load savings, that resulted in widespread product commercialization and/or technology transfer. Ongoing or completed projects of a similar nature, size and scope undertaken by the Applicant and any participating organizations should be discussed.
- 3.2. Personnel Qualifications and Experience - The Applicant shall provide a brief description of the credentials, capabilities, experience (technical and managerial) and availability of the key personnel as they relate to the tasks and subtasks in the work plan and schedule of the proposed project. The roles of key personnel and the percentage of time being devoted to the project should be clearly identified. Resumes of key project personnel shall be included in Appendix B.
- 3.3. Organizational Structure - The Applicant shall provide a brief description and organizational chart identifying the project's technical and administrative responsibilities and lines of authority for the participating organizations and key personnel as they relate to the tasks and subtasks in the work plan. The level of commitment from proposed team members should be discussed and evidenced by letters of commitment or support included in Appendix C.
- 3.4. Facilities and Equipment - The Applicant shall provide a description of the type, quality, availability and appropriateness of facilities, equipment, and materials necessary to accomplish the proposed project, whether they are available or to be purchased, and the location and appropriateness of proposed case study or demonstration sites relative to the target buildings market.

**4. Market Potential** - In this section the Applicant shall provide sufficient information on the market potential of successful project results to enable DOE reviewers to score the application based on Criterion 4 identified in Part V:

- 4.1. Marketing Strategy - The Applicant shall provide a business model/strategy to successfully replicate the demonstrated application and significantly increase market share, including clear derivation of market price with increased demand, without major market restructuring. The applicant should consider potential technical, regulatory, economic, environmental, production or other issues that may impact market success. The Applicant should describe any current relationships, interactions, or activities with key markets that will be targets for the proposed project.

**The Project Narrative will vary depending on the Technical Subtopic. The following list of Project Narrative Instructions apply to Area of Interest 3, Technical Subtopic 3.4:**

The Applicant shall use the following table of contents when preparing the project narrative to facilitate the review process and ensure that all the review criteria are addressed:

	<u>Page</u>
Table of Contents.....	i
List of Tables.....	ii
List of Figures.....	iii
List of Acronyms.....	iv

**TECHNICAL DISCUSSION**

<b>1. TECHNICAL MERIT AND APPROACH.....</b>	<b>#</b>
1.1 Project Description, Goals and Objectives .....	#
1.2 Relationship to Announcement Objectives.....	#
1.3 Current Status of Technology.....	#
1.4 Project Performance Goals .....	#
1.5 Work Plan.....	#
1.6 Labor Hours.....	#
1.7 Project Schedule and Milestones .....	#
1.8 Travel.....	#
1.9 Project Risks.....	#
<b>2. ENERGY, ENVIRONMENTAL AND ECONOMIC BENEFITS.....</b>	<b>#</b>
2.1 Energy Savings .....	#
2.2 Environmental Benefits.....	#
2.3 Economic Impacts .....	#
<b>3. PARTICIPANT ROLES, CAPABILITIES AND INDUSTRY EXPERIENCE.....</b>	<b>#</b>
3.1 Organizational Qualifications and Industry Experience .....	#
3.2 Personnel Qualifications and Experience.....	#
3.3 Organizational Structure.....	#
3.4 Facilities and Equipment .....	#
<b>4. COMMERCIALIZATION POTENTIAL.....</b>	<b>#</b>
4.1 Commercialization and Marketing Strategy.....	#
4.2 Cost Drivers and Consumer Price Targets.....	#

**APPENDICES (WILL NOT COUNT IN THE 25 DOUBLE SPACED PAGE LIMITATION)**

A. STATEMENT OF PROJECT OBJECTIVES.....	A1
B. KEY PERSONNEL RESUMES.....	B1
C. LETTERS OF COMMITMENT.....	C1
D. BIBLIOGRAPHY & REFERENCES CITED .....	D1

**PROJECT NARRATIVE [Twenty-five (25) page limitation, double spaced]**

This section shall contain the major portion of the Technical Application and be prepared in the format of the preceding table of contents. It shall be presented in as much detail as practical and include the following information:

- 1. Technical Merit and Approach** - This section shall describe the goals and objectives of the proposed work, demonstrate the Applicant’s understanding of the DOE’s objectives set forth in the Announcement and provide a clear description of the technical approach that will be implemented to accomplish the project objectives. Sufficient information shall be provided to enable DOE reviewers to score the application based on Criterion 1 identified in Part V.

- 1.1. Project Description, Goals and Objectives - The Applicant shall provide a clear narrative description of the project and its goals and objectives and the scientific and technical basis that provides supporting rationale for the proposed work.
- 1.2. Relationship to Announcement Objectives - The Applicant shall provide a clear narrative description of the relationship of the proposed work to the DOE's goals and objectives for this Announcement and the Technical Subtopic being addressed.
- 1.3. Current State of Knowledge or Technology - The Applicant shall discuss the current state of knowledge and/or technology that serves as background information for the proposed work. The discussion should include identification of any technology or information gaps in the existing technology and provide background on the technologies or knowledge that will be used to address the gaps.
- 1.4. Project Performance Goals - The Applicant shall discuss how the proposed work will advance the current technology relative to DOE's economic, durability and production goals for nominal R5 or greater windows. The Applicant shall also describe the ability of the proposed production engineering supply chain improvements to be applied to a broad cross section of window types (e.g., double-hung, single-hung), to meet consumer performance expectations and result in products that are compatible with current construction practices.
- 1.5. Work Plan - The Applicant shall provide a thorough and detailed narrative description of the planned work. This description should be an expanded version of the Statement of Project Objectives provided in Appendix A and use the headings contained therein (e.g., Objectives, Scope of Work, and Tasks to be Performed). It should be written in the active voice using consistent wording that divides the work into logical tasks and subtasks necessary to accomplish the project's objectives. The Applicant shall provide a clear description of the work to be performed under each task and subtask. The description shall identify the product(s) and deliverables that will result from each task and its relation to the overall project. For multi-phase projects, the Applicant shall define the criteria for determining successful completion of each phase.
- 1.6. Labor Hours - The Applicant shall provide a table listing the estimated labor hours and labor categories (e.g., Project Manager, Principal Investigator, Engineer, Technician, and Clerical) required for each task in the Statement of Project Objectives. The Applicant shall also include a table showing labor hours and labor categories for any proposed subcontracting or consulting effort for each task. These categories should be easily cross-referenced with the key personnel.
- 1.7. Project Schedule and Milestones - The Applicant shall provide a Gantt chart project schedule and milestones, and describe the interrelationships of the project tasks. All significant milestones shall be defined in a milestone log depicted on the schedule and include performance metrics to gauge technical progress towards the project's goals and objectives.
- 1.8. Travel - The Applicant shall describe any proposed travel. The purpose of the trip, number of trips, the origin and destination, trip duration, and the number of personnel shall be included in the explanation. The Applicant shall make provision for a project kick-off meeting and annual project briefings at the National Energy Technology Laboratory in either Morgantown, WV or Pittsburgh, PA.
- 1.9. Project Risks - The Applicant shall describe any project risks that could significantly affect the schedule, completion of planned milestones or project outcome.



- 2. Energy, Environmental and Economic Benefits** - This section shall describe anticipated or potential energy, environmental and economic benefits. Potential energy savings and reductions in carbon dioxide emissions from the proposed technology shall be determined according to the guidelines contained in Attachment A, Guide for Evaluation of Energy Savings Potential dated 1/19/2005. Sufficient information shall be provided to enable DOE reviewers to score the application based on Criterion 2 identified in Part V.
  - 2.1. Energy Savings - The Applicant shall describe potential energy savings and technical performance expected from the proposed technology or product.
  - 2.2. Environmental Benefits - The Applicant shall describe potential environmental benefits resulting from the proposed technology or product, including, but not limited to: reduced global warming potential, increased protection of the stratospheric ozone layer, lower direct releases of water, air and ground pollutants, improved indoor air quality, improved recyclability and beneficial human health impacts.
  - 2.3. Economic Impacts - The Applicant shall describe potential direct economic impacts for the proposed project beyond the monetary value of the estimated energy savings, such as jobs retained and/or created through project implementation and, if successful, product or technology commercialization.
- 3. Participant Roles, Capabilities and Industry Experience** - In this section the Applicant shall provide sufficient information on the Applicant roles, capabilities and industry experience to enable DOE reviewers to score the application based on Criterion 3 identified in Part V.
  - 3.1. Organizational Qualifications and Industry Experience - The Applicant shall provide a brief description of the corporate credentials and industry experience of the proposed organization, including any participating or teaming organizations, in the manufacture and/or high volume distribution of windows or window components, and experience in managing projects of similar type, size and complexity. Ongoing or completed projects of a similar nature, size and scope undertaken by the Applicant and any participating organizations should be discussed.
  - 3.2. Personnel Qualifications and Experience - The Applicant shall provide a brief description of the credentials, capabilities, experience (technical and managerial) and availability of the key personnel as they relate to the tasks and subtasks in the work plan and schedule of the proposed project. The roles of key personnel and the percentage of time being devoted to the project should be clearly identified. Resumes of key project personnel shall be included in Appendix B.
  - 3.3. Organizational Structure - The Applicant shall provide a brief description and organizational chart identifying the project's technical and administrative responsibilities and lines of authority for the participating organizations and key personnel as they relate to the tasks and subtasks in the work plan. The level of commitment from proposed team members, including support for sales at the proposed consumer price premium, should be discussed and evidenced by letters of commitment or support included in Appendix C.
  - 3.4. Facilities and Equipment - The Applicant shall provide a description of the type, quality, availability and appropriateness of facilities, equipment, and materials necessary to accomplish the proposed project and whether they are available or to be purchased.
- 4. Commercialization Potential** - In this section the Applicant shall provide sufficient information on the commercialization and marketing strategy of successful project results to enable DOE reviewers to score the application based on Criterion 4 identified in Part V:

- 4.1. Commercialization and Marketing Strategy - The Applicant shall provide a commercialization strategy to significantly increase the marketability of R5 windows and achieve high volume distribution at the target consumer price premium. The Applicant should describe any current relationships, interactions, or activities with key markets that will be targets for the proposed windows.
- 4.2. Cost Drivers and Consumer Price Targets - The Applicant shall provide cost drivers, including material selection, application, production processes, and market distribution and provide clear derivation of consumer market price with increased demand from product introduction to within two to five years after product maturity (more detailed, current cost information is expected from companies with existing products).

**Each Project Narrative shall include a detailed Statement of Project Objectives as Appendix A1 which shall be formatted as follows:**

#### **APPENDIX A1: STATEMENT OF PROJECT OBJECTIVES (SOPO)**

The Department of Energy's National Energy Technology Laboratory uses a specific format for Statement of Project Objectives in its awards. In announcements such as this one, where the Government does not provide a Statement of Project Objectives, the Applicant is to provide one, which the DOE will then use to generate the Statement of Project Objectives to be included in the award.

The project narrative must contain a detailed work plan that addresses how the project objectives will be met. The Appendix A1: Statement of Project Objectives must contain a shortened, clear, concise description of all activities to be completed during project performance and follow the structure discussed below. The Appendix A1: Statement of Project Objectives may be released to the public by DOE in whole or in part at any time. It is therefore required that it shall not contain proprietary or confidential business information.

**The Statement of Project Objectives for the proposed effort is limited to eight (8) single spaced pages and is EXCLUDED from the project narrative page limitation of twenty-five (25) pages, double spaced. Applicants shall prepare the Statement of Project Objectives in the following format:**

##### TITLE OF WORK TO BE PERFORMED

(Insert the title of work to be performed. Be concise and descriptive.)

#### A. OBJECTIVES

Include one paragraph on the overall objective(s) of the work. Also, include objective(s) for each phase of the work.

#### B. SCOPE OF WORK

This section should not exceed one-half page and should summarize the effort and approach to achieve the objective(s) of the work for each Phase.

#### C. TASKS TO BE PERFORMED

Write tasks concisely and include DOE decision points in a logical sequence. Any specific issues/requirements should be provided as subtasks to the generalized discussion under each task. This section is to provide a brief summary of the planned approach to this project. Specific tasks, subtasks, and phases should follow the format below.

## PHASE I (Optional - for projects with more than 1 phase)

### Task 1.0 - Project Management Plan (Mandatory Task)

As the first task in the Statement of Project Objectives, successful applicants shall be required to submit a Project Management Plan within 20 calendar days of project award that includes details from the negotiation process. This Project Management Plan will be updated by the Recipient as the project progresses, and the Recipient must use this plan to report schedule and budget variances. The DOE Contracting Officer's Technical Representative (COR) shall have 15 calendar days from receipt of the Research Management Plan to review and provide comments to the recipient. Within 15 calendar days after receipt of DOE's comments, the Recipient shall submit a final Research Management Plan to the DOE COR for review and approval. The Project Management Plan will serve as the basis of the project kickoff meeting that shall be held within sixty (60) calendar days after issuance of award. The Project Management Plan shall consist of the following:

#### Executive Summary:

Provide a description of the project that includes the objective, project goals, and expected results. For purposes of the application, this information is included in the Project Narrative and should be simply copied to this document for completeness, so that the Project Management Plan is a stand-alone document.

#### Risk Management:

Provide a summary description of the proposed approach to identify, analyze, and respond to perceived risks associated with the proposed project. Project risk events are uncertain future events that, if realized, impact the success of the project. As a minimum, include the initial identification of significant technical, resource, and management issues that have the potential to impede project progress and strategies to minimize impacts from those issues.

#### Milestone Log:

Provide milestones for each budget period (or phase) of the project. Each milestone should include a title and planned completion date. Milestones should be quantitative and show progress toward budget period and/or project goals.

[Note: During project performance, the Recipient shall report the Milestone Status as part of the required quarterly Progress Report. The Milestone Status must present actual performance in comparison with Milestone Log, and include: the actual status and progress of the project; specific progress made toward achieving the project's milestones, and, any proposed changes in the project's schedule required to complete milestones.]

#### Funding and Costing Profile:

Provide a table (the Project Funding Profile) that shows, by budget period or phase, the amount of Government funding going to each project team member. Also, provide a table (the Project Costing Profile) that projects, by month, the expenditure of Government funds for the first budget period, at a minimum.

#### Project Timeline:

Provide a timeline of the project (similar to a Gantt chart) broken down by each task and subtask, as described in the Statement of Work. The timeline for each task must include a start date and an end date. The timeline must also show interdependencies between

tasks and include the milestones that are identified in the Milestone Log (Section C).

Success Criteria at Decision Points:

Provide success criteria for each decision point in the project, including go/recycle/no-go decision points and the conclusions of budget periods and the entire project to date. The success criteria should be objective and stated in terms of specific, measurable, and repeatable data. Usually, the success criteria pertain to desirable outcomes, results, and observations from the project.

Task 2.0 - Title  
(Description)

Subtask 2.1 – Title (Optional)  
(Description)

Task 3.0 - Title  
(Description)

.

PHASE II (Optional – for projects with more than 1 phase)

Task 4.0 – Title  
(Description)

Subtask 4.1 – Title (Optional)  
(Description)

.

#### D. DELIVERABLES

The periodic, topical, and final reports shall be submitted in accordance with the attached "Federal Assistance Reporting Checklist" and the instructions accompanying the checklist.

[NOTE: The Recipient shall provide a list of deliverables other than those identified on the "Federal Assistance Reporting Checklist" that will be delivered. These reports/deliverables shall also be identified within the context of the Statement of Project Objectives. See the following examples:

1. Task 1.1 (Report/Deliverable Description)
2. Task 1.2 (Report/Deliverable Description)

#### E. BRIEFINGS/TECHNICAL PRESENTATIONS (If applicable)

A project kickoff meeting shall be held within sixty (60) calendar days after issuance of award. This meeting shall present the details of the Project Management Plan and will be held at the COR's facility located in Pittsburgh, PA or Morgantown, W.V.

The Recipient shall prepare detailed budget period briefings and an updated Project Management Plan for presentation to the COR at the COR's facility located in Pittsburgh, PA or Morgantown, WV. Budget period briefings shall explain the plans, progress, and results of the project effort.

**(END OF STATEMENT OF PROJECT OBJECTIVES)**

## **APPENDIX B1: KEY PERSONNEL RESUMES/BIOGRAPHICAL SKETCH**

Provide a biographical sketch for the project director/principal investigator (PD/PI) and each senior/key person listed in Section A on the R&R Budget form. Provide the biographical sketch information as an appendix to your project narrative. Do not attach a separate file. The biographical sketch appendix **WILL NOT COUNT** in the project narrative page limitation. The biographical information for each person must not exceed 2 pages when printed on 8.5" by 11" paper with 1 inch margins (top, bottom, left, and right) with font not smaller than 11 point and must include:

### Education and Training:

Undergraduate, graduate and postdoctoral training, provide institution, major/area, degree, and year.

### Research and Professional Experience:

Beginning with the current position list, in chronological order, professional/academic positions with a brief description.

### Publications:

Provide a list of up to 10 publications most closely related to the proposed project. For each publication, identify the names of all authors (in the same sequence in which they appear in the publication), the article title, book or journal title, volume number, page numbers, year of publication, and website address if available electronically.

Patents, copyrights, and software systems developed may be provided in addition to or substituted for publications.

Synergistic Activities: List no more than 5 professional and scholarly activities related to the effort proposed.

### Current and Pending Support:

Provide a list of all current and pending support (both Federal and non-Federal) for the Project Director/Principal Investigator(s) (PD/PI) and senior/key persons, including subawardees, for ongoing projects and pending applications. For each organization providing support, show the total award amount for the entire award period (including indirect costs) and the number of person-months per year to be devoted to the project by the senior/key person. Concurrent submission of an application to other organizations for simultaneous consideration will not prejudice its review.

## **Identification of Potential Conflicts of Interest or Bias in Selection of Reviewers**

Provide the following information in this section. This appendix **WILL NOT COUNT** in the project narrative page limitation:

**Collaborators and Co-editors:** List in alphabetical order all persons, including their current organizational affiliation, who are, or who have been, collaborators or co-authors with you on a research project, book or book article, report, abstract, or paper during the 48 months preceding the submission of this application. Also, list any individuals who are currently, or have been, co-editors with you on a special issue of a journal, compendium, or conference proceedings during the 24 months preceding the submission of this application. If there are no collaborators or co-editors to report, state "None."

**Graduate and Postdoctoral Advisors and Advisees:** List the names and current organizational affiliations of your graduate advisor(s) and principal postdoctoral sponsor(s) during the last 5 years. Also, list the names and current organizational affiliations of your graduate students and postdoctoral associates

## APPENDIX C1: Commitment Letters

- **Commitment Letters from Third Parties Contributing to Cost Sharing**

If a third party, (i.e., a party other than the organization submitting the application) proposes to provide all or part of the required cost sharing, the Applicant must include a letter from the third party stating that it is committed to providing a specific minimum dollar amount of cost sharing. The letter should also identify the proposed cost sharing (e.g., cash, services, and/or property) to be contributed. Letters must be signed by the person authorized to commit the expenditure of funds by the entity.

- **Budget for DOE Federally Funded Research and Development Center (FFRDC) Contractor, if applicable.**

If a DOE FFRDC contractor is to perform a portion of the work, you must provide a DOE Field Work Proposal in accordance with the requirements in DOE Order 412.1 Work Authorization System. This order and the DOE Field Work Proposal form are available at [http://management.energy.gov/business\\_doe/business\\_forms.htm](http://management.energy.gov/business_doe/business_forms.htm).

## APPENDIX D1: Bibliography & References Cited

Provide a bibliography of any references cited in the Project Narrative. Each reference must include the names of all authors (in the same sequence in which they appear in the publication), the article and journal title, book title, volume number, page numbers, and year of publication. Include only bibliographic citations. Applicants should be especially careful to follow scholarly practices in providing citations for source materials relied upon when preparing any section of the application. In order to reduce the number of files attached to your application, please provide the Bibliography and References Cited information as an appendix to your project narrative. Do not attach a file in Field 9. This appendix **WILL NOT COUNT** in the project narrative page limitation.

### Other Attachments (Field 12 on the form)

If you need to elaborate on your responses to questions 1-6 on the "Other Project Information" document, attach a file in field 12.

## 3. RESEARCH AND RELATED BUDGET (TOTAL FED + NON-FED)

Complete the Research and Related Budget (Total Fed & Non-Fed) form in accordance with the instructions on the form and the following instructions. You must complete a separate budget for each year of support requested. The form will generate a cumulative budget for the total project period. You must complete all the mandatory information on the form before the NEXT PERIOD button is activated. You may request funds under any of the categories listed as long as the item and amount are necessary to perform the proposed work, meet all the criteria for allowability under the applicable Federal cost principles, and are not prohibited by the funding restrictions in this announcement (See Section IV.G).

Budget Justification (Field K on the form).

Provide the required supporting information for the following costs (See R&R instructions): equipment; domestic and foreign travel; participant/trainees; material and supplies; publication; consultant services; ADP/computer services; Subaward/consortium/contractual; equipment or facility rental/user fees; alterations and renovations; and indirect cost type. Provide any other information you wish to submit to justify your budget request. If cost sharing is required, provide an explanation of the source, nature, amount, and availability of any proposed cost sharing.

Attach a single budget justification file for the entire project period in Field K. The file automatically carries over to each budget year.

**4. R&R SUBAWARD (TOTAL FED + NON-FED) FORM**

Budgets for Subawardees other than DOE FFRDC Contractors: You must provide a separate cumulative R&R budget for each Subawardee that is expected to perform work estimated to be more than \$100,000 or 50 percent of the total work effort (whichever is less). Download the R&R Budget Attachment from the R&R SUBAWARD BUDGET (Total Fed + Non-Fed) FORM and e-mail it to each Subawardee that is required to submit a separate budget. After the Subawardee has e-mailed its completed budget back to you, attach it to one of the blocks provided on the form. Use up to 10 letters of the Subawardee's name as the file name.

**5. PROJECT/PERFORMANCE SITE LOCATION(S)**

Indicate the primary site where the work will be performed. If a portion of the project will be performed at any other site(s), identify the site location(s) in the blocks provided.

Note that the Project/Performance Site Congressional District is entered in the format of the 2 digit state code followed by a dash and a 3 digit Congressional district code, for example VA-001. Hover over this field for additional instructions.

Use the Next Site button to expand the form to add additional Project/Performance Site Locations.

**6. DISCLOSURE OF LOBBYING ACTIVITIES (SF-LLL)**

If applicable, complete SF- LLL. Applicability: If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the grant/cooperative agreement, you must complete and submit Standard Form - LLL, "Disclosure Form to Report Lobbying."

**7. SUMMARY OF REQUIRED FORMS AND FILES**

Your application must include the following documents:

Name of Document	Format	Attach to
<b>SF 424 (R&amp;R)</b>	Form	N/A
<b>RESEARCH AND RELATED OTHER PROJECT INFORMATION</b>	Form	N/A
Project Summary/Abstract	PDF	Field 7
Project Narrative, including required Appendices A1: SOPO B1: Key Personnel Resumes/Biographical Sketch C1: Letters of Commitment D1: Bibliography and References Cited	PDF	Field 8
<b>RESEARCH AND RELATED BUDGET (TOTAL FED + NON-FED)</b>	Form	N/A
Budget Justification	PDF	Field K
<b>R&amp;R SUBAWARD BUDGET (TOTAL FED + NON-FED) ATTACHMENT(S) FORM, if applicable</b>	Form	N/A
<b>PROJECT/PERFORMANCE SITE LOCATION(S)</b>	Form	N/A
<b>SF-LLL DISCLOSURE OF LOBBYING ACTIVITIES, if applicable</b>	Form	N/A

#### **D. SUBMISSIONS FROM SUCCESSFUL APPLICANTS**

If selected for award, DOE reserves the right to request additional or clarifying information for any reason deemed necessary, including, but not limited to:

- Indirect cost information
- Other budget information
- Name and phone number of the Designated Responsible Employee for complying with national policies prohibiting discrimination (See 10 CFR 1040.5)
- Representation of Limited Rights Data and Restricted Software, if applicable
- Environmental Questionnaire  
([http://www.netl.doe.gov/business/forms.html#POST\\_SEL\\_AP](http://www.netl.doe.gov/business/forms.html#POST_SEL_AP))

#### **E. SUBMISSION DATES AND TIMES**

##### **1. Pre-application Due Date**

Pre-applications are not required.

##### **2. Application Due Date**

Applications must be received by **August 18, 2009, not later than 8:00:00 PM Eastern Time. You are encouraged to transmit your application well before the deadline (at least 48 hours in advance). APPLICATIONS RECEIVED AFTER THE DEADLINE WILL NOT BE REVIEWED OR CONSIDERED FOR AWARD.**

#### **F. INTERGOVERNMENTAL REVIEW**

This program is not subject to Executive Order 12372 - Intergovernmental Review of Federal Programs.

#### **G. FUNDING RESTRICTIONS**

Cost Principles. Costs must be allowable in accordance with the applicable Federal cost principles referenced in 10 CFR Part 600. The cost principles for commercial organization are in FAR Part 31.

Pre-Award Costs: Recipients may charge to an award resulting from this announcement pre-award costs that were incurred within the ninety (90) calendar day period immediately preceding the effective date of the award, if the costs are allowable in accordance with the applicable Federal cost principles referenced in 10 CFR Part 600. Recipients must obtain the prior approval of the Contracting Officer for any pre-award costs that are for periods greater than this 90 day calendar period.

Pre-award costs are incurred at the Applicant's risk. DOE is under no obligation to reimburse such costs if for any reason the applicant does not receive an award or if the award is made for a lesser amount than the Applicant expected.

#### **H. OTHER SUBMISSION AND REGISTRATION REQUIREMENTS**

##### **1. Where to Submit**

**FedConnect**



**APPLICATIONS MUST BE SUBMITTED THROUGH FEDCONNECT TO BE CONSIDERED FOR AWARD.** Submit electronic applications through the FedConnect portal at [www.fedconnect.net](http://www.fedconnect.net). Information regarding how to submit applications via Fed Connect can be found at [https://www.fedconnect.net/FedConnect/PublicPages/FedConnect\\_Ready\\_Set\\_Go.pdf](https://www.fedconnect.net/FedConnect/PublicPages/FedConnect_Ready_Set_Go.pdf).

Further, it is the responsibility of the applicant, prior to the offer due date and time, to verify successful transmission.

## **2. Registration Process**

### **One Time Registration Process**

There are several one-time actions you must complete in order to submit an application in response to this Announcement (e.g., obtain a Dun and Bradstreet Data Universal Numbering System (DUNS) number, register with the Central Contract Registry (CCR), and register with FedConnect). Applicants, who are not registered with CCR and FedConnect, should allow at least 10 days to complete these requirements. It is suggested that the process be started as soon as possible.

## SECTION V - APPLICATION REVIEW INFORMATION

### A. CRITERIA

#### 1. Initial Review Criteria

##### **Application Award Eligibility**

Prior to a comprehensive merit evaluation, DOE will perform an initial review to determine that (1) the applicant is eligible for an award; (2) the information required by the announcement has been submitted; (3) all mandatory requirements are satisfied; and (4) the proposed project is responsive to the objectives of the Funding Opportunity Announcement.

#### 2. Merit Review Criteria

**The following are the Merit Review Criteria for Technical Subtopics 1.1, 1.2, 1.3, 1.4, 2.1, 2.2, 2.3, 3.1, 3.2, 4.1, 4.2, 4.3, 5.1, 5.2, 5.3, 5.4, 6.1 or 6.2 [Note: Separate criteria are provided for Area of Interest 3, Technical Subtopics 3.3 and 3.4]:**

##### **Criterion 1 - Technical Merit and Approach (40%)**

- Application technical merit will be evaluated on the overall quality, soundness, and reasonableness of: (1) the description and purpose of the proposed project and its goals and objectives; (2) the relationship of the proposed work to the DOE's goals and objectives for the Technical Subtopic addressed; (3) the applicant's understanding and presentation of the current state of knowledge or technology for the proposed work; and (4) how the proposed work will advance the current technology relative to performance, cost reduction, and/or ease of installation.
- Application technical approach will be evaluated on the overall quality, soundness, and reasonableness of: (1) the work plan which divides the project into the logical phases, tasks, and subtasks necessary to accomplish the project's objective(s); (2) the labor hours and justifications, including those for any proposed subcontracting or consulting effort, required for each task, including a table showing labor hours by labor category and task; (3) the project schedule which identifies significant milestones and performance metrics to gauge technical progress; (4) the proposed travel, including the purpose, number of trips, origin and destination, trip duration, and number of personnel; and (5) the potential for any significant risks or delays that could affect the project products or schedule.

##### **Criterion 2 - Energy, Environmental and Economic Benefits (15%)**

- Application energy, environmental and economic benefits will be evaluated on the evidence presented for: (1) potential energy savings and technical performance expected from the proposed technology or product; and (2) potential environmental benefits resulting from the proposed technology or product, including, but not limited to: reduced global warming potential, increased protection of the stratospheric ozone layer, lower direct releases of water, air and ground pollutants, improved indoor air quality, improved recyclability and beneficial human health impacts. **Potential energy savings and reductions in carbon dioxide emissions from the proposed technology shall be determined according to the guidelines contained in Attachment A, *Guide for Evaluation of Energy Savings Potential* dated 1/19/2005.**

- Applications will be evaluated on potential direct economic impacts for the proposed project beyond the monetary value of the estimated energy savings, such as jobs retained and/or created through project implementation and, if successful, product or technology commercialization.

### **Criterion 3 – Participant Roles, Capabilities and Industry Experience (25%)**

Participant roles, capabilities and industry experience will be evaluated on: (1) the corporate credentials and industry experience of the proposed organization, including any participating or teaming organizations, in the development, demonstration, commercialization or transfer of similar projects or technologies to the proposed market; (2) the qualifications, experience and availability of key personnel to complete the proposed project relative to the tasks and subtasks in the work plan and schedule of the proposed project; (3) the project's organizational structure (including participating organizations and key personnel), responsibilities and lines of authority, both technical and administrative, as they relate to the tasks and subtasks in the work plan. The level of commitment from participating organizations should be discussed and evidenced by letters of commitment or support; and (4) the adequacy (quality, availability, and appropriateness) of facilities and equipment to accommodate the proposed project.

### **Criterion 4 – Commercialization and Market Potential (20%)**

Project commercialization potential will be evaluated on: (1) the completeness and practicality of a commercialization strategy for project results (hardware, data, software, system designs, etc.), including intellectual property rights management, or technology transfer to the appropriate market and/or institutional alliances; and (2) the potential for the project results to impact the target market, without major market restructuring, while considering potential technical, regulatory, economic, environmental, production or other issues that may impact market success.

## **The following is the Merit Review Criteria for Area of Interest 3, Technical Subtopic 3.3:**

### **Criterion 1 - Technical Merit and Approach (40%)**

- Application technical merit will be evaluated on the overall quality, soundness, and reasonableness of: (1) the description and purpose of the proposed project and its goals and objectives; (2) the relationship of the proposed work to the DOE's goals and objectives for this Technical Subtopic; (3) the applicant's presentation of the current status and performance of existing technologies versus the proposed technology and why the proposed technology has achieved limited market penetration; (4) how the proposed technology will advance the current technology relative to performance, cost reduction, and/or ease of installation; (5) identified deficiencies in current case studies for the proposed technology and how successful project completion will promote greater success in the marketplace; and (6) applicability of the proposed technology to both new and retrofit products for residential and commercial buildings.
- Application technical approach will be evaluated on the overall quality, soundness, and reasonableness of: (1) the work plan which divides the project into the logical phases, tasks, and subtasks necessary to accomplish the project's objective(s); (2) the labor hours and justifications, including those for any proposed subcontracting or consulting effort, required for each task, including a table showing labor hours by labor category and task; (3) the project schedule which identifies significant milestones and performance metrics to gauge technical progress; (4) the proposed travel including the purpose, number of trips, origin and destination, trip duration, and number of personnel; and (5) the potential for any significant risks or delays that could affect the project schedule.

## **Criterion 2 - Energy, Environmental and Economic Benefits (10%)**

- Application energy, environmental and economic benefits will be evaluated on the evidence presented for: (1) potential energy savings and technical performance expected from the proposed technology or product; and (2) potential environmental benefits resulting from the proposed technology or product, including, but not limited to: reduced global warming potential, increased protection of the stratospheric ozone layer, lower direct releases of water, air and ground pollutants, improved indoor air quality, improved recyclability and beneficial human health impacts. **Potential energy savings and reductions in carbon dioxide emissions from the proposed technology shall be determined according to the guidelines contained in Attachment A, *Guide for Evaluation of Energy Savings Potential* dated 1/19/2005.**
- Applications will be evaluated on potential direct economic impacts for the proposed project beyond the monetary value of the estimated energy savings, such as jobs retained and/or created through project implementation and, if successful, product or technology commercialization.

## **Criterion 3 –Participant Roles, Capabilities and industry Experience (30%)**

Applicant and participant roles, capabilities and industry experience will be evaluated on: (1) the corporate credentials and industry experience of the proposed organization, including any participating or teaming organizations, in both technical expertise and with similar demonstration projects, including scientific measurement of energy and peak energy load savings, that resulted in widespread product commercialization and/or technology transfer; (2) the qualifications, experience and availability of key personnel to complete the proposed project relative to the tasks and subtasks in the work plan and schedule of the proposed project; (3) the project's organizational structure (including participating organizations and key personnel), responsibilities and lines of authority, both technical and administrative, as they relate to the tasks and subtasks in the work plan. The level of commitment from participating organizations should be discussed and evidenced by letters of commitment or support; and (4) the adequacy (quality, availability, and appropriateness) of facilities and equipment to accommodate the proposed project and the appropriateness of proposed demonstration sites relative to the target buildings market.

## **Criterion 4 – Market Potential (20%)**

The Applicant's demonstration/case-study of the proposed technology's market potential will be evaluated on: (1) the completeness and practicality of a business model/strategy, including clear derivation of market price with increased demand, to successfully replicate the demonstrated application and significantly increase market share.

**The following is the Merit Review Criteria for Area of Interest 3, Technical Subtopic 3.4:**

## **Criterion 1 - Technical Merit and Approach (35%)**

- Application technical merit will be evaluated on the overall quality, soundness, and reasonableness of: (1) the description and purpose of the proposed project and its goals and objectives; (2) the relationship of the proposed work to the DOE's goals and objectives for this Technical Subtopic; (3) the applicant's understanding and presentation of the current state of knowledge or technology for the proposed work; (4) how the proposed work will advance the current technology relative to DOE's economic, durability and production goals for nominal R5 or greater windows for various window types (e.g., double-hung, single-hung), meet consumer performance expectations and is compatible with current construction practices.

- Application technical approach will be evaluated on the overall quality, soundness, and reasonableness of: (1) the work plan which divides the project into logical phases, tasks, and subtasks necessary to accomplish the project's objective(s); (2) the labor hours and justifications, including those for any proposed subcontracting or consulting effort, required for each task, including a table showing labor hours by labor category and task; (3) the project schedule which identifies significant milestones and corporate decision points; (4) the proposed travel including the purpose, number of trips, origin and destination, trip duration, and number of personnel; and (5) the potential for any significant risks or delays that could affect the project products or schedule.

#### **Criterion 2 - Energy, Environmental and Economic Benefits (10%)**

- Application energy, environmental and economic benefits will be evaluated on the evidence presented for: (1) potential energy savings and technical performance expected from the proposed technology or product; and (2) potential environmental benefits resulting from the proposed technology or product, including, but not limited to: reduced global warming potential, increased protection of the stratospheric ozone layer, lower direct releases of water, air and ground pollutants, improved indoor air quality, improved recyclability and beneficial human health impacts. **Potential energy savings and reductions in carbon dioxide emissions from the proposed technology shall be determined according to the guidelines contained in Attachment A, *Guide for Evaluation of Energy Savings Potential* dated 1/19/2005.**
- Applications will be evaluated on potential direct economic impacts for the proposed project beyond the monetary value of the estimated energy savings, such as jobs retained and/or created through project implementation and, if successful, product or technology commercialization.

#### **Criterion 3 - Participant Roles, Capabilities, and Industry Experience (25%)**

Participant roles, capabilities and industry experience will be evaluated on: (1) the corporate credentials and industry experience of the proposed organization, including any participating or teaming organizations, in the manufacture and/or high volume distribution of windows or window components, and experience in managing projects of similar type, size and complexity; (2) the qualifications, experience and availability of key personnel to complete the proposed project relative to the tasks and subtasks in the work plan and schedule of the proposed project; (3) the project's organizational structure (including participating organizations and key personnel), responsibilities and lines of authority, both technical and administrative, as they relate to the tasks and subtasks in the work plan. The level of commitment from participating organizations, including support for sales at the proposed consumer price premium, should be discussed and evidenced by letters of commitment or support; and (4) the adequacy (quality, availability, and appropriateness) of facilities and equipment to accommodate the proposed project.

#### **Criterion 4 – Commercialization Potential (30%)**

Application commercialization potential will be evaluated on: (1) the completeness and practicality of a strategy to significantly increase the marketability of R5 windows and achieve high volume distribution at the target consumer price premium; (2) the clarity and completeness of presented cost drivers, including material selection, application, production processes, and market distribution and clear derivation of consumer market price with increased demand from product introduction to within two to five years after product maturity.

### **3. Other Selection Factors**

These factors, while not indicators of the Application's merit, e.g., technical excellence, cost, Applicant's ability, etc., may be essential to the process of selecting the application(s) that, individually or collectively, will best achieve the program objectives. Such factors are often beyond the control of the Applicant. Applicants should recognize that some very good applications may not receive an award because they do not fit within a mix of projects which maximizes the probability of achieving the DOE's overall programmatic objectives. Therefore, the following Program Policy Factors may be used by the Selection Official to assist in determining which of the ranked application(s) shall receive DOE funding support.

1. Selection of Applications which promote and enhance the objectives of the American Recovery and Reinvestment Act of 2009, P.L. 111-5, especially job creation, and/or preservation and economic recovery in an expeditious manner.
2. It may be desirable to select projects from a diversity of types and/or sizes of organizations. This includes, but is not limited to, limiting the number of applications selected from one organization.
3. It may be desirable to select a group of projects which represent a diversity of methods, approaches, applications or kinds of work. This includes, but is not limited to, consideration of ongoing DOE projects in addition to the applications received through this FOA.
4. It may be desirable to support complementary and/or duplicative efforts or projects, which, taken together, will best achieve the research goals and objectives.
5. It may be desirable (because of the nature of energy sources and potential energy savings, the type of projects envisioned, or limitations of past efforts) to select a group of projects with a broad or specific geographical distribution.
6. It may be desirable to select projects based upon target markets proposed in order to provide a balanced programmatic effort and/or a variety of different technical perspectives.
7. It may be desirable to select projects for award that will complement or enhance existing or planned work identified by EERE.
8. It may be desirable to select a project or projects for award of less technical merit than other others if such selection will optimize the use of available funds by allowing more projects to be supported without detriment to the overall objectives of the program.
9. It may be desirable to select project(s) that reduce Federal investment and maximize corporate commitment as demonstrated by cost share levels or other resource leveraging (e.g., in-kind contributions).

The above factors may be independently considered by the Selection Official in determining the optimum mix of applications that shall be selected for support. These policy factors provide the Selection Official with the capability of developing, from the competitive FOA, a broad involvement of organizations and organizational ideas that both enhance the overall portfolio of projects and upgrade the program content to meet the goals of the DOE.

## **B. REVIEW AND SELECTION PROCESS**

### **1. Merit Review**

Applications that pass the initial review will be subjected to a merit review in accordance with the guidance provided in the "Department of Energy Merit Review Guide for Financial Assistance." This guide is available under Financial Assistance, Regulations and Guidance at <http://www.management.energy.gov/documents/meritrev.pdf>.

### **2. Selection**

The Selection Official will consider the merit review recommendation, program policy factors,

and the amount of funds available.

### **3. Discussions and Award**

The Government may enter into discussions with a selected applicant for any reason deemed necessary, including but not limited to: (1) the budget is not appropriate or reasonable for the requirement; (2) only a portion of the application is selected for award; (3) the Government needs additional information to determine that the Recipient is capable of complying with the requirements in 10 CFR part 600; and/or (4) special terms and conditions are required. Failure to resolve satisfactorily the issues identified by the Government will preclude award to the applicant.

### **C. ANTICIPATED NOTICE OF SELECTION AND AWARD DATES**

DOE anticipates notifying applicants selected for award and making awards during the first and second quarters of Fiscal Year 2010.

## **SECTION VI - AWARD ADMINISTRATION INFORMATION**

### **A. AWARD NOTICES**

#### **1. Notice of Selection**

DOE will notify Applicants selected for award. This notice of selection is not an authorization to begin performance. (See Section IV.G with respect to the allowability of pre-award costs.)

Organizations whose applications have not been selected will be advised as promptly as possible. This notice will explain why the application was not selected.

#### **2. Notice of Award**

An Assistance Agreement issued by the contracting officer is the authorizing award document. It normally includes either as an attachment or by reference: (1) Special Terms and Conditions; (2) Applicable program regulations, if any; (3) Application as approved by DOE.; (4) DOE assistance regulations at 10 CFR part 600; (5) National Policy Assurances To Be Incorporated As Award Terms; (6) Budget Summary; and (7) Federal Assistance Reporting Checklist, which identifies the reporting requirements.

For grants and cooperative agreements made to universities, non-profits and other entities subject to OMB Circular A-110, the Award also includes the Research Terms and Conditions located at <http://www.nsf.gov/bfa/dias/policy/rtc/index.jsp>.

### **B. ADMINISTRATIVE AND NATIONAL POLICY REQUIREMENTS**

#### **1. Administrative Requirements**

The administrative requirements for DOE grants and cooperative agreements are contained in 10 CFR Part 600 (See: <http://ecfr.gpoaccess.gov>). Grants and cooperative agreements made to universities, non-profits and other entities subject to OMB Circular A-110 are subject to the Research Terms and Conditions located on the National Science Foundation web site at <http://www.nsf.gov/bfa/dias/policy/rtc/index.jsp>.

#### **ARRA 2009 Award Administration Information:**

Special Provisions relating to work funded under American Recovery and Reinvestment Act of 2009, Pub. L. 111-5 shall apply. Also, the Office of Management and Budget may be promulgating additional provisions or modifying existing provisions. Those additions and modifications will be incorporated into the Special Provisions as they become available. The Recovery Act Special Terms and Conditions are located at [http://management.energy.gov/business\\_doe/business\\_forms.htm](http://management.energy.gov/business_doe/business_forms.htm).

#### **2. Special Terms and Conditions and National Policy Requirements**

Special Terms and Conditions and National Policy Requirements: The DOE Special Terms and Conditions for Use in Most Grants and Cooperative Agreements are located at [http://management.energy.gov/business\\_doe/business\\_forms.htm](http://management.energy.gov/business_doe/business_forms.htm). The *National Policy Assurances To Be Incorporated As Award Terms* are located at DOE [http://management.energy.gov/business\\_doe/business\\_forms.htm](http://management.energy.gov/business_doe/business_forms.htm).



### **Intellectual Property Provisions:**

The standard DOE financial assistance intellectual property provisions applicable to the various types of Recipients are located at [http://www.gc.doe.gov/financial\\_assistance\\_awards.htm](http://www.gc.doe.gov/financial_assistance_awards.htm).

### **Statement of Substantial Involvement**

The award under this Announcement will be a cooperative agreement. The DOE Specialist and DOE Project Officer will negotiate a Statement of Substantial Involvement prior to award similar to the following:

#### **RECIPIENT'S RESPONSIBILITIES:**

- Performing the activities supported by this award, including providing the required personnel, facilities, equipment, supplies, and services;
- Defining approaches and plans, submitting the plans to DOE for review, and incorporating DOE comments;
- Managing and conducting the project activities;
- Providing all deliverables specified in the award in a timely basis;
- Participating in all briefings specified in the award Statement of Project Objectives;
- Submitting technical reports and incorporating DOE comments;
- Presenting the project results at appropriate technical conferences or meetings as specified by the DOE Project Officer; and
- Complying with all requirements associated with the ARRA.

#### **DOE RESPONSIBILITIES:**

- Reviewing in a timely manner project plans, including project management, testing, commercialization, and technology transfer plans, and recommending alternate approaches, if the plans do not address critical programmatic issues;
- Participating in project management planning activities, including risk analysis, to ensure DOE's program requirements or limitations are considered in performance of the work elements. DOE shall determine progression to subsequent Budget Periods or Phases if warranted.
- Integrating and redirecting the work effort to ensure programmatic goals established by DOE EERE, in coordination with the DOE Building Technologies Program are being addressed;
- Promoting and facilitating technology transfer activities, including disseminating program results through presentations, publications, and communications with the building community and other research organizations;
- Serving as scientific/technical liaison between Awardees, industry, and other program staff (e.g., NLCBT, CBEAs).

## **C. REPORTING**

Reporting requirements are identified on the Federal Assistance Reporting Checklist, DOE F 4600.2, attached to the award agreement. For a sample Checklist, see <http://management.energy.gov/documents/DOEF46002PolicyVersion.pdf>.

Also see [http://management.energy.gov/policy\\_guidance/1672.htm](http://management.energy.gov/policy_guidance/1672.htm) for Recovery Act terms, conditions, and reporting requirements.

## **SECTION VII - QUESTIONS/AGENCY CONTACTS**

### **A. QUESTIONS**

Questions regarding the **content** of the announcement must be submitted through the FedConnect portal. You must register with FedConnect to respond as an interested party to submit questions, and to view responses to questions. It is recommended that you register as soon after release of the FOA as possible to have the benefit of all responses. More information is available at <http://www.compusearch.com/products/fedconnect/fedconnect.asp>. DOE will try to respond to a question within 3 business days, unless a similar question and answer have already been posted on the website. As the application deadline approaches, DOE cannot ensure all questions will be answered within the last five business days of the FOA posting.

Questions pertaining to the **submission** of applications through FedConnect should be directed by e-mail to [support@FedConnect.net](mailto:support@FedConnect.net) or by phone to FedConnect Support at 800-899-6665.

### **B. AGENCY CONTACT**

Name: Juliana L. Heynes  
E-mail: [Juliana.Heynes@netl.doe.gov](mailto:Juliana.Heynes@netl.doe.gov)

## **SECTION VIII - OTHER INFORMATION**

### **A. MODIFICATIONS**

Notices of any modifications to this announcement will be posted on Grants.gov and the FedConnect portal. You can receive an email when a modification or an announcement message is posted by registering with FedConnect as an interested party for this FOA. It is recommended that you register as soon after release of the FOA as possible to ensure you receive timely notice of any modifications or other announcements. More information is available at <http://www.fedconnect.net> and <http://www.compusearch.com/products/fedconnect/fedconnect.asp>.

### **B. GOVERNMENT RIGHT TO REJECT OR NEGOTIATE**

DOE reserves the right, without qualification, to reject any or all applications received in response to this announcement and to select any application, in whole or in part, as a basis for negotiation and/or award.

### **C. COMMITMENT OF PUBLIC FUNDS**

The Contracting Officer is the only individual who can make awards or commit the Government to the expenditure of public funds. A commitment by other than the Contracting Officer, either explicit or implied, is invalid.

### **D. PROPRIETARY APPLICATION INFORMATION**

Patentable ideas, trade secrets, proprietary, or confidential commercial or financial information, disclosure of which may harm the applicant, should be included in an application only when such information is necessary to convey an understanding of the proposed project. The use and disclosure of such data may be restricted, provided the applicant includes the following legend on the first page of the project narrative and specifies the pages of the application which are to be restricted:

"The data contained in pages [*Insert pages*] of this application have been submitted in confidence and contain trade secrets or proprietary information, and such data shall be used or disclosed only for evaluation purposes, provided that if this applicant receives an award as a result of or in connection with the submission of this application, DOE shall have the right to use or disclose the data herein to the extent provided in the award. This restriction does not limit the Government's right to use or disclose data obtained without restriction from any source, including the applicant."

To protect such data, each line or paragraph on the pages containing such data must be specifically identified and marked with a legend similar to the following:

"The following contains proprietary information that (name of applicant) requests not be released to persons outside the Government, except for purposes of review and evaluation."

### **E. EVALUATION AND ADMINISTRATION BY NON-FEDERAL PERSONNEL**

In conducting the merit review evaluation, the Government may seek the advice of qualified non-Federal personnel as reviewers. The Government may also use non-Federal personnel to conduct routine, nondiscretionary administrative activities. The applicant, by submitting its application, consents to the use of non-Federal reviewers/administrators. Non-Federal reviewers must sign conflict of interest and non-disclosure agreements prior to reviewing an application. Non-Federal personnel conducting administrative activities must sign a non-disclosure agreement.

### **F. INTELLECTUAL PROPERTY DEVELOPED UNDER THIS PROGRAM**

**Patent Rights:** The Government will have certain statutory rights in an invention that is conceived or first

actually reduced to practice under a DOE award. 42 U.S.C. 5908 provides that title to such inventions vests in the United States, except where 35 U.S.C. 202 provides otherwise for nonprofit organizations or small business firms. However, the Secretary of Energy may waive all or any part of the rights of the United States subject to certain conditions. (See "Notice of Right to Request Patent Waiver" in paragraph G below.)

**Rights in Technical Data:** Normally, the Government has unlimited rights in technical data created under a DOE agreement. Delivery or third party licensing of proprietary software or data developed solely at private expense will not normally be required except as specifically negotiated in a particular agreement to satisfy DOE's own needs or to insure the commercialization of technology developed under a DOE agreement.

#### **Program Covered Under Special Protected Data**

**Special Protected Data Statutes:** This program is covered by a special protected data statute (but is not anticipated by DOE) and will only be considered on a case by case basis. The provisions of the statute provide for the protection from public disclosure, for a period of up to five (5) years from the development of the information, of data that would be trade secret, or commercial or financial information that is privileged or confidential, if the information had been obtained from a non-Federal party. Generally, the provision entitled, Rights in Data Programs Covered Under Special Protected Data Statutes (10 CFR 600 Appendix A to Subpart D), would apply to an award made under this announcement. This provision will identify data or categories of data first produced in the performance of the award that will be made available to the public, notwithstanding the statutory authority to withhold data from public dissemination, and will also identify data that will be recognized by the parties as protected data.

#### **G. NOTICE OF RIGHT TO REQUEST PATENT WAIVER**

Applicants may request a waiver of all or any part of the rights of the United States in inventions conceived or first actually reduced to practice in performance of an agreement as a result of this announcement, in advance of or within 30 days after the effective date of the award. Even if such advance waiver is not requested or the request is denied, the Recipient will have a continuing right under the award to request a waiver of the rights of the United States in identified inventions, i.e., individual inventions conceived or first actually reduced to practice in performance of the award. Any patent waiver that may be granted is subject to certain terms and conditions in 10 CFR 784 <http://www.gc.doe.gov/documents/patwaivclau.pdf>.

Domestic small businesses and domestic nonprofit organizations will receive the patent rights clause at 37 CFR 401.14, i.e., the implementation of the Bayh-Dole Act. This clause permits domestic small business and domestic nonprofit organizations to retain title to subject inventions. Therefore, small businesses and nonprofit organizations do not need to request a waiver.

#### **H. NOTICE REGARDING ELIGIBLE/INELIGIBLE ACTIVITIES**

Eligible activities under this program include those which describe and promote the understanding of scientific and technical aspects of specific energy technologies, but not those which encourage or support political activities such as the collection and dissemination of information related to potential, planned or pending legislation.

**ATTACHMENT A  
GUIDE FOR EVALUATION OF ENERGY SAVINGS POTENTIAL**

**Office of Energy Efficiency and Renewable Energy**

**Building Technologies Program**

**January 19, 2005**

## Introduction

This guide provides a method for estimating the savings in primary energy consumption resulting from technology adoption changes in buildings. The objective of the estimation method is to facilitate a common comparison of a wide variety of building technologies. This guide specifically provides the method's simple calculation framework and generic supporting data.

The method is applicable to technologies for end-use equipment and building envelopes for both residential and commercial buildings. The method can accommodate technologies, which are at the very early stages of development, as well as well-characterized technologies in the midst of the development cycle. To accommodate the wide range of technologies and to reflect major market opportunities, the method incorporates slightly different approaches for building equipment technologies and building envelope technologies. Additionally, this 2005 version has been expanded to include evaluation of "enabling technologies."

The method provides potential energy savings estimates, with the primary purpose to highlight the relative differences among technologies or activities. It may or may not provide an accurate forecast of the likely impact of any specific technology. The estimates of energy savings are expressed in terms of a national annual rate, based on the maximum likely market penetration for the proposed technology.

The straightforward savings calculation method that will accommodate most technologies and markets is displayed below in the "linked boxes" format.

$$\begin{array}{ccccc} \boxed{\begin{array}{c} \% \text{ Energy Savings} \\ \text{over Typical New} \\ \text{Technology} \end{array}} & \times & \boxed{\begin{array}{c} \text{National Energy} \\ \text{Consumption for} \\ \text{End-Use Category} \end{array}} & \times & \boxed{\begin{array}{c} \text{Potential Market} \\ \text{Penetration (\%)} \end{array}} & = & \begin{array}{c} \text{National} \\ \text{Total} \\ \text{Energy} \\ \text{Savings} \end{array} \\ \text{Proposer Provides} & & \text{Detailed Tables} & & \text{Proposer Provides} & & \end{array}$$

The method requires four basic data items to generate an estimate of annual primary energy savings. Those items and their sources are:

1. Primary energy consumption of the end use(s) targeted - Attached Tables
2. Performance level of typical new technology or product - Attached Tables
3. Performance level of proposed technology - Applicant provides with justification
4. Expected market penetration of proposed technology - Applicant provides with justification

Items 1 and 2 above are provided in Tables A through D, covering residential and commercial buildings. Table E provides energy prices, along with carbon emissions factors, if the proposer chooses to show carbon emissions reductions (although not required).

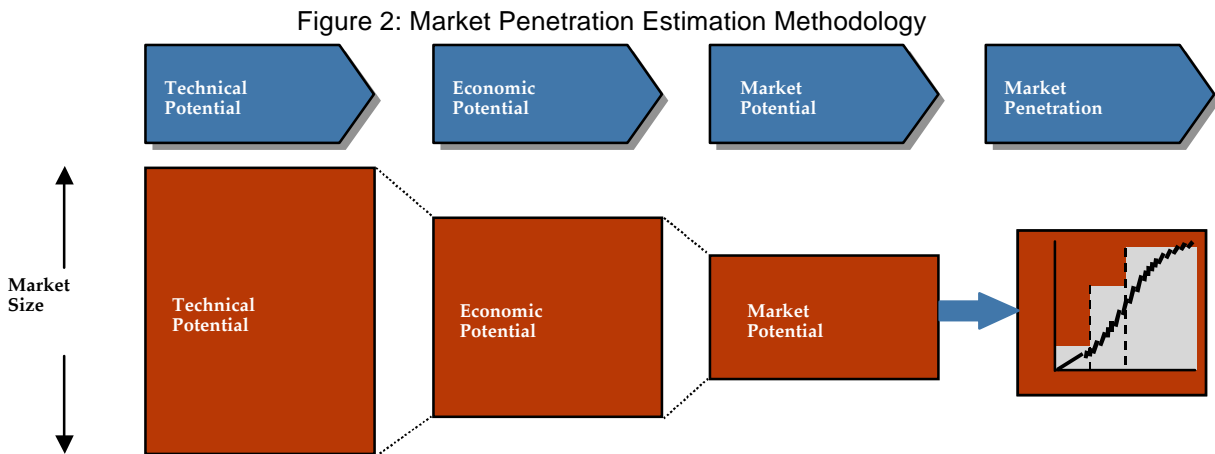
Items 3 and 4 above are provided by the proposer and must have adequate supporting justification. The performance level (item 3) must be based on the attributes of the proposed technology and must be supported by appropriately detailed engineering or scientific analysis, building simulation modeling, and/or literature references. These data are necessary to justify the performance level used.

In many cases, the technology proposed will be a sub-component of the elements listed in Tables A through D. Sub-component technologies will require some calculations prior to Step 1 of the methodology. Proposers must provide sufficient information to explain and justify estimates of system improvements based on improved sub-component technologies.

The methodology is based on comparing the performance level of the proposed new technology with the performance of the typical new technology currently used. In a replacement situation, it is implicitly assumed that replacement would occur in any case. Therefore, the comparison is not based on the performance of the technology actually being replaced, but on the technology most likely to be used today

(displacement not replacement).

The expected market penetration (item 4) is an estimate of the long-term penetration of the target market, on a percentage basis. The expected market penetration must be supported by a brief market analysis and/or supporting literature references. The market analysis needs to consider economic factors (including expected first cost and payback period, relative to other technologies) and non-economic factors, which may limit the penetration in the target market (non-economic factors include product physical size, building characteristics and institutional barriers). A discussion of these factors is necessary to justify the market penetration level proposed. Figure 2 below outlines a potential logic structure for describing and justifying a market penetration.



Determining a product's market potential requires understanding technical, economic and market dynamics, including incorporating the market entry strategy. Accurately demonstrating an understanding of the market potential will be needed to justify the estimated penetration rate. One method, but by no means the only way to estimate market penetration for a new technology, is based on payback analysis, as illustrated in Figure 3 for HVAC energy technologies.

Figure 3: Example of Market Penetration Tool<sup>i</sup>



It is possible to save energy with a technology which does not exceed the maximum efficiency levels currently available in the market, but has lower first cost than current high-efficiency products. (An example would be new technology for natural gas condensing furnaces with 92% AFUE and inherently lower manufacturing cost than current condensing furnaces.) The low-cost technology will create an incremental or additional market penetration above the present sales level for highly efficient products. This incremental market penetration is used in calculating savings.

The savings calculation method outlined herein, if applied directly, may not accurately estimate the savings for certain technologies (such as fuel-switching, crosscutting, or integrated technologies) or niche applications. For these special cases, the proposer may modify this methodology or create a parallel methodology, as long as the methodology provides a comparable level of calculation transparency, contains adequate justification through supporting data, and is fully consistent with the data in Tables A through E. The savings are to be in terms of a national annual rate at the maximum likely market penetration, not cumulative savings over several years nor a savings rate at future point in time.

### **Envelope Technologies**

Many new technologies for building envelopes may find their primary market in newly constructed buildings. Retrofit of existing buildings may represent only a secondary market. Therefore, to best estimate the relative energy savings of building envelope technologies, an estimate of energy savings in both new and existing building markets may be needed. Table A and C provide data on the energy consumption characteristics of both existing buildings and new construction. For new construction, the tables provide ten-year cumulative energy consumption based on current construction characteristics and estimated annual construction rates over the next ten years. These data sets provide a relative basis for accounting for both the retrofit and new construction markets for envelope technologies.

To estimate the percent energy savings for an envelope technology, the proposer estimates the performance level of the proposed technology relative to the typical performance level of current technology. The tables do not provide performance data for current envelope technologies used in new

buildings or in retrofit of existing buildings. The proposer will need to supply these data. These performance levels require justification, either by building modeling results, field measurements, literature references, etc.

The energy consumption baseline for new construction consists of the cumulative energy consumption of ten years of new building construction. This baseline is used to determine relative energy savings regardless of the expected market entry date of the technologies (i.e., even if the technology will not enter the market until late in the 2000 decade or beyond). The calculation method is to provide a relative energy savings estimate appropriate for comparing various envelope technologies, not to accurately predict future savings. If the technology is expected to be used in both existing buildings and new buildings, the proposer will have to estimate market penetrations for both. The market penetrations are justifiable estimates of the ultimate market penetration, whether or not that level of penetration is likely to occur before 2010 or within ten years after market introduction.

Example #1: This example deals with a new insulation technology for building exterior walls. To use the method, the performance level of the proposed wall insulation must be translated into a percent energy savings for the entire wall system. Since there are several heat transfer mechanisms involved in building exterior walls, the translation is generally not a simple one. Thus, Step 1 would need to be supplemented with additional data or calculations to support the estimate of percent energy savings for the wall system.

*Example 1. Building Shell - Current Building Stock*

A newly proposed, advanced-technology wall insulation for retrofit into residential homes is to be evaluated. In this case, only the heating season performance will be considered for energy savings. From detailed heat transfer analysis and/or laboratory tests, the thermal performance of the insulation is determined. From detailed building performance models, laboratory-measured results, or field-measured results, the performance over one year is established for the entire wall system with the advanced-technology retrofit wall insulation product installed. Additional modeling and/or measurements are performed to establish the performance level for the typical new product that would be installed in the house walls. The two performance levels of efficiency for the wall (and thus the percent energy savings) are determined by the proposer, with supporting justification.

From market analysis, the maximum market penetration foreseen is 10% of existing residential homes with the proposed new insulation product. The penetration estimate accounts for fuel cost, first cost differential, number of homes with larger space heating requirements, and installation constraints.

These two values (percent energy savings and potential market penetration) are prepared by the proposer and must have supporting logic, data, and analysis included. Prepare these two values before starting the remaining steps.

**Step 1:** From modeling and/or measurements for the (a) proposed product and for the (b) typical new product on the market, the proposer establishes that the proposed product will have an energy savings over the competitive product of 40%.

**Step 2:** Look up the energy consumption attributable to walls of residential homes in Table A.1. The value is 1.655 quads for existing buildings.

**Step 3:** Provide the value of the potential market penetration, estimated by the proposer. The estimate provided is 10%.

**Step 4:** Place the above three values (40.0%, 1.655 quads, and 10%) into the provided boxes and multiply. The result is a national total energy consumption reduction of 0.066 quads.

% Energy Savings Over Typical New Technology	X	National energy Consumption for End-Use Category	X	Potential Market Penetration (%)	=	National Total Energy Savings
Proposer Provides		Detailed Tables		Proposer Provides		
40.0%	X	1.655 quads	X	10%	=	0.066 quads
						Therefore, the proposed wall

technology is projected to reduce the heating consumption of existing residential buildings by 0.066 quads.

### Equipment Technologies

The approach for estimating the relative energy savings of building equipment technologies is based on the normal replacement of equipment in the existing stock of buildings. The current energy consumption characteristics of existing buildings (Tables A and C) are used as the baseline for market penetration and savings estimates. This method implicitly uses the following approximations:

- All energy-consuming equipment in all current buildings will eventually be replaced with new equipment, either due to wear-out or functional or economic factors.
- Over the next 20 years, replacement of equipment in existing buildings is a much larger market for energy savings than installations in newly-constructed buildings.

Therefore, there is no need to forecast the energy consumption characteristics of building equipment in the future, nor is there a need to calculate energy savings potential in new construction. Sufficient differentiation among equipment technologies is achieved using the energy use characteristics of existing buildings.

**Example #2:** This example deals with technology advances for heat pump water heaters. The target market is residential electric water heating. For the expected market penetration, the example estimates that 30% of the residential electric water heater stock has the potential of eventually being replaced by the heat pump water heater. This penetration level reflects the influence of several factors including: the cost of electricity, the first cost differential relative to competitive products, and the proportion of homes with higher hot water use and installation constraints.

#### *Example 2. Electric Water Heater*

A newly proposed, advanced-technology, electric heat pump water heater (HPWH) is to be evaluated. From detailed engineering models, laboratory-measured results, or field-measured results, the performance over one year is established to be at 2.2 EF (Efficiency Factor). From market analysis, the maximum market penetration foreseen is 30% of the installed electric water heating stock. The penetration estimate accounts for fuel cost, first cost differential, number of homes with larger water heating requirements, and installation constraints. These two values are prepared by the proposer and must have supporting logic and data included. Prepare these two values before starting the remaining steps.

**Step 1:** Insert the EF of the proposed HPWH into two of the boxes. Look up the typical efficiency of a new electric water heater in Table B (found as 0.90 EF) and insert into the middle box. Simple arithmetic provides the percent energy savings over the typical new unit as 59.1%.

$$\left( \begin{array}{c} \boxed{\text{Energy Factor of the Heat Pump Water Heater}} \\ \text{Proposer Provides} \end{array} - \begin{array}{c} \boxed{\text{Energy Factor of the Typical Installed Electric Water Heater}} \\ \text{Table} \end{array} \right) \div \begin{array}{c} \boxed{\text{Energy Factor of the Heat Pump Water Heater}} \\ \text{Proposer Provides} \end{array} \times 100 = \begin{array}{c} \boxed{\% \text{ Energy Savings over Typical New Technology}} \end{array}$$
  

$$\left( \begin{array}{c} \boxed{2.2} \\ \text{Proposer Provides} \end{array} - \begin{array}{c} \boxed{0.90} \\ \text{Table} \end{array} \right) \div \begin{array}{c} \boxed{2.2} \\ \text{Proposer Provides} \end{array} \times 100 = \begin{array}{c} \boxed{59.1\%} \end{array}$$

**Step 2:** Look up the energy consumption of electric water heaters in the residential sector in Table B. The value is 1.32 quads.

**Step 3:** Provide the value of the potential market penetration, estimated by the proposer. The estimate provided is 30%.

$$\begin{array}{c} \boxed{\% \text{ Energy Savings over Typical New Technology}} \\ \text{Proposer Provides} \end{array} \times \begin{array}{c} \boxed{\text{National Energy Consumption for End-Use Category}} \\ \text{Detailed Tables} \end{array} \times \begin{array}{c} \boxed{\text{Potential Market Penetration (\%)}} \\ \text{Proposer Provides} \end{array} = \begin{array}{c} \text{National Total Energy Savings} \end{array}$$
  

$$\begin{array}{c} \boxed{59.1\%} \\ \text{Proposer Provides} \end{array} \times \begin{array}{c} \boxed{1.32 \text{ quads}} \\ \text{Detailed Tables} \end{array} \times \begin{array}{c} \boxed{30\%} \\ \text{Proposer Provides} \end{array} = \begin{array}{c} \text{0.23 quads} \end{array}$$

**Step 4:** Place the above three values (59.1%, 1.32 quads, and 30%) into the provided boxes and multiply. The result is a national total energy savings of 0.23 quads.

Thus, the proposed project is expected to provide 0.23 quads of national energy savings when reaching mature market penetration.

### Enabling Technologies

Enabling technologies are those technologies that indirectly facilitate energy savings. Evaluating enabling technologies is difficult for the Department, as they are not directly related to the resultant energy savings, but in many cases, are the required catalysts to achieve the savings. The technologies enable energy savings through either helping to design a more energy efficient building or piece of equipment or helping the adoption of energy efficient technologies. Enabling technologies include some crosscutting technologies, market research and analysis, and tools. An example of this type of technology is EnergyPlus. It is a design tool that enables the development of energy efficient buildings. No energy is saved directly through EnergyPlus, but using the design tool results in energy savings, and the ability to save energy through better building designs.

The approach for estimating the relative energy savings of enabling technologies is to estimate the effect the enabling technology has on the new technology. The enabling technology can either affect the

energy savings over the typical new technology or the potential market penetration. The effect of the enabling technology on the new technology must first be estimated and then applied to the straightforward savings calculation.

*Example 3. Windows Design Tool*

This example deals with using an enabling technology, WINDOW (version 5.2), to facilitate the design of advanced window technologies. WINDOW 5.2 is a publicly available computer program for calculating total window thermal performance indices (i.e. U-values, solar heat gain coefficients, shading coefficients, and visible transmittances). WINDOW 5.2 provides a versatile heat transfer analysis method consistent with the updated rating procedure developed by the National Fenestration Rating Council (NFRC) that is consistent with the ISO 15099 standard. The program can be used to design and develop new products, to assist educators in teaching heat transfer through windows, and to help public officials in developing building energy codes. The design tool does not directly save energy, but enables industry to understand the performance of existing products and to preview performance of new designs before investing in product engineering and manufacture.

Using WINDOW 5.2, a manufacturer is able to examine the ability to create a new advanced window, expected to have a u-value of 0.2. Without WINDOW 5.2, this product could not be designed. Since the advanced windows are a new product, they are assumed to have a low market penetration. This example estimates that 10% of the window market has the potential to be replaced with the efficient window. In this example, only the heating season performance will be considered for energy savings.

**Step 1:** Using the WINDOW 5.2 software, the proposer establishes that the new advanced window will have a u-value of 0.2, which will provide an energy savings over the competitive product of 50%.

**Step 2:** Look up the heating energy consumption attributable to window conduction in existing residential homes in Table A.1. The value is 2.218 quads.

**Step 3:** Provide the value of the potential market penetration, estimated by the proposer. The estimate provided is 10%.

**Step 4:** Place the above three values (50.0%, 2.218 quads, and 10%) into the provided boxes and multiply. The result is a national total energy consumption reduction of 0.111 quads.

% Energy Savings Over Typical New Technology	X	National energy Consumption for End-Use Category	X	Potential Market Penetration (%)	=	National Total Energy Savings
Proposer Provides		Detailed Tables		Proposer Provides		
50.0%	X	2.218 quads	X	10%	=	0.111 quads

Therefore, WINDOW 5.2 has assisted the new advanced window technology to reduce the heating consumption of existing residential buildings by 0.111 quads.

**List of Tables**

- Table A: Residential Space Conditioning Energy Consumption by Envelope Component  
 A1 - Current Building Stock  
 A2 - Ten Years of Post-2000 New Construction
- Table B: Residential End Use Primary Energy Consumption and Equipment Efficiencies - Current Building Stock
- Table C: Commercial Space Conditioning Energy Consumption by Envelope Component  
 C1 - Current Building Stock  
 C2 - Ten Years of Post-2000 New Construction
- Table D: Commercial End Use Primary Energy Consumption and Equipment Efficiencies - Current Building Stock
- Table E: Conversion Factors

**Input Tables**

**Table A: Residential Space Conditioning Energy Consumption by Envelope Component**

A.1 Current Building Stock

Component	Total Energy Use (quads)		Efficiency
	Heating	Cooling	
Walls	1.655	0.233	Not Available See Example #2
Roofs	1.076	0.339	
Windows (net)	1.506	0.806	
Conduction	[2.218]	[0.021]	
Solar	[-0.712]	[0.785]	
Foundations	1.258	-0.148	
Infiltration	2.433	0.403	
<i>Envelope Subtotal</i>	<i>7.928</i>	<i>1.633</i>	
Internal Loads	-1.307	0.657	
<i>Total</i>	<i>6.62</i>	<i>2.29</i>	

A.2 Ten Years of Post-2000 - New Construction<sup>ii</sup>

Component	Total Energy Use (quads)		Efficiency
	Heating	Cooling	
Walls	0.23	0.05	Not Available See Example #2
Roofs	0.13	0.06	
Windows (net)	0.03	0.12	
Conduction	[+0.15]	[+0.01]	
Solar	[-0.12]	[+0.11]	
Foundations	0.16	0	
Infiltration	0.26	0.06	
<i>Envelope Subtotal</i>	<i>0.81</i>	<i>0.29</i>	
Internal Loads	--	0.14	
<b>Total</b>	<i>0.81</i>	<i>0.43</i>	

**Table B: Residential End-Use Primary Energy Consumption and Equipment Efficiencies - Current Building Stock**

Type	Total Energy Use (quads) <sup>iii</sup>	Typical New Efficiency <sup>iv</sup>	Maximum Efficiency <sup>v</sup>
Heating Equipment			
Gas Furnaces <sup>vi</sup>	2.51	80 AFUE	150 SCOP <sup>vii</sup>
Oil Furnaces	0.24	80 AFUE	96 AFUE
Gas Boilers	0.42	80 AFUE	150 SCOP
Oil Boilers	0.18	80 AFUE	96 AFUE
Electric Heat Pumps	0.60	7.7 HSPF	12 HSPF
Electric Furnaces, built-in Units	1.07	98 %	
Other Electric	0.12	98 %	
Other Gas	0.18		
Geothermal	0.01	3.5 COP	
Market Renewables (Wood)	0.39		
Floor/Wall/Pipeless Furnace	0.18		
Other Fuels	0.48		
Furnace Fans	0.25		
<i>Total Space Heating</i>	<i>6.62</i>		

<b>Cooling Equipment</b>			
Central A/C	1.41	13 SEER	20 SEER
Room A/C	0.40	10 EER	13 EER
Electric Heat Pump	0.36	13 SEER	20 SEER
Dehumidifier	0.13	972 kWh/year	500 kWh/year
<i>Total Space Cooling</i>	2.29		
<b>Thermal Distribution - Heating<sup>viii</sup></b>			
Warm Air Ducts	4.43	65%	100%
Hydronic System	0.60	85%	100%
Spot/Space in Room	1.60	100%	100%
<i>Total Space Heating</i>	6.62		
<b>Thermal Distribution - Cooling<sup>ix</sup></b>			
Warm Air Ducts	1.76	65%	100%
Spot/Space in Room	0.53	100%	100%
<i>Total Space Cooling</i>	2.29		
<b>Water Heating</b>			
Electric	1.32	0.90 EF	3.0 EF
Gas	1.20	0.59 EF	1.4 EF
Oil	0.12	0.53 EF	0.86 EF
Renewable (Solar)	0.02	0.8-4.8 SEF	
<i>Total Water Heating</i>	2.66		
<b>Refrigeration</b>			
Refrigerator	1.37	510 kWh	300 kWh
Freezer	0.43	475 kWh	350 kWh
<i>Total Refrigeration</i>	1.80		
<b>Lighting</b>			
Incandescent	2.24	15 LPW	200 LPW (SSL)
Fluorescent	0.22	70 LPW	200 LPW (SSL)
Other	0.01		
<i>Total Lighting</i>	2.47		
<b>Ventilation</b>	NA	NA	NA
<b>Laundry</b>			



Clothes Washer	0.79	1.04 MEF	2.7 MEF
Clothes Dryer (gas)	0.07	2.67 lbs/kWh	2.8 lbs/kWh
Clothes Dryer (electric)	0.76	3.01 lbs/kWh	4.0 lbs/kWh
<i>Total Laundry</i>	<i>0.93</i>		
<b>Home Electronics</b>			
Television	0.40	NA	
Office Equipment	0.60	NA	
Personal Computer	0.21	NA	
<i>Total Home Electronics</i>	<i>1.21</i>		
<b>Small Appliances</b>			
Motors <sup>x</sup>	0.18	NA	
Miscellaneous Heating <sup>xi</sup>	0.31	NA	
<i>Total Small Appliances</i>	<i>0.49</i>		
<b>Dishwasher</b>			
Dishwasher	0.28 <sup>xii</sup>	0.46 cycle/kWh	1.19 cycle/kWh
<b>Cooking</b>			
Electric	0.71	0.77 EF	0.78 EF
Gas	0.21	0.40 EF	0.75 EF
LPG	0.03	0.40 EF	0.75 EF
<i>Total Cooking</i>	<i>0.94</i>		
<b>Adjust to SEDS<sup>xiii</sup></b>	0.79	NA	NA

**Table C: Commercial Space Conditioning Energy Consumption by Envelope Component<sup>xiv</sup>**

C.1 Current Building Stock

Component	Total Energy Use (quads)			Efficiency
	Heating	Cooling	Vent	
Walls	0.966	0.017		Not Available See Example #2
Roofs	0.572	0.030		
Windows (net)	0.411	0.800		
Conduction	[+1.044]	[-0.18]		
Solar	[-0.633]	[+0.818]		
Foundations	0.516	0.123		
Infiltration	0.844	0.087		
<i>Envelope Subtotal</i>	<i>3.309</i>	<i>1.057</i>		
Internal Loads	-0.849	0.983		
<b>Total</b>	<b>2.46</b>	<b>2.04</b>	<b>1.01</b>	

C.2 Ten Years of Post-2000 - New Construction<sup>xv</sup>

Component	Total Energy Use (quads)			Efficiency
	Heating	Cooling	Vent	
Walls	0.06	0		Not Available See Example #2
Roofs	0.03	0.01		
Windows (net)	0.03	0.05		
Conduction	[+0.07]	[-0.02]		
Solar	[-0.04]	[+0.07]		
Foundations	0.02	0		
Infiltration	0.05	0		
<i>Envelope Subtotal</i>	<i>0.19</i>	<i>0.06</i>		
Internal Loads	--	0.14		
<b>Total</b>	<b>0.19</b>	<b>0.20</b>	<b>0.081</b>	

**Table D: Commercial End-Use Primary Energy Consumption and Equipment Efficiencies- Current Building Stock**

Type	Total Energy Use (quads) <sup>xvi</sup>	Typical New Efficiency <sup>xvii</sup>	Maximum Efficiency <sup>xviii</sup>
<b>Heating Equipment</b>			
Furnaces	0.49		
Gas Furnaces	[0.44]	80 AFUE	150 SCOP
Oil Furnaces	[0.05]	81 AFUE	94 AFUE
Boilers	0.52		
Gas Boilers	[0.40]	80 AFUE	150 SCOP
Oil Boilers	[0.12]	83 AFUE	94 AFUE
Packaged Heating Units	0.62	3.2 COP	
Unit Heaters	0.44	74 AFUE	
Electric Heat Pumps	0.12	3.5 COP	4.7 COP
Individual Space Heaters	0.05	100 %	100 %
District Heat	0.17		
PTHP & WLHP	0.05	3.5 COP	
<i>Total Space Heating</i>	<i>2.46</i>		
<b>Cooling Equipment</b>			
Centrifugal Chillers	0.29	0.60 kW/ton	0.47 kW/ton
Reciprocating Chillers	0.24	1.23 kW/ton	0.90 kW/ton
Absorption Chillers	0.04	1.00 COP	1.60 COP
Rooftop A/C/ Unitary A/C	1.10	1.19 kW/ton	0.75 kW/ton
Screw Chillers	0.06		
Heat Pump	0.14	10.3 EER	15 EER
Room Air Conditioner	0.10	10 EER	13 EER
PTAC	0.06	11 EER	12 EER
<i>Total Space Cooling</i>	<i>2.04</i>		
<b>HVAC Auxiliary Equipment</b>			
Supply and Return Fans	0.75	55% <sup>xix</sup>	65%
Exhaust Fans	0.50	45%	55%
Condenser Fans	0.075	45%	55%
Fan Power Terminal Boxes	0.03	30%	45%
Cooling Tower Fans	0.01	55%	65%

Heating Water Pumps	0.075	65%	75%
Condenser Water Pumps	0.03	70%	80%
Chilled Water Pumps	0.03	70%	80%
<i>Total Auxiliary Equipment</i>	<i>1.50</i>		
<b>Water Heating</b>			
Electric	0.59	98 %	300 %
Gas	0.45	80 %	150 %
Oil	0.07	80 %	94 %
Renewables (Solar)	0.02	0.8-4.8 SEF	
<i>Total Water Heating</i>	<i>1.13</i>		
<b>Refrigeration</b>			
Supermarket- central system	0.33	35.5 kWh/year-ft <sup>2</sup>	26.7 kWh/year-ft <sup>2</sup>
Walk-in	0.18	18,800 kWh/year	12,700 kWh/year
Vending Machines	0.13	3,000 kWh/year	1,740 kWh/year
Beverage Merchandisers	0.05	5,900 kWh/year	2,650 kWh/year
Reach-in Freezer	0.066	4,900 kWh/year	2,700 kWh/year
Reach-in Refrigerator	0.054	3,800 kWh/year	2,100 kWh/year
Ice Machines	0.10	5,000 kWh/year	4,100 kWh/year
<i>Total Refrigeration</i>	<i>0.91</i>		
<b>Lighting</b>			
Incandescent	1.40	15 LPW	200 LPW (SSL)
Fluorescent	2.45	75 LPW	200 LPW (SSL)
HID	0.52	90 LPW	200 LPW (SSL)
<i>Total Lighting</i>	<i>4.37</i>		
<b>Office Equipment</b>			
PC	0.44	NA	
Non-PC	1.00	NA	
<i>Total Office Equipment</i>	<i>1.44</i>		
<b>Laundry<sup>xx</sup></b>			
Clothes Washer	0.054	1.0	1.87
Clothes Dryer	0.136	1.0	1.45
Gas	[0.122]		
Electric	[0.014]		
<i>Total Laundry</i>	<i>0.19</i>		

<b>Cooking</b>			
Gas	0.26	60%	85%
Electric	0.10	40%	75%
Total Cooking	0.36		
<b>Ventilation</b>	1.01	NA	NA
<b>Adjust to SEDS<sup>xxi</sup></b>	2.42	NA	NA

**Table E: Conversion Factors**

<b>Item</b>	<b>Value</b>	<b>Units</b>
Residential Gas Price (2003)	9.32	\$/MMBtu
Commercial Gas Price (2003)	8.06	\$/MMBtu
Residential Oil Price (2003)	9.78	\$/MMBtu
Commercial Oil Price (2003)	7.00	\$/MMBtu
Residential Electricity Price (2003)	0.088	\$/kWh
Commercial Electricity Price (2003)	0.076	\$/kWh
<b>Fuel Specific Carbon Emission Factors</b>		
Electricity	16.02	Kg/MMBtu
Gas	14.40	Kg/MMBtu
Oil	19.75	Kg/MMBtu
<b>Generic Carbon Emission Factors</b>		
Residential Buildings - Space Heating	15.35	Kg/MMBtu
Commercial Buildings - Space Heating	15.19	Kg/MMBtu
Average Delivered Utility Power	11,045	Btu/kW

## References:

Arthur D. Little, Inc. *Guide for Evaluation of Energy Savings Potential*. Prepared for the Office of Building Technology, State and Community Programs (BTS), U. S. Department of Energy. February, 1999.

Energy Information Administration (EIA/DOE). *1999 Commercial Buildings Energy Consumption Survey*. U.S. Department of Energy. December 2001.

Energy Information Administration (EIA/DOE). *Annual Energy Outlook 2004*. U.S. Department of Energy. DOE/EIA - 0383(2004). January 2004.

Energy Information Administration (EIA/DOE). *Assumptions for the Annual Energy Outlook 2004*. U.S. Department of Energy. DOE/EIA - 0554(2004). February 2004.

Energy Information Administration (EIA/DOE). *Historical 1990 through Current Month Retail Sales, Revenues, and Average Retail Price of Electricity by State and by Sector*. U.S. Department of Energy. 2004.

Energy Information Administration (EIA/DOE). *Housing Characteristics 2001*. U.S. Department of Energy. DOE/EIA - 0314(2001). 2002.

Energy Information Administration (EIA/DOE). *US Heating Oil, Diesel Fuel, and Distillate Data*. U.S. Department of Energy. 2004.

Energy Information Administration (EIA/DOE). *US Natural Gas Prices..* U.S. Department of Energy. December 2004.

Huang, Joe Y., James W. Hanford and Fuqiang Yang. *Residential Heating and Cooling Loads Component Analysis*. Lawrence Berkeley National Laboratory. LBL-33101. November 1998.

Navigant Consulting Inc. *EIA-Technology Forecast Updates-Advanced Case*. Prepared by NCI, for the Energy Information Administration, U.S. Department of Energy. September 2004.

Navigant Consulting Inc. *Volume 1: National Lighting Inventory and Energy Consumption Estimate*. Prepared by NCI, for the Office of Energy Efficiency and Renewable Energy, U.S. Department of Energy. September 2002.

Rosen, Karen and A. Meier. *Energy Use of Televisions and Videocassette Recorders in the U.S.* Prepared by Lawrence Berkeley National Laboratory, for the Office of Building Technology, State and Community Programs (BTS), U. S. Department of Energy. LBNL-42393. March, 1999. [www.eren.doe.gov/buildings](http://www.eren.doe.gov/buildings).

U.S. Department of Energy. *2004 Buildings Energy Databook*. Prepared for the Office of Energy Efficiency and Renewable Energy, U.S. Department of Energy. August 2004.

Westphalen, Detlef and Scott Koszliniski. *Energy Consumption Characteristics of Commercial Building HVAC Systems, Volume II: Thermal Distribution, Auxiliary Equipment, and Ventilation*. Prepared by Arthur D. Little, Inc., for the Office of Building Technology, State and Community Programs (BTS), U. S. Department of Energy. NTIS Number PB99-172314. October, 1999. [www.ereee.doe.gov/buildings](http://www.ereee.doe.gov/buildings).

Westphalen, Detlef, et al. *Energy Saving Potential for Commercial Refrigeration Equipment*. Prepared by Arthur D. Little, Inc., for the Building Equipment Division, Office of Building Technologies, U.S. Department of Energy. ADL Reference No. 46230. NTIS Number PB97-128730. June 1996.

Zogg, Robert and D. Alberino. *Electricity Consumption by Small End Uses in Residential Buildings*. Prepared by Arthur D. Little, Inc., for the Office of Building Technology, State and Community Programs

- i. Arthur D. Little analysis
- ii. Assumes: Ten years of new construction @ 1,585,000 new homes per year. New home HVAC energy consumption typical of early 1990's buildings.
- iii. Primary energy consumption that accounts for the generation, transmission, and distribution losses.
- iv. Efficiency as measured at the site.
- v. **“Maximum Efficiency”** - estimate of potential efficiency level (as measured at the site) for future technologies, as a guideline.
- vi. Gas HVAC equipment includes LPG
- vii. SCOP - Seasonal Coefficient of Performance - efficiency level achievable by a gas-fired heat pump.
- viii. Energy consumption for Thermal Distribution is the same as for Heating Equipment, thus caution is needed to not double count the energy savings when evaluating improvements to the full system (heating equipment and thermal distribution). In full system cases, calculate (as in Example 1) the energy savings by the heating equipment. Subtract this energy savings from the listed table value of “Total Energy Use” in the Thermal Distribution section. Use this adjusted value to perform the energy savings estimate (similar to Example 1) for the improvements to the thermal distribution. Sum the two estimates of energy savings to obtain the estimate for the full system.
- ix. Energy consumption for Thermal Distribution is the same as for Space Cooling Equipment, thus caution is needed to not double count the energy savings when evaluating improvements to the full system (space cooling equipment and thermal distribution as in “warm-air ducts”). In full system cases, calculate (as in Example 1) the energy savings by the space cooling equipment. Subtract this energy savings from the listed table value of “Total Energy Use” in the Thermal Distribution section for warm- air ducts. Use this adjusted value to perform the energy savings estimate (similar to Example 1) for the improvements to the thermal distribution. Sum the two estimates of energy savings to obtain the estimate for the full system.
- x. Household motor driven equipment such as pool pumps, well pumps, garbage disposals, and food processors.
- xi. Household spot heating equipment such as clothes irons, electric blankets, and heat tapes.
- xii. The 0.28 quads includes 0.08 quads for electricity at the dishwasher, and 0.20 quads for water heating.
- xxii. Energy attributable to the residential sector, but not directly to specific end-uses (2004 BED).
- xiv. NOTE: The energy consumption data in Table D represent national totals for all building types in all regions. These gains and losses vary considerably by region and building type. The data in Table D represent the net effect on HVAC system energy consumption. In some cases, the cooling energy use on an annual basis is zero, although for individual buildings, this may not be the case. Technologies can be developed that will independently affect either envelope heat gains or losses or that will be applied regionally. Since these effects cannot be captured with the above data, the analyst will have to develop detailed loss data to document potential energy savings. Detailed gain/loss data are included in the table for windows.

- 
- xv. Assumes: Ten years of new construction @ 7.75 million square feet per year and HVAC energy consumption typical of early 1990's buildings.
  - xvi. Primary energy consumption that accounts for the generation, transmission, and distribution losses.
  - xvii. Efficiency as measured at the site.
  - xviii. "**Maximum Efficiency**" - estimate of potential efficiency level (as measured at the site) for future technologies, as a guideline.
  - xix. Includes effects of pump/fan, mechanical drive, and motor losses.
  - xx. Estimate of potential efficiency levels are indexed.
  - xxii. Energy attributable to the commercial sector, but not directly to specific end-uses (2004 BED).