International Energy Agency

EBC Annex 66 Text

Definition and Simulation of Occupant Behavior in Buildings

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1. Background

Currently, there is international public concern over the rapid and continual increase in building energy consumption (BEC). Globally, in 2010, the buildings sector accounted for more than one-fifth of total worldwide consumption of delivered energy, with an increasing projection rate among all sectors [1]. Presently, seventy-three percent of the U.S. electricity and fifty-five percent of the U.S. natural gas are consumed in buildings [2], with other countries sharing common consumption challenges. Figure 1 shows large variations in the BEC per capita and per floor area in eight different countries. Many of the advanced technology users in developed countries, consumed more energy than developing countries, which lack widespread technology use. Having a clearer understanding of the underlying constituents which drive energy consumption, will aid the development of effective efficiency strategies and the ability to achieve prime economic and environmental targets [4, 5]. Figure 2 presents the energy consumption in buildings, broken down by end-use, for six different countries, in different years [6]. The proportions of each end-use are quite different, due to different operating modes of the systems and appliances. In fact, researches have indicated that building energy consumption is influenced by engineering technology, cultural concept, occupant behavior, social equity etc. with each component collectively contributing towards the total consumption [7, 8]. Evidence suggests occupant behavior plays a defining role in influencing the total consumption [8].

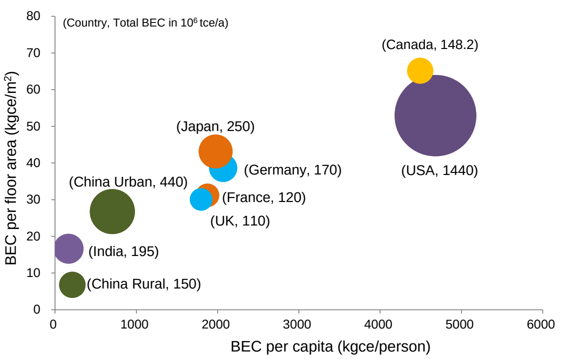

Figure 1: BEC in equivalent carbon emissions per capita per year in eight different countries [3].

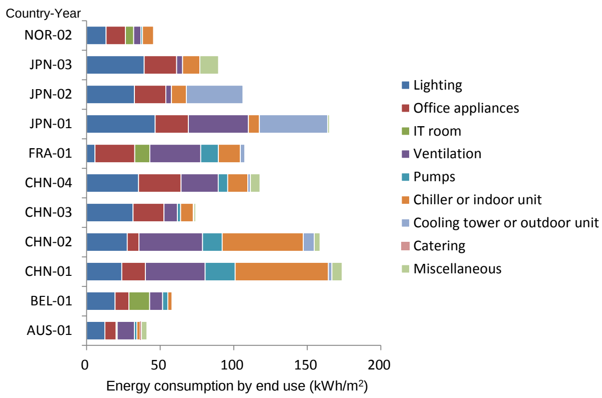

Figure 2: The building energy consumption by end uses [6].

The primary driver behind energy-related occupant behavior, includes the occupants' desire to achieve comfort or satisfaction within their environment. For example, an occupant may, adjust the thermostat, open the window, or turn on the lights, to achieve overall satisfaction. Therefore, occupant behavior greatly influences the operating mode of the equipment and in turn, the consumption. Previous research has demonstrated that similar spaces, with identical enclosures and equipment stock, can have vastly different energy consumption profiles. Data from a split-type, air-conditioner (AC), from 25 nearly identical households in a middle-income apartment building in Beijing, China, showed that the measured AC electricity consumption ranged from nearly 0 to 14 kWh/m^2, with an average of 2.3 kWh/m^2 [9]. The large variance in the energy consumption was primarily due to the operating mode; occupants which elected to run their AC for longer durations, at lower set points and/or throughout a larger space, consumed more energy than occupants which behaved oppositely [9]. Consequently, energy reduction methods must encompass a combination of technological development, building physics, and occupant behavior, to achieve the desired performance [5].

Different occupant behaviors require different technical solutions and different technical solutions may affect or change occupant behavior. Ultimately, this harmony between equipment function, occupant health/comfort, and energy performance, has to be realized. Results from a simulation study which investigated the integration of different occupant lifestyles with different levels of technological upgrades, suggested a 36% reduction in the energy consumption associated a technology upgrade and roughly an 80% reduction in energy consumption, due to lifestyle changes [10]. In a similar fashion, the impact of occupant behavior on equipment operation and energy performance was evaluated by comparing a controllable VRV (Variable Refrigerant Volume) with a non-controllable FCU +OA (Fan Coil Unit + Dedicated Outdoor Air) system. The results suggest the FCU+OA system, which had a higher standard rated coefficient of performance compared with the VRV system, consumed considerably more energy [11]. The flexibility of the VRV system provided users with more authority to control and adjust the room conditions, allowing for more efficient usage.

Disproportionate amounts of attention have been directed towards system or technological efficiency improvements, while ignoring the human dimension. Therefore, the cognition of influences of occupant behavior is quite insufficient both in building systems design and energy retrofit. This limited understanding of occupant behavior results in inappropriate, overly simplified, assumptions which lead to inaccurate expectations of building energy performance and large discrepancies in building design optimization, energy diagnosis, and building energy simulations. Figure 3 shows how occupant behavior influences building operation, which inherently will impact energy use and cost. This process triggers a short-term effect on occupant behavior through psychological, physiological and economic factors and also some long-term factors, such as comfort, culture and economy situation. Therefore, occupant behavior and building performance are highly coupled, with multiple feedback loops, making consistency challenging. Moreover, observations on occupant behavior often lack common principles from sociology and psychology, have restrictions due to privacy limitations and have other non-technical issues.

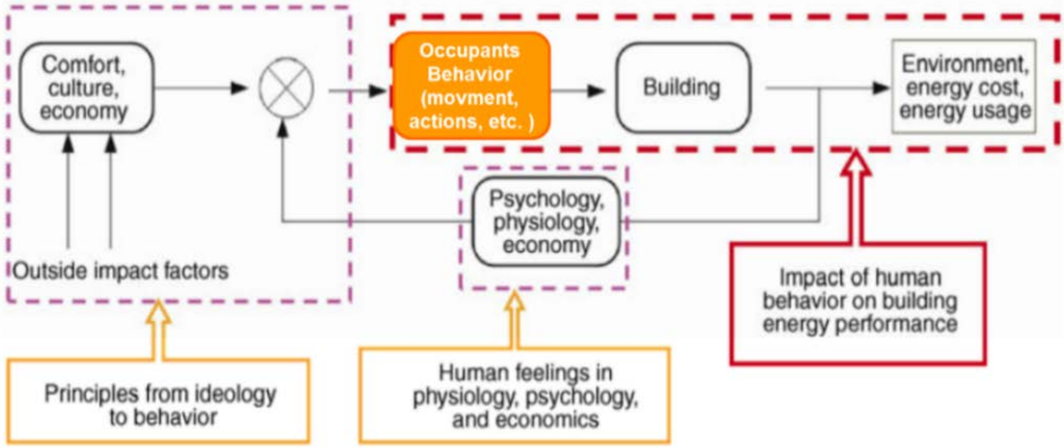

Figure 3: A schematic describing the relationship between occupants and buildings [12]

This Annex will address these challenges by focusing on accurately capturing and/or quantifying the impacts occupant behavior has on building energy performance. The broader aim is to identify and eliminate current inconsistencies in building energy simulation. Notably, the physiology, psychology, and general principles, ranging from ideology to behavioral aspects, will not be our primary focus. The effect of these factors will be considered as a kind of reference, of the diversion among occupant behavior models. Additionally, one top priority of this Annex is to foster international collaboration to establish a robust, universal, research framework. Four key areas which will be addressed: (1) experimental design and data collection, (2) model development and validation, (3) database of behavioral data, and (4) knowledge exchange and sharing. Inherently, the development and validation of a universally consistent and common research language will help provide consistency across the research field. This Annex will tackle the above challenges, with the spirit that the framework will be universally adopted, the models will be integrated into a coherent whole and efforts will be channeled where most needed. A robust occupant behavior research framework will foster innovation and drive broad, sustained growth towards achieving energy targets.

2. Objectives

The objectives of this Annex are outlined to address the following fundamental research question:

How to develop quantitative descriptions of the influence of occupant behavior on building performance, in order to analyze and evaluate the impact of occupant behavior on building energy consumption?

The main focus of this Annex is categorized into four components which contribute towards solving the fundamental research question:

1) Identify quantitative descriptions and classification of occupant behavior;
2) Develop adequate calculation methodologies of occupant behavior;
3) Implement occupant behavior models with building energy simulation tools;
4) Demonstrate the occupant behavior models in design, evaluation and operation optimization by case studies.

3. General technical approach and scope of work

The scope of this Annex will mainly focus on the impact of occupant behavior on building energy performance. The relationship between occupant behavior and the built environment, depends considerably on changes in the physical environment. Therefore, the general technical approach will be to use environmental descriptors as the driving parameters. Descriptors include temperature, relative humidity, CO_2 concentration, illumination, etc. and will be monitored and studied to better understand occupant behavior response. This approach assesses the way occupants respond to their physical environment and allows for the ideological, physiological, psychological and economic aspects of occupant behavior, to be treated as a secondary reference. The current scope is limited to typical offices, apartments and single family homes, with the assessment of the economics excluded.

4. Means

The scope of work outlined for this Annex is shown in Figure 4. The subtasks were created in an effort to provide solutions addressing the Annex objectives. Subtasks A, B and C focus on fundamental research, to develop experimental and analytical methods to represent occupant behavior in buildings. Subtasks D and E focus on practical applications, by integrating the developed models from Subtasks A, B, and C into current Building Energy Modeling (BEM) programs such as EnergyPlus, and applying research findings to case studies. The combined efforts of subtasks A to E, will cultivate solutions to real world problems in building design, operation, and controls.

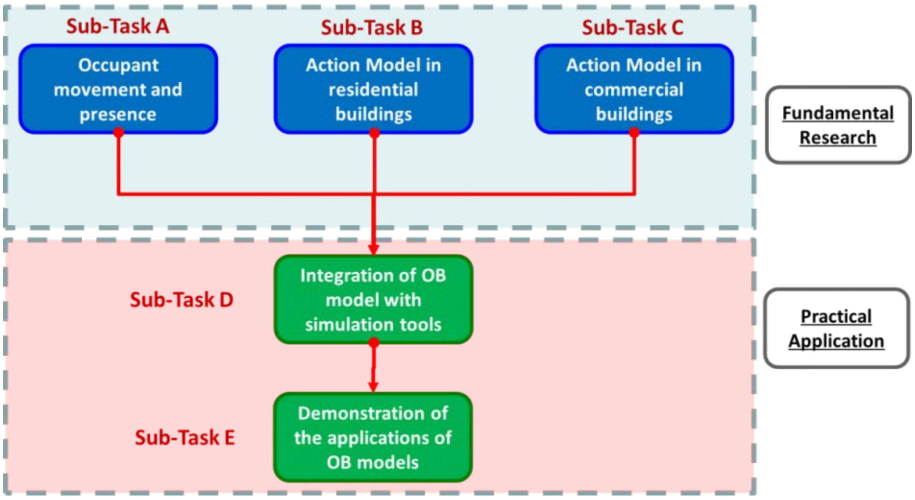

Figure 4: Subtasks structure of Annex 66

The current participants and details regarding each subtasks are as follows:

Subtask A: Occupant movement and presence models in buildings

Subtask leader:

Andreas Wagner, KIT, Germany;

Bing Dong, UTSA, USA

Simulating occupant presence and movement is fundamental for occupant behavior research. The main objective of this subtask is to provide a standard definition and simulation methodology for different personnel movements.

The influencing factors include various types of spaces, times and events. The common method, currently used, is the inverse function method. As occupants move stochastically, models are often probabilistic. Four types of occupancy models are categorized accordingly as: 1) Number of occupants at the Building level; 2) Occupied status at the Space level; 3) Number of occupants at the Space level; 4) Location of an individual at the Occupant level.

The scope of the subtask is as follows:

1. Develop standard definitions and classifications of occupant presence and movement to provide a unified way to describe movement;

Describe sensor technology and data collection methods providing useful data for modeling, measure and collect occupant movement data in the field for the Annex 66 general database;

2. Analyze the measured data and develop models of occupant movement using the standard definitions and classifications;
3. Validate the models using separate sets of measured data;
4. Apply results to actual engineering, including integration with simulation tools.

Subtask B: Occupant action models in residential buildings

Subtask leader:

Darren Robinson, Nottingham University, UK;

Henrik Madsen, DTU, Denmark

From reviewing projects and papers, it seems the occupant behavior field lacks consistency in (1) experimental design, (2) the availability of high quality data, (3) modelling methodologies and, (4) the availability of model algorithms or source codes. This subtask will coordinate efforts to lessen the severity of the above challenges, with the spirit that models are supposed to be integrated into a coherent whole. Avoiding replication and channeling efforts where most needed, will be essential.

The scope of this subtask is as follows:

1. Establish a network of researches on residential occupant modelling;
2. Develop state of the art residential occupant modelling; following the path from presence, activities, behavior to comfort and analysis;
3. Develop field survey and data management protocols for modeling;
4. Develop and define modelling strategies and validation techniques for modeling;
5. Use the findings to fill in the existing gaps between building energy simulations and measurements;
6. Lighthouse contributions of new models and their applications during the Annex lifetime for partner survey of existing and forthcoming linked projects.

Subtask C: Occupant action models in commercial buildings

Subtask leader:

Ardeshir Mahdavi, Austria Institute of Technology, Austria;

Liam O'Brien, Carleton University, Canada

Some specific challenges of occupant behavior modeling exist in commercial buildings, where occupant behavior is of high spatial and functional diversity. Commercial buildings are regulated by multiple, complex, environmental control systems, where the occupants have different levels of control power on their indoor environment. Additionally, occupant decisions in commercial buildings are often affected by social response, mutual influence and negotiation.

The scope of this subtask is as follows:

1. Develop empirical observations of occupant behavior from monitored equipment;
2. Develop mathematical/statistical methods;
3. Validate occupant behavior models by comparing with empirical observations;
4. Apply to real case scenarios in order to formulate guidelines for field survey and simulation.

Subtask D: Integration of occupant behavior models with BEM programs

Subtask leader:

Tianzhen Hong, LBNL, USA

This subtask will bridge Subtasks A-C and Subtask E to enable software development and integration and to promote third-party alliance. The integration of models with BEM programs will generally include three different ways: 1) pre-calculated schedules or settings, which are used as inputs for occupancy or actions without feedback; 2) direct code integration via function calls to dynamic link libraries (DLLs); and 3) co-simulation via functional mock-up interface to allow simultaneous simulations with current BEM programs. This task will aid in achieving the various targets related to building energy evaluation, outline in this Annex.

The scope of the subtask is as follows:

1. Develop a framework and an XML schema to describe energy-related occupant behavior in buildings, which provides a standard language for occupant behavior;
2. Develop a software architecture and module to incorporate the occupant behavior models developed in Subtasks A-C;
3. Produce a Software Developer Guide for third party software developers;
4. Integrate the Schema and software Module with BEM programs;
5. Demonstrate the use of the Schema and software Module through examples.

Subtask E: Applications in building design and operations

Subtask leader:

Khee Poh Lam, CMU, USA;

Cary Chan, Swire Properties, Hong Kong

This subtask will provide case studies to demonstrate the applications of the newly developed occupant behavior definitions and models. The models are intended to be used by building designers, energy saving evaluators, system operators, etc. Case studies will provide verification of the applicability of the models by comparing the measured and the simulated results.

The scope of the subtask is as follows:

1. Develop a behavior guideline to illustrate the impact of occupant behavior on building design and operation;
2. Create a few case studies to validate the software developed in Subtask D;
3. Demonstrate how to use the software module developed in Subtask D by example case studies.

3.2. Interactions with standards and code development

The proposed activities in this Annex will collaborate with the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE), International Organization for Standardization (ISO), and European Committee for Standardization (CEN). The overall goal includes standardizing and implementing human behavior research findings into building energy codes and standards, such as: (1) ASHRAE Thermal Comfort Standard 55, (2) Energy Standard 90.1 and 90.2, (3)Ventilation Standard 62.1 and 62.2, and (4) ISO/CEN new standard under-development: *Criteria for the indoor environment for energy performance of buildings*. Codes and standards development will greatly benefit from the objectives of this Annex, namely by providing accurate quantitative models of occupant behavior in buildings, for building energy calculations and simulations.

5. Summary of the Preliminary Technology Readiness Assessment

Ten of the countries expected to participate in the proposed Annex titled *Definition and Simulation of Occupant Behavior in Buildings*, performed a short, preliminary Technology Readiness Assessment. The aim of this assessment was to gauge the current status of the technologies which are included in this Annex. The following technologies were identified and scored:

1. Methods to describe and model energy-related occupant behavior in residential and commercial buildings;
2. Integration of the definition and models of occupant behavior with current building energy modeling programs;
3. Application of the definition and models of occupant behavior in residential and commercial buildings to improve design, operation, and retrofit of buildings

The Technology Readiness Limit (TRL) rating was as follows: TRL 1: Basic principles observed and reported; TRL 2: Technology concept and / or application formulated; TRL 3: Analytical and experimental critical function and / or characteristic proof of concept; TRL 4: Component and / or system validation in laboratory environment; TRL 5: Laboratory scale, similar system validation in relevant environment; and TRL 6: Engineering / pilot-scale, similar (prototypical) system validation in relevant environment. TRL 7 to 9 apply to demonstration and deployment. The results from the expert ranking are shown in Table 1.

Table 1: Summary of Preliminary Assessment from 10 Countries

Technology	China	USA	UK	Austria	Canada	Australia	Norway	Denmark	Italy	Hungary	Average	Min	Max
1: Methods to describe and model energy-related occupant behaviour in residential and commercial buildings	5	3	4	3	5	3	2	3	2	2	3.2	2	5
2: Integration of the definition and models of occupant behaviour with current building energy modelling programs	4	1	4	3	3	3	1	2	1	1	2.3	1	4
3: Application of the definition and models of occupant behaviour in residential and commercial buildings to improve design, operation, and retrofit	3	2	3	4	2	3	4	2	2	1	2.6	1	4
Confidence in the accuracy of your assessment	5	5	5	4	4	5	3	4	4	3	4.2	3	5

Table 1 shows the three technologies could be ranked from highest to lowest readiness, as follows: Technology 1 > Technology 3 > Technology 2. The highest ranking (TRL 5) was given for Technology 1, by China and Canada. Additionally, most experts demonstrated a high confidence in the accuracy of their assessments. From this survey, it could be concluded that all three technologies, although piloted by a limited number of sources, are important in building design, operation, and policies, to improve energy conservation and energy efficiency in buildings. Additionally, the results support the need for more comprehensive research, considering joint efforts from all the participating countries.

From the Technology Readiness Assessment, the current challenges and needed solutions associated with each technology were summarized, as follows:

Technology 1: Methods to describe and model energy-related occupant behavior in residential and commercial buildings (TRL3)

Current methods used to describe and model occupant behavior in buildings lack robust and uniform formulation. Usually occupant behavior is overly simplified due to the use of pre-determined time schedules and fixed set points. This becomes especially true for energy simulations conducted for building code compliance and performance ratings. Stochastic models have been developed to represent occupant interactions with windows, lights, and blinds/shades, but are very limited when dealing with the operation of HVAC systems or appliances. New research of stochastic methods to describe and model occupant behavior is strongly recommended.

The estimated TRL for this technology from the 10 countries ranged from 2 to 5, with an average of 3.2.

Technology 2: Integration of the definition and models of occupant behavior with current building energy modelling programs (TRL 2)

Due to the wide variation in the definitions and models of occupant behavior, their integration with current BEMPs is ad hoc and rudimentary. Most energy modelers describe occupant behavior in a simplistic fashion, lumping together many different events into a single time schedule and/or fixed set-points. This overly simplified approach is then directly input into all BEMPs. A few tools, such as ESP-r, CitySim, DeST, and DaySim, implement some stochastic models of occupant behavior. However, these models are still hampered by limitations and their applications and limited to researchers. EnergyPlus provides a feature, Energy Management Systems, that allows modelers to write code to simulate occupant behavior considering the inherent uncertainty and complexity, but this modeling requires advanced skill, typically beyond that of most modelers.

The estimated TRL for this technology from the 10 countries ranged from 1 to 4 with an average of 2.3.

Technology 3: Application of the definition and models of occupant behavior in residential and commercial buildings to improve design, operation, and retrofit of buildings (TRL 2/3)

Commonly, for passive energy systems design, occupant behavior is included in building energy simulations, but usually in a qualitative rather than quantitate way. One advantage for commercial buildings is they tend to use advanced control systems to mitigate the impact of occupant behavior. These advanced control systems include occupancy sensors and demand control ventilation. In general, occupant behavior in the building life cycle is oversimplified or ignored. Therefore, the potential energy savings is not realized. Most, if not all, countries emphasize the importance of developing methodologies to better incorporate occupant behavior in building life cycle. Additionally, there is widespread, international agreement that new definitions and models of occupant behavior are needed. This has to occur before occupant behavior can becoming fully integrated into practice.

The estimated TRL for this technology from the 10 countries ranged from 1 to 4 with an average of 2.6.

6. Results

Our work aims to compile and develop new mathematical models to represent occupant behavior using stochastic methods. The anticipated output will be:

- A combination of methods and definitions to encourage standard measurement and collect data techniques;
- The development of new occupant behavior models;
- A software module with a framework to describe occupant behavior to allow for the easy development of behavior models;
- The integration of the software module with building energy modeling programs;
- The use of case studies to demonstrate the use of the deliverables to solve real world problems and to improve building design, operation and energy retrofit analysis.

These products generated during this Annex target researchers, developers of simulation software, building designers and operators, energy saving evaluators, HVAC engineers and energy standards practitioners. The anticipated results generated from the five subtasks are described as follows:

Subtask A: Occupant movement and presence models in buildings

Occupant movement is a fundamental element to occupant behavior research. It is essential to model interactions between occupants and the related energy systems. Occupant presence and movement is under researched and oversimplified with predefined schedules. Subtask A aims to develop technical definitions, classifications, descriptions, measurements, modeling, validation, and applications of occupant movement and presence in buildings. The main outputs of ST-A are standard definitions and a simulation methodology for different occupant movement models.

Subtask B: Occupant action models in residential buildings

Occupant action behavior (e.g. opening window, switching lights, and turning on/off AC) in residential buildings affects building performance significantly. Subtask B aims to study proper procedures for experimental field studies, reliable modeling technology development, with particular attention on the natural sources driving the system. Moreover, scientifically rigorous validation procedures and case studies for model applications, will be key components of this subtask. The expected output of this subtask is a standard description for occupant action behavior simulation, systematic measurement approach and modeling and validation methodology, in residential buildings.

Subtask C: Occupant action models in commercial buildings

Both occupants' actions and building operators' actions influence the energy performance greatly in commercial buildings. Operators' actions include turning on/off chillers, pumps, fans, etc. and also specifying set points of equipment. The interaction between individual occupants is another key factor in commercial buildings, as most occupants share offices. Further the interdependence between different comfort parameters (e.g. thermal and visual comfort) has to be tackled. The expected output of this subtask is a standard description for occupant action behavior simulation, systematic measurement approach and modeling and validation methodology in commercial buildings.

Subtask D: Integration of occupant behavior models with BEM programs

It is essential to integrate the occupant behavior models with the state-of-the-art BEM programs to simulate the influence of occupant behavior on building energy and performance. Subtask D aims to develop and integrate the tools (occupant behavior XML schema and software module developed in the Annex) with current BEM programs like EnergyPlus, DeST, TRNSYS, and IDA ICE. The expected output of this subtask is an occupant behavior XML schema, a software module which can integrate with BEM programs, a software developer's guide, and sample computer codes to demonstrate the use of the schema and the software module.

Subtask E: Applications in building design and operations

Subtask E aims to deploy and demonstrate the use of methods and tools developed in the Annex, to improve building design, operations, and energy performance by case studies (either simulation or combined with field studies). Case studies will provide verification of the applicability of the models by comparing the measured and the simulated results.
The expected output of this subtask includes the development of a behavioral guide, useful to architects, engineers, building operators, and designers of controls systems. The outcomes and targeted audience are listed in Table 2.

Table 2: Outcomes and targeted audience of the subtasks

	Deliverables	Targeted Audience	Related Subtasks
1	A report on the guidelines of behavioral data collection	Building Energy Researchers; Energy Modelers; Simulation Software Developers	Subtask A, B & C
2	A report on the methodologies to develop and validate occupant behavior models	Building Energy Researchers; Energy Modelers; Simulation Software Developers	Subtask A, B & C
3	A report on the integration and applications of occupant behavior models	Building Designers; Energy Saving Evaluators; HVAC Engineers; System Operators	Subtask D & E

7. Time Schedule

This Annex shall remain in force until December 2017. The Preparation Phase includes the International Forum, which was organized on August 23, 2013 in Paris, France. Participants from Netherlands, Germany, Canada, Austria, USA, Australia, China, UK, Korea, Italy, Belgium, France, Norway, Denmark, and Poland, attended. The preparation phase started November 2013 for one year and be followed by the Working Phase from November 2014 to June 2017. The Reporting Phase will last for half a year, from July 2017 to December 2017. Figure 5 shows an overview of the proposed timeline.

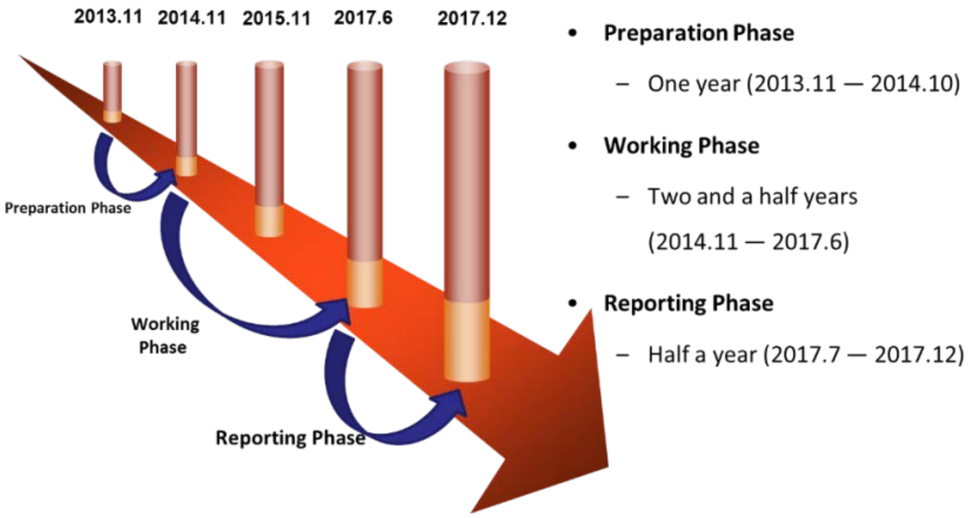

Figure 5: Proposed time schedule for the Annex

8. Funding

Semi-annual meetings: The working meetings shall be hosted in turn by one of the participants. The costs of organizing the meeting shall be borne by the host participant.

Task sharing activities: Each participating country shall commit to a minimum of six person-months of labor, for each year of the Annex term. In addition, the Operating Agent shall commit a further three person-months per year.

Individual financial obligations: Each participating country or in cases where the country is not a member of the Executive Committee, the participant *shall bear all costs incurred* during the preparation, working and reporting phases. Funding, independent of this Annex, is expected to cover labor costs, consumables, investments, reporting (included eventual overhead costs) associated with the travel to two expert meetings per year, during the four years of the working phase of the Annex. For the Operating Agent funding shall allow for an extra four person-months per year and the attendance at the semi-annual Executive Committee meetings.

Publications: The costs of publishing the final reports shall be met by the Operating Agent.

9. Commitments

9.1. Specific obligations and responsibilities of Official Participants

- Participants shall commit to 3 person months per year.
- Each participant shall work on at least one of the subtasks of the Annex.
- Each Participant shall provide the Operating Agent with detailed reports on the results of the work carried out for each Subtask.
- Each Participant shall participate in the editing and reviewing of draft reports of the Annex and Subtasks.
- Each participant shall attend the semi-annual Annex working meetings. If several people from the same country participate, that country should designate at least one expert to act as a technical contact regarding the national contribution.

9.2. Specific obligations and responsibilities of Observing Participants

- The duties of the observer are to actively stay informed and help review document(s) and/or report(s) produced by the Annex.
- Each observer can attend the semi-annual Annex working meetings, but attendance is not mandatory.
- Each observer is not obligated to the person-months labor requirement, but is encouraged to actively participate as much as possible.

9.3. Specific obligations and responsibilities of the Subtask Leaders

Subtask leaders who are responsible for a subtask have the duty to:

- Commit to 4 person months per year.
- Coordinate and supervise work of the subtask;
- Assist the Operating Agent to prepare detailed work plans;
- Report to the Operating Agent with the subtask results;
- Coordinate the final reporting resulting from subtasks;
- Assist the Operating Agent in editing the final reports of the Annex.

9.4. Specific obligations and responsibilities of the Operating Agents

The additional duties of the Operating Agent are to:

- Commit to 6 person months per year.
- Prepare joint assessments of research, development and demonstration priorities;
- Organize workshops, seminars, conferences and other meetings;
- Prepare the detailed Program of Work for the Annex in consultation with the Subtask Leaders and the Participants and submit the Program of Work for approval to the Executive Committee;
- Propose and maintain a methodology and a format for the submission of information;
- Provide, at least semi-annually, periodic reports to the Executive Committee on the progress and the results of the work performed under the Program of Work;
- 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;
- In co-ordination 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;
- Provide the Participants with the necessary guidelines for the work they carry out with minimum duplication;

- Perform such additional services and actions as may be decided by the Executive Committee.

9.5. Operating Agent

The operating agents for this Annex will be:

- Professor Da Yan at Tsinghua University, China, and
- Dr. Tianzhen Hong at Lawrence Berkeley National Laboratory, USA.

9.6. Information and Intellectual Property

All Annex related information will be stored on the website, http://www.annex66.org. Each participating country and each Official Participant has access to the password protected portion of this website. The site will be managed by the Operating Agent. For the duration of the Annex, all specific Annex documents will be highlighted on this website. This excludes information which is not to be in the public domain.

All Annex participants have the right to publish journal papers that report on Annex related work. When doing so, the Annex shall be acknowledged as one of the vehicles that assisted in carrying out the work. All final Annex Reports will be placed in the public domain.

10. Participants in this Annex

There are 15 countries participating in Annex 66, see Table 3 for details.

Table 3: List of participating countries

No.	Country	No.	Country
1	Austria	9	New Zealand
2	Canada	10	Norway
3	China	11	Poland
4	Denmark	12	Republic of Korea
5	France	13	Spain
6	Germany	14	UK
7	Italy	15	USA
8	Netherlands		

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