

SHC TASK 59 / EBC ANNEX 76

HISTORIC BUILDINGS

DEEP RENOVATION OF HISTORIC BUILDINGS TOWARDS LOWEST POSSIBLE ENERGY DEMAND AND CO₂ EMISSION (NZEB)

Annex

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Prepared by:

Alexandra Troi, EURAC (IT), Walter Hüttler, e7 (AT), Tor Broström, UU (SE), Rainer Pfluger, UIBK (AT) and Carsten Hermann, HES (UK)

With contributions from:

UCL, BBRI (BE), Fraunhofer ISE & IBP (DE), SBI (DK), POLIMI (IT), Carrig/ICOMOS (IE), Tecnalia, Cupa innovacion (ES), PSU (US), Auckland and Victoria University (NZ), SUPSI (CH)

Annex Outline

SHC Task 59 / EBC Annex 76

DEEP RENOVATION OF HISTORIC BUILDINGS TOWARDS LOWEST POSSIBLE ENERGY DEMAND AND CO2 EMISSION (NZE)

1. Definitions

Historic Buildings in this Task are defined according to the scope of prEN 16883 according to which a historic building has not necessarily to be formally “listed” or protected, but includes all buildings that have something that is worth preserving. The EN 16883 puts it like this: “This European Standard provides guidelines for sustainably improving the energy performance of historic buildings, e.g. historically, architecturally or culturally valuable buildings, while respecting their heritage significance. The use of this standard is not limited to buildings with statutory heritage designation. It applies to historic buildings of all types and ages”.

NZEB – net zero energy buildings is defined according to IEA SHC Task 40 | EBC Annex 52 where an equalized energy balance is reached by bringing together architectural design, energy efficiency and local use of renewables. This Task, however, does not present the equalized balance as absolute threshold, but as the target towards which to aim - with the above threefold approach.

Lowest possible energy demand on the one hand side, takes into account, that in the case of historic buildings, the preservation of the heritage value might sometimes result in absolute constraints on certain interventions. On the other hand side it also spans a space from “reducing energy demand to a close to NZEB standard, but do this with a focus on preserving as much as possible of the buildings historic/aesthetic value” to “reducing the energy demand as much as possible while preserving all the buildings historic/aesthetic values”. Reality will lie in between, depending on the value of the building, and it will also consider additional parameters like comfort and economic feasibility.

Understanding *Solar renovation* as a holistic approach, which aims at reducing the demand and providing energy from the sun – integrating solar in all its forms, from the daylight and passive solar heating to active solar use via both PV and thermal collectors – is also in the line with the above threefold approach to NZEB balance.

2. Purpose and Objectives

Historic buildings make up a considerable part of our building stock (one fourth for Europe). They are the trademark of numerous cities, and they will only survive if maintained as a living space. This means, that in order to save this heritage for future generations, we need to find conservation compatible energy retrofit approaches and solutions, which allow to preserve the historic and aesthetic values while increasing comfort, lowering energy bills and minimizing environmental impact.

In the last 10 years a shift in paradigm could be observed: While in times of the first EPBD, a strong opposition from conservators and architects could be observed – “don’t touch these buildings” – there is growing a new openness, a much more constructive approach – “let’s find

the right solutions together”. Examples for this development are last but not least the installation of the International Scientific Committee on Energy and Sustainability within ICOMOS and the development of “Guidelines for improving the energy performance of historic buildings” (EN16883, now under final vote) by the CEN TC 346 on Conservation of Cultural Heritage.

Now is an important moment to identify and promote good approaches and solutions.

Standard energy saving measures are often not compatible with preserving the historic buildings’ character, nevertheless the energy performance can be improved considerably if the right package of solutions for the specific building is identified. Actually, also the possibilities to use solar energy in historic buildings are more than one might expect in a first moment, if solar panels/collectors

- are compatible in colour and design to established (roof) material
- are integrated in an architecturally attractive way
- can be positioned in parts of the building where they are not as visible
- panels and mounting systems are reversible
- stand-alone solar systems are not interfering aesthetically with the building itself are possible

Realised examples show that a reduction of “Factor 4” (i.e. reduce the energy demand by 75%) and beyond is possible also in historic buildings preserving their heritage value – depending however on the specific case. While defining a minimum performance as for “standard” buildings does not make sense, when looking at the specific building, the design team should not “stop thinking” too early! A considerable reduction in demand – also thanks to optimisation of passive solar use – opens up the possibility to go with active solar contribution towards nZEB.

The Objectives of the Task are to

- Develop a solid knowledge base on how to save energy in renovation of historic and protected buildings in a cost efficient way.
- Identify the energy saving potential for protected and historic buildings according to typologies of building studied (residential, administrative, cultural...)
- Identify and assess replicable procedures on how experts can work together with integrated design to maintain both the heritage value of the building and at the same time make it energy efficient
- Identify and further develop tools which support this procedure and its single steps
- Identify and assess conservation compatible retrofit solutions in a “whole building perspective”
- Identify specifically the potential for the use of solar energy (passive and active, heating, cooling and electricity) and promote best practice solutions
- Transfer knowledge

In the strategic plan it is stated that to realize this huge potential for solar heating and cooling in the building sector, it is essential to integrate solar technologies into the built environment in an appropriate way. Solar based renovation of existing building stock is listed as one of the most important activities to achieve this.

To reach these objectives the IEA SHC implementing Agreement will collaborate with the IEA EBC Implementing Agreement at a “Moderate Level Collaboration”, and with the IEA PVPS Implementing Agreement at a “Minimum Level Collaboration” as outlined in the SHC Implementing Agreement’s Policy on Collaboration.

3. Activities

(a) *Main activities*

The Task is structured in the following SubTasks:

SubTask A. Knowledge Base

Collection of Best Practice cases, following the approach of IEA SHC Task 37 and 47. Assessment of existing experience and identify energy saving potential.

SubTask B. Multidisciplinary planning process

Identification of replicable procedures on how experts can work together to maintain both the expression of the building, and at the same time make it more energy efficient. Identification and further development of tools which support the process and its single steps

SubTask C. Conservation compatible retrofit solutions and strategies

Identification of replicable solutions from case studies. Connection to and integration of ongoing R&D on conservation compatible retrofit solutions. Assessment of technical solutions from both energy and conservation point of view.

SubTask D. Knowledge transfer and dissemination

(b) *Sub-activities*

Within the 4 Subtasks specific objectives have been defined and respective activities to reach them.

SubTask A. Knowledge Base

The main objective of Subtask A is to collect best practice cases and to assess the existing know-how regarding deep renovation of historic buildings. Subtask A will build on results from national and international research and demonstration projects, such as 3ENCULT, EFFESUS, RIBUILD, 4RinEU, “Gründerzeit mit Zukunft”, “Spara och Bevara” a.o.

Specific objectives of Subtask A are to provide detailed information on technical solutions which can be applied in historical buildings in order to respect and preserve their architectural and cultural value but also allow to modernizing buildings according to actual environmental standards and requirements from the users. In addition, all case studies will have to provide a minimum level on monitoring and evaluation data, regarding energy consumption and costs as well as information on usability.

Furthermore, a specific focus will lie on the decision context for innovative solutions: what were the reasons for buildings owners and/or architects and planners to take innovative solutions for deep renovation into account and to implement them during the renovation process. What are the lessons learned from the case studies in terms of replication potential on national and international level?

Main target groups to be addressed are building owners, architects and planners, real estate developers but also people on the administrative level (urban planning, urban renewal, conservation administration). The format for collecting and presenting the

best practice cases will be a data base, which will be developed based on existing examples e.g. atlas.arch.bz.it and examples from IEA Task 37 and 47.

A.1 Overview on existing best practice examples and detailed definition of scope and format of best practice cases to collect.

A.1.1 Overview on existing best practices will be delivered from all countries in order to derive a common understanding of “best practice”

A.1.2 Detailed definition of scope (type of buildings, age, building ensembles, focus areas ...)

A.1.3 Definition of format and technical implementation of data base (based on existing examples of best practice documentation)

A.2 Gathering information on best practice cases

All participants collect relevant information on best practice cases according scope defined in A.1.

A.2.1 Definition of common template on categories of information (building data, stakeholders, planning process, technical measures, energy consumption, costs)

A.2.2 Gathering of relevant basic information on best practice cases by all participants: first phase -> best practice long list

A.2.3 Common assessment of best practice cases and decision on shortlisted best practice cases to be documented in detail in the second phase. The decision on short listed examples will be based on following criteria: ambition of innovation, available monitoring & evaluation data (energy consumption, costs) as well as decision context -> best practice short list

A.3 Assessment of best practice cases

A.3.1 General conclusions will be drawn in terms of replicability of best practice cases and transferability of specific favourable framework conditions and incentives to other countries.

A.3.2 Further conclusions will focus on technical measures the planning process in order to feed into Subtask B – Multidisciplinary planning process and C – Conservation compatible retrofit solutions.

SubTask B. Multidisciplinary planning process

This subtask takes its point of departure in the new European standard *EN 16883:2017 Conservation of cultural heritage — Guidelines for improving the energy performance of historic buildings*. This standard provides guidelines for sustainably improving the energy performance of historic buildings, while respecting their heritage significance. The standard presents a normative working procedure for selecting measures to improve energy performance, based on an investigation, analysis and documentation of the building including its heritage significance.

In each main step of this generic procedure there may be a need for support and tools beyond what the standard offers, for example on documentation and life cycle assessment. This action aims to investigate to what the extent the standard can be complemented in order to better meet the needs of the end users by providing an integrated design platform. Moreover it looks at how 16883 can be implemented in a way that achieves lowest possible energy demand/NZEB

B.1 Compilation and assessment of existing tools, methods and guidelines that are relevant in relation to standard

- B.1.1 Compile existing documentation on tools, methods and guidelines
- B.1.2 Assessment in relation to the standard
- B.1.3 Identify need for modification (link to Subtask C)
- B.1.4 Selection of useful tools, methods and guidelines

B.2 Assessment of the European standard EN 16883 Conservation of cultural heritage — Guidelines for improving the energy performance of historic buildings

- B.2.1 Define a common method for assessment
- B.2.2 Select case studies
- B.2.3 Carry out assessment
- B.2.4 Analysis
- B.2.5 Proposals for improvement

B.3 Development of an integrated platform to support the planning process towards conservation compatible NZEB

- B.3.1 Workshop with project
- B.3.1 Proposed platform
- B.3.2 Assessment by end users

B.4 “Packaging”: Making the outcome available to the end user

- B.4.1 Design
- B.4.2 Implementation

SubTask C. Conservation compatible retrofit solutions and strategies

The main objective of Subtask C is to identify, assess and in case further develop retrofit solutions and strategies for historic buildings, which fulfil both, the conservation compatibility of historic buildings as well as energy efficiency goals towards lowest possible energy demand and CO₂ emissions (NZEB) and to make them available for comprehensive integrated refurbishing concepts and strategies.

C.1 Review on existing and well approved as well as recently developed conservation compatible retrofit solutions with high impact on sustainability and energy efficiency.

- C.1.1 Window solutions
- C.1.2 Internal Insulation
- C.1.3 Building services and HVAC (with focus on ventilation)
- C.1.4 Roof integrated solar systems for historic buildings: Natural slate solar thermal roof for DHW (domestic hot water)
- C.1.5 Retrofit Strategies: Collection of existing sources and practices.

C.2 Documentation, further development and assessment of the conservation compatible retrofit solutions

- C.2.1 Window solutions: Documentation and evaluation of the thermal enhancement, dependant on the different level of interventions.
- C.2.2 Internal Insulation: Different insulation strategies and materials are assessed from conservational, building physical and LCA point of view. For this purpose, dynamic hygro-thermal simulation as well as assessment by key

performance indicators for the drying potential (e.g. drying coefficient according to G. A. Scheffler and R. Plagge 2009) are performed.

C.2.3 Building services and HVAC: Strategies to avoid or reduce supply air ducting, such as enhanced cascade ventilation and active overflow principle will be prepared and adapted for the use in historic buildings. The assessment will focus on low impact on the historic value of the building and reversibility. Further development of minimal invasive solutions will help the implementation in future projects.

C.2.4 Roof integrated solar systems for historic buildings: Evaluation and further development of natural slate solar thermal roof for DHW (domestic hot water) in terms of energy and conservation compatibility.

C.2.5 Development of several retrofit strategies to achieve high energy and environmental performance as well as heritage value conservation, considering specific building typologies, but also local climate and traditional building practices.

SubTask D. Knowledge transfer and dissemination

The main objective of Subtask D is to transfer the knowledge created in the Task to the relevant stakeholders: (i) architects and consultants; (ii) building owners and building users; (iii) developers and contractors; (iv) policy makers; (v) national authorities concerned with historic monuments and cultural heritage; (vi) craftsperson and construction industry; and (vii) educational bodies (occupational colleges, research institutes, universities etc.). For a more detailed description, see Subtask D.

Subtask D strongly builds upon the results of the other three subtasks, especially the online database, platform and reports with fact sheets and lessons learnt. These will be disseminated in suitable formats to the relevant target groups.

Historic Environment Scotland, working daily at the interface between building owners/user, public authority/policy development and architect/planner, will guide the partners' communication and dissemination activities and coordinate them. Whilst Historic Environment Scotland will utilise its national building conservation centre in Stirling, Scotland, for dissemination activities, also partners will also contribute their facilities: For example, Fraunhofer IPB, with its competence centre in Benediktbeuren, Germany, or University Uppsala, as scientific coordinator of the Swedish Spara och Bevara programme as well as ICOMOS ISCES with its worldwide network, are in an excellent positions to achieve a successful state-of-the-art dissemination.

D.1 Online communication and dissemination activities

D.1.1 Website (regularly updated) and project flyer

D.1.2 News (at least two per year)

D.1.3 Audio-visuals & webinars

D.2 Onsite communication and dissemination activities

D.2.1 Touring exhibition

D.2.2 Participation in stakeholder events (min. 1 per participating country)

D.2.3 Workshop series in conjunction with the six-monthly expert meetings and relevant conferences (EEHB 2018, Docomomo 2018, ICOMOS 2019, EEHB 2020 etc.)

D.2.4 Contribution to policy events (in at least 3 countries)

D.3 Scientific & professional Communication

D.3.1 Scientific papers

D.3.2 Articles in trade magazines

(c) Workshops and seminars

Expert workshops (possibly with participation of observers) on different themes in conjunction with the six-monthly expert meetings

Workshops for Professionals series linked to the expert meetings and relevant conferences (EEHB 2018, Docomomo 2018, ICOMOS 2019, EEHB 2020 etc.)

Info slots at stakeholder events – presenting the Task’s results and bringing back stakeholders’ feedback to the expert group.

Touring exhibition where visual presentation material will be used by all partners in the diverse events they are organising or participating in

(d) Participant and/or expert meetings

There will be physical meetings of the experts involved in the Task at intervals of approximately 6 months. Attendance at these expert meetings of the Task is mandatory. Additional virtual meetings might be organised on demand. Subtask leaders may arrange dedicated meetings in between or in association with the expert meetings.

(e) Publications/newsletters

A Task website will be developed, to provide information on the Task and its objectives, but especially on results and upcoming events. To keep the interest in the Task high, regularly news pieces and audio-visual contribution are uploaded and distributed via the SHC newsletter.

The knowledge base from SubTask A will be provided as online database, the platform of SubTask B will be published online also.

Reports will be provided digitally in PDF format.

4. Expected Results/Deliverables

The following results and deliverables are allocated to the four subtasks:

SubTask A. Knowledge Base

R1 Knowledge base as online database of Best Practice Cases (D.A1 & D.A3)

R2 Assessment report (DA.2)

R3 SubTask Report with management issues

SubTask B. Multidisciplinary planning process

R1 Assessment of existing tools in form of a report with “fact sheets”

R2 Proposal for standard improvement and an informative annex

R3 Platform with tools for holistic historic building retrofit

R3 SubTask Report with management issues

SubTask C. Conservation compatible retrofit solutions

R1 Report on Solutions (Part 1: windows, Part 2, insulation, Part 3, HVAC with ventilation and solar)

R2 Report on Strategies

- R3 SubTask Report with management issues
- SubTask D. Knowledge transfer and dissemination
 - R1 Website & news
 - R2 Touring exhibition
 - R3 Workshop series in conjunction with the six-monthly expert meetings and relevant conferences
 - R4 Report on participation in stakeholder events and their feedback
 - R5 Papers in scientific journals and articles in trade magazines
 - R6 SubTask Report with management issues

5. Rights and Obligations of Participants

In addition to the obligations enumerated in Article 4 of the Implementing Agreement:

- (a) Each participating institution/company shall provide the Operating Agent with detailed reports on the results of the work carried out for each Subtask
- (b) Each participating institution/company shall participate in the editing and reviewing of draft reports of the Task and Subtasks
- (c) Each country will bear the costs of its own participation in the Task, including necessary travel costs.
- (d) The Participants agree on the following funding commitment:
 - 1) Each Participant (country) will contribute to this Task a minimum of 3-person months per year of the Task, i.e. a total minimum of 1 person years.
 - 2) Participation in the Task requires participation in at least one of the Subtasks.
 - 3) The Operating Agent will contribute with a minimum of 2-person months per year to the Task.
 - 4) The Subtask leader shall commit a minimum of 2-person months per year to the Task.
 - 5) Participation may partly involve funding already allocated to a national (or international) activity that is substantially in agreement with the scope of work outlined in 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 that would not be part of activities funded by national or international sources. Examples include the preparation for and participation in Task meetings, coordination with Subtask Participants, contribution to the documentation and dissemination work and Task related R&D work which exceeds the R&D work carried out in the framework of the national (or international) activity.
 - 6) The level of effort to be contributed by each country will be specified in a "Letter of National Participation" which is signed by the Operating Agent and the Executive Committee representative within 3 months from the start date of the Task."

6. Management

- (a) Italy, acting through Alexandra Troi (EURAC research - European Academy of Bolzano), is designated as **Operating Agent**.

- (b) The Operating Agent's rights, obligations and responsibilities in addition to those indicated in the main body of the Implementing Agreement and the organisation of the work under this Annex enumerated in Articles 5 of this Agreement, the Operating Agent shall:
- 1) Prepare and distribute the results mentioned in Article 4;
 - 2) Prepare the detailed Program of Work for the Task in consultation with the Subtask Leaders and the Participants and submit the Program of Work for approval to the Executive Committees of the Solar Heating and Cooling Programme;
 - 3) Provide reports semi-annually to the Executive Committees on the progress and the results of the work performed under the Programme of Work;
 - 4) Provide to the Executive Committees, within six months after completion of all work under the Task, a final report for its approval and transmittal to the Agency;
 - 5) In co-ordination with the Participants, use its best efforts to avoid duplication with activities of other related programmes and projects implemented by or under the auspices of the Agency or by other competent bodies;
 - 6) Provide the Participants with the necessary guidelines for the work they carry out with minimum duplication;
 - 7) Gather documents from Subtask Leaders, edit and distribute the output of the Task either as a printed handbook, electronically or on a website.
- (c) There will be **Experts Meetings** of the Task at intervals of approximately 6 months. Subtask Leaders may arrange meetings in between or in association with Experts meetings of the Task. It is intended to organize expert / industry workshops every year, directly linked to Task meetings.
- (d) A **Subtask Leader** for each of the foregoing Subtasks shall:
- 1) Co-ordinate the work performed under that Subtask;
 - 2) Assist the Operating Agent in preparing the detailed Programme of Work;
 - 3) Direct technical workshops and provide the Operating Agent with written summaries of workshops results and
 - 4) Edit technical reports resulting from the Subtask and organise their publication.
 - 5) Subtask leaders may arrange meetings in between or in association with Experts meetings of the Task.

The Subtask Leader shall be a Participant that provides to the Subtask a high level of expertise and undertakes substantial research and development in the field of the Subtask. The Subtask Leaders shall be proposed by the Operating Agent and designated by the Executive Committee, acting by unanimity of the Participants. Changes in the Subtask Leaders may be agreed to by the Executive Committee, acting by unanimity of the Participants.

- (e) *The following reports will be provided by the Task*
- Six-monthly status reports for the IEA SHC ExCo
 - Annual reports for integration in the Annual report on the IEA SHC programme
 - Regular contribution to the IEA SHC newsletter Solar Update
 - As well as reports within the single Subtasks according the work plan

7. Admission, Participation and Withdrawal of Participants

Admission, Participation and Withdrawal of Participants is subject to the rules of the Implementing Agreement. Share of results produced will be subject to the active contribution of each Participant to the above mentioned activities.

8. Information and Intellectual Property

For purposes of this Annex, in case of conflict with the provisions of the Implementing Agreement, the following provisions shall prevail:

- a) For arising information regarding inventions the following rules shall apply:
 - 1) Arising information regarding inventions shall be owned in all countries by the inventing Participant. The inventing Participant shall promptly identify and report to the Executive Committee any such information along with an indication whether and in which countries the inventing Participant intends to file patent applications, and
 - 2) Information regarding inventions on which the inventing Participant intends to obtain a patent protection shall not be published or publicly disclosed by the Operating Agent or the other Participants until a patent has been filed, provided, however, that this restriction on publication or disclosure shall not extend beyond twelve months from the date of reporting of the invention. It shall be the responsibility of the inventing Participants to appropriately mark Task reports that disclose inventions that have not been appropriately protected by filing a patent application.
- (b) The inventing Participant shall license proprietary information arising from the Task for non-exclusive use as follows:
 - 1) To Participants in the Task:
 - a. On the most favourable terms and conditions for use by the participants in their own country; and
 - b. On favourable terms and conditions for the purpose of sub-licensing others for use in their own country.
 - 2) Subject to sub-paragraph above, to each participant in the Task for use in all countries, on reasonable terms and conditions; and
 - 3) To the government of any Agency Member country and nationals designated by it, for use in such country in order to meet its energy needs.

Royalties, if any, under licenses pursuant to this paragraph shall be the property of the inventing Participant.

9. Entry into Force, Term and Extension

This Annex shall enter into force on September 1st 2017 and shall remain in force for a period of 3.5 years until February 28th 2021. At the conclusion of that period, this Annex can be extended by at least two Participants, acting in the Executive Committee, for a period to be determined at that time, provided that in no event shall the Annex continue beyond the current term, or actual termination, of the Implementing Agreement.