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Holistic Assessment Tool-kit on Energy Efficient Retrofit Measures for Government Buildings (EnERGo)

Annex 46

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ANNEX 46 Holistic Assessment Tool-kit on Energy Efficient Retrofit Measures for Government Buildings (EnERGo)

1. Description of Technical Sector and Definition

1.1 Description of Technical Sector

Analysis of nonresidential building structures shows that many government buildings are characterized by high energy consumption. Since government buildings are constructed similarly in many countries, experience gained with retrofitting such buildings with energy-saving technologies should be widely applicable—on an international scale. Still, energy saving measures are seldom applied when these buildings are retrofitted. Often, decisionmakers simply lack knowledge of the many energy-saving measures available to them, and of the efficiencies and return on investments that such measures can yield. Consequently, decisions to retrofit are often made without sufficient consideration of the many energy saving options available to retrofit designers.

In fact, such considerations can be based on some simple tools. Useful tools like *Energy Concept Adviser for Educational Buildings* (developed in IEA-ECBCS-Annex 36) provide “rules of thumb” for quick and easy estimates of required investments and potential energy savings applicable to Government buildings before analyzing the building structure in detail.

Administrative/office buildings and production and maintenance facilities pose specific challenges to those seeking improved energy management and building energy performance, specifically:

- Lighting and ventilation/air-conditioning are more important energy uses in these buildings than in residential buildings.
- Most nonresidential buildings are very large and require sophisticated energy management systems.
- Total building energy use is heavily influenced by the energy use and the ventilation requirements of building-specific processes and applications, especially in production and maintenance facilities.
- Common to all these buildings is that questions on the energy consumption are generally secondary to the improvement of comfort and/or functionality. This is most pronounced within the existing building stock. Decisions to retrofit a building are often made because of dissatisfaction concerning the comfort level or as a consequence of changes in usage or processes. Therefore the primary goal is to improve these conditions. Decisionmakers often view measures to reduce the energy consumption negatively because they believe these measures may reduce indoor comfort levels, limit their functional/production capabilities, or increase costs. Moreover, if a retrofit compromises on energy efficiency, its energy-saving potential is “locked in” for the long term because of the longevity of the components.

When considering the building stock and the associated energy consumption for heating, cooling, ventilation, and lighting in the IEA member countries, we must realise that energy efficient buildings (most of which were built after 1980) represent about 20% of the building stock, but only 5% of the energy consumption. To meet the objectives of the Kyoto Protocol, we must concentrate on improving the energy-inefficient building stock. Therefore, this project focuses exclusively on the energy retrofit in selected building categories that represent a substantial part of the non-residential building stock: office/administrative buildings, large one-story production facilities and maintenance shops.

Before decisionmakers will consider energy conservation as a goal, they must overcome their reservations about the compatibility of energy conservation with other primary goals (i.e., occupants' comfort and building functionality). They need to see convincing, real-world examples that show how improvements in comfort and functionality can be accompanied by energy savings measures. Good technologies that achieve this end are currently available. The main obstacle to their implementation is simply a general lack of knowledge of their intelligent application.

Similarly, users must become more deeply involved in assessing the energy consumption of their facilities. It should be evident how their choices influence energy consumption. This is particularly important to ensure the long-term efficiency of installations. Simple tools for analysis are needed.

Public models (of which government buildings are an example) can influence a society's values. Government buildings can exemplify the intelligent application of energy-efficient technologies. Private sector individuals are more likely to adopt energy-saving technologies when they can see how Government authorities have constructively addressed energy problems. It is particularly important for Government buildings to demonstrate exemplary solutions and showcase them to the public. In other words, it is not only important to do something positive, but also to take the necessary steps to promote it. Government buildings can potentially change public opinion, and thereby help increase the market penetration of energy-saving technologies.

2. Scope and objectives

2.1 Scope

The scope of the Annex is the decision making process for energy retrofitting of Government non-residential buildings: e.g., office/administrative buildings, dormitories/barracks, service buildings and production and maintenance facilities. This decision making process must improve if it is to successfully cope with the challenges of increasing energy costs and climate change, and if it is to avoid "locking in" long-term commitment to energy-inefficiencies by adopting sub-optimal renovations. Consequently, the target group consists of all actors involved in this decisionmaking process, specifically *executive decisionmakers and energy managers of Government and Public buildings, performance contractors, suppliers and designers*. The IT-tool-kit **EnERGo**, supplemented by guidelines, best-practice, and case studies, will support these different user groups, and facilitate communication between them.

2.2 Objectives

The objectives of this Annex are:

1. To provide tools and guidelines to identify energy conservation opportunities in Government and Public buildings and to improve the indoor environment of these buildings in energy-efficient retrofitting projects.
2. To support decision makers in evaluating the efficiency and acceptance of available energy concepts.
3. To promote energy- and cost-efficient retrofit measures by providing successful examples.
4. To find improved ways of using Energy Performance Contracts (EPCs) for Government and Public buildings retrofit measures.

3. Means

3.1 Subtasks

To accomplish these objectives, participants will carry out research and development in the framework of the following four Subtasks (A, B, C and D):

- Subtask A:** Develop an energy assessment and analysis methodology/protocol and the **“Energy Assessment Guide for Energy Managers and ESCOs”**
- Subtask B:** Develop a database of **“Energy Saving Technologies and Measures for Government Building Retrofits”** with examples of best practices and case-studies
- Subtask C:** *Develop* “Best-Practice Guidelines for Innovative Energy Performance Contracts”
- Subtask D:** *Develop* IT-Toolkit **“EnERGo.”**

Figure 1 shows the structure of the Annex subtasks.

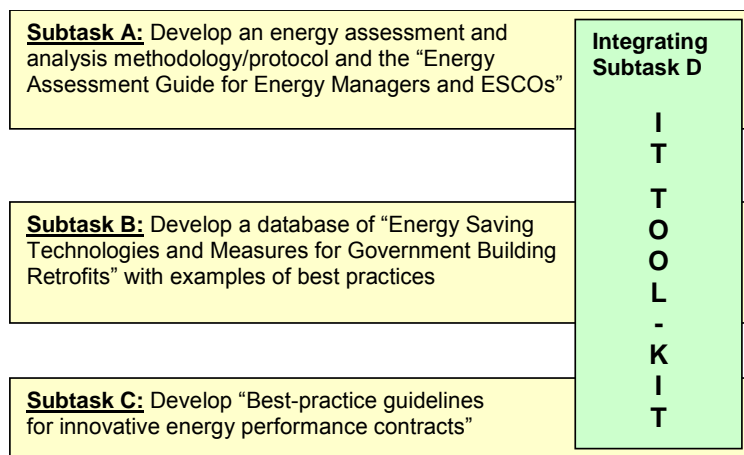


Figure 1. The structure of Annex Subtasks A-D

The IT Toolkit **“EnERGo”** is an intuitive usable electronic interactive source book, which provides a holistic assessment protocol on innovative energy efficient retrofit measures. It allows decision makers and their administrative staff to get extensive information, according to the individual focus of interest, on design inspirations, design advices, decision tools, design tools, commissioning methods and long term monitoring systems. Thus, the user will be able to increase quickly and reliably his knowledge in the respective field of interest. The user will have the choice to analyze design scenarios, benchmark buildings and use the pool of experience gained in the best practice examples to access information on energy saving potentials and requirements.

3.1.1 Subtask A: Develop an energy assessment and analysis methodology/protocol and the “Energy Assessment Guide for Energy Managers and ESCOs”

Subtask A will analyze best practices and procedures of identifying energy conservation opportunities in retrofitted Government and Public buildings. The opportunities relate to the building envelop, lighting, internal loads, HVAC, and other mechanical and energy systems. Subtask A will develop a common protocol for conducting energy assessments at administrative/office buildings, barracks and dormitories, service buildings, production and maintenance facilities. It will document resource consuming activities, and identify wasteful practices, prioritize conservation opportunities, implement best practices, and

guide investment in resource-conserving technology upgrades. The Annex will address several different scope (building stock, individual building, system and component) and depth levels of assessment:

- ◆ *Energy conservation opportunities analysis.* This involves no instrumentation using basic analysis to generate a list of top energy saving ideas (Level 1).
- ◆ *Energy optimization analysis geared toward funds appropriation.* This calculates savings and uses partial instrumentation with cursory analysis (Level 2).
- ◆ *Detailed engineering analysis with implementation, M&V.* This includes performance measurement and verification assessment, and a fully instrumented diagnostic audit (Level 3).

Subtask A will develop the rationale behind each of three levels of assessment. It will state the motivations behind undertaking each level, the expected results, and the degree of effort and instrumentation required. It will specify procedures, calculation tools and suggest the format of the report that will document the assessment findings. The subtask will result in the “Energy Assessment Guide for Energy Managers and ESCOs,” which can be used in Energy Audits and serve as a basis for the Energy Service Performance Contracts. Pilot studies will be conducted to apply and test the guide.

3.1.2. Subtask B: Develop a database of “Energy Saving Technologies and Measures for Government Building Retrofits” with examples of best practices and case-studies.

Subtask B will analyze a series of completed and planned best practices of buildings retrofits with energy efficient technologies of which a few are still under renovation and are to be finished in 2006–2007. Based on these international experiences and best practices, Subtask B will develop a database with case studies of promising energy saving technologies and measures (current, proven, well known or underused). These will include technologies/measures that relate to building envelope, internal load reduction, lighting, HVAC systems, energy consuming processes in the building, supplemental energy systems (e.g., compressed air, steam system), etc.

Subtask B will identify tools/computer programs to screen selected candidate technologies/measures, develop a procedure for that and screen for representative conditions (building type, standard climatic conditions, energy costs, etc). The technology descriptions and the results of the screening analyses and the case studies will be summarized by categories and presented in a user-friendly format. The database of measures and technologies will be used in Subtask D.

3.1.3 Subtask C: Develop “Best-practice guidelines for innovative energy performance contracts”.

Energy Performance Contracts (EPCs) are a method by which governments can finance energy conservation projects in their buildings using the energy and energy-related cost savings generated by the projects themselves. Numerous countries have put in place the mechanisms to permit EPCs in public and private buildings. The objective of this work is to identify and document the approaches countries have used to implement successful EPCs projects at government facilities in their countries, and to develop a set of consensus recommendations that can be used to improve existing EPCs programs, and implement new programs in countries that currently lack them. These recommendations will be compiled in a Best Practices Guide for Innovative Energy Performance Contracts. This guide will be translated as necessary into other languages for use by participating countries.

Country Reports from IEA-DSM Task X (Performance Contracting) provide a strong foundation for the development of Best Practices guidelines. While it is true that the legal, regulatory and energy policy framework of each country has a strong influence on the

way EPCs are implemented, the Country Reports indicate nevertheless that there are a number of issues that have been crucial to the success of EPCs in all of the member countries. These include:

Technical/Analytical Issues

- Baseline development
- Development of energy and cost savings estimates
- Measurement and verification of savings
- Technical assistance in EPCs development

Contract Management Issues

- Financing
- Price reasonableness of ECMs
- Performance period administration

The “*Best-Practice Guidelines for Innovative Energy Performance Contracts*” will be developed and will:

- Identify different goals and motivating factors for the use of EPCs.
- Describe reasoning by different countries for using EPCs in combination with or versus other funding mechanisms.
- Compile model EPCs contracts, documents, and processes. Analyze and compare these to identify best practices and their applicability in different country environments.
- Compare technical/engineering practices in the areas of baseline development, estimation of energy and cost savings, risks and guarantees, and measurement and verification of savings. Identify those techniques that have been most successful in allowing countries to meet their goals.

3.1.4 Subtask D: "IT-Toolkit "EnERGo"

Subtasks A, B, and C will provide their results as input to this joint activity. Subtask D will be based on these results, and will develop an electronic interactive source book (*IT-Toolkit "EnERGo"*). A central database will include all Annex results and will allow users to obtain extensive information, according to their individual focus of interest: energy saving opportunities, design inspirations, design advice, decision tools, design tools, commissioning methods, long-term monitoring systems and measures that require no financial investment. Thus, users will be able to quickly and reliably increase their knowledge in specific fields of interest. They may chose between analyzing design scenarios individually, or they may access a broader pool of information on energy saving potentials and requirements by using experiences gained from “best practice” examples.

The IT Tool-kit “EnERGo” will be based on the Energy Concept Adviser (ECA) tool developed in Annex 36 (www.annex36.com)—a package of selected analysis tools, that take into account the impact of light, cooling, and heating, as well as process requirements in buildings on comfort and energy criteria. The focus will be on interfaces to allow implementation of different national calculation engines. It will also include findings from several other IEA Annexes (e.g., Annex 37 “Low Exergy Systems for Heating and Cooling of Buildings”). Among the major value-added features of the proposed Annex (compared with the completed ones) are tools that identify potential areas of improvement (an Energy Assessment Protocol), an increased scope/menu of the energy efficient technologies and measures (database of “Energy Saving Technologies and Measures for Government Building Retrofits”), and tailored recommendations on their practical implementation (i.e., best-practice guidelines for innovative energy performance contracts).

3.2 Annex Management

The Annex is operated by the Operating Agent, Subtasks A, B, C and D are managed by Subtask Leaders.

3.2.1 Subtask Leaders

The Subtask Leaders of Subtasks A, B, C and D will be responsible for the quality and the management of the work to be performed under their Subtask. They will:

- a) Co-ordinate the work performed under the Subtask;
- b) Assist the Operating Agent in preparing the detailed program of work (including the budget),
- c) Assist in the co-ordination of the Annex and advise the Operating Agent on the performance of the Annex;
- d) Provide semi-annual status reports on progress and results to the Operating Agent and other Participants;
- e) Convene and lead Subtask meetings, as required;
- f) Prepare, edit, and organize the publication of technical reports resulting from the Subtask.

4. Results

All Subtasks will provide material for the final Annex product, the IT-Toolkit “EnERGo”, which will include, but will not be limited to the “Energy Assessment Guide for Energy Managers and ESCOs,” a database of “Energy Saving Technologies and Measures for Government Building Retrofits” and the “Best-Practice Guidelines for Innovative Energy Performance Contracts.”

Information dissemination will focus on the transfer of the research results to be used by practitioners. Methods of information dissemination will include public presentations, articles, and project website. Publications may be written in English or in the languages of the Participants' countries. Workshops will be organized in participating countries to show the latest project results and to provide an exchange platform for the target audience (notably energy managers, designers, ESCOs). Workshop materials will be published as a CD-ROM and on the website. The number of downloads from the project website will be counted to measure the success of the developed toolkit and guidelines.

5. Time Schedule

This Annex will enter into force on January 1, 2006 and will continue for a period of four (4) years.

Subtasks	Milestones	Timeline
A	A1 Collect materials and experiences of EA. Analyze best practices and procedures	1-18 months
	A2 Set up a monitoring, targeting & benchmarking platform for EA, test it and demonstrate	12-24months
	A3 Review and select simple calculation tools for EA. Collect a toolbox and test it in pilot energy audits of buildings	13-30 months
	A4 Develop a common EA model including a Guidebook and a toolbox, test the model by implementing pilot audits by an international team	25-42 months

	A5	Integrate the outputs into the Subtask D	36-48 months
	A6	Final report and dissemination activities	46-48 months
B	B1	Develop a List of ECMs	1-18 months
	B2	Model buildings and Simulation assumptions	1-12 months
	B3	ECMs description	1-24 months
	B4	ECMs screening	7-24 months
	B5	Existing case study descriptions	13-30 months
	B6	Report-transfer results to subtask D	31-36 months
	B7	New case study description	30-46 months
	B8	Final report	47-48 months
C	C1	Identify different goals and motivating factors for the use of EPC	1-10 months
	C2	Describe reasoning by different countries for using EPC in combination with or versus other funding mechanisms	8-18 months
	C3	Compile model EPC contracts, documents, and processes. Analyze and compare these to identify best practices and their applicability in different country environments	1-12 months
	C4	Compare technical/engineering practices in the areas of baseline development, estimation of energy and cost savings, risks and guarantees, and measurement and verification of savings. Identify those techniques that have been most successful in allowing countries to meet their goals	18-28 months
	C5	C5. Develop best-practices guidelines and transfer to Subtask D	25-36 months
	C6	Complete and publish final version of guidelines	47-48 months
D	D1	Analysis of codes/engines to be implemented	1-6months
	D2	Definition of standardized interface for in-output and user interface	6-18 months
	D3	Extended Technologies and Case studies viewer (based on the info from subtask B)	6-36 months
	D4	Development of national default values (building types, constructions, mech. systems, costs, climates, etc.)	12-36 months
	D5	Alpha version	30 month
	D6	Beta version	36 month
	D7	National evaluation and final version	36-48 months

6. Specific Obligations and Responsibilities of the Participants

In addition to the obligations previously enumerated, each Participant shall:

- a) Provide the Operating Agent with detailed reports on the results of the work carried out for each Subtask;
- b) Collect, assess and report to the Operating Agent data on the state of the art of retrofitting of Government buildings in his/her country that is related to his/her activity;
- c) Participate in the editing and reviewing of draft reports of the Annex and Subtasks.

7. Specific Obligations and Responsibilities of the Operating Agent

The Operating Agent is responsible for the overall performance, time schedule, reporting, knowledge transfer, etc. of this Annex. In addition the Operating Agent shall:

- a) Prepare the detailed Program of Work for the Annex in consultation with the Subtask Leaders and the Participants and submit the Program of Work and time schedule for approval to the Executive Committee;
- b) Be responsible for the overall management of the Annex, including overall co-ordination, liaison between the Subtasks and communications with the Executive Committee;
- c) Chair each of the Annex meetings and be responsible for setting the agenda. Assistance at each meeting will be provided by the Participant from the nation hosting the meeting;
- d) Prepare and distribute the results mentioned in the paragraph 4 above;
- e) Prepare joint assessments of research, development and demonstration priorities when desired or necessary;
- f) At the request of the Executive Committee organize workshops, seminars, conferences and other meetings;
- g) Propose and maintain a methodology and a format for the submission of information which is collected by the Participants;
- h) Provide, at least semi-annually, periodic reports to the Executive Committee on the progress and results of the work performed under the Program of Work;
- i) Provide an annual technical report to the Annex Participants;
- j) Provide to the Executive Committee, within six months after completion of all work under the Annex, a final report for its approval and transmittal to the Agency;
- k) Co-ordinate the efforts of all Participants and ensure the flow of information in the Annex;
- l) In coordination with the Participants, use its best efforts to avoid duplication with activities of other related programs and projects implemented by or under the auspices of the Agency or by other competent bodies;
- m) Provide the Participants with the necessary guidelines for the work to be carried out under the Subtasks, for the reports to be made and information to be distributed;
- n) Perform such additional services and actions as may be decided by the Executive Committee, acting by unanimity.

8. Funding

Participation in this Annex requires a minimum effort of 12 person-months per country. Each Participant's country is required to participate in at least one of the Subtasks A, B and C and all participants should participate in the Subtask D "IT-Toolkit." Participation may partly involve funding already allocated to a national activity, which falls substantially within the scope of work to be performed under this Annex. Aside from providing the resources required for performing the work of the Subtasks in which they are participating, all Participants are required to commit the resources necessary for activities that are specifically collaborative in nature and would not be part of a national program; for example, establishing common monitoring procedures, preparation for and participation in Annex meetings, co-ordination with Subtask participants, and contributing to documentation and information dissemination. These activities are estimated to require at least 50 per cent of the total required level of effort for participation in Subtasks.

The annual meetings shall be hosted in turn by the several Participants. The costs of organizing and hosting meetings shall be borne by the host Participant. Each Participant will bear his/her own costs to travel to the expert meetings. Attendance at expert meetings is mandatory.

The cost of publishing the reports and summary assessments described in the Paragraph 4 above shall be met by the Operating Agent.

9. Operating Agent and Subtask Leaders

The Operating Agent for the Annex 46: Alexander Zhivov (US Army Corps of Engineers Engineer Research and Development Center, USA)

The Subtask leaders are:

Subtask A: Jorma Pietilainen (VTT, Finland)

Subtask B: Ove Morck (Cenergia, Denmark) – pending on funding

Subtask C: John Shonder (Oak Ridge National Laboratory, USA)

Subtask D: Hans Erhorn (Fraunhofer Institute of Building Physics, Germany) – pending on funding

10. Information and Intellectual Property

10.1 Executive Committee's Powers

The publication, distribution, handling, protection and ownership of information and intellectual property arising from this Annex shall be determined by the Executive Committee, acting by unanimity, in conformity with the Agreement.

10.2 Right to Publish

Subject only to copyright restrictions, the Participants shall have the right to publish all information provided to or arising from this Annex, except proprietary information.

10.3 Proprietary Information

The Participants and the Operating Agent shall take all necessary measures in accordance with this paragraph, the laws of their respective countries and international law to protect proprietary information provided to or arising from this Annex. For the purposes of this Annex, proprietary information shall mean information of a confidential nature such as trade secrets and know-how (for example computer programs, design procedures and techniques, chemical composition of materials, or manufacturing methods, processes, or treatments) which is appropriately marked, provided such information:

- a) Is not generally known or publicly available from other sources;
- b) Has not previously been made available by the owner to others without obligation concerning its confidentiality;
- c) Is not already in the possession of the recipient Participant without obligation concerning its confidentiality.

It shall be the responsibility of each Participant supplying proprietary information and of the Operating Agent for appraising proprietary information, to identify the information as such and to ensure that it is appropriately marked.

10.4 Arising Information

All information developed in connection with and during activities carried out under this Annex (arising information) shall be provided to each Participant by the Operating Agent, subject only to the need to retain information concerning patentable inventions in confidence until appropriate action can be taken to protect such inventions.

10.5 Production of Relevant Information by Governments

The Operating Agent should encourage the governments of all Agency Participating Countries to make available or to identify to the Operating Agent all published or otherwise freely available information known to them that is relevant to the Annex.

10.6 Production of Available Information by Participants

Each Participant agrees to provide to a Subtask Leader or to the Operating Agent all previously existing information, and information developed independently of the Annex, which is needed by a Subtask Leader or by the Operating Agent to carry out its functions under this Annex and which is freely at the disposal of the Participant and the transmission of which is not subject to any contractual and/or legal limitations:

- a) If no substantial cost is incurred by the Participant in making such information available, at no charge to the Annex therefore;
- b) If substantial costs must be incurred by the Participant to make such information available, at such charges to the Annex as shall be agreed between the Operating Agent and the Participant with the approval of the Executive Committee.

10.7 Use of Confidential Information

If a Participant has access to confidential information which would be useful to a Subtask Leader or to the Operating Agent in conducting studies, assessments, analyses, or evaluations, such information may be communicated to a Subtask Leader or to the Operating Agent but shall not become part of the reports, handbooks, or other documentation, nor be communicated to the other Participants, except as may be agreed, between the Subtask Leader or the Operating Agent and the Participant which supplies such information.

10.8 Reports on Work Performed under the Annex

The Operating Agent shall, in accordance with paragraph 7 above, provide reports of all work performed under the Annex and the results thereof, including studies, assessments, analyses, evaluations and other documentation, but excluding proprietary information; prepare the Annex Brochure and updates to ECBCS Web-Site.

10.9 Copyright

The Operating Agent may take appropriate measures to protect copyrightable material generated under this Annex. Copyrights obtained shall be the property of the Operating Agent for the benefit of the Participants provided, however, that the Participants may reproduce and distribute such material, but if it shall be published with a view to profit, permission should be obtained from the Executive Committee.

10.10 Authors

Each Participant will, without prejudice to any rights of authors under its national laws, take necessary steps to provide the co-operation from its authors required to carry out the provisions of this paragraph. Each Participant will assume the responsibility to pay awards or compensation required to be paid to its employees according to the laws of its country.

11. Participants

The Contracting Parties and their designated Participants in this Annex are indicated in the following table.

Country	Organization	Contribution	National participation letter signed
Canada	Public Works	Subtasks A,B,D	X
Denmark	Cenergia	Subtasks A,B,C, D	
	SBI	Subtasks A,D	
	International Center for Indoor Environment and Energy	Subtask B	
Finland	Technical Research Centre of Finland/VTT	Subtasks A, B,C,D	X
France	Ecole de Nationale des Travaux Publics de l'Etat	Subtasks A,B,D	
Germany	Fraunhofer Institute of Building Physics	Subtask B,C,D	
	Ennovatis, GmbH	Subtask A,C,D	
	Schiller Engineering	Subtask A	
Italy	Politecnico Milano	Subtask B,D	X
Poland	FEWE	Subtasks A, B(Observer), D	X
Russia	ABOK	Subtask B, D (Observer)	
	CRIIB	Subtasks A, B,D(Observer)	
Slovakia	Slovak University of Technology	Subtasks B,D	
UK	University of Strathclyde / Energy Systems Research Unit (ESRU)	Subtasks B,D	
United States of America	US Army Corps of Engineers, ERDC	Subtasks A,B,C,D	X
	US Army Corps of Engineers	Subtasks A,B,C	
	NAVFAC	Subtasks A, B	X
	Oak Ridge National Laboratory	Subtasks C	
	Oklahoma State University	Subtask B	
	University of Illinois, Chicago	Subtasks A,B	X
	Johnson Controls, Inc.	Subtask B	
Plymovent Corp	Subtask B	X	