



TASK 40 / ANNEX 52

# Towards Net Zero Energy Solar Buildings

IEA SHC / ECBCS Project Factsheet

Task 40 / Annex 52

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## CONTEXT (THE ISSUE?):

Energy consumption in commercial and residential buildings worldwide accounts for about one-third of the world's energy and one-quarter of greenhouse gas emissions. If current trends continue, by 2025, buildings worldwide will be the largest consumers of global energy, using as much power as the transportation and industrial sectors combined. Recent studies have found that improving energy efficiency in buildings is the least costly way to reduce a large quantity of carbon emissions. By changing energy management practices and instituting technologies that enhance energy efficiency, building owners and managers can reduce energy consumption by up to 35 per cent. However, energy efficiency efforts in buildings alone can not address future demand for more energy by this sector. In order to achieve breakthrough solutions to this problem, it is evident that a coordinated effort in whole-building systems approach that emphasizes the necessity of integrating renewable on-site or distributed generation and energy efficiency is required to design the buildings of the future. Several International Energy Agency (IEA) countries have adopted a vision of so-called 'net zero energy buildings' (NetZEBs) as long-term goal of their energy policies. However, what is missing is a clear definition and international agreement on the measures of building performance that could inform 'zero energy' building policies, research, development and deployment programmes, and industry adoption around the world.

## HOW TO ADDRESS THIS ISSUE? TASK 40 (JOINT ECBCS ANNEX 52):

In October 2008, the IEA had approved the creation of a new five-year (to September 2013) international collaborative research initiative between the Solar Heating and Cooling (SHC) and the Energy Conservation in Buildings and Community Systems (ECBCS) Implementing Agreements entitled "Towards Net-Zero Energy Solar Buildings". The principle *objective* of this Task 40/Annex 52 work is to study current net-zero, near net-zero and very low energy buildings and to develop a common understanding, a harmonized international definitions framework, tools, innovative solutions and industry guidelines. A primary means of achieving this objective is to document existing NetZEB or near NetZEB examples in the participating countries and to propose practical projects with convincing architectural quality for future demonstration. These projects aim to equalize their small annual energy needs, cost-effectively, through building integrated heating/cooling systems, distributed / on-site power generation and interactions with utilities. These examples and the supporting research results presented in conference papers,

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**The Solar estate 'Solarsiedlung Freiburg am Schlierberg', Freiburg, Germany, source: Büro Disch.**



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**The EnerPos Building, Université de la Réunion, île de la Réunion, France.**



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**The EcoTerra™ house by Les Maisons Alouette, Eastman, Quebec, Canada., source J. Ayoub**



international journals, Task reports, sourcebooks, guidelines and tools are viewed as keys to industry adoption. The Task will build upon recent industry experiences with net-zero and low energy solar buildings and the most recent developments in whole building integrated design and operation. The joint international collaborative activity will address concerns of comparability of performance calculations between building types and communities for different climates in participating countries. The goal is to develop solution options that are attractive for broad market adoption. The **scope** includes major building types (residential and non-residential), new and existing, for the climatic zones represented by the participating countries. The work will be linked to national activities and will focus on individual buildings, clusters of buildings and small settlements. The work will be based on analysis of existing examples that leads to the development of innovative solutions to be incorporated into national demonstration buildings. To-date, the Task has a membership of 55 National Experts and an addition 25 regular participants and contributors representing the participation of 18 OECD member countries. To achieve these results, the work of the Task has been allocated along four major **RESEARCH STREAMS**:

The **FIRST (SUB-TASK A: DEFINITIONS & IMPLICATIONS)** deals with establishing an internationally agreed understanding on NZEBs based on a common methodology. This is done by: reviewing and analyzing existing NetZEB definitions and data with respect to the demand and the supply side; studying grid interaction (power/heating/cooling) and time dependent energy mismatch analysis; developing harmonized international definition framework for the NetZEB concepts considering large-scale implications, exergy and credits for grid interaction (power/ heating/cooling); and, developing a monitoring, verification and compliance guide for checking the annual balance in practice

(energy, emissions and costs) harmonized with the definition. To-date continued to arrive further at an international consensus on a definitions framework, and monitoring procedures of NetZEB as well as adapting the US Department of Energy's High Performance Buildings Database to capture information on NetZEB in participating countries. Results of the work have been encapsulated in four-technical papers entitled "*Load Matching and Grid Interaction of Net Zero Energy Buildings*"; "*Net Zero Energy Buildings: Calculation Methods and input Variables - An international View*"; "*Criteria for Definition of Net Zero Energy Buildings*"; and "*Comfort and Energy Performance Recommendations for Net Zero Energy Buildings*".

**Activity A1:** NZEB definitions framework

**Activity A2:** Monitoring, verification and compliance guide

**Activity A3:** Grid interactions

#### **Sub-task A Leaders:**

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The ***SECOND (SUB-TASK B: DESIGN PROCESSES & TOOLS)*** aims to identify and refine design approaches and tools to support industry adoption (Figure 1). This is done by conducting work along four major R&D stream: in documenting and analyzing processes and tools currently being used to design NetZEBs and under development by participating countries; assessing gaps, needs and problems to inform simulation engine and detailed design tools developers of priorities for NetZEBs; qualitative and quantitative benchmarking of selected tools; and selecting six case studies buildings (detailed analysis of simulated/designed vs. actual performance), and proposing the redesign/optimization of these buildings. Results of the work were developed in four technical papers entitled "*Design, Optimisation and Modelling Issues of Net-Zero Energy Solar Buildings*"; "*Applying A Design Methodology for a Net Zero Energy House to Evaluate Design Processes and Tools*"; "*Solar 2002: A Belgian Pilot Project for Zero Energy Buildings*"; and "*Design Optimisation Methodologies for a Near Net Zero Energy Demonstration Home*".

**Activity B1:** Processes and tools

**Activity B2:** Pre-concept design, feasibility tools

**Activity B3:** Tools guide and worked examples

#### **Sub-task B Leaders:**

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- The **THIRD (SUB-TASK C: DESIGN, ENGINEERING, AND TECHNOLOGIES SOLUTION SETS )** focuses on developing and testing innovative, whole building net-zero solution sets (Figure 2) for cold, moderate and hot climates with exemplary architecture and technologies that would be the basis for demonstration projects and international collaboration. This is achieved by: documenting and analyzing current NetZEBs designs and technologies, benchmarking with near NetZEBs and other very low energy buildings (new and existing), for cold, moderate and hot climates considering sustainability, economy and future prospects using a projects database, literature review and practitioner input (workshops); developing and assessing case studies and demonstration projects in close. Results of the work to-date have been reported in five technical papers entitled *“The Road Towards “Zero Energy” in Buildings: Lessons Learned from The Solar XXI Building in Portugal”*; *“Net Zero Energy Solar Buildings: An Overview and Analysis on Worldwide Building Projects”*; *“Net Zero Energy Buildings in France: From Design Studies to Energy Monitoring - A State of the Art review”*; *“BOLIG+ - an Energy Neutral Multifamily Building”*; and *“Impact of the Zero Energy Mass Custom Home Mission to Japan on Industry Education Toward Commercialisation”*.

Activity C1: NZEB STC Database:

Activity C2: Analysis Matrix

Activity C3: Research analysis of themes undertaken

Activity C4: STC Source Book

#### Sub-task C Leaders:

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- The **FOURTH (SUB-TASK D: DISSEMINATION & TECHNOLOGIES)** and final research stream is a cross-cutting work that focuses on dissemination to support knowledge transfer and market adoption of NetZEBs on a national and international level. This is accomplished by: establishing a NetZEB web page within the IEA SHC/ECBCS Programmes’ framework, and a database that can be expanded and updated with the latest projects and experiences; transferring the Task outputs (reports, sourcebooks, guidelines, other) to national policy groups, industry associations, utilities, academia and funding programs; participating in national and international workshop, seminars, and industry exhibitions highlighting the results and activities of the Task; contributing high quality technical articles and features in journals to stimulate market adoption; and, establishing an education network of highly qualified people that will continue the work in the filed in their future endeavours. To-date, plans have been put in action to hold the first six-day training workshop in Montreal, Canada, in conjunction with the ASHRAE 2011 summer conference, that will provide current PhD students and advanced Master’s students a thorough understanding on NetZEBs and their fundamental principles.

Activity D1: NZEB web page

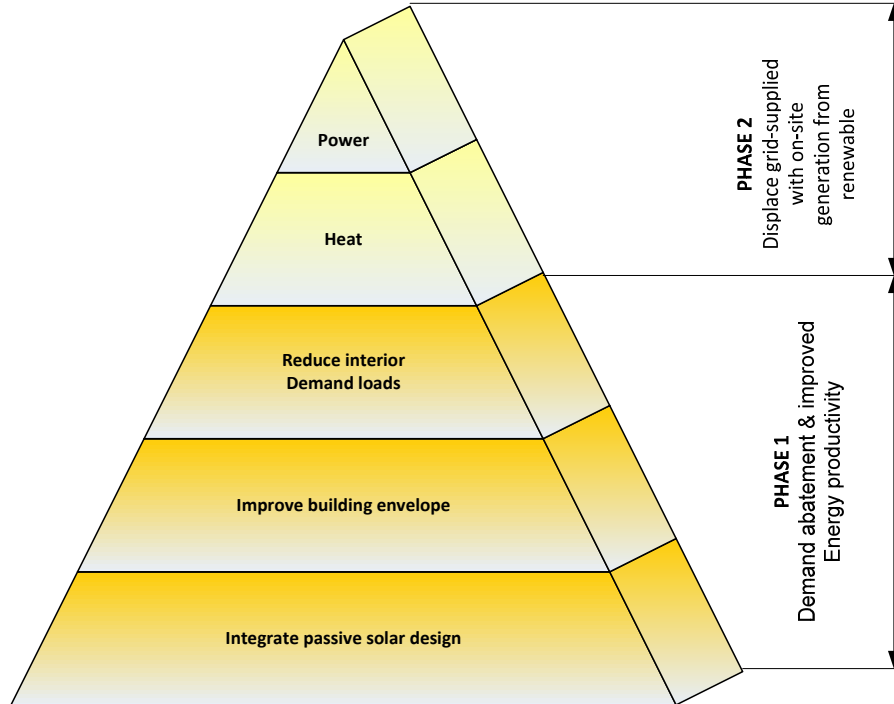
Activity D2: Reports production, Source book(s): Vols. 1, 2 and 3

Activity D3: Education network for PhD students and summer schools

Activity D4: Outreach (conferences, seminars, workshops etc.)

**Sub-task D Leaders:** Josef Ayoub (Operating Agent) and all Sub-Task Leaders, National Experts, and Regular Participants and Contributors.

### APPROACH USED IN THE R&D COLLABORATION:



### PRODUCTS (DELIVERABLES):

- Source books /guides targeting specific groups such as national policy makers, industry and industry associations, utilities, academic, and funding programmes managers
- High quality Technical Papers and Task Reports.
- An international education material and network
- Expansion of the US DOE High Performance Buildings Databases with `as-designed and `as-achieved` NetZEB examples from participating countries
- Knowledge transfer portal / web-site / downloadable material (<http://www.iea-shc.org/task40/>)

### PARTICIPATING COUNTRIES:

Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Italy, Republic of Korea, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, USA.



#### SHC Vision

The greater use of solar designs and technologies in the built environment, and for agricultural and industrial process heat.



#### ECBCS Vision

For near-zero primary energy use and carbon emission solutions to be adopted in buildings and communities, where energy is produced on demand.